The package \texttt{nicematrix}\footnote{This document corresponds to the version 5.19 of \texttt{nicematrix}, at the date of 2021/07/23.}

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Abstract

The \LaTeX{} package \texttt{nicematrix} provides new environments similar to the classical environments \texttt{tabular}, \texttt{array} and \texttt{matrix} of \texttt{array} and \texttt{amsmath} but with extended features.

\[
\begin{array}{cccc}
C_1 & C_2 & \cdots & C_n \\
L_1 & a_{11} & a_{12} & \cdots & a_{1n} \\
L_2 & a_{21} & a_{22} & \cdots & a_{2n} \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
L_n & a_{n1} & a_{n2} & \cdots & a_{nn}
\end{array}
\]

	

<table>
<thead>
<tr>
<th>Product</th>
<th>dimensions (cm)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>l</td>
<td>h</td>
</tr>
<tr>
<td>small</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>standard</td>
<td>5.5</td>
<td>8</td>
</tr>
<tr>
<td>premium</td>
<td>8.5</td>
<td>10.5</td>
</tr>
<tr>
<td>extra</td>
<td>8.5</td>
<td>10</td>
</tr>
<tr>
<td>special</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

The package \texttt{nicematrix} is entirely contained in the file \texttt{nicematrix.sty}. This file may be put in the current directory or in a \texttt{texmf} tree. However, the best is to install \texttt{nicematrix} with a \TeX{} distribution such as MiKTeX, TeXlive or MacTeX.

\textit{Remark}: If you use \LaTeX{} via Internet with, for example, Overleaf, you can upload the file \texttt{nicematrix.sty} in the repertory of your project in order to take full advantage of the latest version de \texttt{nicematrix}.\footnote{The latest version of the file \texttt{nicematrix.sty} may be downloaded from the \texttt{svn} server of \TeX{}Live: \url{https://www.tug.org/svn/texlive/trunk/Master/texmf-dist/tex/latex/nicematrix/nicematrix.sty}}

This package can be used with \texttt{xelatex}, \texttt{lualatex}, \texttt{pdflatex} but also by the classical workflow \texttt{latex-dvips-ps2pdf} (or Adobe Distiller). \textit{However, the file nicematrix.dtx of the present documentation should be compiled with XeLaTeX}.\footnote{If you use Overleaf, Overleaf will do automatically the right number of compilations.}

This package requires and \texttt{loads} the packages \texttt{l3keys2e}, \texttt{array}, \texttt{amsmath}, \texttt{pgfcore} and the module \texttt{shapes} of PGF (\texttt{tikz}, which is a layer over PGF is \textit{not} loaded). The final user only has to load the package with \texttt{\usepackage{nicematrix}}.

The idea of \texttt{nicematrix} is to create PGF nodes under the cells and the positions of the rules of the tabular created by \texttt{array} and to use these nodes to develop new features. As usual with PGF, the coordinates of these nodes are written in the \texttt{.aux} to be used on the next compilation and that’s why \texttt{nicematrix} may need several compilations.\footnote{Most features of \texttt{nicematrix} may be used without explicit use of PGF or Tikz (which, in fact, is not loaded by default).}

Most features of \texttt{nicematrix} may be used without explicit use of PGF or Tikz (which, in fact, is not loaded by default).

A command \texttt{\textbackslash{NiceMatrixOptions}} is provided to fix the options (the scope of the options fixed by this command is the current \LaTeX{} group: they are semi-global).
1 The environments of this package

The package `nicematrix` defines the following new environments.

\begin{itemize}
  \item \texttt{NiceTabular} \texttt{NiceArray} \texttt{NiceMatrix}
  \item \texttt{NiceTabular*} \texttt{pNiceArray} \texttt{pNiceMatrix}
  \item \texttt{bNiceArray} \texttt{bNiceMatrix}
  \item \texttt{BNiceArray} \texttt{BNiceMatrix}
  \item \texttt{vNiceArray} \texttt{vNiceMatrix}
  \item \texttt{VNiceArray} \texttt{VNiceMatrix}
\end{itemize}

The environments \texttt{NiceArray}, \texttt{NiceTabular} and \texttt{NiceTabular*} are similar to the environments \texttt{array}, \texttt{tabular} and \texttt{tabular*} of the package \texttt{array} (which is loaded by \texttt{nicematrix}).

The environments \texttt{pNiceArray}, \texttt{bNiceArray}, etc. have no equivalent in \texttt{array}.

The environments \texttt{NiceMatrix}, \texttt{pNiceMatrix}, etc. are similar to the corresponding environments of \texttt{amsmath} (which is loaded by \texttt{nicematrix}): \texttt{matrix}, \texttt{pmatrix}, etc.

It's recommended to use primarily the classical environments and to use the environments of \texttt{nicematrix} only when some feature provided by these environments is used (this will save memory).

All the environments of the package \texttt{nicematrix} accept, between square brackets, an optional list of \texttt{key=value} pairs. There must be no space before the opening bracket (\texttt{[}) of this list of options.

\textbf{Important}

Before the version 5.0, it was mandatory to use, for technical reasons, the letters \texttt{L}, \texttt{C} et \texttt{R} instead of \texttt{l}, \texttt{c} et \texttt{r} in the preambles of the environments of \texttt{nicematrix}. If we want to be able to go on using these letters, \texttt{nicematrix} must be loaded with the option \texttt{define-L-C-R}.

\begin{verbatim}
\usepackage[define-L-C-R]{nicematrix}
\end{verbatim}

This key will probably be deleted in a future version of \texttt{nicematrix}.

2 The vertical space between the rows

It's well known that some rows of the arrays created by default with \LaTeX{} are, by default, too close to each other. Here is a classical example.

\begin{verbatim}
\begin{pmatrix}
\frac{12}{7} & -\frac{12}{7} \\
\frac{13}{7} & \frac{14}{7}
\end{pmatrix}
\end{verbatim}

Inspired by the package \texttt{cellspace} which deals with that problem, the package \texttt{nicematrix} provides two keys \texttt{cell-space-top-limit} and \texttt{cell-space-bottom-limit} similar to the parameters \texttt{\cellspacetoplimit} and \texttt{\cellspacebottomlimit} of \texttt{cellspace}.

There is also a key \texttt{cell-space-limits} to set both parameters at once. The initial value of these parameters is 0 pt in order to have for the environments of \texttt{nicematrix} the same behaviour as those of \texttt{array} and \texttt{amsmath}. However, a value of 1 pt would probably be a good choice and we suggest to set them with \texttt{\NiceMatrixOptions{cell-space-limits = 1pt}}.

\begin{verbatim}
\NiceMatrixOptions{cell-space-limits = 1pt}
\end{verbatim}

\footnote{One should remark that these parameters apply also to the columns of type \texttt{S} of \texttt{siunitx} whereas the package \texttt{cellspace} is not able to act on such columns of type \texttt{S}.}
\begin{pNiceMatrix}
\frac{1}{2} & -\frac{1}{2} \\
\frac{1}{3} & \frac{1}{4} \\
\end{pNiceMatrix}

(\begin{array}{cc}
\frac{1}{2} & -\frac{1}{2} \\
\frac{1}{3} & \frac{1}{4} \\
\end{array})

3 The vertical position of the arrays

The package \texttt{nicematrix} provides an option \texttt{baseline} for the vertical position of the arrays. This option takes in as value an integer which is the number of the row on which the array will be aligned.

$A = \begin{pNiceMatrix}[baseline=2]
\frac{1}{\sqrt{1+p^2}} & p & 1-p \\
1 & 1 & 1 \\
1 & p & 1+p \\
\end{pNiceMatrix}$

\begin{enumerate}
\item an item
\item $A = \begin{array}{ccc}
\frac{1}{\sqrt{1+p^2}} & p & 1-p \\
1 & 1 & 1 \\
1 & p & 1+p \\
\end{array}$
\end{enumerate}

It’s also possible to use the option \texttt{baseline} with one of the special values \texttt{t}, \texttt{c} or \texttt{b}. These letters may also be used absolutely like the option of the environments \texttt{tabular} and \texttt{array} of \texttt{array}. The initial value of \texttt{baseline} is \texttt{c}.

In the following example, we use the option \texttt{t} (equivalent to \texttt{baseline=t}) immediately after an \texttt{item} of list. One should remark that the presence of a \texttt{\hline} at the beginning of the array doesn’t prevent the alignment of the baseline with the baseline of the first row (with \texttt{tabular} or \texttt{array} of \texttt{array}, one must use \texttt{\firsthline}).

\begin{enumerate}
\item an item
\item \renewcommand{\arraystretch}{1.2}$\begin{NiceArray}[t]{lcccccc}
\hline
n & 0 & 1 & 2 & 3 & 4 & 5 \\
u_n & 1 & 2 & 4 & 8 & 16 & 32 \\
\hline
\end{NiceArray}$
\end{enumerate}

However, it’s also possible to use the tools of \texttt{booktabs}: \texttt{\toprule}, \texttt{\bottomrule}, \texttt{\midrule}, etc.

\begin{enumerate}
\item an item
\item \renewcommand{\arraystretch}{1.2}$\begin{NiceArray}[t]{lcccccc}
\toprule
n & 0 & 1 & 2 & 3 & 4 & 5 \\
u_n & 1 & 2 & 4 & 8 & 16 & 32 \\
\bottomrule
\end{NiceArray}$
\end{enumerate}

It’s also possible to use the key \texttt{baseline} to align a matrix on an horizontal rule (drawn by \texttt{\hline}). In this aim, one should give the value \texttt{line-i} where \texttt{i} is the number of the row following the horizontal rule.

\NiceMatrixOptions{cell-space-limits=1pt}

\footnote{The extension \texttt{booktabs} is \textit{not} loaded by \texttt{nicematrix}.}
\[ A = \begin{pNiceArray}{cc|cc} \dfrac{1}{A} & \dfrac{1}{B} & 0 & 0 \\ \dfrac{1}{C} & \dfrac{1}{D} & 0 & 0 \\ \hline & & & \end{pNiceArray} \]

4 The blocks

4.1 General case

In the environments of nicematrix, it’s possible to use the command \Block in order to place an element in the center of a rectangle of merged cells of the array.\(^5\)

The command \Block must be used in the upper leftmost cell of the array with two arguments.

- The first argument is the size of the block with the syntax i\(\times\)j where i is the number of rows of the block and j its number of columns.
  
  If this argument is empty, its default value is 1\(\times\)1. If the number of rows is not specified, or equal to *, the block extends until the last row (idem for the columns).

- The second argument is the content of the block. It’s possible to use \ in that content to have a content on several lines. In \{NiceTabular\} the content of the block is composed in text mode whereas, in the other environments, it is composed in math mode.

Here is an example of utilisation of the command \Block in mathematical matrices.

\[
\begin{bNiceArray}{ccc|c}[margin]
\Block{3-3}{A} & & & 0 \\
& & & \Vdots \\
& & & 0 \\
\hline \\
0 & \Cdots & 0 & 0
\end{bNiceArray}
\]

One may wish to raise the size of the “A” placed in the block of the previous example. Since this element is composed in math mode, it’s not possible to use directly a command like \large, \Large and \LARGE. That’s why the command \Block provides an option between angle brackets to specify some TeX code which will be inserted before the beginning of the math mode.\(^6\)

\[
\begin{bNiceArray}{ccc|c}[margin]
\Block{3-3}<{\Large}>{A} & & & 0 \\
& & & \Vdots \\
& & & 0 \\
\hline \\
0 & \Cdots & 0 & 0
\end{bNiceArray}
\]

It’s possible to set the horizontal position of the block with one of the keys l, c and r.

\(^5\)The spaces after a command \Block are deleted.

\(^6\)This argument between angular brackets may also be used to insert a command of font such as \bfseries when the command \ in is used in the content of the block.
\begin{NiceArray}{ccc|c}[margin]
\Block[r]{3-3}<\LARGE>{A} & & & 0 \\
& \hspace*{1cm} & & \Vdots \\
& & & 0 \\
\hline
0 & \Cdots & 0 & 0
\end{NiceArray}

In fact, the command \Block accepts as first optional argument (between square brackets) a list of couples key-value. The available keys are as follows:

- the keys \texttt{l}, \texttt{c} and \texttt{r} are used to fix the horizontal position of the content of the block, as explained previously;
- the key \texttt{fill} takes in as value a color and fills the block with that color;
- the key \texttt{draw} takes in as value a color and strokes the frame of the block with that color (the default value of that key is the current color of the rules of the array);
- the key \texttt{color} takes in as value a color and apply that color the content of the block but draws also the frame of the block with that color;
- the key \texttt{line-width} is the width (thickness) of the frame (this key should be used only when the key \texttt{draw} or the key \texttt{hvlines} is in force);
- the key \texttt{rounded-corners} requires rounded corners (for the frame drawn by \texttt{draw} and the shape drawn by \texttt{fill}) with a radius equal to the value of that key (the default value is 4 pt)
- the key \texttt{borders} provides the ability to draw only some borders of the blocks; the value of that key is a (comma-separated) list of elements covered by \texttt{left}, \texttt{right}, \texttt{top} and \texttt{bottom};
- the keys \texttt{t} and \texttt{b} fix the base line that will be given to the block when it has a multi-line content (the lines are separated by \texttt{\\});
- the keys \texttt{hvlines} draws all the vertical and horizontal rules in the block;
- \texttt{New 5.19} when the key \texttt{tikz} is used, the Tikz path corresponding of the rectangle which delimits the block is executed with Tikz\textsuperscript{8} by using as options the value of that key \texttt{tikz} (which must be a list of keys allowed for a Tikz path). For examples, cf. p. 41.

One must remark that, by default, the commands \Block\s don’t create space\s. There is exception only for the blocks mono-row and the blocks mono-column as explained just below.

In the following example, we have had to enlarge by hand the columns 2 and 3 (with the construction \texttt{wc{...}} of \texttt{array}).

\begin{NiceTabular}{cwc{2cm}wc{3cm}c}
rose & tulipe & marguerite & dahlia \\
violette & \Block[draw=red,fill={RGB}{204,204,255},rounded-corners]{2-2} \\
& & De très jolies fleurs\\
& & souci \\
pervenche & & lys \\
arum & iris & jacinthe & muguet
\end{NiceTabular}

\textsuperscript{7}This value is the initial value of the \texttt{rounded corners} of Tikz.
\textsuperscript{8}Tikz should be loaded (by default, \texttt{nicematrix} only loads \texttt{pgf}) and, if it’s not, an error will be raised.
4.2 The mono-column blocks

The mono-column blocks have a special behaviour.

- The natural width of the contents of these blocks is taken into account for the width of the current column.
- The specification of the horizontal position provided by the type of column (c, r or l) is taken into account for the blocks.
- The specifications of font specified for the column by a construction \{\ldots\} in the preamble of the array are taken into account for the mono-column blocks of that column (this behaviour is probably expected).

\begin{NiceTabular}{@{}>{\bfseries}lr@{}}
\hline
\Block{2-1}{John} & 12 \\ & 13 \\
Steph & 8 \\
\Block{3-1}{Sarah} & 18 \\ & 17 \\ & 15 \\
Ashley & 20 \\
Henry & 14 \\
\Block{2-1}{Madison} & 15 \\ & 19 \\
\end{NiceTabular}

4.3 The mono-row blocks

For the mono-row blocks, the natural height and depth are taken into account for the height and depth of the current row (as does a standard \multicolumn of LaTeX).

4.4 The mono-cell blocks

A mono-cell block inherits all the properties of the mono-row blocks and mono-column blocks.

At first sight, one may think that there is no point using a mono-cell block. However, there are some good reasons to use such a block.

- It’s possible to use the command \\\ in a (mono-cell) block.
- It’s possible to use the option of horizontal alignment of the block in derogation of the type of column given in the preamble of the array.
- It’s possible do draw a frame around the cell with the key draw of the command \Block and to fill the background with rounded corners with the keys fill and rounded-corners.\footnote{If one simply wishes to color the background of a unique cell, there is no point using the command \Block: it’s possible to use the command \cellcolor (when the key colorbltl-like is used).}
- It’s possible to draw one or several borders of the cell with the key borders.

\begin{NiceTabular}{cc}
\toprule
Writer & \Block[1]\{year\ of\ birth\} \\
\midrule
Hugo & 1802 \\
Balzac & 1799 \\
\bottomrule
\end{NiceTabular}

We recall that if the first mandatory argument of \Block is left blank, the block is mono-cell.\footnote{One may consider that the default value of the first mandatory argument of \Block is 1-1.}
4.5 Horizontal position of the content of the block

By default, the horizontal position of the content of a block is computed by using the positions of the contents of the columns implied in that block. That’s why, in the following example, the header “First group” is correctly centered despite the instruction \(\texttt{!{\quad}}\) in the preamble which has been used to increase the space between the columns (this is not the behaviour of \texttt{\multicolumn}).

\begin{NiceTabular}{@{}c!{\quad}ccc!{\quad}ccc@{}}
\toprule
Rank & \Block{1-3}{First group} & & & \Block{1-3}{Second group} \\
& 1A & 1B & 1C & 2A & 2B & 2C \\
\midrule
1 & 0.657 & 0.913 & 0.733 & 0.830 & 0.387 & 0.893 \\
2 & 0.343 & 0.537 & 0.655 & 0.690 & 0.471 & 0.333 \\
3 & 0.783 & 0.885 & 0.015 & 0.306 & 0.643 & 0.263 \\
4 & 0.161 & 0.708 & 0.386 & 0.257 & 0.074 & 0.336 \\
\bottomrule
\end{NiceTabular}

\begin{NiceTabular}{|c|c|}
\hline
First & Second \\
\hline
Peter \\
\hline
Mary & George \\
\hline
\end{NiceTabular}

\textbf{New 5.17} In order to have an horizontal positioning of the content of the block computed with the limits of the columns of the LaTeX array (and not with the contents of those columns), one may use the key \texttt{L}, \texttt{R} and \texttt{C} of the command \texttt{\Block}.

5 The rules

The usual techniques for the rules may be used in the environments of nicematrix (excepted \texttt{\vline}). However, there is some small differences with the classical environments.

5.1 Some differences with the classical environments

5.1.1 The vertical rules

In the environments of nicematrix, the vertical rules specified by | in the preambles of the environments are never broken, even by an incomplete row or by a double horizontal rule specified by \texttt{\hline}\texttt{\hline} (there is no need to use \texttt{\hhline}).

\begin{NiceTabular}{|c|c|}
\hline
First & Second \\
\hline
Peter \\
\hline
Mary & George \\
\hline
\end{NiceTabular}

However, the vertical rules are not drawn in the blocks (created by \texttt{\Block}; cf. p. 4) nor in the corners (created by the key \texttt{corner}; cf. p. 10).
If you use \texttt{booktabs} (which provides \texttt{\toprule}, \texttt{\midrule}, \texttt{\bottomrule}, etc.) and if you really want to add vertical rules (which is not in the spirit of \texttt{booktabs}), you should notice that the vertical rules drawn by \texttt{nicematrix} are compatible with \texttt{booktabs}.

\begin{NiceArray}{|cccc|}
\toprule
a & b & c & d \\
1 & 2 & 3 & 4 \\
1 & 2 & 3 & 4 \\
\bottomrule
\end{NiceArray}

However, it’s still possible to define a specifier (named, for instance, I) to draw vertical rules with the standard behaviour of array.
\newcolumntype{I}{!{\vrule}}

However, in this case, it is probably more clever to add a command \texttt{\OnlyMainNiceMatrix} (cf. p. 38):
\newcolumntype{I}{!{\OnlyMainNiceMatrix{\vrule}}}

\subsection{The command \texttt{\cline}}

The horizontal and vertical rules drawn by \texttt{\hline} and the specifier “|” make the array larger or wider by a quantity equal to the width of the rule (with \texttt{array} and also with \texttt{nicematrix}). For historical reasons, this is not the case with the command \texttt{\cline}, as shown by the following example.

\setlength{\arrayrulewidth}{2pt}
\begin{tabular}{cccc}
\hline
A & B & C & D \\
A & B & C & D \\
\hline
\end{tabular}

\setlength{\arrayrulewidth}{2pt}
\begin{NiceTabular}{cccc}
\hline
A & B & C & D \\
A & B & C & D \\
\hline
\end{NiceTabular}

In the environments of \texttt{nicematrix}, this situation is corrected (it’s still possible to go to the standard behaviour of \texttt{\cline} with the key \texttt{standard-cline}).

\setlength{\arrayrulewidth}{2pt}
\begin{NiceTabular}{cccc}
\hline
A & B & C & D \\
A & B & C & D \\
\hline
\end{NiceTabular}

\subsection{The thickness and the color of the rules}

The environments of \texttt{nicematrix} provide a key \texttt{rules/width} to set the width (in fact the thickness) of the rules in the current environment. In fact, this key merely sets the value of the length \texttt{\arrayrulewidth}.

It’s well known that \texttt{colortbl} provides the command \texttt{\arrayrulecolor} in order to specify the color of the rules.

With \texttt{nicematrix}, it’s possible to specify the color of the rules even when \texttt{colortbl} is not loaded. For sake of compatibility, the command is also named \texttt{\arrayrulecolor}. The environments of \texttt{nicematrix} also provide a key \texttt{rules/color} to fix the color of the rules in the current environment. This key sets the value locally (whereas \texttt{\arrayrulecolor} acts globally).

\begin{NiceTabular}{|ccc|}
\hline
rose & tulipe & lys \\
arum & iris & violette \\
muguet & dahlia & souci \\
\hline
\end{NiceTabular}

\begin{NiceTabular}{|ccc|}
\hline
rose & tulipe & lys \\
arum & iris & violette \\
muguet & dahlia & souci \\
\hline
\end{NiceTabular}

If one wishes to define new specifiers for columns in order to draw vertical rules (for example with a specific color or thicker than the standard rules), he should consider the command \texttt{\OnlyMainNiceMatrix} described on page 38.
5.3 The tools of nicematrix for the rules

Here are the tools provided by nicematrix for the rules.

- the keys \texttt{hlines}, \texttt{vlines}, \texttt{hvlines} and \texttt{hvlines-except-borders};
- the specifier “|” in the preamble (for the environments with preamble);
- the command \texttt{\Hline}.

All these tools don’t draw the rules in the blocks nor in the empty corners (when the key \texttt{corners} is used).

- These blocks are:
  - the blocks created by the command \texttt{\Block}\textsuperscript{11} presented p. 4;
  - the blocks implicitly delimited by the continuous dotted lines created by \texttt{\Cdots}, \texttt{\Vdots}, etc. (cf. p. 19).
- The corners are created by the key \texttt{corners} explained below (see p. 10).

In particular, this remark explains the difference between the standard command \texttt{\hline} and the command \texttt{\Hline} provided by nicematrix.

5.3.1 The keys \texttt{hlines} and \texttt{vlines}

The keys \texttt{hlines} and \texttt{vlines} (which draw, of course, horizontal and vertical rules) take in as value a list of numbers which are the numbers of the rules to draw.

In fact, for the environments with delimiters (such as \texttt{\pNiceMatrix} or \texttt{\bNiceArray}), the key \texttt{vlines} don’t draw the exterior rules (this is certainly the expected behaviour).

\begin{verbatim}
$\begin{pNiceMatrix}[vlines,rules/width=0.2pt]
1 & 2 & 3 & 4 & 5 & 6 \\
1 & 2 & 3 & 4 & 5 & 6 \\
1 & 2 & 3 & 4 & 5 & 6 \\
\end{pNiceMatrix}$
\end{verbatim}

5.3.2 The keys \texttt{hvlines} and \texttt{hvlines-except-borders}

The key \texttt{hvlines} (no value) is the conjunction of the keys \texttt{hlines} and \texttt{vlines}.

\begin{verbatim}
\setlength{\arrayrulewidth}{1pt}
\begin{NiceTabular}{cccc}[hvlines,rules/color=blue]
rose & tulipe & marguerite & dahlia \\
violette & \Block[draw=red]{2-2}{\LARGE fleurs} & & souci \\
pervenche & & & lys \\
arum & iris & jacinthe & muguet
\end{NiceTabular}
\end{verbatim}

New 5.17 The key \texttt{hvlines-except-borders} is similar to the key \texttt{hvlines} but does not draw the rules on the horizontal and vertical borders of the array.

\textsuperscript{11}And also the command \texttt{\multicolumn} but it’s recommended to use instead \texttt{\Block} in the environments of nicematrix.
5.3.3 The (empty) corners

The four corners of an array will be designed by NW, SW, NE and SE (north west, south west, north east and south east).

For each of these corners, we will call empty corner (or simply corner) the reunion of all the empty rectangles starting from the cell actually in the corner of the array.

However, it’s possible, for a cell without content, to require \texttt{nicematrix} to consider that cell as not empty with the key \texttt{\\NotEmpty}.

In the example on the right (where B is in the center of a block of size $2 \times 2$), we have colored in blue the four (empty) corners of the array.

When the key \texttt{corners} is used, \texttt{nicematrix} computes the (empty) corners and these corners will be taken into account by the tools for drawing the rules (the rules won’t be drawn in the corners).

\textit{Remark:} In the previous versions of \texttt{nicematrix}, there was only a key \texttt{hvlines-except-corners} (now considered as obsolete).

\begin{verbatim}
\NiceMatrixOptions{cell-space-top-limit=3pt}
\begin{NiceTabular}{*{6}{c}}[corners, hvlines]
& & & & A \\
& & A & A & A \\
& & & A \\
& A & A & A \\
& \Block{2-2}{B} & & A \\
& & & A \\
\end{NiceTabular}
\end{verbatim}

It’s also possible to provide to the key \texttt{corners} a (comma-separated) list of corners (designed by NW, SW, NE and SE).

\begin{verbatim}
\NiceMatrixOptions{cell-space-top-limit=3pt}
\begin{NiceTabular}{*{6}{c}}[corners=NE, hvlines]
1 \& 1 \& 1 \\
1 \& 2 & 1 \\
1 \& 3 & 3 & 1 \\
1 \& 4 & 6 & 4 & 1 \\
& \& \& \& \& 1
\end{NiceTabular}
\end{verbatim}

\textsuperscript{12}For sake of completeness, we should also say that a cell contained in a block (even an empty cell) is not taken into account for the determination of the corners. That behaviour is natural.
5.4 The command \texttt{\diagbox}

The command \texttt{\diagbox} (inspired by the package \texttt{diagbox}), allows, when it is used in a cell, to slash that cell diagonally downwards.\footnote{The author of this document considers that type of construction as graphically poor.}

\begin{verbatim}
$\begin{NiceArray}{*{5}{c}}[hvlines]
\diagbox{x}{y} & e & a & b & c \\
e & e & a & b & c \\
a & a & e & c & b \\
b & b & c & e & a \\
c & c & b & a & e 
\end{NiceArray}$
\end{verbatim}

It’s possible to use the command \texttt{\diagbox} in a \texttt{\Block}.

5.5 Dotted rules

In the environments of the package \texttt{nicematrix}, it’s possible to use the command \texttt{\hdottedline} (provided by \texttt{nicematrix}) which is a counterpart of the classical commands \texttt{\hline} and \texttt{\hlashline} (the latter is a command of \texttt{arydshln}).

\begin{verbatim}
\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
\hdottedline
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15 
\end{pNiceMatrix}
\end{verbatim}

In the environments with an explicit preamble (like \texttt{\NiceTabular}, \texttt{\NiceArray}, etc.), it’s possible to draw a vertical dotted line with the specifier “:”.

\begin{verbatim}
\left(\begin{NiceArray}{cccc}
1 & 2 & 3 & 4 & 5 \\
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15 
\end{NiceArray}\right)
\end{verbatim}

It’s possible to change in \texttt{nicematrix} the letter used to specify a vertical dotted line with the option \texttt{letter-for-dotted-lines} available in \texttt{\NiceMatrixOptions}. Thus released, the letter “:” can be used otherwise (for example by the package \texttt{arydshln} \footnote{However, one should remark that the package \texttt{arydshln} is not fully compatible with \texttt{nicematrix}.}).

Remark: In the package \texttt{array} (on which the package \texttt{nicematrix} relies), horizontal and vertical rules make the array larger or wider by a quantity equal to the width of the rule\footnote{In fact, with \texttt{array}, this is true only for \texttt{\hline} and “|” but not for \texttt{\cline}: cf p. 8}. In \texttt{nicematrix}, the dotted lines drawn by \texttt{\hdottedline} and “:” do likewise.

6 The color of the rows and columns

6.1 Use of \texttt{colortbl}

We recall that the package \texttt{colortbl} can be loaded directly with \texttt{\usepackage{colortbl}} or by loading \texttt{xcolor} with the key \texttt{table}: \texttt{\usepackage\{table\}\{xcolor\}}.

Since the package \texttt{nicematrix} is based on \texttt{array}, it’s possible to use \texttt{colortbl} with \texttt{nicematrix}.

However, there is two drawbacks:
• The package `colortbl` patches `array`, leading to some incompatibilities (for instance with the command `\hdotsfor`).

• The package `colortbl` constructs the array row by row, alternating colored rectangles, rules and contents of the cells. The resulting PDF is difficult to interpret by some PDF viewers and may lead to artefacts on the screen.
  
  – Some rules seem to disappear. This is because many PDF viewers give priority to graphical element drawn posteriorly (which is in the spirit of the “painting model” of PostScript and PDF). Concerning this problem, MuPDF (which is used, for instance, by SumatraPDF) gives better results than Adobe Reader.
  
  – A thin white line may appear between two cells of the same color. This phenomenon occurs when each cell is colored with its own instruction `fill` (the PostScript operator `fill` noted `f` in PDF). This is the case with `colortbl`: each cell is colored on its own, even when `\columncolor` or `\rowcolor` is used.

As for this phenomenon, Adobe Reader gives better results than MuPDF.

The package `nicematrix` provides tools to avoid those problems.

6.2 The tools of nicematrix in the `\CodeBefore`

The package `nicematrix` provides some tools (independent of `colortbl`) to draw the colored panels first, and, then, the content of the cells and the rules. This strategy is more conform to the “painting model” of the formats PostScript and PDF and is more suitable for the PDF viewers. However, it requires several compilations.\footnote{If you use Overleaf, Overleaf will do automatically the right number of compilations.}

The extension `nicematrix` provides a key `code-before` for some code that will be executed before the drawing of the tabular.

An alternative syntax is provided: it’s possible to put the content of that `code-before` between the keywords `\CodeBefore` and `\Body` at the beginning of the environment.

\begin{pNiceArray}{preamble}
\CodeBefore
instructions of the code-before
\Body
contents of the environment
\end{pNiceArray}

New commands are available in that `\CodeBefore`: `\cellcolor`, `\rectanglecolor`, `\rowcolor`, `\columncolor`, `\rowcolors`, `\chessboardcolors` and `\arraycolor`.\footnote{Remark that, in the `\CodeBefore`, PGF/Tikz nodes of the form “(i-|j)” are also available to indicate the position to the potential rules: cf. p. 36.}

All these commands accept an optional argument (between square brackets and in first position) which is the color model for the specification of the colors.

These commands don’t color the cells which are in the “corners” if the key `corners` is used. This key has been described p. 10.

• The command `\cellcolor` takes its name from the command `\cellcolor` of `colortbl`.

  This command takes in as mandatory arguments a color and a list of cells, each of which with the format `i-j` where `i` is the number of the row and `j` the number of the column of the cell.
• The command \rectanglersoncecolor takes three mandatory arguments. The first is the color. The second is the upper-left cell of the rectangle and the third is the lower-right cell of the rectangle.

\begin{NiceTabular}{|c|c|c|}
\CodeBefore
\cellcolor{HTML}{FFFF88}{3-1,2-2,1-3}
\Body
\hline
a & b & c \\ \hline
e & f & g \\ \hline
h & i & j \\ \hline
\end{NiceTabular}

\begin{NiceTabular}{|c|c|c|}
\CodeBefore
\rectanglecolor{blue!15}{2-2}{3-3}
\Body
\hline
a & b & c \\ \hline
e & f & g \\ \hline
h & i & j \\ \hline
\end{NiceTabular}

• The command \arraycolor takes in as mandatory argument a color and color the whole tabular with that color (excepted the potential exterior rows and columns: cf. p. 17). It’s only a particular case of \rectanglersoncecolor.

• The command \chessboardcolors takes in as mandatory arguments two colors and it colors the cells of the tabular in quincunx with these colors.

\begin{pNiceMatrix}[r,margin]
\CodeBefore
\chessboardcolors{red!15}{blue!15}
\Body
\begin{pmatrix}
1 & -1 & 1 \\
-1 & 1 & -1 \\
1 & -1 & 1
\end{pmatrix}
\end{pNiceMatrix}

We have used the key r which aligns all the columns rightwards (cf. p. 31).

• The command \rowcolor takes its name from the command \rowcolor of colorbl. Its first mandatory argument is the color and the second is a comma-separated list of rows or interval of rows with the form \textit{a-b} (an interval of the form \textit{a-} represent all the rows from the row \textit{a} until the end).

\begin{NiceArray}{lll}[hvlines]
\CodeBefore
\rowcolor{red!15}{1,3-5,8-}
\Body
\begin{pmatrix}
a_1 & b_1 & c_1 \\
a_2 & b_2 & c_2 \\
a_3 & b_3 & c_3 \\
a_4 & b_4 & c_4 \\
a_5 & b_5 & c_5 \\
a_6 & b_6 & c_6 \\
a_7 & b_7 & c_7 \\
a_8 & b_8 & c_8 \\
a_9 & b_9 & c_9 \\
a_{10} & b_{10} & c_{10}
\end{pmatrix}
\end{NiceArray}
• The command \columncolor takes its name from the command \columncolor of colortbl. Its syntax is similar to the syntax of \rowcolor.

• The command \rowcolors (with a s) takes its name from the command \rowcolors of xcolor\textsuperscript{18}. The s emphasizes the fact that there is two colors. This command colors alternately the rows of the tabular with the two colors (provided in second and third argument), beginning with the row whose number is given in first (mandatory) argument.

In fact, the first (mandatory) argument is, more generally, a comma separated list of intervals describing the rows involved in the action of \rowcolors (an interval of the form $i$- describes in fact the interval of all the rows of the tabular, beginning with the row $i$).

The last argument of \rowcolors is an optional list of pairs key-value (the optional argument in the first position corresponds to the colorimetric space). The available keys are cols, restart and respect-blocks.

  – The key cols describes a set of columns. The command \rowcolors will color only the cells of these columns. The value is a comma-separated list of intervals of the form $i$-$j$ (where $i$ or $j$ may be replaced by *).

  – With the key restart, each interval of rows (specified by the first mandatory argument) begins with the same color.\textsuperscript{19}

  – With the key respect-blocks the "rows" alternately colored may extend over several rows if they have to incorporate blocks (created with the command \Block: cf. p. 4).

\begin{NiceTabular}{clr}[hvlines]
\CodeBefore
\rowcolors[gray]{2}{0.8}{}[cols=2-3,restart]
\Body
\Block{1-}{}{Results} \\
John & 12 \\
Stephen & 8 \\
Sarah & 18 \\
Ashley & 20 \\
Henry & 14 \\
Madison & 15
\end{NiceTabular}

\begin{NiceTabular}{lr}[hvlines]
\CodeBefore
\rowcolors{1}{blue!10}{}[respect-blocks]
\Body
\Block{2-1}{}{John} & 12 \\
& 13 \\
Steph & 8 \\
\Block{3-1}{}{Sarah} & 18 \\
& 17 \\
& 15 \\
Ashley & 20 \\
Henry & 14 \\
\Block{2-1}{}{Madison} & 15 \\
& 19
\end{NiceTabular}

\textsuperscript{18}The command \rowcolors of xcolor is available when xcolor is loaded with the option table. That option also loads the package colortbl.

\textsuperscript{19}Otherwise, the color of a given row relies only upon the parity of its absolute number.
We recall that all the color commands we have described don’t color the cells which are in the “corners”. In the following example, we use the key `corners` to require the determination of the corner north east (NE).

```latex
\begin{NiceTabular}{cccccc}[corners=NE,margin,hvlines,first-row,first-col]
\CodeBefore
\rowcolors{1}{blue!15}{}
\Body
\hline
0 & 1 & 2 & 3 & 4 & 5 \\
0 & 1 \\
1 & 1 \\
2 & 1 & 2 \\
3 & 1 & 3 & 1 \\
4 & 1 & 4 & 4 \\
5 & 1 & 5 & 5 \\
6 & 1 & 6 & 6 \\
\end{NiceTabular}
```

One should remark that all the previous commands are compatible with the commands of `booktabs` (`\toprule`, `\midrule`, `\bottomrule`, etc). However, `booktabs` is not loaded by `nicematrix`.

```latex
\begin{NiceTabular}[c]{lSSSS}
\CodeBefore
\rowcolor{red!15}{1-2}
\rowcolors{3}{blue!15}{}
\Body
\toprule
\Block{2-1}{Product} & \Block{1-3}{dimensions (cm)} & & & \Block{2-1}{\rotate Price} \\
\cmidrule(rl){2-4}
& L & l & h \\
\midrule
small & 3 & 5.5 & 1 & 30 \\
standard & 5.5 & 8 & 1.5 & 50.5 \\
premium & 8.5 & 10.5 & 2 & 80 \\
extra & 8.5 & 10 & 1.5 & 85.5 \\
special & 12 & 12 & 0.5 & 70 \\
\bottomrule
\end{NiceTabular}
```

We have used the type of column `S` of `siunitx`.

## 6.3 Color tools with the syntax of colortbl

It’s possible to access the preceding tools with a syntax close to the syntax of `colortbl`. For that, one must use the key `colortbl-like` in the current environment. There are three commands available (they are inspired by `colortbl` but are independent of `colortbl`):

- \cellcolor which colorizes a cell;
- \rowcolor which must be used in a cell and which colorizes the end of the row;
- \columncolor which must be used in the preamble of the environment with the same syntax as the corresponding command of `colortbl` (however, unlike the command \columncolor of `colortbl`, this command \columncolor can appear within another command, itself used in the preamble of the array).

\footnote{Up to now, this key is not available in \NiceMatrixOptions.}
The command $\texttt{\textbackslash RowStyle}$

**New 5.18** The command $\texttt{\textbackslash RowStyle}$ takes as argument some formatting instructions that will be applied to each cell on the rest of the current row.

That command also takes in as optional argument (between square brackets) a list of key-value pairs. The available keys are $\texttt{cell-space-top-limit}$, $\texttt{cell-space-bottom-limit}$ and $\texttt{cell-space-limits}$ with the same meaning that the corresponding global keys (cf. p. 2).

$$
\begin{NiceTabular}{cccc}[hlines,colortbl-like]
\textcolor{white}{\textbackslashRowStyle[\texttt{\textbackslash rotate}]} \texttt{\textbackslash RowStyle[\texttt{cell-space-limits=3pt}]}\texttt{\textbackslash rotate} \\
\texttt{\textbackslash RowStyle[\texttt{\color{white}\textbackslash sffamily}]} \\
\texttt{\textbackslash RowStyle[\texttt{\color{white}\textbackslash sffamily}]} \\
\texttt{\textbackslash RowStyle[\texttt{\color{white}\textbackslash sffamily}]}  \\
1 & 2 & 3 & 4 \\
\end{NiceTabular}
$$

The command $\texttt{\textbackslash rotate}$ is described p. 31.

The width of the columns

In the environments with an explicit preamble (like $\texttt{\textbackslash NiceTabular}$, $\texttt{\textbackslash NiceArray}$, etc.), it’s possible to fix the width of a given column with the standard letters $w$ and $W$ of the package $\texttt{array}$.

$$
\begin{NiceTabular}{Wc{2cm}cc}[hvlines]  
\texttt{\textbackslash RowStyle[\texttt{columns-width = 1cm}]}  
1 & 12 & -123 \\
12 & 0 & 0 \\
4 & 1 & 2  
\end{NiceTabular}
$$

In the environments of $\texttt{nicematrix}$, it’s also possible to fix the minimal width of all the columns of an array directly with the key $\texttt{columns-width}$.
Note that the space inserted between two columns (equal to \( \texttt{tabcolsep} \) in \{NiceTabular\} and to \( \texttt{arraycolsep} \) in the other environments) is not suppressed (of course, it’s possible to suppress this space by setting \( \texttt{tabcolsep} \) or \( \texttt{arraycolsep} \) equal to 0 pt before the environment).

It’s possible to give the special value \texttt{auto} to the option \texttt{columns-width}: all the columns of the array will have a width equal to the widest cell of the array.\(^\text{21}\)

\[
\begin{pNiceMatrix} \texttt{[columns-width = auto]} \\
1 & 12 & -123 \\
12 & 0 & 0 \\
4 & 1 & 2 \\
\end{pNiceMatrix}
\]

\[
\begin{pmatrix} 1 & 12 & -123 \\ 12 & 0 & 0 \\ 4 & 1 & 2 \end{pmatrix}
\]

Without surprise, it’s possible to fix the minimal width of the columns of all the matrices of a current scope with the command \texttt{\NiceMatrixOptions}.

\[
\begin{NiceMatrixOptions} \texttt{columns-width=10mm} \end{NiceMatrixOptions}
\]

\[
\begin{pNiceMatrix} \\
a & b \\
c & d \\
\end{pNiceMatrix}
\]

\[
\begin{pmatrix} a & b \\ c & d \end{pmatrix}
\]

\[
\begin{pmatrix} 1 & 1245 \\ 345 & 2 \end{pmatrix}
\]

\[
\begin{pmatrix} 1 & 1245 \\ 345 & 2 \end{pmatrix}
\]

But it’s also possible to fix a zone where all the matrices will have their columns of the same width, equal to the widest cell of all the matrices. This construction uses the environment \{NiceMatrixBlock\} with the option \texttt{auto-columns-width}\(^\text{22}\). The environment \{NiceMatrixBlock\} has no direct link with the command \texttt{\Block} presented previously in this document (cf. p. 4).

\[
\begin{NiceMatrixBlock} \texttt{[auto-columns-width]} \\
\begin{bNiceMatrix} 9 & 17 \\ -2 & 5 \\
\end{bNiceMatrix} \\
\begin{bNiceMatrix} 1 & 1245345 \\ 345 & 2 \\
\end{bNiceMatrix} \\
\end{NiceMatrixBlock}
\]

The exterior rows and columns

The options \texttt{first-row, last-row, first-col} and \texttt{last-col} allow the composition of exterior rows and columns in the environments of \texttt{nicematrix}.

A potential “first row” (exterior) has the number 0 (and not 1). Idem for the potential “first column”.

\[
\begin{pNiceMatrix} \texttt{[first-row, last-row, first-col, last-col, nullify-dots]} \\
& C_1 & \texttt{\&} \texttt{\&} C_4 & \texttt{\&} \\
L_1 & a_{11} & a_{12} & a_{13} & a_{14} & L_1 \\
\texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \texttt{\&} \\
L_4 & a_{41} & a_{42} & a_{43} & a_{44} & L_4 \\
\end{pNiceMatrix}
\]

\(^{21}\)The result is achieved with only one compilation (but PGF/Tikz will have written informations in the .\texttt{aux} file and a message requiring a second compilation will appear).\(^{22}\)At this time, this is the only usage of the environment \{NiceMatrixBlock\} but it may have other usages in the future.
The dotted lines have been drawn with the tools presented p. 19.

We have several remarks to do.

- For the environments with an explicit preamble (i.e. \texttt{NiceTabular}, \texttt{NiceArray} and its variants), no letter must be given in that preamble for the potential first column and the potential last column: they will automatically (and necessarily) be of type \texttt{r} for the first column and \texttt{l} for the last one.\footnote{The users wishing exteriors columns with another type of alignment should consider the command \texttt{\SubMatrix} available in the \texttt{\CodeAfter} (cf. p. 25).}

- One may wonder how \texttt{nicematrix} determines the number of rows and columns which are needed for the composition of the “last row” and “last column”.

  \begin{itemize}
  \item For the environments with explicit preamble, like \texttt{NiceTabular} and \texttt{pNiceArray}, the number of columns can obviously be computed from the preamble.
  \item When the option \texttt{light-syntax} (cf. p. 33) is used, \texttt{nicematrix} has, in any case, to load the whole body of the environment (and that’s why it’s not possible to put verbatim material in the array with the option \texttt{light-syntax}). The analysis of this whole body gives the number of rows (but not the number of columns).
  \item In the other cases, \texttt{nicematrix} compute the number of rows and columns during the first compilation and write the result in the \texttt{aux} file for the next run. However, it’s possible to provide the number of the last row and the number of the last column as values of the options \texttt{last-row} and \texttt{last-col}, tending to an acceleration of the whole compilation of the document. That’s what we will do throughout the rest of the document.
  \end{itemize}

It’s possible to control the appearance of these rows and columns with options \texttt{code-for-first-row}, \texttt{code-for-last-row}, \texttt{code-for-first-col} and \texttt{code-for-last-col}. These options specify tokens that will be inserted before each cell of the corresponding row or column.

\begin{NiceMatrix}[first-row,last-row=5,first-col,last-col,nullify-dots] & C_1 & \Cdots & & C_4 & \\
L_1 & a_{11} & a_{12} & a_{13} & a_{14} & L_1 \\
\vdots & a_{21} & a_{22} & a_{23} & a_{24} & \vdots \\
L_4 & a_{41} & a_{42} & a_{43} & a_{44} & L_4 \\
C_1 & \Cdots & & C_4 & \end{NiceMatrix}
Remarks

- As shown in the previous example, the horizontal and vertical rules doesn’t extend in the exterior rows and columns. However, if one wishes to define new specifiers for columns in order to draw vertical rules (for example thicker than the standard rules), he should consider the command `\OnlyMainNiceMatrix` described on page 38.

- A specification of color present in `code-for-first-row` also applies to a dotted line draw in this exterior “first row” (excepted if a value has been given to `xdots/color`). Idem for the other exterior rows and columns.

- Logically, the potential option `columns-width` (described p. 16) doesn’t apply to the “first column” and “last column”.

- For technical reasons, it’s not possible to use the option of the command `\ ` after the “first row” or before the “last row”. The placement of the delimiters would be wrong. If you are looking for a workaround, consider the command `\SubMatrix` in the `\CodeAfter` described p. 25.

10 The continuous dotted lines

Inside the environments of the package `nicematrix`, new commands are defined: `\Ldots`, `\Cdots`, `\Vdots`, `\Ddots`, and `\Iddots`. These commands are intended to be used in place of `\dots`, `\cdots`, `\vdots`, `\ddots` and `\iddots`. Each of them must be used alone in the cell of the array and it draws a dotted line between the first non-empty cells on both sides of the current cell. Of course, for `\Ldots` and `\Cdots`, it’s an horizontal line; for `\Vdots`, it’s a vertical line and for `\Ddots` and `\Iddots` diagonal ones. It’s possible to change the color of these lines with the option `color`.26

\begin{bNiceMatrix}
 a_1 & \Cdots & & & a_1 \\
 \Vdots & a_2 & \Cdots & & a_2 \\
 \vline & \Vdots & \Ddots \[\text{color=red}\] \\
 a_1 & a_2 & & & a_n
\end{bNiceMatrix}

\begin{bNiceMatrix}
 a_1 & \Cdots & a_1 \\
 \vline & a_2 \vline & \vline & \vline & a_2 \\
 \vline & \vline & \vline & \vline & \vline \\
 a_1 & a_2 & a_3 & \vline & a_n
\end{bNiceMatrix}

In order to represent the null matrix, one can use the following codage:

\begin{bNiceMatrix}
 0 & \Cdots & 0 \\
 \vline & \Cdots & \vline & \Vdots \\
 0 & \Cdots & 0
\end{bNiceMatrix}

\begin{bNiceMatrix}
 0 \vline \vline \vline \vline \vline \vline \\
 0 \vline \vline \vline \vline \vline \vline
\end{bNiceMatrix}

---

24 The command `\iddots`, defined in `nicematrix`, is a variant of `\ddots` with dots going forward. If `mathdots` is loaded, the version of `mathdots` is used. It corresponds to the command `\adots` of `unicode-math`.

25 The precise definition of a “non-empty cell” is given below (cf. p. 39).

26 It’s also possible to change the color of all these dotted lines with the option `xdots/color` (`xdots` to remind that it works for `\Cdots`, `\Ldots`, `\Vdots`, etc.): cf. p. 23.
However, one may want a larger matrix. Usually, in such a case, the users of LaTeX add a new row and a new column. It’s possible to use the same method with \texttt{nicematrix}:

\begin{bNiceMatrix}
0 & \Cdots & \Cdots & 0 \\
\Vdots & & & \Vdots \\
\Vdots & & & \Vdots \\
0 & \Cdots & \Cdots & 0
\end{bNiceMatrix}

\[
\begin{bmatrix}
0 & \ldots & 0 \\
\vdots & \ddots & \vdots \\
\vdots & \ddots & \vdots \\
0 & \ldots & 0
\end{bmatrix}
\]

In the first column of this example, there are two instructions \texttt{\Vdots} but, of course, only one dotted line is drawn.

In fact, in this example, it would be possible to draw the same matrix more easily with the following code:

\begin{bNiceMatrix}
0 & \Cdots & & 0 \\
\Vdots & & & \Vdots \\
& & & \Vdots \\
0 & & \Cdots & 0
\end{bNiceMatrix}

\[
\begin{bmatrix}
0 & \ldots & 0 \\
\vdots & \ddots & \vdots \\
\vdots & \ddots & \vdots \\
0 & \ldots & 0
\end{bmatrix}
\]

There are also other means to change the size of the matrix. Someone might want to use the optional argument of the command \texttt{\\} for the vertical dimension and a command \texttt{\hspace\*} in a cell for the horizontal dimension.\footnote{In \texttt{nicematrix}, one should use \texttt{\hspace\*} and not \texttt{\hspace} for such an usage because \texttt{nicematrix} loads \texttt{array}. One may also remark that it’s possible to fix the width of a column by using the environment \texttt{\NiceArray} (or one of its variants) with a column of type \texttt{w} or \texttt{W}; see p. 16.}

However, a command \texttt{\hspace\*} might interfere with the construction of the dotted lines. That’s why the package \texttt{nicematrix} provides a command \texttt{\Hspace} which is a variant of \texttt{\hspace} transparent for the dotted lines of \texttt{nicematrix}.

\begin{bNiceMatrix}
0 & \Cdots & \Hspace\*{1cm} & 0 \\
\Vdots & & & \Vdots \\
0 & & \Hspace\*{1cm} & 0
\end{bNiceMatrix}

\[
\begin{bmatrix}
0 & \ldots & 0 \\
\vdots & \ddots & \vdots \\
\vdots & \ddots & \vdots \\
0 & \ldots & 0
\end{bmatrix}
\]

\textbf{10.1 The option nullify-dots}

Consider the following matrix composed classically with the environment \texttt{\pmatrix} of \texttt{amsmath}.

$A = \begin{pmatrix}
h & i & j & k & l & m \\
x & & & & & x
\end{pmatrix}$

If we add \texttt{\\\ldots} instructions in the second row, the geometry of the matrix is modified.

$B = \begin{pmatrix}
h & i & j & k & l & m \\
x & \ldots & \ldots & \ldots & \ldots & x
\end{pmatrix}$

By default, with \texttt{nicematrix}, if we replace \texttt{\pmatrix} by \texttt{\pNiceMatrix} and \texttt{\\\ldots} by \texttt{\Ldots}, the geometry of the matrix is not changed.

$C = \begin{pNiceMatrix}
h & i & j & k & l & m \\
x & \Ldots & \Ldots & \Ldots & \Ldots & x
\end{pNiceMatrix}$
However, one may prefer the geometry of the first matrix $A$ and would like to have such a geometry with a dotted line in the second row. It’s possible by using the option \texttt{nullify-dots} (and only one instruction \texttt{\Ldots} is necessary).

$D = \begin{pNiceMatrix}
\nullify-dots \\
h & i & j & k & l & m \\
x & \Ldots & & & & x \\
\end{pNiceMatrix}$

The option \texttt{nullify-dots} smashes the instructions \texttt{\Ldots} (and the variants) horizontally but also vertically.

10.2 The commands \texttt{\Hdotsfor} and \texttt{\Vdotsfor}

Some people commonly use the command \texttt{\Hdotsfor} of \texttt{amsmath} in order to draw horizontal dotted lines in a matrix. In the environments of \texttt{nicematrix}, one should use instead \texttt{\Hdotsfor} in order to draw dotted lines similar to the other dotted lines drawn by the package \texttt{nicematrix}.

As with the other commands of \texttt{nicematrix} (like \texttt{Cdots}, \texttt{\Ldots}, \texttt{\Vdots}, etc.), the dotted line drawn with \texttt{\Hdotsfor} extends until the contents of the cells on both sides.

$\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
1 & \Hdotsfor{3} & 5 \\
1 & 2 & 3 & 4 & 5 \\
1 & 2 & 3 & 4 & 5 \\
\end{pNiceMatrix}$

However, if these cells are empty, the dotted line extends only in the cells specified by the argument of \texttt{\Hdotsfor} (by design).

$\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
& \Hdotsfor{3} \\
1 & 2 & 3 & 4 & 5 \\
1 & 2 & 3 & 4 & 5 \\
\end{pNiceMatrix}$

Remark: Unlike the command \texttt{\Hdotsfor} of \texttt{amsmath}, the command \texttt{\Hdotsfor} may be used even when the package \texttt{colortbl}\footnote{We recall that when \texttt{xcolor} is loaded with the option \texttt{table}, the package \texttt{colortbl} is loaded.} is loaded (but you might have problem if you use \texttt{\rowcolor} on the same row as \texttt{\Hdotsfor}).

The package \texttt{nicematrix} also provides a command \texttt{\Vdotsfor} similar to \texttt{\Hdotsfor} but for the vertical dotted lines. The following example uses both \texttt{\Hdotsfor} and \texttt{\Vdotsfor}:

\begin{bNiceMatrix}
C[a_{1},a_1] & \Cdots & C[a_{1},a_n] \\
& \hspace*{20mm} & \Cdots & C[a_{1},a_{1}^{(p)}] & \Cdots & C[a_{1},a_n^{(p)}] \\
\Vdots & \Ddots & \Vdots & \Hdotsfor{1} & \Vdots & \Ddots & \Vdots \\
C[a_n,a_1] & \Cdots & C[a_n,a_n] \\
& \hspace*{20mm} & \Cdots & C[a_n,a_{1}^{(p)}] & \Cdots & C[a_n,a_n^{(p)}] \\
\rule{0pt}{15mm}\NotEmpty & \Vdotsfor{1} & \Ddots & \Vdots \\
C[a_1^{(p)},a_1] & \Cdots & C[a_1^{(p)},a_n] \\
& \hspace*{20mm} & \Cdots & C[a_1^{(p)},a_{1}^{(p)}] & \Cdots & C[a_1^{(p)},a_n^{(p)}] \\
\Vdots & \Ddots & \Vdots \\
& \Hdotsfor{1} & \Cdots & C[a_n^{(p)},a_{1}^{(p)}] & \Cdots & C[a_n^{(p)},a_n^{(p)}] \\
\end{bNiceMatrix}
How to generate the continuous dotted lines transparently

Imagine you have a document with a great number of mathematical matrices with ellipsis. You may wish to use the dotted lines of nicematrix without having to modify the code of each matrix. It’s possible with the keys \texttt{renew-dots} and \texttt{renew-matrix}.\footnote{The options \texttt{renew-dots, renew-matrix} can be fixed with the command \texttt{NiceMatrixOptions} like the other options. However, they can also be fixed as options of the command \texttt{usepackage}. There is also a key \texttt{transparent} which is an alias for the conjunction of \texttt{renew-dots} and \texttt{renew-matrix} but it must be considered as obsolete.}

- The option \texttt{renew-dots}
  
  With this option, the commands $\ldots$, $\cdots$, $\vdots$, $\ddots$, $\iddots$ and $\hdotsfor$ are redefined within the environments provided by \texttt{nicematrix} and behave like $\Ldots$, $\Cdots$, $\Vdots$, $\Ddots$, $\Iddots$ and $\Hdotsfor$, the command $\dots$ ("automatic dots" of \texttt{amsmath}) is also redefined to behave like $\Ldots$.

- The option \texttt{renew-matrix}
  
  With this option, the environment \texttt{\{matrix\}} is redefined and behave like \texttt{\{NiceMatrix\}}, and so on for the five variants.

Therefore, with the keys \texttt{renew-dots} and \texttt{renew-matrix}, a classical code gives directly the output of \texttt{nicematrix}.

\begin{verbatim}
\NiceMatrixOptions{renew-dots,renew-matrix}
\begin{pmatrix}
1 & \cdots & \cdots & 1 \\
0 & \ddots & & \vdots \\
\vdots & \ddots & \ddots & \vdots \\
0 & \cdots & 0 & 1
\end{pmatrix}
\end{verbatim}

The labels of the dotted lines

The commands $\ldots$, $\cdots$, $\vdots$, $\ddots$, $\iddots$ and $\hdotsfor$ (and the command $\line$ in the \texttt{\CodeAfter} which is described p. 24) accept two optional arguments specified by the tokens $\_\text{\_}$ and $\wedge\text{\wedge}$ for labels positioned below and above the line. The arguments are composed in math mode with $\scriptstyle$.

\begin{verbatim}
\begin{bNiceMatrix}
1 & \hspace*{1cm} & 0 \\
& \Ddots^{n \text{ times}} & \\
0 & & 1
\end{bNiceMatrix}
\end{verbatim}

\begin{verbatim}
\begin{bNiceMatrix}
1 \& \hspace*{1cm} \& 0 \& [8mm] \\
\& \\Ddots"^(n \text{ times}) \& 0 \& 1
\end{bNiceMatrix}$
\end{verbatim}
10.5 Customisation of the dotted lines

The dotted lines drawn by \Ldots, \Cdots, \Ddots, \Iddots and \Hdots (and by the command \line in the \CodeAfter which is described p. 24) may be customized by three options (specified between square brackets after the command):

- color;
- shorten;
- line-style.

These options may also be fixed with \NiceMatrixOptions, as options of \CodeAfter or at the level of a given environment but, in those cases, they must be prefixed by xdots, and, thus have for names:

- xdots/color;
- xdots/shorten;
- xdots/line-style.

For the clarity of the explanations, we will use those names.

The option xdots/color

The option xdots/color fixes the color or the dotted line. However, one should remark that the dotted lines drawn in the exterior rows and columns have a special treatment: cf. p. 17.

The option xdots/shorten

The option xdots/shorten fixes the margin of both extremities of the line. The name is derived from the options “shorten >” and “shorten <” of Tikz but one should notice that nicematrix only provides xdots/shorten. The initial value of this parameter is 0.3 em (it is recommanded to use a unit of length dependent of the current font).

The option xdots/line-style

It should be pointed that, by default, the lines drawn by Tikz with the parameter dotted are composed of square dots (and not rounded ones).\footnote{The first reason of this behaviour is that the PDF format includes a description for dashed lines. The lines specified with this descriptor are displayed very efficiently by the PDF readers. It’s easy, starting from these dashed lines, to create a line composed by square dots whereas a line of rounded dots needs a specification of each dot in the PDF file.}

\begin{verbatim}
\tikz \draw [dotted] (0,0) -- (5,0) ;
\end{verbatim}

In order to provide lines with rounded dots in the style of those provided by \ldots (at least with the Computer Modern fonts), the package nicematrix embeds its own system to draw a dotted line (and this system uses PGF and not Tikz). This style is called standard and that’s the initial value of the parameter xdots/line-style.

However (when Tikz is loaded) it’s possible to use for xdots/line-style any style provided by Tikz, that is to say any sequence of options provided by Tikz for the Tizk pathes (with the exception of “color”, “shorten >” and “shorten <”).

Here is for example a tridiagonal matrix with the style loosely dotted:

\begin{pNiceMatrix}[nullify-dots,xdots/line-style=loosely dotted]
a & b & 0 & & \Cdots & 0 \\b & a & b & \Ddots & & \Vdots \\0 & b & a & \Ddots & & \\& \Ddots & \Ddots & \Ddots & & 0 \\\Vdots & & & & & b \\0 & \Cdots & & 0 & b & a
\end{pNiceMatrix}
10.6 The dotted lines and the rules

The dotted lines determine virtual blocks which have the same behaviour regarding the rules (the rules specified by the specifier \texttt{I} in the preamble, by the command \texttt{\Hline} and by the keys \texttt{hlines, vlines and hvlines are not drawn within the blocks}).

\begin{bNiceMatrix} \[ \text{margin, hvlines} \] \end{bNiceMatrix}

\begin{bNiceMatrix}[margin, hvlines]
\Block{3-3}<\LARGE>{A} & & & 0 \\
\& & \hspace*{1cm} & & \Vdots \\
\& & & 0 \\
0 & \Cdots & 0 & 0
\end{bNiceMatrix}

\begin{bNiceMatrix}[margin, hvlines]
\Block{3-3}<\LARGE>{A} & & & 0 \\
\& & \hspace*{1cm} & & \Vdots \\
\& & & 0 \\
0 & \Cdots & 0 & 0
\end{bNiceMatrix}

11 The \texttt{\textbackslash CodeAfter}

The option \texttt{code-after} may be used to give some code that will be executed after the construction of the matrix.

For the legibility of the code, an alternative syntax is provided: it’s possible to give the instructions of the \texttt{code-after} at the end of the environment, after the keyword \texttt{\CodeAfter}. Although \texttt{\CodeAfter} is a keyword, it takes in an optional argument (between square brackets). The keys accepted form a subset of the keys of the command \texttt{\WithArrowsOptions}.

The experienced users may, for instance, use the PGF/Tikz nodes created by \texttt{ninematrix} in the \texttt{\CodeAfter}. These nodes are described further beginning on p. 34.

Moreover, two special commands are available in the \texttt{\CodeAfter: line} and \texttt{\SubMatrix}.

11.1 The command \texttt{\textbackslash line} in the \texttt{\textbackslash CodeAfter}

The command \texttt{\line} draws directly dotted lines between nodes. It takes in two arguments for the two cells to link, both of the form \texttt{i-j} where \texttt{i} is the number of the row and \texttt{j} is the number of the column. The options available for the customisation of the dotted lines created by \texttt{\Cdots, \Vdots, etc.} are also available for this command (cf. p. 23).

This command may be used, for example, to draw a dotted line between two adjacent cells.

\begin{NiceMatrixOptions}{xdots/shorten = 0.6 em}
\begin{NiceMatrix}
I & 0 & \Cdots & 0 \\
0 & I & \Ddots & \Vdots \\
\Vdots & \Ddots & I & 0 \\
0 & \Cdots & 0 & I
\end{NiceMatrix}
\CodeAfter \line{2-2}{3-3}
\end{NiceMatrix}

It can also be used to draw a diagonal line not parallel to the other diagonal lines (by default, the dotted lines drawn by \texttt{\Ddots} are “parallelized”: cf. p. 39).

\textsuperscript{31}On the other side, the command \texttt{\line} in the \texttt{\CodeAfter} (cf. p. 24) does not create block.

\textsuperscript{32}There is also a key \texttt{code-before} described p. 12.
11.2 The command `\SubMatrix` in the `\CodeAfter`

The command `\SubMatrix` provides a way to put delimiters on a portion of the array considered as a submatrix. The command `\SubMatrix` takes in five arguments:

- the first argument is the left delimiter, which may be any extensible delimiter provided by LaTeX: `(`, `[`, `{`, `\langle`, `\lgroup`, `\lfloor`, etc. but also the null delimiter `;`;
- the second argument is the upper-left corner of the submatrix with the syntax `i-j` where `i` the number of row and `j` the number of column;
- the third argument is the lower-right corner with the same syntax;
- the fourth argument is the right delimiter;
- the last argument, which is optional, is a list of key-value pairs.\(^{33}\)

One should remark that the command `\SubMatrix` draws the delimiters after the construction of the array: no space is inserted by the command `\SubMatrix` itself. That’s why, in the following example, we have used the key `margin` and you have added by hand some space between the third and fourth column with `@{\hspace{1.5em}}` in the preamble of the array.

```
\begin{NiceArray}{ccc}
& 1 & 1 & 1 & x \\
1/4 & 1/2 & 1/4 & y \\
1 & 2 & 3 & z
\SubMatrix\[{2-2}{3-3}\]^{T}
\end{NiceArray}
```

New 5.18 In fact, the command `\SubMatrix` also takes in two optional arguments specified by the traditional symbols ^ and _ for material in superscript and subscript.

```
\begin{bNiceMatrix}
1 & a & b \\
1 & c & d
\CodeAfter \SubMatrix\[{2-2}{3-3}\]^T
\end{bNiceMatrix}
```

The options of the command `\SubMatrix` are as follows:

\(^{33}\)There is no optional argument between square brackets in first position because a square bracket just after `\SubMatrix` must be interpreted as the first (mandatory) argument of the command `\SubMatrix`: that bracket is the left delimiter of the sub-matrix to construct (eg.: `\SubMatrix\[{2-2}{4-7}\]`).
• **left-xshift** and **right-xshift** shift horizontally the delimiters (there exists also the key **xshift** which fixes both parameters);

• **extra-height** adds a quantity to the total height of the delimiters (height \ht + depth \dp);

• **delimiters/color** fixes the color of the delimiters (also available in \NiceMatrixOptions, in the environments with delimiters and as option of the keyword \CodeAfter);

• **slim** is a boolean key: when that key is in force, the horizontal position of the delimiters is computed by using only the contents of the cells of the submatrix whereas, in the general case, the position is computed by taking into account the cells of the whole columns implied in the submatrix (see example below).

• **vlines** contains a list of numbers of vertical rules that will be drawn in the sub-matrix (if this key is used without value, all the vertical rules of the sub-matrix are drawn);

• **hlines** is similar to **vlines** but for the horizontal rules;

• **hvlines**, which must be used without value, draws all the vertical and horizontal rules.

One should remark that these keys add their rules after the construction of the main matrix: no space is added between the rows and the columns of the array for theses rules.

All these keys are also available in \NiceMatrixOptions, at the level of the environments of nicematrix or as option of the command \CodeAfter with the prefix sub-matrix which means that their names are therefore sub-matrix/left-xshift, sub-matrix/right-xshift, sub-matrix/xshift, etc.

```latex
$\begin{NiceArray}{cc@{\hspace{5mm}}l}[cell-space-limits=2pt]
& & \frac12 \\
& & \frac14 \\
\begin{array}{c}
\begin{NiceArray}{cc}
& \frac12 \\
\end{NiceArray}
\end{array}
\end{NiceArray}$
```

Here is the same example with the key **slim** used for one of the submatrices.

```latex
$\begin{NiceArray}{cc@{\hspace{5mm}}l}[cell-space-limits=2pt]
& & \frac12 \\
& & \frac14 \\
\begin{array}{c}
\begin{NiceArray}{cc}
& \frac12 \\
\end{NiceArray}
\end{array}$
```

There is also a key **name** which gives a name to the submatrix created by \SubMatrix. That name is used to create PGF/Tikz nodes: cf p. 37.

It’s also possible to specify some delimiters\footnote{Those delimiters are \(, [, \{, \) and the closing ones. Of course, it’s also possible to put ~l and I| in the preamble of the environment.} by placing them in the preamble of the environment (for the environments with a preamble: \{NiceArray}, \{pNiceArray}, etc.). This syntax is inspired by the extension bkarray.

When there are two successive delimiters (necessarily a closing one following by an opening one for another submatrix), a space equal to \enskip is automatically inserted.
\begin{NiceArray}{(c)(c)(c)}
a_{11} & a_{12} & a_{13} \\
a_{21} & \displaystyle \int_0^1 \frac{1}{x^2+1} \, dx & a_{23} \\
a_{31} & a_{32} & a_{33}
\end{NiceArray}\\

\begin{pmatrix}
\begin{pmatrix}a_{11} \\ a_{21} \\ a_{31}\end{pmatrix} & \begin{pmatrix}a_{12} \\ \int_0^1 \frac{1}{x^2+1} \, dx \\ a_{32}\end{pmatrix} & \begin{pmatrix}a_{13} \\ a_{23} \\ a_{33}\end{pmatrix}
\end{pmatrix}

12  The notes in the tabulars

12.1  The footnotes

The package nicematrix allows, by using footnote or footnotehyper, the extraction of the notes inserted by \footnote in the environments of nicematrix and their composition in the footpage with the other notes of the document.

If nicematrix is loaded with the option footnote (with \usepackage[footnote]{nicematrix} or with \PassOptionsToPackage), the package footnote is loaded (if it is not yet loaded) and it is used to extract the footnotes.

If nicematrix is loaded with the option footnotehyper, the package footnotehyper is loaded (if it is not yet loaded) and it is used to extract footnotes.

Caution: The packages footnote and footnotehyper are incompatible. The package footnotehyper is the successor of the package footnote and should be used preferently. The package footnote has some drawbacks, in particular: it must be loaded after the package xcolor and it is not perfectly compatible with hyperref.

12.2  The notes of tabular

The package nicematrix also provides a command \tabularnote which gives the ability to specify notes that will be composed at the end of the array with a width of line equal to the width of the array (excepted the potential exterior columns). With no surprise, that command is available only in the environments without delimiters, that is to say \{NiceTabular\}, \{NiceArray\} and \{NiceMatrix\}.

In fact, this command is available only if the extension enumitem has been loaded (before or after nicematrix). Indeed, the notes are composed at the end of the array with a type of list provided by the package enumitem.

\begin{NiceTabular}{@{}llr@{}}
\toprule 
RowStyle{\bfseries} 
Last name & First name & Birth day \ \\
\midrule 
Achard\tabularnote{Achard is an old family of the Poitou.} & Jacques & 5 juin 1962 \ \\
& Mathilde & 23 mai 1988 \ \\
& Vanesse & Stepahy & 30 octobre 1994 \ \\
& Dupont & Chantal & 15 janvier 1998 \ \\
\bottomrule
\end{NiceTabular}
Achard\textsuperscript{a} is an old family of the Poitou.

The name Lefebvre is an alteration of the name Lefebure.

\begin{table}
\begin{NiceTabular}{@{}llc@{}}
\toprule
Last name & First name & Birth day \\
\midrule
Achard\textsuperscript{a} & Jacques & June 5, 2005 \\
Lefebvre\textsuperscript{b} & Mathilde & January 23, 1975 \\
Vanesse & Stephany & October 30, 1994 \\
Dupont & Chantal & January 15, 1998 \\
\bottomrule
\end{NiceTabular}
\end{table}

\footnotesize{\textsuperscript{a} Achard is an old family of the Poitou.}

\footnotesize{\textsuperscript{b} The name Lefebvre is an alteration of the name Lefebure.}

- If you have several successive commands \texttt{\textbackslash tabularnote{...}} with no space at all between them, the labels of the corresponding notes are composed together, separated by commas (this is similar to the option \texttt{multiple} of \texttt{footmisc} for the footnotes).

- If a command \texttt{\textbackslash tabularnote{...}} is exactly at the end of a cell (with no space at all after), the label of the note is composed in an overlapping position (towards the right). This structure may provide a better alignment of the cells of a given column.

- If the key \texttt{notes/para} is used, the notes are composed at the end of the array in a single paragraph (as with the key \texttt{para} of \texttt{threeparttable}).

- There is a key \texttt{tabularnote} which provides a way to insert some text in the zone of the notes before the numbered tabular notes.

- If the package \texttt{booktabs} has been loaded (before or after \texttt{nicematrix}), the key \texttt{notes/bottomrule} draws a \texttt{\textbackslash bottomrule} of \texttt{booktabs} after the notes.

- The command \texttt{\textbackslash tabularnote} may be used before the environment of \texttt{nicematrix}. Thus, it’s possible to use it on the title inserted by \texttt{\textbackslash caption} in an environment \texttt{\{table\}} of \LaTeX{}.

- It’s possible to create a reference to a tabular note created by \texttt{\textbackslash tabularnote} (with the usual command \texttt{\textbackslash label} used after the \texttt{\textbackslash tabularnote}).

For an illustration of some of those remarks, see table 1, p. 29. This table has been composed with the following code.

\begin{verbatim}
\begin{table}
\setlength{\belowcaptionskip}{1ex}
\centering
\caption{Use of \texttt{\textbackslash tabularnote}\tabularnote{It's possible to put a note in the caption.}}
\label{t:tabularnote}
\begin{NiceTabular}{@{}llc@{}}
\toprule
Last name & First name & Length of life \\
\midrule
Churchill & Wiston & 91 \\
Nightingale\tabularnote{Considered as the first nurse of history.}\tabularnote{Nicknamed \"the Lady with the Lamp\".} & Florence & 90 \\
Schoelcher & Victor & 89\tabularnote{The label of the note is overlapping.} \\
Touchet & Marie & 89 \\
Wallis & John & 87 \\
\bottomrule
\end{NiceTabular}
\end{table}
\end{verbatim}
12.3 Customisation of the tabular notes

The tabular notes can be customized with a set of keys available in \NiceMatrixOptions. The name of these keys is prefixed by notes.

- notes/para
- notes/bottomrule
- notes/style
- notes/label-in-tabular
- notes/label-in-list
- notes/enumitem-keys
- notes/enumitem-keys-para
- notes/code-before

For sake of commodity, it is also possible to set these keys in \NiceMatrixOptions via a key notes which takes in as value a list of pairs key=value where the name of the keys need no longer be prefixed by notes:

\NiceMatrixOptions
{ notes =

  { bottomrule ,
    style = ... ,
    label-in-tabular = ... ,
    enumitem-keys =
    { labelsep = ... ,
      align = ... ,
      ...
    }
  }
}

We detail these keys.

- The key notes/para requires the composition of the notes (at the end of the tabular) in a single paragraph.
  Initial value: false
  That key is also available within a given environment.

Some text before the notes.

\begin{table}[h]
\centering
\begin{tabular}{lll}
\hline
Last name & First name & Length of life \\
\hline
Churchill & Wiston & 91 \\
Nightingale$^{b,c}$ & Florence & 90 \\
Schoelcher & Victor & 89$^d$ \\
Touchet & Marie & 89 \\
Wallis & John & 87 \\
\hline
\end{tabular}
\caption{Use of \texttt{\tabularnote}\textsuperscript{a}}
\end{table}

$^a$ It’s possible to put a note in the caption.
$^b$ Considered as the first nurse of history.
$^c$ Nicknamed “the Lady with the Lamp”.
$^d$ The label of the note is overlapping.
• The key `notes/bottomrule` adds a `\bottomrule` of `booktabs` after the notes. Of course, that rule is drawn only if there is really notes in the tabular. The package `booktabs` must have been loaded (before or after the package `nicematrix`). If it is not, an error is raised.

Initial value: `false`

That key is also available within a given environment.

• The key `notes/style` is a command whose argument is specified by `#1` and which gives the style of numeration of the notes. That style will be used by `\ref` when referencing a tabular note marked with a command `\label`. The labels formatted by that style are used, separated by commas, when the user puts several consecutive commands `\tabularnote`. The marker `#1` is meant to be the name of a LaTeX counter.

Initial value: `\textit{\textalpha{}#1}`

Another possible value should be a mere `\textarabic{#1}`

• The key `notes/label-in-tabular` is a command whose argument is specified by `#1` which is used when formatting the label of a note in the tabular. Internally, this number of note has already been formatted by `notes/style` before sent to that command.

Initial value: `\textsuperscript{#1}`

In French, it’s a tradition of putting a small space before the label of note. That tuning could be acheived by the following code:

```
\NiceMatrixOptions{notes/label-in-tabular = \.,\textsuperscript{#1}}
```

• The key `notes/label-in-list` is a command whose argument is specified by `#1` which is used when formatting the label in the list of notes at the end of the tabular. Internally, this number of note has already been formatted by `notes/style` before sent to that command.

Initial value: `\textsuperscript{#1}`

In French, the labels of notes are not composed in upper position when composing the notes. Such behaviour could be acheived by:

```
\NiceMatrixOptions{notes/label-in-list = #1.\nobreak\hspace{0.25em}}
```

The command `\nobreak` is for the event that the option `para` is used.

• The notes are composed at the end of the tabular by using internally a style of list of `enumitem`. The key `notes/enumitem-keys` specifies a list of pairs `key=value` (following the specifications of `enumitem`) to customize that type of list.

Initial value: `noitemsep , leftmargin = * , align = left , labelsep = 0pt`

This initial value contains the specification `align = left` which requires a composition of the label leftwards in the box affected to that label. With that tuning, the notes are composed flush left, which is pleasant when composing tabulars in the spirit of `booktabs` (see for example the table 1, p. 29).

• The key `notes/enumitem-keys-para` is similar to the previous one but corresponds to the type of list used when the option `para` is in force. Of course, when the option `para` is used, a list of type `inline` (as called by `enumitem`) is used and the pairs `key=value` should correspond to such a list of type `inline`.

Initial value: `afterlabel = \nobreak, itemjoin = \quad`

• The key `notes/code-before` is a token list inserted by `nicematrix` just before the composition of the notes at the end of the tabular.

Initial value: `empty`

For example, if one wishes to compose all the notes in gray and `\footnotesize`, he should use that key:

```
\NiceMatrixOptions{notes/code-before = \footnotesize \color{gray}}
```
It’s also possible to add \raggedright or \RaggedRight in that key (\RaggedRight is a command of ragged2e).

For an example of customisation of the tabular notes, see p. 41.

12.4 Use of \{NiceTabular\} with threeparttable

If you wish to use the environment \{NiceTabular\} or \{NiceTabular*\} in an environment \{threeparttable\} of the eponymous package, you have to patch the environment \{threeparttable\} with the following code (with a version of LaTeX at least 2020/10/01).

\makeatletter
\AddToHook{env/threeparttable/begin}{\TPT@hookin{NiceTabular}\TPT@hookin{NiceTabular*}}
\makeatother

13 Other features

13.1 Use of the column type \texttt{S} of siunitx

If the package siunitx is loaded (before or after nicematrix), it’s possible to use the \texttt{S} column type of siunitx in the environments of nicematrix. The implementation doesn’t use explicitly any private macro of siunitx.

\begin{pNiceArray}{ScWc{1cm}c}[nullify-dots,first-row]
\{C_1} \& \Cdots & \& C_n \\
2.3 \& 0 \& \Cdots \& 0 \\
12.4 \& \Vdots \& \& \Vdots \\
1.45 \\
7.2 \& 0 \& \Cdots \& 0
\end{pNiceArray}

\[
\begin{bNiceMatrix}[r]
\cos x \& - \sin x \\
\sin x \& \cos x
\end{bNiceMatrix}
\]

On the other hand, the \texttt{d} columns of the package dcolumn are not supported by nicematrix.

13.2 Alignment option in \{NiceMatrix\}

The environments without preamble (\{NiceMatrix\}, \{pNiceMatrix\}, \{bNiceMatrix\}, etc.) provide two options \texttt{l} and \texttt{r} which generate all the columns aligned leftwards (or rightwards).

\begin{bNiceMatrix}[r]
\cos x \& - \sin x \\
\sin x \& \cos x
\end{bNiceMatrix}

13.3 The command \texttt{\rotate}

The package nicematrix provides a command \texttt{\rotate}. When used in the beginning of a cell, this command composes the contents of the cell after a rotation of 90° in the direct sens.

In the following command, we use that command in the \texttt{code-for-first-row}.

\footnote{It can also be used in \texttt{RowStyle} (cf. p. 16.)}
If the command \texttt{\rotate} is used in the “last row” (exterior to the matrix), the corresponding elements are aligned upwards as shown below.

\begin{verbatim}
\NiceMatrixOptions%
{code-for-first-row = \scriptstyle \rotate \text{image of },
  code-for-last-col = \scriptstyle }
$A = \begin{pNiceMatrix}[first-row,last-col=4]
e_1 & e_2 & e_3 & \text{image of } e_1 \\
1 & 2 & 3 & e_1 \\
4 & 5 & 6 & e_2 \\
7 & 8 & 9 & e_3 \\
\end{pNiceMatrix}$

$A = \begin{pNiceMatrix}[last-row=4,last-col=4]
1 & 2 & 3 & e_1 \\
4 & 5 & 6 & e_2 \\
7 & 8 & 9 & e_3 \\
\text{image of } e_1 & e_2 & e_3 \\
\end{pNiceMatrix}$
\end{verbatim}

13.4 The option \texttt{small}

With the option \texttt{small}, the environments of the package nicematrix are composed in a way similar to the environment \texttt{\smallmatrix} of the package amsmath (and the environments \texttt{psmallmatrix}, \texttt{bsmallmatrix}, etc. of the package mathtools).

\begin{verbatim}
$\begin{bNiceArray}{cccc|c}
\small,
last-col,
\text{code-for-last-col = \scriptscriptstyle,}
columns-width = 3mm \\
1 & -2 & 3 & 4 & 5 \\
0 & 3 & 2 & 1 & 2 & L_2 \gets 2 L_1 - L_2 \\
0 & 1 & 1 & 2 & 3 & L_3 \gets L_1 + L_3 \\
\end{bNiceArray}$
\end{verbatim}

One should note that the environment \texttt{\NiceMatrix} with the option \texttt{small} is not composed \textit{exactly} as the environment \texttt{\smallmatrix}. Indeed, all the environments of nicematrix are constructed upon \texttt{\array} (of the package \texttt{array}) whereas the environment \texttt{\smallmatrix} is constructed directly with an \texttt{\halign} of TeX.

In fact, the option \texttt{small} corresponds to the following tuning:

- the cells of the array are composed with \texttt{\scriptstyle};
- \texttt{\arraystretch} is set to 0.47;
- \texttt{\arraycolsep} is set to 1.45 pt;
- the characteristics of the dotted lines are also modified.
13.5 The counters \textit{iRow} and \textit{jCol}

In the cells of the array, it’s possible to use the LaTeX counters \texttt{iRow} and \texttt{jCol} which represent the number of the current row and the number of the current column\footnote{We recall that the exterior “first row” (if it exists) has the number 0 and that the exterior “first column” (if it exists) has also the number 0.}. Of course, the user must not change the value of these counters which are used internally by \textit{nicematrix}.

In the \texttt{CodeBefore} (cf. p.~12) and in the \texttt{CodeAfter} (cf. p.~24), \texttt{iRow} represents the total number of rows (excepted the potential exterior rows) and \texttt{jCol} represents the total number of columns (excepted the potential exterior columns).

\begin{verbatim}
$\begin{pNiceMatrix}% don't forget the \\
  \[first-row, \\
  \quad \text{first-col,} \\
  \quad \text{code-for-first-row = } \text{\texttt{\textbackslash mathbf{\texttt{alph}}\{\texttt{jCol}\}},} \\
  \quad \text{code-for-first-col = } \text{\texttt{\textbackslash mathbf{\texttt{arabic}}\{\texttt{iRow}\}}}] \\
  \texttt{k} & \texttt{k} & \texttt{k} & \texttt{k} & \\
  \texttt{k} & \texttt{1} & \texttt{k} & \texttt{2} & \texttt{k} & \texttt{3} & \texttt{k} & \texttt{4} & \\
  \texttt{k} & \texttt{5} & \texttt{k} & \texttt{6} & \texttt{k} & \texttt{7} & \texttt{k} & \texttt{8} & \\
  \texttt{k} & \texttt{9} & \texttt{k} & \texttt{10} & \texttt{k} & \texttt{11} & \texttt{k} & \texttt{12} & \& \texttt{a} & \texttt{b} & \texttt{c} & \texttt{d} \\
  \texttt{1} & \texttt{2} & \texttt{3} & \texttt{4} & \\
  \texttt{5} & \texttt{6} & \texttt{7} & \texttt{8} & \\
  \texttt{9} & \texttt{10} & \texttt{11} & \texttt{12} \\
\end{pNiceMatrix}$$
\end{verbatim}

If LaTeX counters called \texttt{iRow} and \texttt{jCol} are defined in the document by packages other than \textit{nicematrix} (or by the final user), they are shadowed in the environments of \textit{nicematrix}.

The package \textit{nicematrix} also provides commands in order to compose automatically matrices from a general pattern. These commands are \texttt{\textbackslash AutoNiceMatrix}, \texttt{\textbackslash pAutoNiceMatrix}, \texttt{\textbackslash bAutoNiceMatrix}, \texttt{\textbackslash vAutoNiceMatrix}, \texttt{\textbackslash VAutoNiceMatrix} and \texttt{\textbackslash BAutoNiceMatrix}.

These commands take in two mandatory arguments. The first is the format of the matrix, with the syntax \texttt{n-p} where \texttt{n} is the number of rows and \texttt{p} the number of columns. The second argument is the pattern (it’s a list of tokens which are inserted in each cell of the constructed matrix, excepted in the cells of the potential exterior rows and columns).

\begin{verbatim}
$C = \text{\texttt{\textbackslash pAutoNiceMatrix}\{3-3\}\{C_{\texttt{\textbackslash arabic\{iRow\}},\texttt{\textbackslash arabic\{jCol\}}}]$}
\end{verbatim}

\[ C = \begin{pmatrix} C_{1,1} & C_{1,2} & C_{1,3} \\ C_{2,1} & C_{2,2} & C_{2,3} \\ C_{3,1} & C_{3,2} & C_{3,3} \end{pmatrix} \]

13.6 The option \texttt{light-syntax}

The option \texttt{light-syntax} (inspired by the package \textit{spalign}) allows the user to compose the arrays with a lighter syntax, which gives a better legibility of the TeX source.

When this option is used, one should use the semicolon for the end of a row and spaces or tabulations to separate the columns. However, as usual in the TeX world, the spaces after a control sequence are discarded and the elements between curly braces are considered as a whole.

\begin{verbatim}
$\begin{bNiceMatrix}[texttt{light-syntax},texttt{first-row},texttt{first-col}]
{} & a & b \\
{2\cos a} & \{\cos a + \cos b\} & a \\
{\cos a + \cos b} & \{2 \cos b\} & \begin{pmatrix} 2 \cos a & \cos a + \cos b \\ \cos a + \cos b & 2 \cos b \end{pmatrix} \\
\end{bNiceMatrix}$
\end{verbatim}

It’s possible to change the character used to mark the end of rows with the option \texttt{end-of-row}. As said before, the initial value is a semicolon.

When the option \texttt{light-syntax} is used, it is not possible to put verbatim material (for example with the command \texttt{\textbackslash verb}) in the cells of the array.\footnote{The reason is that, when the option \texttt{light-syntax} is used, the whole content of the environment is loaded as a TeX argument to be analyzed. The environment doesn’t behave in that case as a standard environment of LaTeX which only put TeX commands before and after the content.}
13.7 Color of the delimiters

For the environments with delimiters ({\texttt{pNiceArray}}, {\texttt{pNiceMatrix}}, etc.), it’s possible to change the color of the delimiters with the key \texttt{delimiters/color}.

\begin{bNiceMatrix}[delimiters/color=red]
1 & 2 \\
3 & 4
\end{bNiceMatrix}

This colour also applies to the delimiters drawn by the command \texttt{\SubMatrix} (cf. p. 25).

13.8 The environment {\texttt{NiceArrayWithDelims}}

In fact, the environment \texttt{pNiceArray} and its variants are based upon a more general environment, called \texttt{NiceArrayWithDelims}. The first two mandatory arguments of this environment are the left and right delimiters used in the construction of the matrix. It’s possible to use \texttt{NiceArrayWithDelims} if we want to use atypical or asymmetrical delimiters.

\begin{NiceArrayWithDelims}

\downarrow \{ \uparrow \}

\begin{array}{ccc}
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9
\end{array}

\end{NiceArrayWithDelims}

14 Use of Tikz with \texttt{nicematrix}

14.1 The nodes corresponding to the contents of the cells

The package \texttt{nicematrix} creates a PGF/Tikz node for each (non-empty) cell of the considered array. These nodes are used to draw the dotted lines between the cells of the matrix (inter alia).

\textbf{Caution:} By default, no node is created in an empty cell.

However, it’s possible to impose the creation of a node with the command \texttt{\NotEmpty}.\footnote{One should note that, with that command, the cell is considered as non-empty, which has consequences for the continuous dotted lines (cf. p. 19) and the computation of the “corners” (cf. p. 10).}

The nodes of a document must have distinct names. That’s why the names of the nodes created by \texttt{nicematrix} contains the number of the current environment. Indeed, the environments of \texttt{nicematrix} are numbered by internal global counter.

In the environment with the number \( n \), the node of the row \( i \) and column \( j \) has for name \texttt{nm-\( n \)-\( i \)-\( j \)}.

The command \texttt{\NiceMatrixLastEnv} provides the number of the last environment of \texttt{nicematrix} (for \LaTeX, it’s a “fully expandable” command and not a counter).

However, it’s advisable to use instead the key \texttt{name}. This key gives a name to the current environment. When the environment has a name, the nodes are accessible with the name “name-\( i \)-\( j \)” where \texttt{name} is the name given to the array and \( i \) and \( j \) the numbers of row and column. It’s possible to use these nodes with PGF but the final user will probably prefer to use Tikz (which is a convenient layer upon PGF). However, one should remind that \texttt{nicematrix} doesn’t load Tikz by default. In the following examples, we assume that Tikz has been loaded.

\begin{pNiceMatrix}[name=mymatrix]
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9
\end{pNiceMatrix}

\tikz[remember picture,overlay]
\draw (mymatrix-2-2) circle (2mm) ;
Don’t forget the options remember picture and overlay.

In the \CodeAfter, the things are easier: one must refer to the nodes with the form $i-j$ (we don’t have to indicate the environment which is of course the current environment).

\begin{pNiceMatrix}
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9
\CodeAfter \tikz \draw (2-2) circle (2mm) ;
\end{pNiceMatrix}

In the following example, we have underlined all the nodes of the matrix (we explain below the technic used: cf. p. 47).

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

### 14.2 The “medium nodes” and the “large nodes”

In fact, the package nicematrix can create “extra nodes”: the “medium nodes” and the “large nodes”. The first ones are created with the option `create-medium-nodes` and the second ones with the option `create-large-nodes`.

These nodes are not used by nicematrix by default, and that’s why they are not created by default. The names of the “medium nodes” are constructed by adding the suffix “-medium” to the names of the “normal nodes”. In the following example, we have underlined the “medium nodes”. We consider that this example is self-explanatory.

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

The names of the “large nodes” are constructed by adding the suffix “-large” to the names of the “normal nodes”. In the following example, we have underlined the “large nodes”. We consider that this example is self-explanatory.

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

The “large nodes” of the first column and last column may appear too small for some usage. That’s why it’s possible to use the options `left-margin` and `right-margin` to add space on both sides of the array and also space in the “large nodes” of the first column and last column. In the following example, we have used the options `left-margin` and `right-margin`.

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

---

39 There is also an option `create-extra-nodes` which is an alias for the conjunction of `create-medium-nodes` and `create-large-nodes`.

40 There is no “large nodes” created in the exterior rows and columns (for these rows and columns, cf. p. 17).

41 The options `left-margin` and `right-margin` take dimensions as values but, if no value is given, the default value is used, which is \arraycolsep (by default: 5 pt). There is also an option `margin` to fix both `left-margin` and `right-margin` to the same value.
It's also possible to add more space on both side of the array with the options `extra-left-margin` and `extra-right-margin`. These margins are not incorporated in the “large nodes”. It’s possible to fix both values with the option `extra-margin` and, in the following example, we use `extra-margin` with the value 3 pt.

\[
\begin{pmatrix}
  & a + b & a + b + c \\
 a + b & a & a + b \\
 a & a & a
\end{pmatrix}
\]

**Be careful**: These nodes are reconstructed from the contents of the contents cells of the array. Usually, they do not correspond to the cells delimited by the rules (if we consider that these rules are drawn).

Here is an array composed with the following code:

```latex
\begin{NiceTabular}{wl{2cm}ll}[hvlines]
fraise & amande & abricot \\
prune & pêche & poire \\
noix & noisette & brugnon
\end{NiceTabular}
```

Here, we have colored all the cells of the array with \texttt{\chessboardcolors}.

Here are the “large nodes” of this array (without use of \texttt{margin} nor \texttt{extra-margin}).

The nodes we have described are not available by default in the \texttt{\CodeBefore} (described p. 12). It’s possible to have these nodes available in the \texttt{\CodeBefore} by using the key \texttt{create-cell-nodes} of the keyword \texttt{\CodeBefore} (in that case, the nodes are created first before the construction of the array by using informations written on the \texttt{aux} file and created a second time during the construction of the array itself).

### 14.3 The nodes which indicate the position of the rules

The package \texttt{nicematrix} creates a PGF/Tikz node merely called $i$ (with the classical prefix) at the intersection of the horizontal rule of number $i$ and the vertical rule of number $i$ (more specifically the potential position of those rules because maybe there are not actually drawn). The last node has also an alias called \texttt{last}. There is also a node called $i.5$ midway between the node $i$ and the node $i + 1$. These nodes are available in the \texttt{\CodeBefore} and the \texttt{\CodeAfter}.

<table>
<thead>
<tr>
<th>1</th>
<th>1.5</th>
<th>tulipe</th>
<th>lys</th>
</tr>
</thead>
<tbody>
<tr>
<td>arum</td>
<td>1.5</td>
<td>violette mauve</td>
<td></td>
</tr>
<tr>
<td>muguet</td>
<td>dahlia</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

If we use Tikz (we remind that \texttt{nicematrix} does not load Tikz by default, by only \texttt{pgf}, which is a sub-layer of Tikz), we can access, in the \texttt{\CodeAfter} but also in the \texttt{\CodeBefore}, to the intersection of the (potential) horizontal rule $i$ and the (potential) vertical rule $j$ with the syntax \texttt{(i-|j)}. 

36
The nodes of the form $i.5$ may be used, for example to cross a row of a matrix (if Tikz is loaded).

\begin{pNiceArray}{ccc|c}
2 & 1 & 3 & 0 \\
3 & 3 & 1 & 0 \\
3 & 3 & 1 & 0
\CodeAfter
\tikz \draw [red] (3.5-|1) -- (3.5-|last) ;
\end{pNiceArray}

14.4 The nodes corresponding to the command \texttt{\textbackslash SubMatrix}

The command \texttt{\textbackslash SubMatrix} available in the \texttt{\CodeAfter} has been described p. 25.

If a command \texttt{\textbackslash SubMatrix} has been used with the key \texttt{name} with an expression such as \texttt{name=MyName} three PGF/Tikz nodes are created with the names \texttt{MyName-left}, \texttt{MyName} and \texttt{MyName-right}.

The nodes \texttt{MyName-left} and \texttt{MyName-right} correspond to the delimiters left and right and the node \texttt{MyName} correspond to the submatrix itself.

In the following example, we have highlighted these nodes (the submatrix itself has been created with \texttt{\textbackslash SubMatrix}\{{2-2}{3-3}\}).

\[
\begin{pmatrix}
121 & 23 & 345 & 345 \\
45 & 346 & 863 & 444 \\
3462 & 38458 & 34 & 294 \\
34 & 7 & 78 & 309
\end{pmatrix}
\]
15 API for the developers

The package nicematrix provides two variables which are internal but public:\footnote{According to the \LaTeX{}3 conventions, each variable with name beginning with \texttt{\g_nicematrix} ou \texttt{\l_nicematrix} is public and each variable with name beginning with \texttt{\g__nicematrix} ou \texttt{\l__nicematrix} is private.}:

- \texttt{\g_nicematrix_code_before_tl};
- \texttt{\g_nicematrix_code_after_tl}.

These variables contain the code of what we have called the “code-before” and the “code-after”. The developer can use them to add code from a cell of the array (the affectation must be global, allowing to exit the cell, which is a \TeX{} group).

One should remark that the use of \texttt{\g_nicematrix_code_before_tl} needs one compilation more (because the instructions are written on the aux file to be used during the next run).

\textit{Example} : We want to write a command \texttt{\hatchcell} to hatch the current cell (with an optional argument between brackets for the color). It’s possible to program such command \texttt{\hatchcell} as follows, explicitly using the public variable \texttt{\g_nicematrix_code_before_tl} (this code requires the \texttt{Tikz} library \texttt{\patterns}:
\texttt{\usetikzlibrary{patterns}}).

\begin{verbatim}
\ExplSyntaxOn
\cs_new_protected:Nn \__pantigny_hatch:nnn { \tikz \fill [ pattern = north-west~lines , pattern~color = #3 ]
( #1 -| #2) rectangle ( \int_eval:n { #1 + 1 } -| \int_eval:n { #2 + 1 } ) ; }
\NewDocumentCommand \hatchcell { ! O { black } } { \tl_gput_right:Nx \g_nicematrix_code_before_tl { \__pantigny_hatch:nnn { \arabic { iRow } } { \arabic { jCol } } { #1 } } }
\ExplSyntaxOff
\end{verbatim}

Here is an example of use:
\begin{verbatim}
\begin{NiceTabular}{ccc}[hvlines]
Tokyo & Paris & London \\
Lima & \hatchcell[blue!30]Oslo & Miami \\
Los Angeles & Madrid & Roma
\end{NiceTabular}
\end{verbatim}

16 Technical remarks

16.1 Definition of new column types

The package nicematrix provides the command \texttt{\OnlyMainNiceMatrix} which is meant to be used in definitions of new column types. Its argument is evaluated if and only if we are in the main part of the array, that is to say not in a potential exterior row.

For example, one may wish to define a new column type \texttt{?} in order to draw a (black) heavy rule of width 1 pt. The following definition will do the job:\footnote{The command \texttt{\vrule} is a \TeX{} (and not \LaTeX) command.}:

\begin{verbatim}
\newcolumntype{?}{!{\OnlyMainNiceMatrix{\vrule width 1 pt}}}
\end{verbatim}
The heavy vertical rule won’t extend in the exterior rows.\footnote{Of course, such rule is defined by the classical technics of \texttt{nicematrix} and, for this reason, won’t cross the double rules of \texttt{\hline}/\texttt{\hline}.}

\begin{pNiceArray}{cc?cc} [first-row,last-row=3] 
\begin{array}{cccc}
C_1 & C_2 & C_3 & C_4 \\
\hline
a & b & c & d \\
e & f & g & h \\
C_1 & C_2 & C_3 & C_4
\end{array}
\end{pNiceArray}

This specifier ? may be used in the standard environments \{\texttt{tabular}\} and \{\texttt{array}\} (of the package \texttt{array}) and, in this case, the command \texttt{\OnlyMainNiceMatrix} is no-op.

### 16.2 Diagonal lines

By default, all the diagonal lines\footnote{We speak of the lines created by \texttt{\Ddots} and not the lines created by a command \texttt{\line} in code-after.} of a same array are “parallelized”. That means that the first diagonal line is drawn and, then, the other lines are drawn parallel to the first one (by rotation around the left-most extremity of the line). That’s why the position of the instructions \texttt{\Ddots} in the array can have a marked effect on the final result.

In the following examples, the first \texttt{\Ddots} instruction is written in color:

**Example with parallelization (default):**

\begin{verbatim}
$A = \begin{pNiceMatrix}
1 & \Cdots & & 1 \\
a+b & \Ddots & & \Vdots \\
\Vdots & \Ddots & \Ddots & \\
a+b & \Cdots & a+b & 1
\end{pNiceMatrix}$
\end{verbatim}

\begin{equation*}
A = \begin{pmatrix}
1 & \ldots & \ldots & 1 \\
a+b & \ldots & a+b \\
a+b & \ldots & a+b
\end{pmatrix}
\end{equation*}

It’s possible to turn off the parallelization with the option \texttt{parallelize-diags} set to \texttt{false}:

**The same example without parallelization:**

\begin{verbatim}
$A = \begin{pNiceMatrix}
1 & \Cdots & & 1 \\
a+b & \Cdots & a+b & 1
\end{pNiceMatrix}$
\end{verbatim}

\begin{equation*}
A = \begin{pmatrix}
1 & \ldots & \ldots & 1 \\
a+b & \ldots & a+b \\
a+b & \ldots & a+b
\end{pmatrix}
\end{equation*}

It’s possible to specify the instruction \texttt{\Ddots} which will be drawn first (and which will be used to draw the other diagonal dotted lines when the parallelization is in force) with the key \texttt{draw-first}: \texttt{\Ddots[draw-first]}.

### 16.3 The “empty” cells

An instruction like \texttt{\Ldots}, \texttt{\Cdots}, etc. tries to determine the first non-empty cell on both sides. However, an “empty cell” is not necessarily a cell with no TeX content (that is to say a cell with no token between the two ampersands \texttt{&}). The precise rules are as follow.

- An implicit cell is empty. For example, in the following matrix:

\begin{pNiceArray}{c}
1 & \Cdots & & 1 \\
a+b & \Ddots & & \Vdots \\
\Vdots & \Ddots & \Ddots & \\
a+b & \Cdots & a+b & 1
\end{pNiceArray}

\begin{equation*}
A = \begin{pmatrix}
1 & \ldots & \ldots & 1 \\
a+b & \ldots & a+b \\
a+b & \ldots & a+b
\end{pmatrix}
\end{equation*}
the last cell (second row and second column) is empty.

- Each cell whose TeX output has a width equal to zero is empty.

- A cell containing the command \NotEmpty is not empty (and a PGF/Tikz node) is created in that cell.

- A cell with a command \Hspace (or \Hspace*) is empty. This command \Hspace is a command defined by the package nicematrix with the same meaning as \hspace except that the cell where it is used is considered as empty. This command can be used to fix the width of some columns of the matrix without interfering with nicematrix.

- A cell of a column of type p, m or t is always considered as not empty. Caution: One should not rely upon that point because it may change if a future version of nicematrix.

### 16.4 The option exterior-arraycolsep

The environment \{array\} inserts an horizontal space equal to \arraycolsep before and after each column. In particular, there is a space equal to \arraycolsep before and after the array. This feature of the environment \{array\} was probably not a good idea\(^{46}\). The environment \{matrix\} of amsmath and its variants (\{pmatrix\}, \{vmatrix\}, etc.) of amsmath prefer to delete these spaces with explicit instructions \hskip -\arraycolsep\(^{47}\). The package nicematrix does the same in all its environments, \{NiceArray\} included. However, if the user wants the environment \{NiceArray\} behaving by default like the environment \{array\} of array (for example, when adapting an existing document) it’s possible to control this behaviour with the option exterior-arraycolsep, set by the command \NiceMatrixOptions. With this option, exterior spaces of length \arraycolsep will be inserted in the environments \{NiceArray\} (the other environments of nicematrix are not affected).

### 16.5 Incompatibilities

The package nicematrix is not fully compatible with the package arydshln (because this package redefines many internal of array).

Anyway, in order to use arydshln, one must first free the letter “:” by giving a new letter for the vertical dotted rules of nicematrix:

\NiceMatrixOptions{letter-for-dotted-lines=;}

Up to now, the package nicematrix is not compatible with aastex63. If you want to use nicematrix with aastex63, send me an email and I will try to solve the incompatibilities.

the package nicematrix is not compatible with the class ieeearxiv (because that class is not compatible with PGF/Tikz).

\(^{46}\)In the documentation of \{amsmath\}, we can read: The extra space of \arraycolsep that array adds on each side is a waste so we remove it [in \{matrix\}] (perhaps we should instead remove it from array in general, but that’s a harder task).

\(^{47}\)And not by inserting @{} on both sides of the preamble of the array. As a consequence, the length of the \hline is not modified and may appear too long, in particular when using square brackets.
17 Examples

17.1 Utilisation of the key “tikz” of the command \Block

\begin{NiceTabular}{m{4.5cm}m{4.5cm}m{4.5cm}}[hvlines]
\Block[tikz={pattern=grid,pattern color=lightgray}]{%
{pattern = grid, \ pattern color = lightgray}
}& \Block[tikz={pattern = north west lines,pattern color=blue}]{%
{pattern = north west lines, \ pattern color = blue}}
& \Block[tikz={outer color = red!50, inner color=white}]{2-1}
{outer color = red!50, \ inner color = white} \\
\Block[tikz={pattern = sixpointed stars, pattern color = blue!15}]{%
{pattern = sixpointed stars, \ pattern color = blue!15}}
& \Block[tikz={left color = blue!50}]{%
{left color = blue!50}}
\end{NiceTabular}

17.2 Notes in the tabulars

The tools provided by \nicematrix for the composition of the tabular notes have been presented in the section 12 p. 27.

Let’s consider that we wish to number the notes of a tabular with stars.\footnote{Of course, it’s realistic only when there is very few notes in the tabular.\footnote{In fact: the value of its argument.}}

First, we write a command \stars similar the well-known commands \arabic, \alph, \Alph, etc. which produces a number of stars equal to its argument \footnote{In fact: the value of its argument.}

\ExplSyntaxOn
\NewDocumentCommand \stars { m } { \prg_replicate:nn { \value { #1 } } { \strut $ \star $ \strut } }
\ExplSyntaxOff

Of course, we change the style of the labels with the key notes/style. However, it would be interesting to change also some parameters in the type of list used to compose the notes at the end of the tabular. First, we required a composition flush right for the labels with the setting align=right. Moreover, we want the labels to be composed on a width equal to the width of the widest label. The widest label is, of course, the label with the greatest number of stars. We know that number: it is equal to \value{tabularnote} (because tabularnote is the LaTeX counter used by \tabularnote and, therefore, at the end of the tabular, its value is equal to the total number of tabular notes). We use the key widest* of \enumerate in order to require a width equal to that value: widest*=\value{tabularnote}.

\NiceMatrixOptions
{ notes =
  { style = \stars{#1} ,
    enumitem-keys =
  }
}
\begin{NiceTabular}{{}llr{}}
\toprule
\RowStyle{\bfseries}
Last name & First name & Birth day \\
\midrule
Achard\tabularnote{Achard is an old family of the Poitou.} & Jacques & 5 juin 1962 \\
Lefebvre\tabularnote{The name Lefebvre is an alteration of the name Lefebure.} & Mathilde & 23 mai 1988 \\
Vanesse & Stephany & 30 octobre 1994 \\
Dupont & Chantal & 15 janvier 1998 \\
\bottomrule
\end{NiceTabular}

17.3 Dotted lines

An example with the resultant of two polynomials:

\begin{vNiceArray}{cccc:ccc}[columns-width=6mm]
\setlength{\extrarowheight}{1mm}
\begin{align*}
a_0 & & k & & k & b_0 & k & k \\
a_1 & \Ddots & & & k & b_1 & \Ddots & \\
\Vdots & \Ddots & & & \Vdots & \Ddots & b_0 \\
a_p & & k & \& k & a_0 & & k & b_1 \\
& \Ddots & & k & b_q & \& \Vdots \& \\
& & \Vdots & & \Ddots & \& b_q \\
& & & \Vdots & & \& \Ddots \\
& & & & \& a_p & & b_q
\end{align*}
\end{vNiceArray}

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An example for a linear system:

\[
\begin{pNiceArray}{*6c|c}
\nullify-dots, last-col, code-for-last-col=\scriptstyle
\begin{array}{ccccccc}
1 & 1 & 1 & \Cdots & & 1 & 0 \\
0 & 0 & 1 & \Ddots & & 0 & & L_2 \gets L_2-L_1 \\
0 & k & k & \Vdots & & \Vdots & & L_3 \gets L_3-L_1 \\
\vdots & \Ddots & & \Vdots & & \Vdots & \\
0 & \Cdots & 0 & 1 & & 0 & \Vdots \Vdots \\
0 & & & \Cdots & 0 & 1 & 0 & L_n \gets L_n-L_1
\end{array}
\end{pNiceArray}
\]

17.4 Dotted lines which are no longer dotted

The option line-style controls the style of the lines drawn by \Ldots, \Cdots, etc. Thus, it’s possible with these commands to draw lines which are not longer dotted.

\[
\begin{pNiceMatrix}[last-row,last-col,nullify-dots,xdots/line-style={dashed,blue}]
1 & & & \Vdots & & & & \Vdots \\
& \Ddots[\text{line-style=standard}] \\
& & 1 \\
\Cdots[\text{color=blue, line-style=dashed}] & & & \blue 0 & \Cdots & & & \blue 1 & & & \Cdots & \leftarrow i \\
& & & \Vdots & & \Ddots[\text{line-style=standard}] & & \Vdots \\
& & & \Vdots & & \Vdots & & \Vdots \\
& & \Cdots & \blue 1 & \Cdots & & \Cdots & \blue 0 & \Cdots & \blue \leftarrow j \\
\end{pNiceMatrix}
\]

In fact, it’s even possible to draw solid lines with the commands \Cdots, \Vdots, etc.
17.5 Stacks of matrices

We often need to compose mathematical matrices on top on each other (for example for the resolution of linear systems).

In order to have the columns aligned one above the other, it’s possible to fix a width for all the columns. That’s what is done in the following example with the environment \{NiceMatrixBlock\} and its option auto-columns-width.

\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
{
  light-syntax,
  last-col, code-for-last-col = \color{blue} \scriptstyle,
}
\setlength{\extrarowheight}{1mm}
\begin{pNiceArray}{rrrr|rrrrrrrr}
12 -8 7 5 3 & & & & & ;
3 -18 12 1 4 & & & & & ;
-3 -46 29 -2 -15 & & & & & ;
9 10 -5 4 7 & & & & & \\
\end{pNiceArray}
\smallskip
\begin{pNiceArray}{rrrr|rrrrrrrr}
12 -8 7 5 3 & & & & & ;
0 64 -41 1 19 \{ L_2 \gets L_1-4L_2 \} ;
0 -192 123 -3 -57 \{ L_3 \gets L_1+4L_3 \} ;
0 -64 41 -1 -19 \{ L_4 \gets 3L_1-4L_4 \} ;
\end{pNiceArray}
\smallskip
\begin{pNiceArray}{rrrr|rrrrrrrr}
12 -8 7 5 3 & & & & & ;
0 64 -41 1 19 ;
\end{pNiceArray}
\smallskip
\begin{pNiceArray}{rrrr|rrrrrrrr}
12 -8 7 5 3 {} ;
0 64 -41 1 19 ;
\end{pNiceArray}
However, one can see that the last matrix is not perfectly aligned with others. That’s why, in LaTeX, the parenthesis have not exactly the same width (smaller parenthesis are a bit slimmer).

In order the solve that problem, it’s possible to require the delimiters to be composed with the maximal width, thanks to the boolean key `delimiters/max-width`.

```latex
\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\setlength{\extrarowheight}{1mm}
\begin{pNiceArray}{rrrr|r}
\end{pNiceArray}
\end{NiceMatrixBlock}
```

```latex
\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\setlength{\extrarowheight}{1mm}
\begin{pNiceArray}{rrrr|r}
\end{pNiceArray}
\end{NiceMatrixBlock}
```

```latex
\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\setlength{\extrarowheight}{1mm}
\begin{pNiceArray}{rrrr|r}
\end{pNiceArray}
\end{NiceMatrixBlock}
```

```latex
\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\setlength{\extrarowheight}{1mm}
\begin{pNiceArray}{rrrr|r}
\end{pNiceArray}
\end{NiceMatrixBlock}
```
\[
\begin{pmatrix}
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & 0 & 0 & 0 & 0 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
\end{pmatrix}
\]

If you wish an alignment of the different matrices without the same width for all the columns, you can construct a unique array and place the parenthesis with commands \SubMatrix in the \CodeAfter. Of course, that array can’t be broken by a page break.

\setlength{\extrarowheight}{1mm}
\[
\begin{NiceMatrix}
[ r, last-col=6, code-for-last-col = \scriptstyle \color{blue} ]
12 & -8 & 7 & 5 & 3 \\
3 & -18 & 12 & 1 & 4 \\
-3 & -46 & 29 & -2 & -15 \\
9 & 10 & -5 & 4 & 7 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 & L_2 \gets L_1-4L_2 \\
0 & -192 & 123 & -3 & -57 & L_3 \gets L_1+4L_3 \\
0 & -64 & 41 & -19 & L_4 \gets 3L_1-4L_4 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & 0 & 0 & 0 & 0 & L_3 \gets 3L_2+L_3 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
\end{NiceMatrix}
\]

\setlength{\extrarowheight}{1mm}
\[
\begin{NiceMatrix}
[ r, last-col=6, code-for-last-col = \scriptstyle \color{blue} ]
12 & -8 & 7 & 5 & 3 \\
3 & -18 & 12 & 1 & 4 \\
-3 & -46 & 29 & -2 & -15 \\
9 & 10 & -5 & 4 & 7 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 & L_2 \gets L_1-4L_2 \\
0 & -192 & 123 & -3 & -57 & L_3 \gets L_1+4L_3 \\
0 & -64 & 41 & -19 & L_4 \gets 3L_1-4L_4 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & 0 & 0 & 0 & 0 & L_3 \gets 3L_2+L_3 \\
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
\end{NiceMatrix}
\]

12
-8
7
5
3

3
-18
12
1
4

-3
-46
29
-2
-15

9
10
-5
4
7

46
17.6 How to highlight cells of a matrix

In order to highlight a cell of a matrix, it’s possible to “draw” that cell with the key `draw` of the command `\Block` (this is one of the uses of a mono-cell block\(^{50}\)).

\[
\begin{pNiceArray}{>{\strut}cccc}
\Block[draw]{}{a_{11}} & a_{12} & a_{13} & a_{14} \\
a_{21} & \Block[draw]{}{a_{22}} & a_{23} & a_{24} \\
a_{31} & a_{32} & \Block[draw]{}{a_{33}} & a_{34} \\
a_{41} & a_{42} & a_{43} & \Block[draw]{}{a_{44}}
\end{pNiceArray}
\]

We should remark that the rules we have drawn are drawn after the construction of the array and thus, they don’t spread the cells of the array. We recall that, on the other side, the commands `\hline` and `\Hline`, the specifier “|” and the options `hlines`, `vlines` and `hvlines` spread the cells.\(^{51}\)

It’s possible to color a row with `\rowcolor` in the code-before (or with `\rowcolor` in the first cell of the row if the key `colortbl-like` is used—even when `colortbl` is not loaded).

\[
\begin{pNiceArray}{>{\strut}cccc}
\rowcolor[red!15]{}{A_{11}} & A_{12} & A_{13} & A_{14} \\
A_{21} & \rowcolor[red!15]{}{A_{22}} & A_{23} & A_{24} \\
A_{31} & A_{32} & \rowcolor[red!15]{}{A_{33}} & A_{34} \\
A_{41} & A_{42} & A_{43} & \rowcolor[red!15]{}{A_{44}}
\end{pNiceArray}
\]

However, it’s not possible to do a fine tuning. That’s why we describe now a method to highlight a row of the matrix. We create a rectangular Tikz node which encompasses the nodes of the second row with the Tikz library `fit`. This Tikz node is filled after the construction of the matrix. In order to see the text under this node, we have to use transparency with the blend mode equal to multiply.

**Caution**: Some PDF readers are not able to show transparency.\(^{52}\)

That example and the following ones require Tikz (by default, `nicematrix` only loads PGF, which is a sub-layer of Tikz) and the Tikz library `fit`. The following lines in the preamble of your document do the job:

```
\usepackage{tikz}
\usetikzlibrary{fit}
```

We create a rectangular Tikz node which encompasses the nodes of the second row by using the tools of the Tikz library `fit`. Those nodes are not available by default in the `\CodeBefore` (for efficiency). We have to require their creation with the key `create-cell-nodes` of the keyword `\CodeBefore`.

\(^{50}\)We recall that, if the first mandatory argument of the command `\Block` is left empty, that means that the block is a mono-cell block.

\(^{51}\)For the command `\Hline`, see the remark p. 8.

\(^{52}\)In Overleaf, the “built-in” PDF viewer does not show transparency. You can switch to the “native” viewer in that case.
We consider now the following matrix. If we want to highlight each row of this matrix, we can use the previous technique three times.

\[
\begin{pNiceArray}{ccc}[last-col,create-medium-nodes]
\CodeBefore [create-cell-nodes]
\begin{tikzpicture} [name suffix = -medium]
\node [highlight = (1-1) (1-3)] {} ;
\node [highlight = (2-1) (2-3)] {} ;
\node [highlight = (3-1) (3-3)] {} ;
\end{tikzpicture}
\Body
a & a + b & a + b + c & L_1 \\
a & a & a + b & L_2 \\
a & a & a & L_3
\end{pNiceArray}\]

The result may seem disappointing. We can improve it by using the “medium nodes” instead of the “normal nodes”.

\[
\begin{pNiceArray}{ccc}[last-col,create-medium-nodes]
\CodeBefore [create-cell-nodes]
\begin{tikzpicture}
\node [highlight = (1-1) (1-3)] {} ;
\node [highlight = (2-1) (2-3)] {} ;
\node [highlight = (3-1) (3-3)] {} ;
\end{tikzpicture}
\Body
a & a + b & a + b + c & L_1 \\
a & a & a + b & L_2 \\
a & a & a & L_3
\end{pNiceArray}\]
17.7 Utilisation of SubMatrix in the CodeBefore

In the following example, we illustrate the mathematical product of two matrices. The whole figure is an environment \texttt{NiceArray} and the three pairs of parenthesis have been added with \texttt{SubMatrix} in the \texttt{CodeBefore}.

\[ \begin{NiceArray}{*{6}{c}@{\hspace{6mm}}*{5}{c}} \nullify-dots \\
\CodeBefore \create-cell-nodes \\
\SubMatrix({2-7}{6-11}) \\
\SubMatrix({7-2}{11-6}) \\
\SubMatrix({7-7}{11-11}) \\
\begin{tikzpicture} \\
\node [highlight = (9-2) (9-6)] { } ; \\
\node [highlight = (2-9) (6-9)] { } ; \\
\end{tikzpicture} \CodeAfter \\
\end{NiceArray} \]

18 Implementation

By default, the package nicematrix doesn’t patch any existing code.
However, when the option `renew-dots` is used, the commands `\cdots`, `\ldots`, `\ldots`, `\vdots`, and `\ddots` are redefined in the environments provided by `nicematrix` as explained previously. In the same way, if the option `renew-matrix` is used, the environment `{matrix}` of `amsmath` is redefined.

On the other hand, the environment `{array}` is never redefined.

Of course, the package `nicematrix` uses the features of the package `array`. It tries to be independent of its implementation. Unfortunately, it was not possible to be strictly independent. For example, the package `nicematrix` relies upon the fact that the package `array` uses `\ialign` to begin the `\halign`.

Declaration of the package and packages loaded

The prefix `nicematrix` has been registered for this package.

See: http://mirrors.ctan.org/macros/latex/contrib/l3kernel/l3prefixes.pdf

First, we load `pgfcore` and the module `shapes`. We do so because it’s not possible to use `\usepgfmodule` in `\ExplSyntaxOn`.

\begin{verbatim}
1 \RequirePackage{pgfcore}
2 \usepgfmodule{shapes}
\end{verbatim}

We give the traditional declaration of a package written with the L3 programming layer.

\begin{verbatim}
3 \RequirePackage{13keys2e}
4 \ProvidesExplPackage{nicematrix}{\myfiledate}{\myfileversion}{Enhanced arrays with the help of PGF/TikZ}
5 \\PackageRequirements{\xparse}{\array}{\amsmath}
6 \cs_new_protected:Npn \@@_error:n \msg_error:n { \nicematrix }
7 \cs_new_protected:Npn \@@_error:nn \msg_error:nnn \nicematrix }
8 \cs_new_protected:Npn \@@_error:nnn \msg_error:nnnn \nicematrix }
9 \cs_new_protected:Npn \@@_fatal:n \msg_fatal:n { \nicematrix }
10 \cs_new_protected:Npn \@@_fatal:nn \msg_fatal:nnn \nicematrix }
11 \cs_new_protected:Npn \@@_msg_new:nn \msg_new:nnn \nicematrix }
12 \cs_new_protected:Npn \@@_msg_new:nnn \msg_new:nnnn \nicematrix }
13 \cs_new_protected:Npn \@@_msg_redirect_name:nn \msg_redirect_name:nnn \nicematrix }
14 \bool_new:N \c_@@_arydshln_loaded_bool
15 \bool_new:N \c_@@_booktabs_loaded_bool
16 \bool_new:N \c_@@_enumitem_loaded_bool
17 \bool_new:N \c_@@_tikz_loaded_bool
\end{verbatim}

Technical definitions

\begin{verbatim}
21 \bool_new:N \c_@@_in_preamble_bool
22 \bool_set_true:N \c_@@_in_preamble_bool
23 \AtBeginDocument { \bool_set_false:N \c_@@_in_preamble_bool }
24 \bool_new:N \c_@@_arydshln_loaded_bool
25 \bool_new:N \c_@@_booktabs_loaded_bool
26 \bool_new:N \c_@@_enumitem_loaded_bool
27 \bool_new:N \c_@@_tikz_loaded_bool
\end{verbatim}

50
\AtBeginDocument
{
\ifpackageloaded { arydshln }
  { \bool_set_true:N \c_@@_arydshln_loaded_bool }
\}
\ifpackageloaded { booktabs }
  { \bool_set_true:N \c_@@_booktabs_loaded_bool }
\}
\ifpackageloaded { enumitem }
  { \bool_set_true:N \c_@@_enumitem_loaded_bool }
\}
\ifpackageloaded { tikz }
  {
In some constructions, we will have to use a \textit{pgfpicture} which \textit{must} be replaced by a \textit{tikzpicture} if Tikz is loaded. However, this switch between \textit{pgfpicture} and \textit{tikzpicture} can’t be done dynamically with a conditional because, when the Tikz library \texttt{external} is loaded by the user, the pair \texttt{tikzpicture}-\texttt{endtikzpicture} (or \texttt{begin(tikzpicture)}-\texttt{end(tikzpicture)}) must be statically “visible” (even when externalization is not activated). That’s why we create \c_@@_pgfortikzpicture_tl and \c_@@_endpgfortikzpicture_tl which will be used to construct in a \texttt{\AtBeginDocument} the correct version of some commands.
\begin{verbatim}
\bool_set_true:N \c_@@_tikz_loaded_bool
\tl_const:Nn \c_@@_pgfortikzpicture_tl { \exp_not:N \tikzpicture }
\tl_const:Nn \c_@@_endpgfortikzpicture_tl { \exp_not:N \endtikzpicture }
\end{verbatim}
\}

We test whether the current class is \texttt{revtex4-1} (deprecated) or \texttt{revtex4-2} because these classes redefine \texttt{array} (of \texttt{array}) in a way incompatible with our programmation. At the date January 2021, the current version \texttt{revtex4-2} is 4.2e (compatible with \texttt{booktabs}).
\begin{verbatim}
\bool_new:N \c_@@_revtex_bool
\@ifclassloaded { revtex4-1 }
{ \bool_set_true:N \c_@@_revtex_bool }
{ }
\@ifclassloaded { revtex4-2 }
{ \bool_set_true:N \c_@@_revtex_bool }
{ }
\end{verbatim}

Maybe one of the previous classes will be loaded inside another class... We try to detect that situation.
\begin{verbatim}
\cs_if_exist:NT \rvtx@ifformat@geq { \bool_set_true:N \c_@@_revtex_bool }
\cs_generate_variant:Nn \tl_if_single_token_p:n { V }
\end{verbatim}

The following regex will be used to modify the preamble of the array when the key \texttt{colortbl-like} is used.
\begin{verbatim}
\regex_const:Nn \c_@@_columncolor_regex { \c { columncolor } }
\end{verbatim}

If the final user uses \texttt{nicematrix}, PGF/Tikz will write instruction \texttt{pgfsyspdfmark} in the aux file. If he changes its mind and no longer loads \texttt{nicematrix}, an error may occur at the next compilation because of remanent instructions \texttt{pgfsyspdfmark} in the aux file. With the following code, we try to avoid that situation.
\begin{verbatim}
\cs_new_protected:Npn \@@_provide_pgfsyspdfmark:
{ \tl_if_single_token_p:n { V }\cs_if_exist:NT \rvtx@ifformat@geq { \bool_set_true:N \c_@@_revtex_bool }
\cs_generate_variant:Nn \tl_if_single_token_p:n { V }
\regex_const:Nn \c_@@_columncolor_regex { \c { columncolor } }
\end{verbatim}

If the final user uses \texttt{nicematrix}, PGF/Tikz will write instruction \texttt{pgfsyspdfmark} in the aux file. If he changes its mind and no longer loads \texttt{nicematrix}, an error may occur at the next compilation because of remanent instructions \texttt{pgfsyspdfmark} in the aux file. With the following code, we try to avoid that situation.
We define a command \iddots similar to \ddots (\ldots) but with dots going forward (\ldots). We use \ProvideDocumentCommand and so, if the command \iddots has already been defined (for example by the package mathdots), we don’t define it again.

\ProvideDocumentCommand \iddots { }
{
  \mathinner {
    \tex_mkern:D 1 \mu
    \box_move_up:nn { 1 pt } { \hbox:n { . } }
    \tex_mkern:D 2 \mu
    \box_move_up:nn { 4 pt } { \hbox:n { . } }
    \tex_mkern:D 2 \mu
    \box_move_up:nn { 7 pt }
    { \vbox:n { \kern 7 pt \hbox:n { . } } }
    \tex_mkern:D 1 \mu
  }
}

This definition is a variant of the standard definition of \ddots.

In the aux file, we will have the references of the PGF/Tikz nodes created by nicematrix. However, when booktabs is used, some nodes (more precisely, some row nodes) will be defined twice because their position will be modified. In order to avoid an error message in this case, we will redefine \pgfutil@check@rerun in the aux file.

\AtBeginDocument
{
  \@ifpackageloaded { booktabs }
  { \io_w_now:Nn \@mainaux \nicematrix@redefine@check@rerun }
  { }
  \cs_set_protected:Npn \nicematrix@redefine@check@rerun
  { \cs_set_protected:Npn \pgfutil@check@rerun ##1 ##2
    { \str_if_eq:eeF { nm- } { \tl_range:nnn { ##1 } 1 3 }
      { \@@_old_pgfutil@check@rerun { ##1 } { ##2 } }
    }
  }
}

The new version of \pgfutil@check@rerun will not check the PGF nodes whose names start with nm- (which is the prefix for the nodes created by nicematrix).

\AtBeginDocument
{
  \@ifpackageloaded { colortbl }
  { \io_w_now:Nn \@mainaux \colortbl@redefine@check@rerun }
  { }
  \cs_set_protected:Npn \colortbl@redefine@check@rerun
  { \cs_set_protected:Npn \pgfutil@check@rerun \CT@arc@ { }
    { \bool_if:NnTF \c_@@_colortbl_loaded_bool
      { \ct@arc { #1 } { #2 } }
      { \@@_old_pgfutil@check@rerun \CT@arc { #1 } { #2 } }
    }
  }
}

We have to know whether colortbl is loaded in particular for the redefinition of \everycr.

\bool_new:N \c_@@_colortbl_loaded_bool
\AtBeginDocument
{
  \@ifpackageloaded { colortbl }
  { \bool_set_true:N \c_@@_colortbl_loaded_bool }
  { }
}

The command \CT@arc@ is a command of colortbl which sets the color of the rules in the array. We will use it to store the instruction of color for the rules even if colortbl is not loaded.
\dim_compare:nNnT \baselineskip = \c_zero_dim \noalign
\cs_gset:Npn \CT@arc@ { \color #1 { #2 } }

Idem for \CT@drsc@.
\cs_set:Npn \doublerulesepcolor #1 # { \CT@drsc { #1 } }
\cs_set:Npn \hline
\futurelet \reserved@a \@xhline
\skip_horizontal:N \c_zero_dim
\leaders \hrule \@height \arrayrulewidth \hfill

The following version of \cline spreads the array of a quantity equal to \arrayrulewidth as does \hline. It will be loaded excepted if the key standard-cline has been used.
\cs_set:Npn \@@_cline
\everycr { }
\noalign { \skip_vertical:N -\arrayrulewidth }

Our \everycr has been modified. In particular, the creation of the row node is in the \everycr (maybe we should put it with the incrementation of \c@iRow). Since the following \cr correspond to a "false row", we have to nullify \everycr.
\everycr { }
\cr
\noalign { \skip_vertical:N -\arrayrulewidth }

The following version of \cline must be used in that column. The second is a standard argument of \cline of the form i-j.
\cs_set:Npn \@@_cline_i:nn #1 \#2 { \@@_cline_i:w #1 \#2 \q_stop }
\cs_set:Npn \@@_cline_i:w #1-#2-#3 \q_stop

\noalign { \skip_horizontal:N \c_zero_dim
\leaders \hrule \@height \arrayrulewidth \hfill

We have to act in a fully expandable way since there may be (in the \multispan) to detect. That's why we use \@@_cline_i:en.
\everycr { }
\noalign { \skip_vertical:N -\arrayrulewidth }

\noalign { \skip_horizontal:N \c_zero_dim
\leaders \hrule \@height \arrayrulewidth \hfill

\noalign { \skip_horizontal:N \c_zero_dim
\leaders \hrule \@height \arrayrulewidth \hfill

53See question 99041 on TeX StackExchange.
Now, \#1 is the number of the current column and we have to draw a line from the column \#2 to the column \#3 (both included).

\begin{verbatim}
\int_compare:nNnT { #1 } < { #2 }
\{ \multispan { \int_eval:n { #2 - #1 } } & \}
\multispan { \int_eval:n { #3 - #2 + 1 } }
\{
\CT@arc@ \leaders \hrule \@height \arrayrulewidth \hfill \skip_horizontal:N \c_zero_dim
\}
\end{verbatim}

You look whether there is another \cline to draw (the final user may put several \cline).

\begin{verbatim}
\peek_meaning_remove_ignore_spaces:NTF \cline
{ \@@_cline_i:en \@@_succ:n { #3 } }
{ \everycr { } \cr }
\cs_generate_variant:Nn \@@_cline_i:nn { e n }
\end{verbatim}

The following commands are only for efficiency. They must not be protected because it will be used (for instance) in names of \pgf nodes.

\begin{verbatim}
\cs_new:Npn \@@_succ:n #1 { \the \numexpr #1 + 1 \relax }
\cs_new:Npn \@@_pred:n #1 { \the \numexpr #1 - 1 \relax }
\end{verbatim}

The following command is a small shortcut.

\begin{verbatim}
\cs_new_protected:Npn \@@_set_CT@arc@: { \peek_meaning:NTF \[ \@@_set_CT@arc@_i: \@@_set_CT@arc@_ii: }
\cs_new_protected:Npn \@@_set_CT@arc@_i: \[ #1 \] \q_stop { \cs_set:Npn \CT@arc@ { \color \[ #1 \] { #2 } } }
\cs_new_protected:Npn \@@_set_CT@arc@_ii: \[ #1 \] \q_stop { \cs_set:Npn \CT@arc@ { \color { #1 } } }
\cs_set_eq:NN \@@_old_pgfpointanchor \pgfpointanchor
\end{verbatim}

The column S of siunitx

We want to know whether the package siunitx is loaded and, if it is loaded, we redefine the S columns of siunitx.

\begin{verbatim}
\bool_new:N \c_@@_siunitx_loaded_bool
\AtBeginDocument
\{ \@ifpackageloaded { siunitx } { \bool_set_true:N \c_@@_siunitx_loaded_bool } { }
\}
\end{verbatim}

The command \@@_renew_NC@rewrite@S: will be used in each environment of \nicematrix in order to “rewrite” the S column in each environment.

\begin{verbatim}
\AtBeginDocument
\{ \bool_if:nTF { ! \c_@@_siunitx_loaded_bool } { \cs_set_eq:NN \@@_renew_NC@rewrite@S: \prg_do_nothing: } { }
\}
\end{verbatim}

For version of siunitx at least equal to 3.0, the adaptation is different from previous ones. We test the version of siunitx by the existence of the control sequence \siunitx\_cell\_begin:w.

\begin{verbatim}
\class_if_exist:NFT \siunitx\_cell\_begin:w
{ \cs_new_protected:Npn \@@_renew_NC@rewrite@S: }
\end{verbatim}
\renewcommand*{\NC@end_rewrite@S}{[1][\]
\@temptokena \exp_after:wN \tex_the:D \@temptokena
> { \@@_Cell:
  \keys_set:nn { siunitx } { ##1 }
  \siunitx_cell_begin:w
}
\@@_true_c: will be replaced statically by c at the end of the construction of the preamble.
\@@_true_c:
< { \siunitx_cell_end: \@@_end_Cell: }
\NC@find
}
}
\cs_new_protected:Npn \@@_renew_NC@rewrite@S:
{ \renewcommand*{\NC@rewrite@S}{[1][\]
\@temptokena \exp_after:wN \tex_the:D \@temptokena
> { \@@_Cell:
  \cs@@_table_collect_begin_tl S {##1} }
\@@_true_c:
< { \cs@@_table_print_tl \@@_end_Cell: }
}
\NC@find
}
}
\AtBeginDocument
{ \cs_set_eq:NN \@@_adapt_S_column: \prg_do_nothing:
  \bool_lazy_and:nnT
  { \c_@@_siunitx_loaded_bool }
  { ! \cs_if_exist_p:N \siunitx_cell_begin:w }
  { \cs_set_protected:Npn \@@_adapt_S_column:
    { \group_begin: \@temptokena = { } \cs_set_eq:NN \@@_adapt_S_column: \prg_do_nothing:
      \NC@end_rewrite@S { } \tl_gset:NV \g_tmpa_tl \@temptokena
        \group_end:
        \tl_new:N \c_@@_table_collect_begin_tl
        \tl_set:Nx \l_tmpa_tl { \tl_item:Nn \g_tmpa_tl 2 }
        \tl_gset:Nx \c_@@_table_collect_begin_tl { \tl_item:Nn \l_tmpa_tl 1 }
        \tl_new:N \c_@@_table_print_tl
        \tl_gset:Nx \c_@@_table_print_tl { \tl_item:Nn \g_tmpa_tl { -1 } }
        \cs_gset_eq:NN \@@_adapt_S_column: \prg_do_nothing:
      }
    }
  }
}
The following code is used to define \c_@@_table_collect_begin_tl and \c_@@_table_print_tl
when the version of siunitx is prior to 3.0. The command \@@_adapt_S_column is used in the
environment \{NiceArrayWithDelims\}.
Parameters

For compatibility with versions prior to 5.0, we provide a load-time option `define_L_C_R`. With this option, it’s possible to use the letters L, C and R instead of l, c and r in the preamble of the environments of `nicematrix` as it was mandatory before version 5.0. This key will probably be deleted in a future version.

\begin{verbatim}
\bool_new:N \c_@@_define_L_C_R_bool
\cs_new_protected:Npn \@@_define_L_C_R:
{ \newcolumntype L l \newcolumntype C c \newcolumntype R r }
\end{verbatim}

The following counter will count the environments `NiceArray`. The value of this counter will be used to prefix the names of the Tikz nodes created in the array.

\begin{verbatim}
\int_new:N \g_@@_env_int
\end{verbatim}

The following command is only a syntaxic shortcut. It must not be protected (it will be used in names of PGF nodes).

\begin{verbatim}
\cs_new:Npn \@@_env: { \int_use:N \g_@@_env_int }
\end{verbatim}

The command `\NiceMatrixLastEnv` is not used by the package `nicematrix`. It’s only a facility given to the final user. It gives the number of the last environment (in fact the number of the current environment but it’s meant to be used after the environment in order to refer to that environment — and its nodes — without having to give it a name). This command must be expandable since it will be used in PGF nodes.

\begin{verbatim}
\NewExpandableDocumentCommand \NiceMatrixLastEnv { } { \int_use:N \g_@@_env_int }
\end{verbatim}

The following command is only a syntaxic shortcut. The q in `qpoint` means `quick`.

\begin{verbatim}
\cs_new_protected:Npn \@@_qpoint:n #1
{ \pgfpointanchor { \@@_env: - #1 } { center } }
\end{verbatim}

The following counter will count the environments `NiceMatrixBlock`.

\begin{verbatim}
\int_new:N \g_@@_NiceMatrixBlock_int
\end{verbatim}

The dimension `l_@@_columns_width_dim` will be used when the options specify that all the columns must have the same width (but, if the key `columns-width` is used with the special value `auto`, the boolean `l_@@_auto_columns_width_bool` also will be raised).

\begin{verbatim}
\dim_new:N \l_@@_columns_width_dim
\end{verbatim}

The following counters will be used to count the numbers of rows and columns of the array.

\begin{verbatim}
\int_new:N \g_@@_row_total_int
\int_new:N \g_@@_col_total_int
\end{verbatim}

The following token list will contain the type of the current cell (l, c or r). It will be used by the blocks.

\begin{verbatim}
\tl_new:N \l_@@_cell_type_tl
\tl_set:Nn \l_@@_cell_type_tl { c }
\end{verbatim}
When there is a mono-column block (created by the command \Block), we want to take into account the width of that block for the width of the column. That’s why we compute the width of that block in the \g_@@_blocks_wd_dim and, after the construction of the box \l_@@_cell_box, we change the width of that box to take into account the length \g_@@_blocks_wd_dim.

\dim_new:N \g_@@_blocks_wd_dim

Idem pour the mono-row blocks.

\dim_new:N \g_@@_blocks_ht_dim
\dim_new:N \g_@@_blocks_dp_dim

The sequence \g_@@_names_seq will be the list of all the names of environments used (via the option name) in the document: two environments must not have the same name. However, it’s possible to use the option allow-duplicate-names.

\seq_new:N \g_@@_names_seq

We want to know whether we are in an environment of nicematrix because we will raise an error if the user tries to use nested environments.

\bool_new:N \l_@@_in_env_bool

If the user uses \{NiceArray} or \{NiceTabular} the flag \l_@@_NiceArray_bool will be raised.

\bool_new:N \l_@@_NiceArray_bool

In fact, if there is delimiters in the preamble of \{NiceArray} (eg: \[[cccc\]), this boolean will be set to false.

If the user uses \{NiceTabular} or \{NiceTabular*} we will raise the following flag.

\bool_new:N \l_@@_NiceTabular_bool

If the user uses \{NiceTabular*}, the width of the tabular (in the first argument of the environment \{NiceTabular*}) will be stored in the following dimension.

\dim_new:N \l_@@_tabular_width_dim

If the user uses an environment without preamble, we will raise the following flag.

\bool_new:N \l_@@_Matrix_bool

The following boolean will be raised when the command \rotate is used.

\bool_new:N \g_@@_rotate_bool

We will write in \g_@@_aux_tl all the instructions that we have to write on the aux file for the current environment. The contain of that token list will be written on the aux file at the end of the environment (in an instruction \tl_gset:cn { c_@@_ \int_use:N \g_@@_env_int _ tl }).

\tl_new:N \g_@@_aux_tl

\cs_new_protected:Npn \@@_test_if_math_mode: 
\{ 
\if_mode_math: \else: 
\@@_fatal:n \{ Outside-math-mode \} 
\fi: 
\}

The letter used for the vlines which will be drawn only in the sub-matrices. vlism stands for vertical lines in sub-matrices.

\tl_new:N \l_@@_letter_vlism_tl

The list of the columns where vertical lines in sub-matrices (vlism) must be drawn. Of course, the actual value of this sequence will be known after the analyse of the preamble of the array.

\seq_new:N \g_@@_cols_vlism_seq
The following colors will be used to memorize the color of the potential “first col” and the potential “first row”.
\colorlet { nicematrix-last-col } { . }
\colorlet { nicematrix-last-row } { . }

The following string is the name of the current environment or the current command of \nicematrix (despite its name which contains \texttt{env}).
\str_new:N \g_@@_name_env_str

The following string will contain the word \texttt{command} or \texttt{environment} whether we are in a command of \nicematrix or in an environment of \nicematrix. The default value is \texttt{environment}.
\tl_set:Nn \g_@@_com_or_env_str { environment }

The following command will be able to reconstruct the full name of the current command or environment (despite its name which contains \texttt{env}). This command must \texttt{not} be protected since it will be used in error messages and we have to use \str_if_eq:VnTF and not \tl_if_eq:NnTF because we need to be fully expandable).
\cs_new:Npn \@@_full_name_env:
\begin{verbatim}
{\str_if_eq:VnTF \g_@@_com_or_env_str { command }
{ command \space \c_backslash_str \g_@@_name_env_str }
{ environment \space \{ \g_@@_name_env_str \} }
}
\end{verbatim}

The following token list corresponds to the option \texttt{code-after} (it’s also possible to set the value of that parameter with the keyword \CodeAfter).
\tl_new:N \g_nicematrix_code_after_tl

For the key \texttt{code} of the command \SubMatrix (itself in the main \CodeAfter), we will use the following token list.
\tl_new:N \l_@@_code_tl

The following token list has a function similar to \g_nicematrix_code_after_tl but it is used internally by \nicematrix. In fact, we have to distinguish between \g_nicematrix_code_after_tl and \g_@@_internal_code_after_tl because we must take care of the order in which instructions stored in that parameters are executed.
\tl_new:N \g_@@_internal_code_after_tl

The counters \l_@@_old_iRow_int and \l_@@_old_jCol_int will be used to save the values of the potential \LaTeX counters iRow and jCol. These \LaTeX counters will be restored at the end of the environment.
\int_new:N \l_@@_old_iRow_int
\int_new:N \l_@@_old_jCol_int

The \TeX counters \c@iRow and \c@jCol will be created in the beginning of \texttt{NiceArrayWithDelims} (if they don’t exist previously).

The following token list corresponds to the key \texttt{rules/color} available in the environments.
\tl_new:N \l_@@_rules_color_tl

The number of letters \texttt{X} in the preamble of the array.
\int_new:N \g_@@_nb_of_X_int

If there is at least one \texttt{X}-column in the preamble of the array, the following flag will be raised via the \texttt{aux} file. The length \l_@@_X_columns_dim will be the width of the \texttt{X}-columns. That value is computed after the construction of the array during the first compilation in order to be used in the following run.
\bool_new:N \l_@@_X_columns_aux_bool
\dim_new:N \l_@@_X_columns_dim
This boolean will be used only to detect in an expandable way whether we are at the beginning of the (potential) column zero, in order to raise an error if \Hdotsfor is used in that column.

\bool_new:N \g_@@_after_col_zero_bool

A kind of false row will be inserted at the end of the array for the construction of the col nodes (and also to fix the width of the columns when columns-width is used). When this special row will be created, we will raise the flag \g_@@_row_of_col_done_bool in order to avoid some actions set in the redefinition of \everycr when the last \cr of the \halign will occur (after that row of col nodes).

\bool_new:N \g_@@_row_of_col_done_bool

It’s possible to use the command \NotEmpty to specify explicitly that a cell must be considered as non empty by nicematrix (the Tikz nodes are constructed only in the non empty cells).

\bool_new:N \g_@@_not_empty_cell_bool

\l_@@_code_before_tl may contain two types of informations:

- A code-before written in the aux file by a previous run. When the aux file is read, this code-before is stored in \g_@@_code_before_i_tl (where i is the number of the environment) and, at the beginning of the environment, it will be put in \l_@@_code_before_tl.
- The final user can explicitly add material in \l_@@_code_before_tl by using the key code-before or the keyword \CodeBefore (with the keyword \Body).

\tl_new:N \l_@@_code_before_tl
\bool_new:N \l_@@_code_before_bool

The following token list will contain ce code inserted in each cell of the current row (this token list will be cleared at the beginning of each row).

\tl_new:N \g_@@_row_style_tl

The following dimensions will be used when drawing the dotted lines.

\dim_new:N \l_@@_x_initial_dim
\dim_new:N \l_@@_y_initial_dim
\dim_new:N \l_@@_x_final_dim
\dim_new:N \l_@@_y_final_dim

The L3 programming layer provides scratch dimensions \l_tmpa_dim and \l_tmpb_dim. We creates two more in the same spirit (if they don’t exist yet: that’s why we use \dim_zero_new:N).

\dim_zero_new:N \l_tmpc_dim
\dim_zero_new:N \l_tmpd_dim

Some cells will be declared as “empty” (for example a cell with an instruction \Cdots).

\bool_new:N \g_@@_empty_cell_bool

The following dimensions will be used internally to compute the width of the potential “first column” and “last column”.

\dim_new:N \g_@@_width_last_col_dim
\dim_new:N \g_@@_width_first_col_dim

The following sequence will contain the characteristics of the blocks of the array, specified by the command \Block. Each block is represented by 6 components surrounded by curly braces: {imin}{jmin}{imax}{jmax}{options}{contents}.

The variable is global because it will be modified in the cells of the array.

\seq_new:N \g_@@_blocks_seq
We also manage a sequence of the positions of the blocks. Of course, it’s redundant with the previous sequence, but it’s for efficiency. In that sequence, each block is represented by only the four first components: \{imin\}{jmin\}{imax\}{jmax\}.

\seq_new:N \g_@@_pos_of_blocks_seq

In fact, this sequence will also contain the positions of the cells with a \diagbox. The sequence \g_@@_pos_of_blocks_seq will be used when we will draw the rules (which respect the blocks).

We will also manage a sequence for the positions of the dotted lines. These dotted lines are created in the array by \Cdots, \Vdots, \Ddots, etc. However, their positions, that is to say, their extremities, will be determined only after the construction of the array. In this sequence, each item contains four components: \{imin\}{jmin\}{imax\}{jmax\}.

\seq_new:N \g_@@_pos_of_xdots_seq

The sequence \g_@@_pos_of_xdots_seq will be used when we will draw the rules required by the key hvlines (these rules won’t be drawn within the virtual blocks corresponding to the dotted lines).

The final user may decide to “stroke” a block (using, for example, the key draw=red!15 when using the command \Block). In that case, the rules specified, for instance, by hvlines must not be drawn around the block. That’s why we keep the information of all that stroken blocks in the following sequence.

\seq_new:N \g_@@_pos_of_stroken_blocks_seq

If the user has used the key corners (or the key hvlines_except-corners), all the cells which are in an (empty) corner will be stored in the following sequence.

\seq_new:N \l_@@_corners_cells_seq

The list of the names of the potential \SubMatrix in the \CodeAfter of an environment. Unfortunately, that list has to be global (we have to use it inside the group for the options of a given \SubMatrix).

\seq_new:N \g_@@_submatrix_names_seq

The sequence \g_@@_multicolumn_cells_seq will contain the list of the cells of the array where a command \multicolumn{n}{...}{...} with n > 1 is issued. In \g_@@_multicolumn_sizes_seq, the “sizes” (that is to say the values of n) correspondent will be stored. These lists will be used for the creation of the “medium nodes” (if they are created).

\seq_new:N \g_@@_multicolumn_cells_seq
\seq_new:N \g_@@_multicolumn_sizes_seq

The following counters will be used when searching the extremities of a dotted line (we need these counters because of the potential “open” lines in the \SubMatrix—the \SubMatrix in the code-before).

\int_new:N \l_@@_row_min_int
\int_new:N \l_@@_row_max_int
\int_new:N \l_@@_col_min_int
\int_new:N \l_@@_col_max_int

The following sequence will be used when the command \SubMatrix is used in the code-before (and not in the \CodeAfter). It will contain the position of all the sub-matrices specified in the code-before. Each sub-matrix is represented by an “object” of the forme \{i\}{j\}{k\}{l\} where i and j are the number of row and column of the upper-left cell and k and l the number of row and column of the lower-right cell.

\seq_new:N \g_@@_submatrix_seq

We are able to determine the number of columns specified in the preamble (for the environments with explicit preamble of course and without the potential exterior columns).

\int_new:N \g_@@_static_num_of_col_int
The following parameters correspond to the keys `fill`, `draw`, `tikz`, `borders`, and `rounded-corners` of the command \Block.

338 \tl_new:N \l_@@_fill_tl 339 \tl_new:N \l_@@_draw_tl 340 \seq_new:N \l_@@_tikz_seq 341 \clist_new:N \l_@@_borders_clist 342 \dim_new:N \l_@@_rounded_corners_dim

The last parameter has no direct link with the [empty] corners of the array (which are computed and taken into account by \nicematrix when the key `corners` is used).

The following token list correspond to the key `color` of the command \Block.

343 \tl_new:N \l_@@_color_tl

Here is the dimension for the width of the rule when a block (created by \Block) is stroked.

344 \dim_new:N \l_@@_line_width_dim

The parameters of the horizontal position of the label of a block. If the user uses the key `c` or `C`, the value is `c`. If the user uses the key `l` or `L`, the value is `l`. If the user uses the key `r` or `R`, the value is `r`. If the user has used a capital letter, the boolean \l_@@_hpos_of_block_cap_bool will be raised (in the second pass of the analyze of the keys of the command \Block).

345 \tl_new:N \l_@@_hpos_of_block_tl 346 \tl_set:Nn \l_@@_hpos_of_block_tl { c } 347 \bool_new:N \l_@@_hpos_of_block_cap_bool

For the vertical position, the possible values are `c`, `t` and `b`. Of course, it would be interesting to program a key `T` and a key `B`.

348 \tl_new:N \l_@@_vpos_of_block_tl 349 \tl_set:Nn \l_@@_vpos_of_block_tl { c }

Used when the key `draw-first` is used for \Ddots or \Iddots.

350 \bool_new:N \l_@@_draw_first_bool

The following flag corresponds to the key `hvlines` of the command \Block.

351 \bool_new:N \l_@@_hvlines_block_bool

The blocks which use the key `-` will store their content in a box. These boxes are numbered with the following counter.

352 \int_new:N \g_@@_block_box_int 353 \dim_new:N \l_@@_submatrix_extra_height_dim 354 \dim_new:N \l_@@_submatrix_left_xshift_dim 355 \dim_new:N \l_@@_submatrix_right_xshift_dim 356 \clist_new:N \l_@@_hlines_clist 357 \clist_new:N \l_@@_vlines_clist 358 \clist_new:N \l_@@_submatrix_hlines_clist 359 \clist_new:N \l_@@_submatrix_vlines_clist

Variables for the exterior rows and columns

The keys for the exterior rows and columns are `first-row`, `first-col`, `last-row` and `last-col`. However, internally, these keys are not coded in a similar way.

- **First row**
  The integer \l_@@_first_row_int is the number of the first row of the array. The default value is `1`, but, if the option `first-row` is used, the value will be `0`.

360 \int_new:N \l_@@_first_row_int 361 \int_set:Nn \l_@@_first_row_int 1
• First column

The integer \l_@@_first_col_int is the number of the first column of the array. The default value is 1, but, if the option first-col is used, the value will be 0.

\int_new:N \l_@@_first_col_int
\int_set:Nn \l_@@_first_col_int 1

• Last row

The counter \l_@@_last_row_int is the number of the potential “last row”, as specified by the key last-row. A value of \(-2\) means that there is no “last row”. A value of \(-1\) means that there is a “last row” but we don’t know the number of that row (the key last-row has been used without value and the actual value has not still been read in the aux file).

\int_new:N \l_@@_last_row_int
\int_set:Nn \l_@@_last_row_int { -2 }

If, in an environment like \{pNiceArray\}, the option last-row is used without value, we will globally raise the following flag. It will be used to know if we have, after the construction of the array, to write in the aux file the number of the “last row”.

\bool_new:N \l_@@_last_row_without_value_bool

Idem for \l_@@_last_col_without_value_bool

\bool_new:N \g_@@_last_col_found_bool

This boolean is set to false at the end of \@@_pre_array_ii:

• Last column

For the potential “last column”, we use an integer. A value of \(-2\) means that there is no last column. A value of \(-1\) means that we are in an environment without preamble (e.g. \{bNiceMatrix\}) and there is a last column but we don’t know its value because the user has used the option last-col without value. A value of 0 means that the option last-col has been used in an environment with preamble (like \{pNiceArray\}): in this case, the key was necessary without argument.

\int_new:N \l_@@_last_col_int
\int_set:Nn \l_@@_last_col_int { -2 }

However, we have also a boolean. Consider the following code:

\begin{pNiceArray}{cc}[last-col]
1 & 2 \\
3 & 4
\end{pNiceArray}

In such a code, the “last column” specified by the key last-col is not used. We want to be able to detect such a situation and we create a boolean for that job.

\bool_new:N \g_@@_last_col_found_bool

This boolean is set to false at the end of \@@_pre_array_i::

\footnote{We can’t use \l_@@_last_row_int for this usage because, if nicematrix has read its value from the aux file, the value of the counter won’t be \(-1\) any longer.}
The command \texttt{\tabularnote}

The \LaTeX\ counter \texttt{tabularnote} will be used to count the tabular notes during the construction of the array (this counter won’t be used during the composition of the notes at the end of the array). You use a \LaTeX\ counter because we will use \texttt{\refstepcounter} in order to have the tabular notes referenceable.

\begin{verbatim}
\newcounter{tabularnote}
\end{verbatim}

We will store in the following sequence the tabular notes of a given array.

\begin{verbatim}
\seq_new:N \g_@@_tabularnotes_seq
\end{verbatim}

However, before the actual tabular notes, it’s possible to put a text specified by the key \texttt{tabularnote} of the environment. The token list \texttt{\l_@@_tabularnote_tl} corresponds to the value of that key.

\begin{verbatim}
\tl_new:N \l_@@_tabularnote_tl
\end{verbatim}

The following counter will be used to count the number of successive tabular notes such as in \texttt{\tabularnote(Note 1)\tabularnote(Note 2)\tabularnote(Note 3)}. In the tabular, the labels of those nodes are composed as a comma separated list (e.g. \texttt{a,b,c}).

\begin{verbatim}
\int_new:N \l_@@_number_of_notes_int
\end{verbatim}

The following function can be redefined by using the key \texttt{notes/style}.

\begin{verbatim}
\cs_new:Npn \@@_notes_style:n #1 { \textit { \alph { #1 } } }
\end{verbatim}

The following function can be redefined by using the key \texttt{notes/label-in-tabular}.

\begin{verbatim}
\cs_new:Npn \@@_notes_label_in_tabular:n #1 { \textsuperscript { #1 } }
\end{verbatim}

The following function can be redefined by using the key \texttt{notes/label-in-list}.

\begin{verbatim}
\cs_new:Npn \@@_notes_label_in_list:n #1 { \textsuperscript { #1 } }
\end{verbatim}

We define \texttt{\thetabularnote} because it will be used by \LaTeX\ if the user want to reference a footnote which has been marked by a \texttt{\label}. The \TeX\ group is for the case where the user has put an instruction such as \texttt{\color{red} in \@@_notes_style:n}.

\begin{verbatim}
\cs_set:Npn \thetabularnote { \@@_notes_style:n { tabularnote } }
\end{verbatim}

The tabular notes will be available for the final user only when \texttt{enumitem} is loaded. Indeed, the tabular notes will be composed at the end of the array with a list customized by \texttt{enumitem} (a list \texttt{tabularnotes} in the general case and a list \texttt{tabularnotes*} if the key \texttt{para} is in force). However, we can test whether \texttt{enumitem} has been loaded only at the beginning of the document (we want to allow the user to load \texttt{enumitem} after \texttt{nicematrix}).

\begin{verbatim}
\AtBeginDocument
\begin{verbatim}
\bool_if:nTF { ! \c_@@_enumitem_loaded_bool }
\begin{verbatim}
\NewDocumentCommand \tabularnote { m }
\begin{verbatim}
\@@_error:n { enumitem~not~loaded }
\end{verbatim}
\end{verbatim}
\end{verbatim}
\end{verbatim}
\end{verbatim}

The type of list \texttt{tabularnotes} will be used to format the tabular notes at the end of the array in the general case and \texttt{tabularnotes*} will be used if the key \texttt{para} is in force.

\begin{verbatim}
\newlist { tabularnotes } { enumerate } { 1 }
\setlist [ tabularnotes ]
\begin{verbatim}
topsep = 0pt ,
noitemsep ,
leftmargin = *,
\end{verbatim}
\end{verbatim}

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The command \tabularnote is available in the whole document (and not only in the environments of \nicematrix) because we want it to be available in the caption of a \texttt{table} (before the following \texttt{NiceTabular} or \texttt{NiceArray}). That’s also the reason why the variables \c@tabularnote and \g_@@_tabularnotes_seq will be cleared at the end of the environment of \nicematrix (and not at the beginning).

Unfortunately, if the package caption is loaded, the command \caption evaluates its argument twice and since it is not aware (of course) of \tabularnote, the command \tabularnote is, in fact, not usable in \caption when caption is loaded.\textsuperscript{55}

\NewDocumentCommand \tabularnote { m }
\bool_if:nTF { ! \l_@@_NiceArray_bool && \l_@@_in_env_bool }
{ \@@_error:n { tabularnote~forbidden } }
{ \l_@@_number_of_notes_int is used to count the number of successive tabular notes such as in \tabularnote(Note 1)\tabularnote(Note 2)\tabularnote(Note 3). We will have to compose the labels of these notes as a comma separated list (e.g. a,b,c).
\int_incr:N \l_@@_number_of_notes_int
We expand the content of the note at the point of use of \tabularnote as does \footnote.
\seq_gput_right:Nn \g_@@_tabularnotes_seq { #1 }
\peek_meaning:NF \tabularnote
{ If the following token is not a \tabularnote, we have finished the sequence of successive commands \tabularnote and we have to format the labels of these tabular notes in the array. We compose those labels in a box \l_tmpa_box because we will do a special construction in order to have this box in an overlapping position if we are at the end of a cell.
\hbox_set:Nn \l_tmpa_box
{ We remind that it is the command \@@_notes_label_in_tabular:n that will (most of the time) put the labels in a \textsuperscript{textsuperscript}.}
We use \refstepcounter in order to have the (last) tabular note referenceable (with the standard command \label) and that’s why we have to go back with a decrementation of the counter \tabularnote first.

```latex
\addtocounter{tabularnote}{-1}
\refstepcounter{tabularnote}
\int_zero:N \l_@@_number_of_notes_int
\bbox_overlap_right:n { \box_use:N \l_tmpa_box }
```

If the command \tabularnote is used exactly at the end of the cell, the \unskip (inserted by array?) will delete the skip we insert now and the label of the footnote will be composed in an overlapping position (by design).

```latex
\skip_horizontal:n { \box_wd:N \l_tmpa_box }
```

The command \@@_pgf_rect_node:nnnn is a variant of \@@_pgf_rect_node:nnn: it takes two PGF points as arguments instead of the four dimensions which are the coordinates.

```latex
\cs_new_protected:Npn \@@_pgf_rect_node:nnnn #1 #2 #3 #4 #5
{ \begin { pgfscope } \pgfset { \pgftransformshift { \pgfpointscale { 0.5 } { \pgfpointadd { #2 } { #3 } } } } \pgfnode { rectangle } { center } { \vbox_to_ht:nn { \dim_abs:n { #5 - #3 } } { \vfill } \bbox_to_wd:nn { \dim_abs:n { #4 - #2 } } { } } \end { pgfscope } }
```

The command \@@_pgf_rect_node:nnn is a variant of \@@_pgf_rect_node:nnnn: it takes two PGF points as arguments instead of the four dimensions which are the coordinates.

```latex
\cs_new_protected:Npn \@@_pgf_rect_node:nnn #1 #2 #3
{ \begin { pgfscope } \pgfset { \pgftransformshift { \pgfpoint { 0.5 * ( #2 + #4 ) } { 0.5 * ( #3 + #5 ) } } } \pgfnode { rectangle } { center } { \vbox_to_ht:nn { \dim_abs:n { #5 - #3 } } { \vfill } \bbox_to_wd:nn { \dim_abs:n { #4 - #2 } } { } } \end { pgfscope } }
```
The options

By default, the commands \cellcolor and \rowcolor are available for the user in the cells of the tabular (the user may use the commands provided by \colortbl). However, if the key colortbl-like is used, these commands are available.

\bool_new:N \l_@@_colortbl_like_bool

By default, the behaviour of \cline is changed in the environments of nicematrix: a \cline spreads the array by an amount equal to \arrayrulewidht. It’s possible to disable this feature with the key \l_@@_standard_line_bool.

\bool_new:N \l_@@_standard_cline_bool

The following dimensions correspond to the options cell-space-top-limit and co (these parameters are inspired by the package cellspace).

\dim_new:N \l_@@_cell_space_top_limit_dim
\dim_new:N \l_@@_cell_space_bottom_limit_dim

The following dimension is the distance between two dots for the dotted lines (when line-style is equal to standard, which is the initial value). The initial value is 0.45 em but it will be changed if the option small is used.

\dim_new:N \l_@@_inter_dots_dim
\AtBeginDocument \{ \dim_set:Nn \l_@@_inter_dots_dim \{ 0.45 \text{ em} \} \}

The \AtBeginDocument is only a security in case revtex4-1 is used (even though it is obsolete).

The following dimension is the minimal distance between a node (in fact an anchor of that node) and a dotted line (we say “minimal” because, by definition, a dotted line is not a continuous line and, therefore, this distance may vary a little).

\dim_new:N \l_@@_xdots_shorten_dim
\AtBeginDocument \{ \dim_set:Nn \l_@@_xdots_shorten_dim \{ 0.3 \text{ em} \} \}

The \AtBeginDocument is only a security in case revtex4-1 is used (even though it is obsolete).

The following dimension is the radius of the dots for the dotted lines (when line-style is equal to standard, which is the initial value). The initial value is 0.53 pt but it will be changed if the option small is used.

\dim_new:N \l_@@_radius_dim
\AtBeginDocument \{ \dim_set:Nn \l_@@_radius_dim \{ 0.53 \text{ pt} \} \}
The `\AtBeginDocument` is only a security in case `revtex4-1` is used (even if it is obsolete).

The token list `\l_@@_xdots_line_style_tl` corresponds to the option `tikz` of the commands `\Cdots`, `\Ldots`, etc. and of the options `line-style` for the environments and `\NiceMatrixOptions`. The constant `\c_@@_standard_tl` will be used in some tests.

```
\tl_new:N \l_@@_xdots_line_style_tl
\tl_const:Nn \c_@@_standard_tl { standard }
\tl_set_eq:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl
```

The boolean `\l_@@_light_syntax_bool` corresponds to the option `light-syntax`.

```
\bool_new:N \l_@@_light_syntax_bool
```

The string `\l_@@_baseline_tl` may contain one of the three values `t`, `c` or `b` as in the option of the environment `{array}`. However, it may also contain an integer (which represents the number of the row to which align the array).

```
\tl_new:N \l_@@_baseline_tl
\tl_set:Nn \l_@@_baseline_tl c
```

The flag `\l_@@_exterior_arraycolsep_bool` corresponds to the option `exterior-arraycolsep`. If this option is set, a space equal to `\arraycolsep` will be put on both sides of an environment `{NiceArray}` (as it is done in `{array}` of `array`).

```
\bool_new:N \l_@@_exterior_arraycolsep_bool
\bool_set_true:N \l_@@_exterior_arraycolsep_bool
```

The flag `\l_@@_parallelize_diags_bool` controls whether the diagonals are parallelized. The initial value is `true`.

```
\bool_new:N \l_@@_parallelize_diags_bool
\bool_set_true:N \l_@@_parallelize_diags_bool
```

The following parameter correspond to the key `corners`. The elements of that clist must be in `NW`, `SW`, `NE` and `SE`.

```
\clist_new:N \l_@@_corners_clist
```

The string `\l_@@_name_str` will contain the optional name of the environment: this name can be used to access to the Tikz nodes created in the array from outside the environment.

```
\str_new:N \l_@@_name_str
```

The `\AtBeginDocument` is only a security in case `revtex4-1` is used (even if it is obsolete).

The flag `\l_@@_nullify_dots_bool` corresponds to the option `nullify-dots`. When the flag is down, the instructions like `\vdots` are inserted within a `\hphantom` (and so the constructed matrix has exactly the same size as a matrix constructed with the classical `{matrix}` and `{\ldots}, `{\vdots}`, etc.).

```
\bool_new:N \l_@@_nullify_dots_bool
```

The following flag will be used when the current options specify that all the columns of the array must have the same width equal to the largest width of a cell of the array (except the cells of the potential exterior columns).

```
\bool_new:N \l_@@_auto_columns_width_bool
```

The following boolean corresponds to the key `create-cell-nodes` of the keyword `\CodeBefore`.

```
\bool_new:N \g_@@_recreate_cell_nodes_bool
```

The string `\l_@@_name_str` will contain the optional name of the environment: this name can be used to access to the Tikz nodes created in the array from outside the environment.

```
\str_new:N \l_@@_name_str
```
The boolean \texttt{\_\_\_medium_nodes_bool} will be used to indicate whether the “medium nodes” are created in the array. Idem for the “large nodes”.

\begin{verbatim}
\bool_new:N \_\_\_medium_nodes_bool
\bool_new:N \_\_\_large_nodes_bool
\end{verbatim}

The boolean \texttt{\_\_\_except_borders_bool} will be raised when the key \texttt{hvlines-except-borders} will be used (but that key has also other effects).

\begin{verbatim}
\bool_new:N \_\_\_except_borders_bool
\end{verbatim}

The dimension \texttt{\_\_\_left_margin_dim} correspond to the option \texttt{left-margin}. Idem for the right margin. These parameters are involved in the creation of the “medium nodes” but also in the placement of the delimiters and the drawing of the horizontal dotted lines (\texttt{\hdottedline}).

\begin{verbatim}
\dim_new:N \_\_\_left_margin_dim
\dim_new:N \_\_\_right_margin_dim
\end{verbatim}

The dimensions \texttt{\_\_\_extra_left_margin_dim} and \texttt{\_\_\_extra_right_margin_dim} correspond to the options \texttt{extra-left-margin} and \texttt{extra-right-margin}.

\begin{verbatim}
\dim_new:N \_\_\_extra_left_margin_dim
\dim_new:N \_\_\_extra_right_margin_dim
\end{verbatim}

The token list \texttt{\_\_\_end_of_row_tl} corresponds to the option \texttt{end-of-row}. It specifies the symbol used to mark the ends of rows when the light syntax is used.

\begin{verbatim}
\tl_new:N \_\_\_end_of_row_tl
\tl_set:Nn \_\_\_end_of_row_tl { ; }
\end{verbatim}

The following parameter is for the color the dotted lines drawn by \texttt{\Cdots}, \texttt{\Ldots}, \texttt{\Vdots}, \texttt{\Ddots}, \texttt{\Iddots} and \texttt{\Hdots} for but \texttt{not} the dotted lines drawn by \texttt{\hdottedline} and “:”.

\begin{verbatim}
\tl_new:N \_\_\_xdots_color_tl
\end{verbatim}

The following token list corresponds to the key \texttt{delimiters/color}.

\begin{verbatim}
\tl_new:N \_\_\_delimiters_color_tl
\end{verbatim}

Sometimes, we want to have several arrays vertically juxtaposed in order to have an alignment of the columns of these arrays. To acheive this goal, one may wish to use the same width for all the columns (for example with the option \texttt{columns-width} or the option \texttt{auto-columns-width} of the environment \texttt{\NiceMatrixBlock}). However, even if we use the same type of delimiters, the width of the delimiters may be different from an array to another because the width of the delimiter is fonction of its size. That’s why we create an option called \texttt{delimiters/max-width} which will give to the delimiters the width of a delimiter (of the same type) of big size. The following boolean corresponds to this option.

\begin{verbatim}
\bool_new:N \_\_\_delimiters_max_width_bool
\keys_define:nn { NiceMatrix / xdots }
{
  line-style .code:n =
  {
    \bool_lazy_or:nnTF
    \cs_if_exist_p:N \tikzpicture
    { \str_if_eq_p:nn { #1 } { standard } }
    { \tl_set:Nn \_\_\_xdots_line_style_tl { #1 } }
    \@@_error:n { bad~option~for~line-style }
  },
  line-style .value_required:n = true ,
  color .tl_set:N = \_\_\_xdots_color_tl ,
  color .value_required:n = true ,
  shorten .dim_set:N = \_\_\_xdots_shorten_dim ,
  shorten .value_required:n = true ,
}
\end{verbatim}

We can’t use \texttt{\_\_\_tikz_loaded_bool} to test whether \texttt{tikz} is loaded because \texttt{\NiceMatrixOptions} may be used in the preamble of the document.

\begin{verbatim}
\keys_define:nn { NiceMatrix / tikz }
{
  \cs_if_exist_p:N \tikzpicture 
  { \str_if_eq_p:nn { \_\_\_tikz_loaded_bool } 0 }
  { \tl_set:Nn \_\_\_xdots_line_style_tl { \_\_\_tikz_loaded_bool } }
  \@@_error:n { bad-option-for-line-style }
}
\end{verbatim}
The options down and up are not documented for the final user because he should use the syntax with `^` and `_`:

```latex
\down .tl_set:N = \l_@@_xdots_down_tl ,
\up .tl_set:N = \l_@@_xdots_up_tl ,
```

The key draw-first, which is meant to be used only with \Ddots and \Iddots, which be catched when \Ddots or \Iddots is used (during the construction of the array and not when we draw the dotted lines).

```latex
\draw-first .code:n = \prg_do_nothing: ,
\unknown .code:n = \@@_error:n { Unknown-key-for-xdots }
```

First, we define a set of keys “NiceMatrix / Global” which will be used (with the mechanism of .inherit:n) by other sets of keys.

```latex
\keys_define:nn { NiceMatrix / Global }
\{ 
  \delimiters .code:n = \keys_set:nn { NiceMatrix / delimiters } { #1 } ,
  \delimiters .value_required:n = true ,
  \rules .code:n = \keys_set:nn { NiceMatrix / rules } { #1 } ,
  \rules .value_required:n = true ,
  \standard-cline .bool_set:N = \l_@@_standard_cline_bool ,
  \standard-cline .default:n = true ,
  \cell-space-top-limit .dim_set:N = \l_@@_cell_space_top_limit_dim ,
  \cell-space-top-limit .value_required:n = true ,
  \cell-space-bottom-limit .dim_set:N = \l_@@_cell_space_bottom_limit_dim ,
  \cell-space-bottom-limit .value_required:n = true ,
  \cell-space-limits .meta:n =
  \{ 
    \cell-space-top-limit = #1 ,
    \cell-space-bottom-limit = #1 ,
  \} ,
  \cell-space-limits .value_required:n = true ,
  \xdots .code:n = \keys_set:nn { NiceMatrix / xdots } { #1 } ,
  \light-syntax .bool_set:N = \l_@@_light_syntax_bool ,
  \light-syntax .default:n = true ,
  \end-of-row .tl_set:N = \l_@@_end_of_row_tl ,
  \end-of-row .value_required:n = true ,
  \first-col .code:n = \int_zero:N \l_@@_first_col_int ,
  \first-row .code:n = \int_zero:N \l_@@_first_row_int ,
  \last-row .int_set:N = \l_@@_last_row_int ,
  \last-row .default:n = -1 ,
  \code-for-first-col .tl_set:N = \l_@@_code_for_first_col_tl ,
  \code-for-first-col .value_required:n = true ,
  \code-for-last-col .tl_set:N = \l_@@_code_for_last_col_tl ,
  \code-for-last-col .value_required:n = true ,
  \code-for-first-row .tl_set:N = \l_@@_code_for_first_row_tl ,
  \code-for-first-row .value_required:n = true ,
  \code-for-last-row .tl_set:N = \l_@@_code_for_last_row_tl ,
  \code-for-last-row .value_required:n = true ,
  \hlines .clist_set:N = \l_@@_hlines_clist ,
  \vlines .clist_set:N = \l_@@_vlines_clist ,
  \hlines .default:n = all ,
  \vlines .default:n = all ,
\}
```

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vlines-in-sub-matrix .code:n =
{
	\tl_if_single_token:nTF { #1 }
	{ \tl_set:Nn \l_@@_letter_vlism_tl { #1 } }
	{ \@@_error:n { One-letter-allowed } }
}
, vlines-in-sub-matrix .value_required:n = true ,
vlines .code:n =
{
\clist_set:Nn \l_@@_vlines_clist { all }
\clist_set:Nn \l_@@_hlines_clist { all }
}, hvlines-except-borders .code:n =
{
\clist_set:Nn \l_@@_corners_clist { all }
\clist_set:Nn \l_@@_vlines_clist { all }
\clist_set:Nn \l_@@_hlines_clist { all }
 boolean_set_true:N \l_@@_except_borders_bool
}, parallelize-diags .bool_set:N = \l_@@_parallelize_diags_bool ,

With the option renew-dots, the command \cdots, \ldots, \vdots, \ddots, etc. are redefined and
behave like the commands \Cdots, \Ldots, \Vdots, \Ddots, etc.

renew-dots .bool_set:N = \l_@@_renew_dots_bool ,
renew-dots .value_forbidden:n = true ,
nullify-dots .bool_set:N = \l_@@_nullify_dots_bool ,
create-medium-nodes .bool_set:N = \l_@@_medium_nodes_bool ,
create-large-nodes .bool_set:N = \l_@@_large_nodes_bool ,
create-extra-nodes .meta:n =
{ create-medium-nodes , create-large-nodes },
left-margin .dim_set:N = \l_@@_left_margin_dim ,
left-margin .default:n = \arraycolsep ,
right-margin .dim_set:N = \l_@@_right_margin_dim ,
right-margin .default:n = \arraycolsep ,
margin .meta:n = { left-margin = #1 , right-margin = #1 },
margin .default:n = \arraycolsep ,
extra-left-margin .dim_set:N = \l_@@_extra_left_margin_dim ,
extra-right-margin .dim_set:N = \l_@@_extra_right_margin_dim ,
extra-margin .meta:n =
{ extra-left-margin = #1 , extra-right-margin = #1 },
extra-margin .value_required:n = true ,
}

We define a set of keys used by the environments of nicematrix (but not by the command \NiceMatrixOptions).
\keys_define:nn { NiceMatrix / Env }
{

The key hvlines-except-corners is now deprecated.
hvlines-except-corners .code:n =
{
\clist_set:Nn \l_@@_corners_clist { #1 }
\clist_set:Nn \l_@@_vlines_clist { all }
\clist_set:Nn \l_@@_hlines_clist { all }
},
hvlines-except-corners .default:n = { NW , SW , NE , SE },
corners .clist_set:N = \l_@@_corners_clist ,
corners .default:n = { NW , SW , NE , SE },
code-before .code:n =
{ \tl_if_empty:nF { #1 }
\{
The options c, t, and b of the environment \{NiceArray\} have the same meaning as the option of the classical environment \{array\}.

\begin{verbatim}
c .code:n = \tl_set:Nn \l_@@_baseline_tl c ,
t .code:n = \tl_set:Nn \l_@@_baseline_tl t ,
b .code:n = \tl_set:Nn \l_@@_baseline_tl b ,
baseline .tl_set:N = \l_@@_baseline_tl ,
baseline .value_required:n = true ,
columns-width .code:n =
  \tl_if_eq:nnTF { #1 } { auto }
  { \bool_set_true:N \l_@@_auto_columns_width_bool }
  { \dim_set:Nn \l_@@_columns_width_dim { #1 } } ,
columns-width .value_required:n = true ,
name .code:n =
  \legacy_if:nF { measuring@ }
  { \str_set:Nn \l_tmpa_str { #1 } }
  \seq_if_in:NVTF \g_@@_names_seq \l_tmpa_str
    { \@@_error:nn { Duplicate~name } { #1 } }
  { \seq_gput_left:NV \g_@@_names_seq \l_tmpa_str }
  \str_set_eq:NN \l_@@_name_str \l_tmpa_str ,
name .value_required:n = true ,
code-after .tl_gset:N = \g_nicematrix_code_after_tl ,
code-after .value_required:n = true ,
colortbl-like .code:n =
  \bool_set_true:N \l_@@_colortbl_like_bool
  \bool_set_true:N \l_@@_code_before_bool ,
colortbl-like .value_forbidden:n = true
\end{verbatim}

We test whether we are in the measuring phase of an environment of amsmath (always loaded by nicematrix) because we want to avoid a fallacious message of duplicate name in this case.

\begin{verbatim}
\keys_define:nn { NiceMatrix / notes }
{ 
  \legacy_if:nF { measuring@ }
  { 
    \str_set:Nn \l_tmpa_str { #1 } 
    \seq_if_in:NVTF \g_@@_names_seq \l_tmpa_str
      { \\_error:nn { Duplicate-name } { #1 } } 
    { \\g_nicematrix_code_after_tl } ,
    \bool_set_true:N \l_@@_notes_bottomrule_bool ,
    \bool_set_true:N \l_@@_notes_code_after_tl ,
    \\_notes_style:n = \cs_set:Nn \@@_notes_style:n { #1 } ,
    \\_notes_label_in_list:n = \cs_set:Nn \@@_notes_label_in_list:n { #1 } ,
    \\_notes_label_in_tabular:n = \cs_set:Nn \@@_notes_label_in_tabular:n { #1 } ,
    \\_notes_style:n = \cs_set:Nn \@@_notes_style:n { #1 } ,
    \\_notes_label_in_list:n = \cs_set:Nn \@@_notes_label_in_list:n { #1 } ,
    \\_notes_style:n = \cs_set:Nn \@@_notes_style:n { #1 } ,
    \\_notes_label_in_list:n = \cs_set:Nn \@@_notes_label_in_list:n { #1 } ,
    \\_notes_style:n = \cs_set:Nn \@@_notes_style:n { #1 } ,
    \\_notes_label_in_list:n = \cs_set:Nn \@@_notes_label_in_list:n { #1 } ,
    \\_notes_style:n = \cs_set:Nn \@@_notes_style:n { #1 } ,
  }
\end{verbatim}

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We begin the construction of the major sets of keys (used by the different user commands and environments).

```latex
\keys_define:nn { NiceMatrix / delimiters }
{
  max-width .bool_set:N = \l_@@_delimiters_max_width_bool ,
  max-width .default:n = true ,
  color .tl_set:N = \l_@@_delimiters_color_tl ,
  color .value_required:n = true ,
}
```

```latex
\keys_define:nn { NiceMatrix / xdots }
{
  \keys_define:nn { NiceMatrix / Global }
  \keys_define:nn { NiceMatrix / Env }
}
```

```latex
\keys_define:nn { NiceMatrix / rules }
{
  \keys_define:nn { NiceMatrix / Global }
  \keys_define:nn { NiceMatrix / Env }
}
```

```latex
\keys_define:nn { NiceMatrix / delimiters }
{
  \keys_define:nn { NiceMatrix / Global }
  \keys_define:nn { NiceMatrix / Env }
}
```

We begin the construction of the major sets of keys (used by the different user commands and environments).
We finalise the definition of the set of keys “NiceMatrix / NiceMatrixOptions” with the options specific to \NiceMatrixOptions.

\keys_define:nn { NiceMatrix / NiceMatrixOptions }
\{ last-col .code:n = \tl_if_empty:nF { #1 } \nl_if_non_empty-for-NiceMatrixOptions , \int_zero:N \l_@@_last_col_int , \bool_set:N \l_@@_small_bool , \valueForbidden:n = true , \}

With the option renew-matrix, the environment \{matrix\} of \amsmath and its variants are redefined to behave like the environment \NiceMatrix and its variants.

renew-matrix .code:n = \@@_renew_matrix: , renew-matrix .value_forbidden:n = true ,

The key transparent is now considered as obsolete (because its name is ambiguous).

transparent .code:n = \@@_renew_matrix: , \bool_set_true:N \l_@@_renew_dots_bool \error:n { Key-transparent } , transparent .value_forbidden:n = true ,

The option exterior-arraycolsep will have effect only in \NiceArray for those who want to have for \NiceArray the same behaviour as \{array\}.

exterior-arraycolsep .bool_set:N = \l_@@_exterior_arraycolsep_bool ,

If the option columns-width is used, all the columns will have the same width.

In \NiceMatrixOptions, the special value auto is not available.

columns-width .code:n = \tl_if_eq:nnTF { #1 } { auto } \error:n { Option-auto-for-columns-width } , \dim_set:Nn \l_@@_columns_width_dim { #1 } ,

Usually, an error is raised when the user tries to give the same name to two distincts environments of nicematrix (theses names are global and not local to the current TeX scope). However, the option allow-duplicate-names disables this feature.

allow-duplicate-names .code:n = \@@_msg_redirect_name:nn { Duplicate-name } { none } , allow-duplicate-names .value_forbidden:n = true ,
By default, the specifier used in the preamble of the array (for example in \{pNiceArray\}) to draw a vertical dotted line between two columns is the colon "::". However, it’s possible to change this letter with letter-for-dotted-lines and, by the way, the letter "::" will remain free for other packages (for example arodshln).

\NiceMatrixOptions is the command of the nicematrix package to fix options at the document level. The scope of these specifications is the current TeX group.

We finalise the definition of the set of keys “NiceMatrix / NiceMatrix” with the options specific to \{NiceMatrix\}.

We finalise the definition of the set of keys “NiceMatrix / NiceArray” with the options specific to \{NiceArray\}.

In the environments \{NiceArray\} and its variants, the option last-col must be used without value because the number of columns of the array is read from the preamble of the array.
tabularnote .value_required:n = true ,
\error:n \{ r-or-l-with-preamble \},
l .code:n = \error:n \{ r-or-l-with-preamble \},
unknown .code:n = \error:n \{ Unknown-key-for-NiceArray \}
}
\keys_define:n { NiceMatrix / pNiceArray }
{
  first-col .code:n = \int_zero:N \l_@@_first_col_int ,
last-col .code:n = \tl_if_empty:nF {#1}
  \error:n \{ last-col-non-empty-for-NiceArray \}
  \int_zero:N \l_@@_last_col_int ,
first-row .code:n = \int_zero:N \l_@@_first_row_int ,
small .bool_set:N = \l_@@_small_bool ,
small .value_forbidden:n = true ,
x .code:n = \error:n \{ r-or-l-with-preamble \},
l .code:n = \error:n \{ r-or-l-with-preamble \},
unknown .code:n = \error:n \{ Unknown-key-for-NiceArray \}
}

We finalise the definition of the set of keys “NiceMatrix / NiceTabular” with the options specific to {NiceTabular}.
\keys_define:n { NiceMatrix / NiceTabular }
{
  notes / para .bool_set:N = \l_@@_notes_para_bool ,
  notes / para .default:n = true ,
  notes / bottomrule .bool_set:N = \l_@@_notes_bottomrule_bool ,
  notes / bottomrule .default:n = true ,
tabularnote .tl_set:N = \l_@@_tabularnote_tl ,
tabularnote .value_required:n = true ,
last-col .code:n = \tl_if_empty:nF {#1}
  \error:n \{ last-col-non-empty-for-NiceArray \}
  \int_zero:N \l_@@_last_col_int ,
x .code:n = \error:n \{ r-or-l-with-preamble \},
l .code:n = \error:n \{ r-or-l-with-preamble \},
unknown .code:n = \error:n \{ Unknown-key-for-NiceTabular \}
}

Important code used by {NiceArrayWithDelims}

The pseudo-environment \@@_Cell:–\@@_end_Cell: will be used to format the cells of the array. In the code, the affectations are global because this pseudo-environment will be used in the cells of a \halign (via an environment \{array\}).
\cs_new_protected:Npn \@@_Cell:
{
The token list \g_@@_post_treatment_cell_tl will be set during the composition of the box \l_@@_cell_box and will be used after the composition in order to modify that box (that’s why it’s called a post-treatment).
\tl_gclear:N \g_@@_post_treatment_cell_tl
At the beginning of the cell, we link \CodeAfter to a command which do not begin with \omit (whereas the standard version of \CodeAfter begins with \omit).
\cs_set_eq:NN \CodeAfter \@@_CodeAfter_i:n
We increment \c@jCol, which is the counter of the columns.
\int_gincr:N \c@jCol
Now, we increment the counter of the rows. We don’t do this incrementation in the everycr because some packages, like arydshln, create special rows in the halign that we don’t want to take into account.

\int_compare:nNnT \c@jCol = 1
\{ \int_compare:nNnT \l_@@_first_col_int = 1 \@@_begin_of_row: \}

The content of the cell is composed in the box \l_@@_cell_box because we want to compute some dimensions of the box. The \hbox_set:end: corresponding to this \hbox_set:Nw will be in the \@@_end_Cell: (and the potential \c_math_toggle_token also).

\hbox_set:Nw \l_@@_cell_box
\bool_if:NF \l_@@_NiceTabular_bool
{ \c_math_toggle_token
 \bool_if:NT \l_@@_small_bool \scriptstyle
}

We will call corners of the matrix the cases which are at the intersection of the exterior rows and exterior columns (of course, the four corners doesn’t always exist simultaneously).

The codes \l_@@_code_for_first_row_tl and \l_@@_code_for_last_row_tl don’t apply in the corners of the matrix.

\g_@@_row_style_tl
\int_compare:nNnTF \c@iRow = 0
{ \int_compare:nNnT \c@jCol > 0
  { \l_@@_code_for_first_row_tl
    \xglobal \colorlet { nicematrix-first-row } { . }
  }
}

\int_compare:nNnT \c@iRow = \l_@@_last_row_int
{ \l_@@_code_for_last_row_tl
  \xglobal \colorlet { nicematrix-last-row } { . }
}

The following macro \@@_begin_of_row is usually used in the cell number 1 of the row. However, when the key first-col is used, \@@_begin_of_row is executed in the cell number 0 of the row.

\cs_new_protected:Npn \@@_begin_of_row:
  { \tl_gclear:N \g_@@_row_style_tl
    \int_gincr:N \c@iRow
    \dim_gset_eq:NN \g_@@_dp_ante_last_row_dim \g_@@_dp_last_row_dim
    \dim_gset:Nn \g_@@_ht_last_row_dim { \box_ht:N \@arstrutbox }
    \pgfpicture
    \pgfrememberpicturepositiononpagetrue
    \pgfcoordinate
    \@@_env: - row - \int_use:N \c@iRow - base
    \pgfclosepath
    \pgframedpicture
    \pgfrememberpicturepositiononpagefalse
    \pgfcoordinate
    \@@_env: - row - \int_use:N \c@iRow - base
    \pgfclosepath
  }

Remark: If the key recreate-cell-nodes of the \CodeBefore is used, then we will add some lines to that command.
The following code is used in each cell of the array. It actualises quantities that, at the end of the array, will give informations about the vertical dimension of the two first rows and the two last rows. If the user uses the last-row, some lines of code will be dynamically added to this command.

```latex
\cs_new_protected:Npn \@@_update_for_first_and_last_row:
\{\int_compare:nNnTF \c@iRow = 0
\{\dim_gset:Nn \g_@@_dp_row_zero_dim
\{\dim_max:nn \g_@@_dp_row_zero_dim { \box_dp:N \l_@@_cell_box } \}
\dim_gset:Nn \g_@@_ht_row_zero_dim
\{\dim_max:nn \g_@@_ht_row_zero_dim { \box_ht:N \l_@@_cell_box } \}
\}
\{\int_compare:nNnT \c@iRow = 1
\{\dim_gset:Nn \g_@@_ht_row_one_dim
\{\dim_max:nn \g_@@_ht_row_one_dim { \box_ht:N \l_@@_cell_box } \}
\}
\}
\cs_new_protected:Npn \@@_rotate_cell_box:
\{\box_rotate:Nn \l_@@_cell_box { 90 }\int_compare:nNnT \c@iRow = \l_@@_last_row_int
\{\vbox_set_top:Nn \l_@@_cell_box
\vbox_to_zero:n { }\skip_vertical:n { - \box_ht:N \@arstrutbox + 0.8 ex }\box_use:N \l_@@_cell_box
\}
\bool_gset_false:N \g_@@_rotate_bool
\}
\cs_new_protected:Npn \@@_adjust_size_box:
\{\dim_compare:nNnT \g_@@_blocks_wd_dim > \c_zero_dim
\{\box_set_wd:Nn \l_@@_cell_box
\{\dim_max:nn \box_wd:N \l_@@_cell_box \g_@@_blocks_wd_dim \}
\dim_gzero:N \g_@@_blocks_wd_dim
\}
\dim_compare:nNnT \g_@@_blocks_dp_dim > \c_zero_dim
\{\box_set_dp:Nn \l_@@_cell_box
\{\dim_max:nn \box_dp:N \l_@@_cell_box \g_@@_blocks_dp_dim \}
\dim_gzero:N \g_@@_blocks_dp_dim
\}
\dim_compare:nNnT \g_@@_blocks_ht_dim > \c_zero_dim
\{\box_set_ht:Nn \l_@@_cell_box
\{\dim_max:nn \box_ht:N \l_@@_cell_box \g_@@_blocks_ht_dim \}
\dim_gzero:N \g_@@_blocks_ht_dim
\}
\}
\cs_new_protected:Npn \@@_end_Cell:
\{\@@_math_toggle_token:\hbox_set_end:\}
\}
```

The token list \g_@@_post_treatment_cell_tl is (potentially) set during the composition of the box \l_@@_cell_box and is used now after the composition in order to modify that box.
We want to compute in \texttt{\g@@_max_cell_width_dim} the width of the widest cell of the array (except the cells of the “first column” and the “last column”).

\begin{verbatim}
\dim_gset:Nn \g@@_max_cell_width_dim
  \dim_max:nn \g@@_max_cell_width_dim \{ \box_wd:N \l@@_cell_box \}
\end{verbatim}

The following computations are for the “first row” and the “last row”.

\begin{verbatim}
\bool_gset_false:N \g@@_empty_cell_bool
\bool_gset_false:N \g@@_not_empty_cell_bool
\end{verbatim}

If the cell is empty, or may be considered as if, we must not create the PGF node, for two reasons:

- it’s a waste of time since such a node would be rather pointless;
- we test the existence of these nodes in order to determine whether a cell is empty when we search the extremities of a dotted line.

However, it’s very difficult to determine whether a cell is empty. Up to now we use the following technic:

- if the width of the box \texttt{\l@@_cell_box} (created with the content of the cell) is equal to zero, we consider the cell as empty (however, this is not perfect since the user may have used a \texttt{\rlap}, a \texttt{\llap} or a \texttt{\mathclap} of \texttt{mathtools}.
- the cells with a command \texttt{\Ldots} or \texttt{\Cdots}, \texttt{\Vdots} etc., should also be considered as empty; if \texttt{nullify-dots} is in force, there would be nothing to do (in this case the previous commands only write an instruction in a kind of \texttt{\CodeAfter}); however, if \texttt{nullify-dots} is not in force, a phantom of \ldots, \cdots, \vdots is inserted and its width is not equal to zero; that’s why these commands raise a boolean \texttt{\g@@_empty_cell_bool} and we begin by testing this boolean.

\begin{verbatim}
\bool_if:NTF \g@@_empty_cell_bool
  \bool_lazy_or:nnTF \g@@_not_empty_cell_bool
    \dim_compare_p:nNn { \box_wd:N \l@@_cell_box } > \c_zero_dim
  \int_gset:Nn \g@@_col_total_int \{ \int_max:nn \g@@_col_total_int \c@jCol \}
\end{verbatim}

The following command creates the PGF name of the node with, of course, \texttt{\l@@_cell_box} as the content.

\begin{verbatim}
\cs_new_protected:Npn \@@_node_for_cell:
  \pgfpicture
  \pgfsetbaseline \c_zero_dim
  \pgfruememberpicturepositionnonpagetrue
  \pgfset
    inner-sep = \c_zero_dim ,
    minimum-width = \c_zero_dim
  \pgfnode
    \{ rectangle \}
\end{verbatim}
As its name says, the following command is a patch for the command \@@_node_for_cell: This patch will be appended on the left of \@@_node_for_the_cell: when the construction of the cell nodes (of the form (i-j)) in the CodeBefore is required.

\cs_new_protected:Npn \@@_patch_node_for_cell:n #1
{\ifstr_if_empty:NF \l_@@_name_str
{\pgfnodealias
{\l_@@_name_str - \int_use:N \c@iRow - \int_use:N \c@jCol }
{\@@_env: - \int_use:N \c@iRow - \int_use:N \c@jCol }
}
\endpgfpicture
}

I don't know why the following adjustment is needed when the compilation is done with \LaTeXe or with the classical way latex, divps, ps2pdf (or Adobe Distiller). However, it seems to work.

\bool_lazy_or:nnTF \sys_if_engine_xetex_p: \sys_if_output_dvi_p:
{\@@_patch_node_for_cell:n
{\skip_horizontal:n { 0.5 \box_wd:N \l_@@_cell_box }
}
{ \@@_patch_node_for_cell:n { }
}

We have no explanation for the different behaviour between the \TeX engines...

The second argument of the following command \@@_instruction_of_type:nnn defined below is the type of the instruction (Cdots, Vdots, Ddots, etc.). The third argument is the list of options. This command writes in the corresponding \g_@@_type_lines_tl the instruction which will actually draw the line after the construction of the matrix.

For example, for the following matrix,

\begin{pNiceMatrix}
1 & 2 & 3 & 4 \\ 5 & \Cdots & & 6 \\ 7 & \Cdots[color=red]
\end{pNiceMatrix}
the content of \_@\_Cdots_lines_tl will be:
\_@\_draw_Cdots:nnn {2}{2}{}
\_@\_draw_Cdots:nnn {3}{2}{color=red}

The first argument is a boolean which indicates whether you must put the instruction on the left or on the right on the list of instructions.

We want to use \array of array. However, if the class used is revtex4-1 or revtex4-2, we have to do some tuning and use the command \@array\array instead of \array because these classes do a redefinition of \array incompatible with our use of \array.

It colorbl is loaded, \@tabarray has been redefined to incorporate \CT\start.

\_@\_baseline_tl may have the value t, c or b. However, if the value is b, we compose the \array (of array) with the option t and the right translation will be done further. Remark that \str_if_eq:VnTF is fully expandable and you need something fully expandable here.

We keep in memory the standard version of \ialign because we will redefine \ialign in the environment \NiceArrayWithDelims but restore the standard version for use in the cells of the array. The following command creates a row node (and not a row of nodes!).
The \hbox is mandatory.

\begin{verbatim}
\hbox
{ \bool_if:NT \l_@@_code_before_bool
{ \vtop
{ \skip_vertical:N 0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - row - \@@_succ:n \c@iRow }
\skip_vertical:N -0.5\arrayrulewidth
}
}
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate { \@@_env: - row - \@@_succ:n \c@iRow }
{ \pgfpoint \c_zero_dim { - 0.5 \arrayrulewidth } }
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias
{ \l_@@_name_str - row - \@@_succ:n \c@iRow }
{ \@@_env: - row - \@@_succ:n \c@iRow }
}
\endpgfpicture
}
\end{verbatim}

The following must not be protected because it begins with \noalign.

\begin{verbatim}
\cs_new:Npn \@@_everycr: { \noalign { \@@_everycr_i: } }
\cs_new_protected:Npn \@@_everycr_i:
{ \int_gzero:N \c@jCol
\bool_gset_false:N \g_@@_after_col_zero_bool
\bool_if:NF \g_@@_row_of_col_done_bool
{ \@@_create_row_node:

We don’t draw the rules of the key hlines (or hvlines) but we reserve the vertical space for these rules.

\begin{verbatim}
\tl_if_empty:NF \l_@@_hlines_clist
{ \tl_if_eq:NnF \l_@@_hlines_clist { all }
{ \exp_args:NNx \clist_if_in:NnT \l_@@_hlines_clist
\l_@@_hlines_clist
{ \@@_succ:n \c@iRow }
}
}
\end{verbatim}

The counter \c@iRow has the value \texttt{-1} only if there is a “first row” and that we are before that “first row”, i.e. just before the beginning of the array.

\begin{verbatim}
\int_compare:nNnT \c@iRow > { -1 }
{ \int_compare:nNnF \c@iRow = \l_@@_last_row_int
The command \CT@arc@ is a command of colortbl which sets the color of the rules in the array. The package nicematrix uses it even if colortbl is not loaded. We use a TeX group in order to limit the scope of \CT@arc@.

\begin{verbatim}
{ \hrule height \arrayrulewidth width \c_zero_dim }
}
\end{verbatim}

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The command \@@_newcolumntype is the command \newcolumntype of array without the warnings for redefinitions of columns types (we will use it to redefine the columns types w and W).

\begin{verbatim}
\cs_set_protected:Npn \@@_newcolumntype #1
\{\cs_set:cpn { NC @ find @ #1 } ##1 #1 { \NC@ { ##1 } }
\peek_meaning:NTF [ {
\{ \newc@l@ #1 \}
\{ \newc@l@ #1 [ 0 ] \}
}\}
\end{verbatim}

When the key \texttt{renew-dots} is used, the following code will be executed.

\begin{verbatim}
\cs_set_protected:Npn \@@_renew_dots:
\{\cs_set_eq:NN \ldots \@@_Ldots
\cs_set_eq:NN \cdots \@@_Cdots
\cs_set_eq:NN \vdots \@@_Vdots
\cs_set_eq:NN \ddots \@@_Ddots
\cs_set_eq:NN \iddots \@@_Iddots
\cs_set_eq:NN \dots \@@_Ldots
\cs_set_eq:NN \hdotsfor \@@_Hdotsfor:
\}
\end{verbatim}

When the key \texttt{colortbl-like} is used, the following code will be executed.

\begin{verbatim}
\cs_new_protected:Npn \@@_colortbl_like:
\{\cs_set_eq:NN \cellcolor \@@_cellcolor_tabular
\cs_set_eq:NN \rowcolor \@@_rowcolor_tabular
\cs_set_eq:NN \columncolor \@@_columncolor_preamble
\}
\end{verbatim}

The following code \@@_pre_array_ii: is used in \texttt{NiceArrayWithDelims}. It exists as a standalone macro only for legibility.

\begin{verbatim}
\cs_new_protected:Npn \@@_pre_array_ii:
\{\bool_if:NT \c_@@_booktabs_loaded_bool { \tl_put_left:Nn \@@_create_row_node: }
\box_clear_new:N \l_@@_cell_box
\normalbaselines
\}
\end{verbatim}

If \texttt{booktabs} is loaded, we have to patch the macro \texttt{\@BTnormal} which is a macro of \texttt{booktabs}. The macro \texttt{\@BTnormal} draws an horizontal rule but it occurs after a vertical skip done by a low level TeX command. When this macro \texttt{\@BTnormal} occurs, the row node has yet been inserted by \texttt{nicematrix} before the vertical skip (and thus, at a wrong place). That why we decide to create a new row node (for the same row). We patch the macro \texttt{\@BTnormal} to create this row node. This new row node will overwrite the previous definition of that row node and we have managed to avoid the error messages of that redefinition \footnote{cf. \nicematrix@redefine@check@rerun}.

\begin{verbatim}
\bool_if:NT \c_@@_booktabs_loaded_bool { \tl_put_left:Nn \@@_create_row_node: }
\box_clear_new:N \l_@@_cell_box
\normalbaselines
\}
\end{verbatim}

If the option \texttt{small} is used, we have to do some tuning. In particular, we change the value of \texttt{\arraystretch} (this parameter is used in the construction of \texttt{\arstrutbox} in the beginning of \texttt{array}).

\begin{verbatim}
\bool_if:NT \l_@@_small_bool { \cs_set:nopar:Npn \arraystretch { 0.47 }
\cs_set:Nn \arraycolsep { 1.45 pt }
}\}
\end{verbatim}
The environment \texttt{array} uses internally the command \texttt{\ialign}. We change the definition of \texttt{\ialign} for several reasons. In particular, \texttt{\ialign} sets \texttt{\everycr} to \{ \} and we need to have to change the value of \texttt{\everycr}.

\begin{verbatim}
\cs_set_nopar:Npn \ialign {
    \bool_if:NTF \c_@@_colortbl_loaded_bool {
        \CT@everycr {
            \noalign { \cs_gset_eq:NN \CT@row@color \prg_do_nothing: }
            \@@_everycr:
        }
    } {
        \everycr { \@@_everycr: }
    }
    \tabskip = \c_zero_skip
}
\end{verbatim}

The box \texttt{@arstrutbox} is a box constructed in the beginning of the environment \texttt{array}. The construction of that box takes into account the current value of \texttt{\extrarowheight} (of \texttt{array}). That box is inserted (via \texttt{@arstrut}) in the beginning of each row of the array. That’s why we use the dimensions of that box to initialize the variables which will be the dimensions of the potential first and last row of the environment. This initialization must be done after the creation of \texttt{@arstrutbox} and that’s why we do it in the \texttt{\ialign}.

\begin{verbatim}
\dim_gzero_new:N \g_@@_dp_row_zero_dim
\dim_gset:Nn \g_@@_dp_row_zero_dim { \box_dp:N \@arstrutbox }
\dim_gzero_new:N \g_@@_ht_row_zero_dim
\dim_gset:Nn \g_@@_ht_row_zero_dim { \box_ht:N \@arstrutbox }
\dim_gzero_new:N \g_@@_ht_row_one_dim
\dim_gset:Nn \g_@@_ht_row_one_dim { \box_ht:N \@arstrutbox }
\dim_gzero_new:N \g_@@_dp_ante_last_row_dim
\dim_gzero_new:N \g_@@_ht_last_row_dim
\dim_gset:Nn \g_@@_ht_last_row_dim { \box_ht:N \@arstrutbox }
\dim_gzero_new:N \g_@@_dp_last_row_dim
\dim_gset:Nn \g_@@_dp_last_row_dim { \box_dp:N \@arstrutbox }
\end{verbatim}

After its first use, the definition of \texttt{\ialign} will revert automatically to its default definition. With this programmation, we will have, in the cells of the array, a clean version of \texttt{\ialign}.

\begin{verbatim}
\cs_set_eq:NN \ialign \@@_old_ialign:
\cs_set_eq:NN \ldots \@@_old_ldots
\cs_set_eq:NN \cdots \@@_old_cdots
\cs_set_eq:NN \vdots \@@_old_vdots
\cs_set_eq:NN \ddots \@@_old_ddots
\cs_set_eq:NN \iddots \@@_old_iddots
\bool_if:NTF \l_@@_standard_cline_bool {
    \cs_set_eq:NN \cline \@@_standard_cline
}
\end{verbatim}

We keep in memory the old versions or \texttt{\ldots}, \texttt{\cdots}, etc. only because we use them inside \texttt{\phantom} commands in order that the new commands \texttt{\ldots}, \texttt{\cdots}, etc. give the same spacing (except when the option \texttt{nullify-dots} is used).

\begin{verbatim}
\bool_if:NTF \l_@@_standard_cline_bool {
    \cs_set_eq:NN \cline \@@_standard_cline
}
\end{verbatim}

\footnote{The option \texttt{small} of \texttt{nicematrix} changes (among other) the value of \texttt{\extrarowheight}. This is done, of course, before the call of \texttt{\array}.}
The sequence \g_@@_multicolumn_cells_seq will contain the list of the cells of the array where a command \multicolumn{n}{...}{...} with n > 1 is issued. In \g_@@_multicolumn_sizes_seq, the “sizes” (that is to say the values of n) correspondent will be stored. These lists will be used for the creation of the “medium nodes” (if they are created).

\seq_gclear:N \g_@@_multicolumn_cells_seq
\seq_gclear:N \g_@@_multicolumn_sizes_seq

The counter \c@iRow will be used to count the rows of the array (its incrementation will be in the first cell of the row).

\int_gset:Nn \c@iRow \l_@@_first_row_int - 1

At the end of the environment \{array\}, \c@iRow will be the total number de rows. \g_@@_row_total_int will be the number or rows excepted the last row (if \l_@@_last_row_bool has been raised with the option last-row).

\int_gzero_new:N \g_@@_row_total_int

The counter \c@jCol will be used to count the columns of the array. Since we want to know the total number of columns of the matrix, we also create a counter \g_@@_col_total_int. These counters are updated in the command \@@_Cell: executed at the beginning of each cell.

\int_gzero_new:N \g_@@_col_total_int
\cs_set_eq:NN \@ifnextchar \new@ifnextchar
\bool_gset_false:N \g_@@_last_col_found_bool
\tl_gclear_new:N \g_@@_Cdots_lines_tl
\tl_gclear_new:N \g_@@_Ldots_lines_tl
\tl_gclear_new:N \g_@@_Vdots_lines_tl
\tl_gclear_new:N \g_@@_Ddots_lines_tl
\tl_gclear_new:N \g_@@_Iddots_lines_tl
\tl_gclear_new:N \g_@@_HVdotsfor_lines_tl
\tl_gclear_new:N \g_nicematrix_code_before_tl
}

This is the end of \@@_pre_array_ii:. The command \@@_pre_array: will be executed after analyse of the keys of the environment.

\cs_new_protected:Npn \@@_pre_array: }
{
We recall that \texttt{l_@@_last_row_int} and \texttt{l_@@_last_column_int} are not the numbers of the last row and last column of the array. There are only the values of the keys \texttt{last-row} and \texttt{last-column} (maybe the user has provided erroneous values). The meaning of that counters does not change during the environment of \texttt{nicematrix}. There is only a slight adjustment: if the user have used one of those keys without value, we provide now the right value as read on the aux file (of course, it’s possible only after the first compilation).

If there is a exterior row, we patch a command used in \texttt{@@_Cell}: in order to keep track of some dimensions needed to the construction of that “last row”.

Now the \texttt{\CodeBefore}.

The value of \texttt{g_@@_pos_of_blocks_seq} has been written on the aux file and loaded before the (potential) execution of the \texttt{\CodeBefore}. Now, we clear that variable because it will be reconstructed during the creation of the array.

Idem for other sequences written on the aux file.

The code in \texttt{\@@_pre_array_ii} is used only here.

The array will be composed in a box (named \texttt{l_@@_the_array_box}) because we have to do manipulations concerning the potential exterior rows.
If the user has loaded `nicematrix` with the option `define-L-C-R`, he will be able to use `L`, `C` and `R` instead of `l`, `c` and `r` in the preambles of the environments of `nicematrix` (it’s a compatibility mode since `L`, `C` and `R` were mandatory before version 5.0).

The preamble will be constructed in `\g@@_preamble_tl`.

Now, the preamble is constructed in `\g@@_preamble_tl`

We compute the width of both delimiters. We remember that, when the environment `{NiceArray}` is used, it’s possible to specify the delimiters in the preamble (eg `[ccc]`).

The command `\bBigg@` is a command of `amsmath`.

Here is the beginning of the box which will contain the array. The `\hbox_set_end:` corresponding to this `\hbox_set:Nw` will be in the second part of the environment (and the closing `\c_math_toggle_token` also).

The following command `\@@_pre_array_i:w` will be used when the keyword `\CodeBefore` is present at the beginning of the environment.

We go on with `\@@_pre_array`: which will (among other) execute the `\CodeBefore` (specified in the key `code-before` or after the keyword `\CodeBefore`). By definition, the `\CodeBefore` must be executed before the body of the array...
The \CodeBefore

The following command will be executed if the \CodeBefore has to be actually executed.

\cs_new_protected:Npn \@@_pre_code_before: { \sbox\@@_env:n { \usebeamertemplate{row} } \usebeamertemplate{row} \footnotesize } First, we give values to the LaTeX counters iRow and jCol. We remind that, in the code-before (and in the \CodeAfter) they represent the numbers of rows and columns of the array (without the potential last row and last column). The value of \g_@@_row_total_int is the number of the last row (with potentially a last exterior row) and \g_@@_col_total_int is the number of the last column (with potentially a last exterior column).

Now, we will create all the col nodes and row nodes with the informations written in the aux file. You use the technique described in the page 1229 of pgfmanual.pdf, version 3.1.4b.

First, the recreation of the row nodes.

\int_step_inline:nnn \l_@@_first_row_int { \g_@@_row_total_int + 1 } { \pgf@relevantforpicturesizefalse \pgf@relevantforpicturesizefalse }
Now, the recreation of the \texttt{col} nodes.

\begin{verbatim}
 \int_step_inline:nnn \l_@@_first_col_int \{ \g_@@_col_total_int + 1 \}
 \{
 \pgfsys@getposition \{ \@@_env: - col - ##1 \} \@@_node_position:
 \pgfcoordinate \{ \@@_env: - col - ##1 \}
 \pgfpointdiff \@@_picture_position: \@@_node_position: \}
\end{verbatim}

Now, you recreate the diagonal nodes by using the \texttt{row} nodes and the \texttt{col} nodes.

\begin{verbatim}
\@@_create_diag_nodes:
\end{verbatim}

Now, the creation of the cell nodes (\textit{i-j}), and, maybe also the “medium nodes” and the “large nodes”.

\begin{verbatim}
\bool_if:NT \g_@@_recreate_cell_nodes_bool \@@_recreate_cell_nodes:
\end{verbatim}

\begin{verbatim}
\bool_if:NT \c_@@_tikz_loaded_bool
\{
\tikzset
\{
\text{every-picture / .style} =
\{ \text{overlay, name-prefix = \@@_env: -} \}
\}
\cs_set_eq:NN \cellcolor \@@_cellcolor
\cs_set_eq:NN \rectanglecolor \@@_rectanglecolor
\cs_set_eq:NN \roundedrectanglecolor \@@_roundedrectanglecolor
\cs_set_eq:NN \rowcolor \@@_rowcolor
\cs_set_eq:NN \rowcolors \@@_rowcolors
\cs_set_eq:NN \arraycolor \@@_arraycolor
\cs_set_eq:NN \columncolor \@@_columncolor
\cs_set_eq:NN \chessboardcolors \@@_chessboardcolors
\cs_set_eq:NN \SubMatrix \@@_SubMatrix_in_code_before
\}
\cs_new_protected:Npn \@@_exec_code_before:
\{
\seq_gclear_new:N \g_@@_colors_seq
\bool_gset_false:N \g_@@_recreate_cell_nodes_bool
\group_begin:
\exp_last_unbraced:NV \@@_CodeBefore_keys: \l_@@_code_before_tl \q_stop
\group_end:
\bool_if:NT \g_@@_recreate_cell_nodes_bool
\{
\tl_put_left:Nn \@@_node_for_cell: \@@_patch_node_for_cell: \}
\end{verbatim}

We compose the \texttt{code-before} in math mode in order to nullify the spaces put by the user between instructions in the \texttt{code-before}.

\begin{verbatim}
\bool_if:NT \l_@@_NiceTabular_bool \l_@@_code_before_token
\{\text{\CodeBefore}\}
\end{verbatim}

Here is the \CodeBefore. The construction is a bit complicated because \_\texttt{l_@@_code_before_tl} may begin with keys between square brackets. Moreover, after the analyze of those keys, we sometimes have to decide to \texttt{do not} execute the rest of \texttt{l_@@_code_before_tl} (when it is asked for the creation of cell nodes in the \CodeBefore). That’s why we begin with a \texttt{\q_stop}: it will be used to discard the rest of \texttt{l_@@_code_before_tl}.

\begin{verbatim}
\exp_last_unbraced:NV \l_@@_CodeBefore_keys: \_\texttt{l_@@_code_before_tl} \_\texttt{\q_stop}
\end{verbatim}

Now, all the cells which are specified to be colored by instructions in the \CodeBefore will actually be colored. It’s a two-stages mechanism because we want to draw all the cells with the same color at the same time to absolutely avoid thin white lines in some PDF viewers.

\begin{verbatim}
\_\texttt{l_@@_actually_color:}
\\texttt{\l_@@_code_before_tl}
\\texttt{\l_@@_patch_node_for_cell:}
\end{verbatim}

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\keys_define:nn { NiceMatrix / CodeBefore } 
{
create-cell-nodes .bool_gset:N = \g_@@_recreate_cell_nodes_bool ,
create-cell-nodes .default:n = true ,
sub-matrix .code:n = \keys_set:nn { NiceMatrix / sub-matrix } { #1 } ,
sub-matrix .value_required:n = true ,
delimiters / color .tl_set:N = \l_@@_delimiters_color_tl ,
delimiters / color .value_required:n = true ,
unknown .code:n = \@@_error:n { Unknown-key-for-CodeAfter } 
}
\NewDocumentCommand \@@_CodeBefore_keys: { O { } }
{\keys_set:nn { NiceMatrix / CodeBefore } { #1 } \@@_CodeBefore:w }

We have extracted the options of the keyword \CodeBefore in order to see whether the key create-cell-nodes has been used. Now, you can execute the rest of the \CodeAfter, excepted, of course, if we are in the first compilation.
\cs_new_protected:Npn \@@_CodeBefore:w #1 \q_stop
{
  \bool_if:NT \g_@@_aux_found_bool 
  { \@@_pre_code_before: 
    #1 
  }
}

By default, if the user uses the \CodeBefore, only the col nodes, row nodes and diag nodes are available in that \CodeBefore. With the key create-cell-nodes, the cell nodes, that is to say the nodes of the form (i-j) (but not the extra nodes) are also available because those nodes also are recreated and that recreation is done by the following command.
\cs_new_protected:Npn \@@_recreate_cell_nodes:
{
  \int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int 
  { \pgfsys@getposition { \@@_env: - ##1 - base } \@@_node_position: 
    \pgfcoordinate { \@@_env: - row - ##1 - base } 
    \pgfpointdiff \@@_picture_position: \@@_node_position: }
  \int_step_inline:nnn \l_@@_first_col_int \g_@@_col_total_int 
  { \pgfpointdiff \@@_picture_position: \@@_node_position_i: }
  \cs_if_exist:cT 
  { pgf @ sys @ pdf @ mark @ pos @ \@@_env: - ##1 - ####1 - NW }
  { \pgfsys@getposition 
    \pgfcoordinate { \@@_env: - row - #1 - base } 
    \pgfpointdiff \@@_picture_position: \@@_node_position: }
  \pgfpointdiff \@@_picture_position: \@@_node_position_i: }
  \@@_create_extra_nodes: }

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The environment \{NiceArrayWithDelims\}

The aim of the following \bgroup (the corresponding \egroup is, of course, at the end of the environment) is to be able to put an exposant to a matrix in a mathematical formula.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

The following line will be deleted when we will consider that only versions of siunitx after v3.0 are compatible with nicematrix.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

The command \textbackslash CT@arc@ contains the instruction of color for the rules of the array\textsuperscript{58}. This command is used by \textbackslash CT@arc@ but we use it also for compatibility with colortbl. But we want also to be able to use color for the rules of the array when \textbackslash colortbl is not loaded. That’s why we do the following instruction which is in the patch of the beginning of arrays done by \textbackslash colortbl. Of course, we restore the value of \textbackslash CT@arc@ at the end of our environment.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

We deactivate Tikz externalization because we will use PGF pictures with the options overlay and remember picture (or equivalent forms). We deactivate with \texttt{tikzexternaldisable} and not with \texttt{tikzset{external/export=false}} which is not equivalent.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

We increment the counter \texttt{\g_@@_env_int} which counts the environments of the package.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

The sequence \texttt{\g_@@_blocks_seq} will contain the characteristics of the blocks (specified by \texttt{\Block}) of the array. The sequence \texttt{\g_@@_pos_of_blocks_seq} will contain only the position of the blocks. Of course, this is redundant but it’s for efficiency.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

In fact, the sequence \texttt{\g_@@_pos_of_blocks_seq} will also contain the positions of the cells with a \texttt{\diagbox}.

\begin{NiceArrayWithDelims}
\begin{tabular}{ m m O { } m ! O { } t }
\end{tabular}
\end{NiceArrayWithDelims}

\footnote{e.g. \texttt{\color{rgb}(0.5,0.5,0)}}
We load all the informations written in the aux file during previous compilations corresponding to the current environment.

Now, we prepare the token list for the instructions that we will have to write on the aux file at the end of the environment.

The set of keys is not exactly the same for \texttt{NiceArray} and for the variants of \texttt{NiceArray} (\texttt{pNiceArray}, \texttt{bNiceArray}, etc.) because, for \texttt{NiceArray}, we have the options \texttt{t}, \texttt{c}, \texttt{b} and \texttt{baseline}.

The argument \texttt{#6} is the last argument of \texttt{NiceArrayWithDelims}. With that argument of type “t \texttt{CodeBefore}”, we test whether there is the keyword \texttt{CodeBefore} at the beginning of the environment. If that keyword is present, we have now to extract all the content between that keyword \texttt{CodeBefore} and the (other) keyword \texttt{Body}. It’s the job that will do the command \texttt{@@_pre_array_i:w}. After that job, the command \texttt{@@_pre_array_i:w} will go on with \texttt{@@_pre_array:}.

End of the construction of the array (in the box \texttt{l@@_the_array_box}).

Now, if there is at least one X-column in the environment, we compute the width that those columns will have (in the next compilation).
It the user has used the key last-row with a value, we control that the given value is correct (since we have just constructed the array, we know the real number of rows of the array).

Now, the definition of \c@jCol and \g@@_col_total_int change: \c@jCol will be the number of columns without the “last column”; \g@@_col_total_int will be the number of columns with this “last column”.

We fix also the value of \c@iRow and \g@@_row_total_int with the same principle.

Now, we begin the real construction in the output flow of \TeX. First, we take into account a potential “first column” (we remind that this “first column” has been constructed in an overlapping position and that we have computed its width in \g@@_width_first_col_dim: see p. 116).

The construction of the real box is different when \l@@_NiceArray_bool is true ({NiceArray}) or {NiceTabular}) and in the other environments because, in {NiceArray} or {NiceTabular}, we have no delimiter to put (but we have tabular notes to put). We begin with this case.

\begin{Verbatim}
\begin{Verbatim}
\end{Verbatim}
\end{Verbatim}

\footnote{We remind that the potential “first column” (exterior) has the number 0.}
Now, in the case of an environment `{pNiceArray}`, `{bNiceArray}`, etc. We compute \l_tmpa_dim which is the total height of the “first row” above the array (when the key \texttt{first-row} is used).

\begin{verbatim}
\int_compare:nNnTF \l_@@_first_row_int = 0
\{ \dim_set_eq:NN \l_tmpa_dim \g_@@_dp_row_zero_dim
\dim_add:Nn \l_tmpa_dim \g_@@_ht_row_zero_dim \}
\{ \dim_zero:N \l_tmpa_dim \}
\end{verbatim}

We compute \l_tmpb_dim which is the total height of the “last row” below the array (when the key \texttt{last-row} is used). A value of \(-2\) for \l_@@_last_row_int means that there is no “last row”.

\begin{verbatim}
\int_compare:nNnTF \l_@@_last_row_int > { -2 }
\{ \dim_set_eq:NN \l_tmpb_dim \g_@@_ht_last_row_dim
\dim_add:Nn \l_tmpb_dim \g_@@_dp_last_row_dim \}
\{ \dim_zero:N \l_tmpb_dim \}
\hbox_set:Nn \l_tmpa_box \{
\c_math_toggle_token
\tl_if_empty:NF \l_@@_delimiters_color_tl
\{ \color { \l_@@_delimiters_color_tl } \}
\exp_after:wN \left \g_@@_left_delim_tl \vcenter
\hbox{\hbox:n (or \hbox) is necessary here.}
\skip_vertical:N -\l_tmpa_dim
\hbox \{
\bool_if:NTF \l_@@_NiceTabular_bool
\{ \skip_horizontal:N -\tabcolsep \}
\{ \skip_horizontal:N -\arraycolsep \}
\@@_use_arraybox_with_notes_c:
\bool_if:NTF \l_@@_NiceTabular_bool
\{ \skip_horizontal:N -\tabcolsep \}
\{ \skip_horizontal:N -\arraycolsep \}
\}
\exp_after:wN \right \g_@@_right_delim_tl \c_math_toggle_token
\}
\end{verbatim}

We take into account the “first row” (we have previously computed its total height in \l_tmpa_dim).
The \hbox:n (or \hbox) is necessary here.
\begin{verbatim}
\skip_vertical:N -\l_tmpa_dim
\hbox
\{
\bool_if:NTF \l_@@_NiceTabular_bool
\{ \skip_horizontal:N -\tabcolsep \}
\{ \skip_horizontal:N -\arraycolsep \}
\@@_use_arraybox_with_notes_c:
\bool_if:NTF \l_@@_NiceTabular_bool
\{ \skip_horizontal:N -\tabcolsep \}
\{ \skip_horizontal:N -\arraycolsep \}
\}
\end{verbatim}

We take into account the “last row” (we have previously computed its total height in \l_tmpb_dim).
\begin{verbatim}
\skip_vertical:N -\l_tmpb_dim
\end{verbatim}

Curiously, we have to put again the following specification of color. Otherwise, with XeLaTeX (and not with the other engines), the closing delimiter is not colored.
\begin{verbatim}
\tl_if_empty:NF \l_@@_delimiters_color_tl
\{ \color { \l_@@_delimiters_color_tl } \}
\exp_after:wN \right \g_@@_right_delim_tl \vcenter
\c_math_toggle_token
\}
\end{verbatim}

Now, the box \l_tmpa_box is created with the correct delimiters.
We will put the box in the TeX flow. However, we have a small work to do when the option \texttt{delimiters/max-width} is used.
\begin{verbatim}
\bool_if:NTF \l_@@_delimiters_max_width_bool
\{ \@@_put_box_in_flow_bis:nn \g_@@_left_delim_tl \g_@@_right_delim_tl \}
\@@_put_box_in_flow:
\end{verbatim}

\footnote{A value of \(-1\) for \l_@@_last_row_int means that there is a “last row” but the user have not set the value with the option \texttt{last row} (and we are in the first compilation).}
We take into account a potential “last column” (this “last column” has been constructed in an overlapping position and we have computed its width in \texttt{\g_@@_width_last_col_dim}: see p. 117).

\begin{verbatim}
\bool_if:NT \g_@@_last_col_found_bool
 { \skip_horizontal:N \g_@@_width_last_col_dim
 \skip_horizontal:N \col@sep 
 }

\bool_if:NF \l_@@_Matrix_bool
 { \int_compare:nNnT \c@jCol < \g_@@_static_num_of_col_int
 { \@@_error:n { columns~not~used } } 
 }
\group_begin:
\globaldefs = 1
\@@_msg_redirect_name:nn { columns~not~used } { error }
\group_end:
\@@_after_array:
\end{verbatim}

The aim of the following \texttt{\egroup} (the corresponding \texttt{\bgroup} is, of course, at the beginning of the environment) is to be able to put an exponent to a matrix in a mathematical formula.

\begin{verbatim}
\egroup
\end{verbatim}

We want to write on the aux file all the informations corresponding to the current environment.

\begin{verbatim}
\iow_now:Nn \@mainaux { \ExplSyntaxOn }
\iow_now:Nn \@mainaux { \char_set_catcode_space:n { 32 } }
\iow_now:Nx \@mainaux
 { \tl_gset:cn { c_@@_ \int_use:N \g_@@_env_int _ tl } \exp_not:V \g_@@_aux_tl }
\iow_now:Nn \@mainaux { \ExplSyntaxOff }
\bool_if:NT \c_@@_footnote_bool \endsavenotes
\end{verbatim}

This is the end of the environment \texttt{\{NiceArrayWithDelims\}}.

We construct the preamble of the array

The transformation of the preamble is an operation in several steps.

The preamble given by the final user is in \texttt{\g_@@_preamble_tl} and the modified version will be stored in \texttt{\g_@@_preamble_tl} also.

\begin{verbatim}
\cs_new_protected:Npn \@@_construct_preamble:
 { 
 First, we will do an “expansion” of the preamble with the tools of the package \texttt{array} itself. This “expansion” will expand all the constructions with * and with all column types (defined by the user or by various packages using \texttt{\newcolumntype}).
 Since we use the tools of \texttt{array} to do this expansion, we will have a program which is not in the style of the L3 programming layer.

 We redefine the column types w and W. We use \texttt{\@_newcolumntype} instead of \texttt{\newcolumntype} because we don’t want warnings for column types already defined. These redefinitions are in fact protections of the letters w and W. We don’t want these columns type expanded because we will do the patch ourselves after. We want to be able the standard column types w and W in potential \texttt{\{tabular\}} of \texttt{array} in some cells of our array. That’s why we do those redefinitions in a TeX group.

\group_begin:
\end{verbatim}
If we are in an environment without explicit preamble, we have nothing to do (excepted the treatment on both sides of the preamble which will be done at the end).

First, we have to store our preamble in the token register \@temptokena (those “token registers” are not supported by the L3 programming layer).

Initialisation of a flag used by array to detect the end of the expansion.

The following line actually does the expansion (it’s has been copied from array.sty). The expanded version is still in \@temptokena.

Now, we have to “patch” that preamble by transforming some columns. We will insert in the TeX flow the preamble in its actual form (that is to say after the “expansion”) following by a marker \q_stop and we will consume these tokens constructing the (new form of the) preamble in \g_@@_preamble_tl. This is done recursively with the command \@@_patch_preamble:n. In the same time, we will count the columns with the counter \c@jCol.

The number of letters X in the preamble of the array.

The sequence \g_@@_cols_vlism_seq will contain the numbers of the columns where you will have to draw vertical lines in the potential sub-matrices (hence the name vlism).

The counter \l_tmpa_int will count the number of consecutive occurrences of the symbol \|.

Now, we actually patch the preamble (and it is constructed in \g_@@_preamble_tl).

Now, we replace \columncolor by \@@_columncolor_preamble.
Now, we can close the TeX group which was opened for the redefinition of the columns of type $w$ and $W$.

\group_end:

If there was delimiters at the beginning or at the end of the preamble, the environment \{NiceArray\} is transformed into an environment \{xNiceMatrix\}.

\bool_lazy_or:nnT
\{ ! \str_if_eq_p:Vn \g_@@_left_delim_tl { . } \}
\{ ! \str_if_eq_p:Vn \g_@@_right_delim_tl { . } \}
\{ \bool_set_false:N \l_@@_NiceArray_bool \}

We want to remind whether there is a specifier | at the end of the preamble.

\bool_if:NT \g_tmpb_bool { \bool_set_true:N \l_@@_bar_at_end_of_pream_bool }

We complete the preamble with the potential “exterior columns” (on both sides).

\int_compare:nNnTF \l_@@_first_col_int = 0
\{ \tl_gput_left:NV \g_@@_preamble_tl \c_@@_preamble_first_col_tl \}
\}
\bool_lazy_all:nT
\{ \l_@@_NiceArray_bool
\{ \bool_not_p:n \l_@@_NiceTabular_bool \}
\{ \tl_if_empty_p:N \l_@@_vlines_clist \}
\{ \bool_not_p:n \l_@@_exterior_arraycolsep_bool \}
\}
\int_compare:nNnTF \l_@@_last_col_int > { -1 }
\{ \tl_gput_right:NV \g_@@_preamble_tl \c_@@_preamble_last_col_tl \}
\}
\bool_lazy_all:nT
\{ \l_@@_NiceArray_bool
\{ \bool_not_p:n \l_@@_NiceTabular_bool \}
\{ \tl_if_empty_p:N \l_@@_vlines_clist \}
\{ \bool_not_p:n \l_@@_exterior_arraycolsep_bool \}
\}
\tl_gput_right:Nn \g_@@_preamble_tl \c_@@_preamble_last_col_tl

We add a last column to raise a good error message when the user puts more columns than allowed by its preamble. However, for technical reasons, it’s not possible to do that in \{NiceTabular*\} ($\l_@@_tabular_width_dim=0pt$).

\dim_compare:nNnT \l_@@_tabular_width_dim = \c_zero_dim
\{ \tl_gput_right:Nn \g_@@_preamble_tl
\}

\cs_new_protected:Npn \@@_patch_preamble:n #1
\{ \str_case:nnF { #1 } { c { \@@_patch_preamble_i:n #1 } l { \@@_patch_preamble_i:n #1 } r { \@@_patch_preamble_i:n #1 } > { \@@_patch_preamble_ii:nn #1 } ! { \@@_patch_preamble_ii:nn #1 } @ { \@@_patch_preamble_ii:nn #1 } | { \@@_patch_preamble_ii:nnn t #1 } p { \@@_patch_preamble_iv:nnn n #1 } }
For c, l and r
\cs_new_protected:Npn \@@_patch_preamble_i:n #1
\tl_gput_right:Nn \g_@@_preamble_tl
\{ \@@_Cell: \tl_set:Nn \l_@@_cell_type_tl { #1 } \}

We increment the counter of columns and then we test for the presence of a <.
\int_gincr:N \c@jCol
\@@_patch_preamble:x:n
\}

For >, ! and @
\cs_new_protected:Npn \@@_patch_preamble_ii:nn #1 #2
\tl_gput_right:Nn \g_@@_preamble_tl
\{ \@@_Cell: \tl_set:Nn \l_@@_cell_type_tl { #1 } \}
\#1
\< \l_@@_end_Cell:
\}

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F or  
|  
\cs_new_protected:Npn \@@_patch_preamble_iii:n #1  
\l_tmpa_int is the number of successive occurrences of |  
\int_incr:N \l_tmpa_int  
\@@_patch_preamble_iii_i:n  
\cs_new_protected:Npn \@@_patch_preamble_iii_i:n #1  
\str_if_eq:nnTF { #1 } |  
{ \@@_patch_preamble_iii:n | }  
{  
\tl_gput_right:Nx \g_@@_preamble_tl  
{ \exp_not:N !  
{ \skip_horizontal:n  
{ \dim_eval:n  
{ \arrayrulewidth * \l_tmpa_int  
+ \doublerulesep * ( \l_tmpa_int - 1)  
}  
}  
\tl_gput_right:Nx \g_@@_internal_code_after_tl  
{ \@@_vline:nn { \@@_succ:n \c@jCol } { \int_use:N \l_tmpa_int } }  
\int_zero:N \l_tmpa_int  
\str_if_eq:nnT { #1 } { \q_stop }  
{ \bool_gset_true:N \g_tmpb_bool }  
\@@_patch_preamble:n #1  
}  
\bool_new:N \l_@@_bar_at_end_of_pream_bool  
\for p and b  
\cs_new_protected:Npn \@@_patch_preamble_iv:nnn #1 #2 #3  
\tl_gput_right:Nn \g_@@_preamble_tl  
{ \@@_Cell:  
\begin { minipage } [ #1 ] { \dim_eval:n { #3 } }  

The following lines have been taken from array.sty.  
\everypar  
{ \vrule height \box_ht:N \@arstrutbox width \c_zero_dim  
\everypar { }  
\g_@@_row_style_tl % added the 2021-07-17  
\arraybackslash  
\c }  
\end { minipage }  

The following line has been taken from array.sty.  
\@finalstrut \@arstrutbox  
\end { minipage }  

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If the letter in the preamble is \texttt{m}, you require a post-treatment for the box \_l\_\_cell_box.

\begin{verbatim}
\str_if_eq:nnT { #2 } m \_\_center_cell_box:
\_\_end_Cell:
\end{verbatim}

We increment the counter of columns, and then we test for the presence of a \texttt{<}.

\begin{verbatim}
\int_gincr:N \_c@jCol
\_\_patch_preamble_x:n
\end{verbatim}

The following command will be used in \texttt{m}-columns in order to center vertically the box. In fact, despite its name, the command does not always center the cell. Indeed, if there is only one row in the cell, it should not be centered vertically. It’s not possible to know the number of rows of the cell. However, you consider (as in \texttt{array}) that if the height of the cell is no more that the height of \texttt{@arstrutbox}, there is only one row.

\begin{verbatim}
\cs_new_protected:Npn \_\_center_cell_box:
\end{verbatim}

By putting instructions in \texttt{\_g@\_post_treatment_cell_tl}, we require a post-treatment of the box \_l\_\_cell_box.

\begin{verbatim}
\tl_gput_right:Nn \_g@\_post_treatment_cell_tl
\end{verbatim}

For \texttt{w} and \texttt{W}

\begin{verbatim}
\cs_new_protected:Npn \_\_patch_preamble_v:nnnn #1 #2 #3 #4
\end{verbatim}

\begin{verbatim}
\tl_gput_right:Nn \_g@\_preamble_tl
\end{verbatim}
We increment the counter of columns and then we test for the presence of a <.  
\int_gincr:N \c@jCol
\@@_patch_preamble_x:n
}

For \@@_true_c: which will appear in our redefinition of the columns of type S (of siunitx).
\cs_new_protected:Npn \@@_patch_preamble_vi:n #1
{  
  \tl_gput_right:Nn \g_@@_preamble_tl { c }
}

We increment the counter of columns and then we test for the presence of a <.  
\int_gincr:N \c@jCol
\@@_patch_preamble_x:n
}

For (, [ and \{. We have two arguments for the following command because we directly read the following letter in the preamble (we have to see whether we have a opening delimiter following and we also have to see whether we are at the end of the preamble because, in that case, our letter must be considered as the right delimiter of the environment if the environment is \{NiceArray\}).
\cs_new_protected:Npn \@@_patch_preamble_viii:nn #1 #2
{  
  \bool_if:NT \l_@@_small_bool { \@@_fatal:n { Delimiter-with-small } }  
  \tl_if_eq:VnTF \g_@@_left_delim_tl { . }  
  { 
    \tl_gset:Nn \g_@@_left_delim_tl { #1 }  
    \tl_gset:Nn \g_@@_right_delim_tl { . }  
    \@@_patch_preamble:n #2  
  }  
  {  
    \tl_gput_right:Nn \g_@@_preamble_tl { ! { \enskip } }  
    \@@_patch_preamble_vii_i:nn { #1 } { #2 }  
  }  
  { \@@_patch_preamble_vii_i:nn { #1 } { #2 }  
}

\cs_new_protected:Npn \@@_patch_preamble_vii:nn #1 #2
{  
  \tl_gput_right:Nn \g_@@_preamble_tl { \enskip }  
  \@@_patch_preamble_vii_i:nn { #1 } { #2 }  
}

\cs_new_protected:Npn \@@_patch_preamble_vii_i:nn #1 #2
{  
  \tl_gput_right:Nn \g_@@_internal_code_after_tl { \@@_delimiter:nnn #1 { \@@_succ:n \c@jCol } \c_true_bool }  
  \tl_if_in:nnTF { ( \[ \{ ) \] } { #2 }  
  { \@@_error:nn { delimiter-after-opening } { #2 }  
    \@@_patch_preamble:n #2  
  }  
  { \@@_patch_preamble:n #2 }  
}

In that case, in fact, the first letter of the preamble must be considered as the left delimiter of the array.
\tl_gset:Nn \g_@@_left_delim_tl { #1 }  
\tl_gset:Nn \g_@@_right_delim_tl { . }  
\@@_patch_preamble:n #2  
}

For (, [ and \{. We have two arguments for the following command because we directly read the following letter in the preamble (we have to see whether we have a opening delimiter following and we also have to see whether we are at the end of the preamble because, in that case, our letter must be considered as the right delimiter of the environment if the environment is \{NiceArray\}).
\cs_new_protected:Npn \@@_patch_preamble_viii:nn #1 #2
{  
  \bool_if:NT \l_@@_small_bool { \@@_fatal:n { Delimiter-with-small } }  
  \tl_if_eq:nnTF { \q_stop } { #2 }  
  { \@@_patch_preamble_viii_i:nnn #1 #2 }  
  { \@@_patch_preamble:n #2 }  
}

\cs_new_protected:Npn \@@_patch_preamble_viii_i:nnn #1 #2
{  
  \tl_gput_right:Nn \g_@@_internal_code_after_tl { \@@_delimiter:nnn #1 { \@@_succ:n \c@jCol } \c_true_bool }  
  \tl_if_eq:nnTF { \q_stop } { #2 }  
  { \@@_patch_preamble_viii_i:nnn #1 #2 }  
  { \@@_patch_preamble:n #2 }  
}
The command `\@@_vdottedline:n` is protected, and, therefore, won't be expanded before writing on `\g_@@_internal_code_after_tl`.

After a specifier of column, we have to test whether there is one or several `<{..}` because, after those potential `<{..`, we have to insert `!\skip_horizontal:N ...` when the key `vlines` is used.
For the case of a letter $X$

\cs_new_protected:Npn \@@_patch_preamble_xii:n #1
\{\tl_gput_right:Nn \g_@@_preamble_tl { < { #1 } } \}
\@@_patch_preamble_x:n
\}

We test whether you know the width of the $X$-columns by reading the value in the aux file (of course, this is not possible at the first compilation).
\bool_if:NTF \l_@@_X_columns_aux_bool
\{ \exp_args:NNNV \@@_patch_preamble_iv:nnn t p \l_@@_X_columns_dim \}
\tl_gput_right:Nn \g_@@_preamble_tl
\{
\tl_set:Nn \l_@@_cell_type_tl { c }
\}
\int_gincr:N \c@jCol
\@@_patch_preamble_x:n
\}

The following code will nullify the box of the cell.
\tl_gput_right:Nn \g_@@_post_treatment_cell_tl
\{ \hbox_set:Nn \l_@@_cell_box { } \}

The content of the cell is composed in \l_tmpa_box which will be discarded.
\}
\int_gincr:N \c@jCol
\@@_patch_preamble_x:n
\}

The redefinition of \multicolumn

The following command must not be protected since it begins with \multispan (a TeX primitive).
\cs_new:Npn \@@_multicolumn:nnn #1 #2 #3
\{

The following lines are from the definition of \multicolumn in array (and not in standard \LaTeX). The first line aims to raise an error if the user has put more than one column specifier in the preamble of \multicolumn.

```
\multicolumn \begingroup
\cs_set:Npn \@addamp { \if@firstamp \@firstampfalse \else \@preamerr 5 \fi }
```

You do the expansion of the (small) preamble with the tools of array.

```
\@emptokena = { #2 }
\@tempswatrue
\@whilesw \if@tempswa \fi { \@tempswafalse \the \NC@list }
```

Now, patch the (small) preamble as we have done with the main preamble of the array.

```
\tl_gclear:N \g_@@_preamble_tl
\exp_after:wN \@@_patch_m_preamble:n \the \@emptokena \q_stop
```

The following lines are an adaptation of the definition of \multicolumn in array.

```
\exp_args:NV \@mkpream \g_@@_preamble_tl
\@addtopreamble \@empty
\endgroup
```

Now, you do a treatment specific to nicematrix which has no equivalent in the original definition of \multicolumn.

```
\int_compare:nNnT { #1 } > 1
{ \seq_gput_left:Nx \g_@@_multicolumn_cells_seq
{ \int_use:N \c@iRow - \@@_succ:n \c@jCol }
\seq_gput_left:Nx \g_@@_multicolumn_sizes_seq { #1 }
\seq_gput_right:Nx \g_@@_pos_of_blocks_seq
{ \int_use:N \c@iRow }
\int_eval:n { \c@jCol + 1 } }
{ \int_use:N \c@iRow }
\int_eval:n { \c@jCol + #1 }
```

The following lines were in the original definition of \multicolumn.

```
\cs_set:Npn \@sharp { #3 }
\@arstrut
\@preamble
\null
```

We add some lines.

```
\int_gadd:Nn \c@jCol { #1 - 1 }
\int_compare:nNnT \c@jCol > \g_@@_col_total_int
{ \int_gset_eq:NN \g_@@_col_total_int \c@jCol }
\ignorespaces
```

The following commands will patch the (small) preamble of the \multicolumn. All those commands have a m in their name to recall that they deal with the redefinition of \multicolumn.

```
\cs_new_protected:Npn \@@_patch_m_preamble:n #1
{ \str_case:nnF { #1 }
{ c { \@@_patch_m_preamble_i:n #1 }
  l { \@@_patch_m_preamble_i:n #1 }
  r { \@@_patch_m_preamble_i:n #1 }
  > { \@@_patch_m_preamble_ii:nn #1 }
  ! { \@@_patch_m_preamble_ii:nn #1 }
  @ { \@@_patch_m_preamble_ii:nn #1 }
  }
  }
```

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For c, l and r
\cs_new_protected:Npn \@@_patch_m_preamble_i:n #1
\tl_gput_right:Nn \g_@@_preamble_tl
\@@_patch_m_preamble:n

We test for the presence of a <.
\@@_patch_m_preamble_x:n

For >, ! and @
\cs_new_protected:Npn \@@_patch_m_preamble_ii:nn #1 #2
\tl_gput_right:Nn \g_@@_preamble_tl { #1 { #2 } }
\@@_patch_m_preamble:n

For |
\cs_new_protected:Npn \@@_patch_m_preamble_iii:n #1
\tl_gput_right:Nn \g_@@_preamble_tl { #1 }
\@@_patch_m_preamble:n

For p, m and b
\cs_new_protected:Npn \@@_patch_m_preamble_iv:nnn t #1
\tl_gput_right:Nn \g_@@_preamble_tl { \@@_Cell: \tl_set:Nn \l_@@_cell_type_tl { #1 } }#1
\@@_end_Cell:

\vrule height \box_ht:N \@arstrutbox depth 0 pt width 0 pt
\arraybackslash
\begin { minipage } { \dim_eval:n { #3 } }
\mode_leave_vertical:
\vrule height \box_ht:N \@arstrutbox depth 0 pt width 0 pt
\end { minipage }
\@@_end_Cell:
We test for the presence of a `<.
\@@_patch_m_preamble_x:n
}

For w and W
\cs_new_protected:Npn \@@_patch_m_preamble_v:nnnn #1 #2 #3 #4
{\tl_gput_right:Nn\g_@@_preamble_tl
 > {\hbox_set:Nw\l_@@_cell_box
 \@@_Cell:
 \tl_set:Nn\l_@@_cell_type_tl{#3}
 }
c
 < {\@@_end_Cell:
 #1\hbox_set_end:
 bool_if:NT\g_@@_rotate_bool\@@_rotate_cell_box:
 \@@_adjust_size_box:
 \makebox[\#4][\#3]{\box_use_drop:N\l_@@_cell_box}
}
}

We test for the presence of a `<.
\@@_patch_m_preamble_x:n
}

For \@@_true_c: which will appear in our redefinition of the columns of type S (of siunitx).
\cs_new_protected:Npn \@@_patch_m_preamble_vi:n #1
{\tl_gput_right:Nn\g_@@_preamble_tl {c}
}

We test for the presence of a `<.
\@@_patch_m_preamble_x:n
}

After a specifier of column, we have to test whether there is one or several `<{...}` because, after those potential `<{...`, we have to insert `!{\skip_horizontal:N ...}` when the key vlines is used.
\cs_new_protected:Npn \@@_patch_m_preamble_x:n #1
{\str_if_eq:nnTF {#1} {<}
 \@@_patch_m_preamble_ix:n
 {\tl_if_eq:NnTF\l_@@_vlines_clist{all}
  {\tl_gput_right:Nn\g_@@_preamble_tl
   { ! {\skip_horizontal:N \arrayrulewidth} }
  }
  {exp_args:NNx\clist_if_in:NnT\l_@@_vlines_clist\@@_succ:n\c@jCol}
   {\tl_gput_right:Nn\g_@@_preamble_tl
    { ! {\skip_horizontal:N \arrayrulewidth} }
   }
  }
 \@@_patch_m_preamble:n { #1} 
}
The command \@@_put_box_in_flow: puts the box \l_tmpa_box (which contains the array) in the flow. It is used for the environments with delimiters. First, we have to modify the height and the depth to take back into account the potential exterior rows (the total height of the first row has been computed in \l_tmpa_dim and the total height of the potential last row in \l_tmpb_dim).

The command \@@_put_box_in_flow_i: is used when the value of \l_@@_baseline_tl is different of c (which is the initial value and the most used).

Now, \g_tmpa_dim contains the y-value of the center of the array (the delimiters are centered in relation with this value).

We take into account the position of the mathematical axis.
Now, \texttt{\g_tmpa_dim} contains the value of the $y$ translation we have to do.

\begin{verbatim}
\endpgfpicture
\box_move_up:nn \g_tmpa_dim { \box_use_drop:N \l_tmpa_box }
\box_use_drop:N \l_tmpa_box
\}

The following command is \textit{always} used by \texttt{\NiceArrayWithDelims} (even if, in fact, there is no tabular notes: in fact, it’s not possible to know whether there is tabular notes or not before the composition of the blocks).

\begin{verbatim}
\cs_new_protected:Npn \@@_use_arraybox_with_notes_c:
\end{verbatim}

With an environment \texttt{\Matrix}, you want to remove the exterior \texttt{\arraycolsep} but we don’t know the number of columns (since there is no preamble) and that’s why we can’t put \texttt{@{}} at the end of the preamble. That’s why we remove a \texttt{\arraycolsep} now.

\begin{verbatim}
\bool_lazy_and:nnT \l_@@_Matrix_bool \l_@@_NiceArray_bool
\begin{verbatim}
\box_set_wd:Nn \l_@@_the_array_box { \box_wd:N \l_@@_the_array_box - \arraycolsep }
\end{verbatim}
\end{verbatim}

We need a \texttt{\minipage} because we will insert a \LaTeX{} list for the tabular notes (that means that a \texttt{\vtop{\hsize=...}} is not enough).

\begin{verbatim}
\begin { minipage } \[ t \] { \box_wd:N \l_@@_the_array_box }
\end{verbatim}

The \texttt{\hbox} avoids that the \texttt{pgfpicture} inside \texttt{\@@_draw_blocks} adds a extra vertical space before the notes.

\begin{verbatim}
\hbox:n
\box_use_drop:N \l_@@_the_array_box
\end{verbatim}

We have to draw the blocks right now because there may be tabular notes in some blocks (which are not mono-column: the blocks which are mono-column have been composed in boxes yet)... and we have to create (potentially) the extra nodes before creating the blocks since there are \texttt{medium} nodes to create for the blocks.

\begin{verbatim}
\@@_create_extra_nodes:
\seq_if_empty:NF \g_@@_blocks_seq \@@_draw_blocks:
\end{verbatim}

\begin{verbatim}
\bool_lazy_or:nnT { \int_compare_p:nNn \c@tabularnote > 0 } { \tl_if_empty_p:V \l_@@_tabularnote_tl }
\@@_insert_tabularnotes:
\end{verbatim}

\begin{verbatim}
\cs_new_protected:Npn \@@_insert_tabularnotes:
\begin { tabularnotes* }
\seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 }
\end { tabularnotes* }
\end{verbatim}

The \TeX{} group is for potential specifications in the \texttt{\l_@@_notes_code_before_tl}.

\begin{verbatim}
\group_begin:
\l_@@_notes_code_before_tl
\tl_if_empty:NF \l_@@_tabularnote_tl { \l_@@_tabularnote_tl \par }
\end{verbatim}

We compose the tabular notes with a list of \texttt{enumitem}. The \texttt{\strut} and the \texttt{\unskip} are designed to give the ability to put a \texttt{\bottomrule} at the end of the notes with a good vertical space.

\begin{verbatim}
\int_compare:nNnT \c@tabularnote > 0
\begin{verbatim}
\bool_if:NTF \l_@@_notes_para_bool
\begin { tabularnotes* }
\seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 } \strut
\end { tabularnotes* }
\end{verbatim}
\end{verbatim}

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The following `\par` is mandatory for the event that the user has put `\footnotesize` (for example) in the `notes/code-before`.

```
\par
\tabularnotes
\seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 } \strut
\endtabularnotes
```

The two dimensions `\aboverulesep` et `\heavyrulewidth` are parameters defined by `booktabs`.

```
\CT@arc@ is the specification of color defined by `colortbl` but you use it even if `colortbl` is not loaded.
```

The case of `baseline` equal to `b`. Remember that, when the key `b` is used, the `{array}` (of `array`) is constructed with the option `t` (and not `b`). Now, we do the translation to take into account the option `b`.

```
\cs_new_protected:Npn \@@_use_arraybox_with_notes_b:
{
\pgfpicture
\@@_qpoint:n { row - 1 }
\dim_gset_eq:NN \g_tmpa_dim \pgf@y
\@@_qpoint:n { row - \int_use:N \c@iRow - base }
\dim_gsub:Nn \g_tmpa_dim \pgf@y
\endpgfpicture
\dim_gadd:Nn \g_tmpa_dim \arrayrulewidth
\int_compare:nNnT \l_@@_first_row_int = 0
{
\dim_gadd:Nn \g_tmpa_dim \g_@@_ht_row_zero_dim
\dim_gadd:Nn \g_tmpa_dim \g_@@_dp_row_zero_dim
}
\box_move_up:nn \g_tmpa_dim { \hbox { \@@_use_arraybox_with_notes_c: } }
}\box_move_up:nn \g_tmpa_dim { \texttt{ gala \\
```

Now, the general case.

```
\cs_new_protected:Npn \@@_use_arraybox_with_notes:
{
We convert a value of `t` to a value of `1`.
```

```
\tl_if_eq:NnT \l_@@_baseline_tl { t }
\tl_set:Nn \l_@@_baseline_tl { 1 }
\pgfpicture
\@@_qpoint:n { row - 1 }
\dim_gset_eq:NN \g_tmpa_dim \pgf@y
\str_if_in:NnTF \l_@@_baseline_tl { line- }
```

Now, we convert the value of `\l_@@_baseline_tl` (which should represent an integer) to an integer stored in `\l_tmpa_int`.

```
\pgfpicture
\@@_qpoint:n { row - 1 }
\dim_gset_eq:NN \g_tmpa_dim \pgf@y
\str_if_in:NnTF \l_@@_baseline_tl { line- }
```
The command \@@_put_box_in_flow_bis: is used when the option delimiters/max-width is used because, in this case, we have to adjust the widths of the delimiters. The arguments #1 and #2 are the delimiters specified by the user.

\cs_new_protected:Npn \@@_put_box_in_flow_bis:nn #1 #2
{


}
Here, you should use \box_ht_plus_dp:N when TeXLive 2021 will be available on Overleaf.

\{ \box_ht:N \l_tmpa_box + \box_dp:N \l_tmpa_box \}
\{ \}
\right #2
\c_math_toggle_token
\dim_set:Nn \l_@@_real_right_delim_dim
\{ \box_wd:N \l_tmpb_box - \nulldelimiterspace \}

Now, we can put the box in the TeX flow with the horizontal adjustments on both sides.

\skip_horizontal:N \l_@@_left_delim_dim
\skip_horizontal:N -\l_@@_real_left_delim_dim
@@_put_box_in_flow:
\skip_horizontal:N \l_@@_right_delim_dim
\skip_horizontal:N -\l_@@_real_right_delim_dim
\}

The construction of the array in the environment \{NiceArrayWithDelims\} is, in fact, done by the environment \@@-light-syntax\ or by the environment \@@-normal-syntax\ (whether the option light-syntax is in force or not). When the key light-syntax is not used, the construction is a standard environment (and, thus, it’s possible to use verbatim in the array).

\NewDocumentEnvironment { \@@-normal-syntax } { }
First, we test whether the environment is empty. If it is empty, we raise a fatal error (it’s only a security). In order to detect whether it is empty, we test whether the next token is \end and, if it’s the case, we test if this is the end of the environment (if it is not, an standard error will be raised by LaTeX for incorrect nested environments).

\peek_meaning_ignore_spaces:NTF \end \@@_analyze_end:Nn
Here is the call to \array (we have a dedicated macro \@@_array: because of compatibility with the classes revtex4-1 and revtex4-2).

\{ \exp_args:NV \@@_array: \g_@@_preamble_tl \}
\}
\{
\@@_create_col_nodes:
endarray
\}

When the key light-syntax is in force, we use an environment which takes its whole body as an argument (with the specifier b of xparse).

\NewDocumentEnvironment { \@@-light-syntax } { b }
First, we test whether the environment is empty. It’s only a security. Of course, this test is more easy than the similar test for the “normal syntax” because we have the whole body of the environment in \#1.

\tl_if_empty:nT { \#1 } \{ \@@_fatal:n { empty-environment } \}
\tl_map_inline:nn { \#1 }
\str_if_eq:nnT { ##1 } { & } \{ \@@_fatal:n { ampersand-in-light-syntax } \}
\str_if_eq:nnT { ##1 } { \\ } \{ \@@_fatal:n { double-backslash-in-light-syntax } \}
\}

Now, you extract the \CodeAfter of the body of the environment. Maybe, there is no command \CodeAfter in the body. That’s why you put a marker \CodeAfter after \#1. If there is yet a \CodeAfter in \#1, this second (or third...) \CodeAfter will be catched in the value of \g_nicematrix_code_after_tl. That doesn’t matter because \CodeAfter will be set to no-op before the execution of \g_nicematrix_code_after_tl.

\@@_light_syntax_i \#1 \CodeAfter \q_stop

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Now, the second part of the environment. It is empty. That’s not surprising because we have caught the whole body of the environment with the specifier \texttt{b} provided by \texttt{xparse}.

\begin{Verbatim}
\cs_new_protected:Npn \@@_light_syntax_i #1\CodeAfter \#2\q_stop
\{  \tl_gput_right:Nn \g_nicematrix_code_after_tl \ { #2 \}
\end{Verbatim}

The body of the array, which is stored in the argument \texttt{#1}, is now splitted into items (and \textit{not} tokens).

\begin{Verbatim}
\seq_gclear_new:N \g_@@_rows_seq  
\tl_set_rescan:Nno \l_@@_end_of_row_tl \{ \l_@@_end_of_row_tl \exp_args:NNV \seq_gset_split:Nnn \g_@@_rows_seq \l_@@_end_of_row_tl \{ \#1 \}
\end{Verbatim}

If the environment uses the option \texttt{last-row} without value (i.e. without saying the number of the rows), we have now the opportunity to know that value. We do it, and so, if the token list \texttt{\_@@_code_for_last_row_tl} is not empty, we will use directly where it should be.

\begin{Verbatim}
\int_compare:nNnT \l_@@_last_row_int = \{ -1 \}
\{ \int_set:Nn \l_@@_last_row_int \{ \seq_count:N \g_@@_rows_seq \} \}
\end{Verbatim}

Here is the call to \texttt{\array} (we have a dedicated macro \texttt{\_@@_array}: because of compatibility with the classes \texttt{revtex4-1} and \texttt{revtex4-2}).

\begin{Verbatim}
\exp_args:NV \_@@_array: \g_@@_preamble_tl
\end{Verbatim}

We need a global affectation because, when executing \texttt{\_l_tmpa_tl}, we will exit the first cell of the array.

\begin{Verbatim}
\seq_gpop_left:NN \g_@@_rows_seq \l_tmpa_tl
\exp_args:NV \_@@_line_with_light_syntax_i:n \l_tmpa_tl
\seq_map_inline:Nn \g_@@_rows_seq \_@@_line_with_light_syntax:n
\_@@_create_col_nodes:
\end{array}
\end{Verbatim}

The following command is used by the code which detects whether the environment is empty (we raise a fatal error in this case: it’s only a security).

\begin{Verbatim}
\cs_new_protected:Npn \_@@_analyze_end:Nn #1 #2
\{ \str_if_eq:VnT \g_@@_name_env_str \{ #2 \} \{ \tl_gif_empty:nF \{ #1 \} \{ \_@@_line_with_light_syntax_i:n \{ #1 \} \} \}
\end{Verbatim}

We reput in the stream the \texttt{\end{...}} we have extracted and the user will have an error for incorrect nested environments.

\begin{Verbatim}
\end \{ #2 \}
\end{Verbatim}

The command \texttt{\_@@_create_col_nodes:} will construct a special last row. That last row is a false row used to create the \texttt{col} nodes and to fix the width of the columns (when the array is constructed with an option which specifies the width of the columns).

\begin{Verbatim}
\_\texttt{crrc}  
\int_compare:nNnT \l_@@_first_col_int = 0
\{ \_\texttt{omit}  
\end{Verbatim}
The following instruction must be put after the instruction `\omit`.

\bool_gset_true:N \g_@@_row_of_col_done_bool

First, we put a `col` node on the left of the first column (of course, we have to do that after the `\omit`).

\int_compare:nNnTF \l_@@_first_col_int = 0
{
  \bool_if:NT \l_@@_code_before_bool
  {
    \hbox
    {
      \skip_horizontal:N -0.5\arrayrulewidth
      \pgfsys@markposition { \@@_env: - col - 1 }
      \skip_horizontal:N 0.5\arrayrulewidth
    }
  }
  \pgfpicture
  \pgfrememberpicturepositiononpagetrue
  \pgfcoordinate { \@@_env: - col - 1 } \c_zero_dim
  \str_if_empty:NF \l_@@_name_str
  { \pgfnodealias { \l_@@_name_str - col - 1 } { \@@_env: - col - 1 } }
  \endpgfpicture
}
\omit

We compute in `\g_tmpa_skip` the common width of the columns (it’s a skip and not a dimension). We use a global variable because we are in a cell of an `\halign` and because we have to use this variable in other cells (of the same row). The affectation of `\g_tmpa_skip`, like all the affectations, must be done after the `\omit` of the cell.
We give a default value for $\gtmpa$_skip (0 pt plus 1 fill) but it will just after be erased by a fixed value in the concerned cases.

\skip_gset:Nn \gtmpa$_skip \{ 0 \, pt \plus 1 \, fill \}
\bool_if:NF \l_@@_auto_columns_width_bool
{ \dim_compare:nNnT \l_@@_columns_width_dim > \c_zero_dim }
{ \bool_lazy_and:nnTF \l_@@_auto_columns_width_bool
{ \bool_not_p:n \l_@@_block_auto_columns_width_bool }
{ \skip_gset_eq:NN \gtmpa$_skip \g@@$_max_cell_width_dim }
{ \skip_gset_eq:NN \gtmpa$_skip \l_@@_columns_width_dim }
\skip_gadd:Nn \gtmpa$_skip \{ 2 \, \col@sep \}
}
\skip_horizontal:N \gtmpa$_skip
\hbox
{ \bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition \{ \col@env: - \col - 2 \}
\skip_horizontal:N 0.5\arrayrulewidth
} }
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate \{ \col@env: - \@@_succ:n \gtmpa$_int \}
\pgfpoint \{ - 0.5 \arrayrulewidth \} \c_zero_dim
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias \{ \l_@@_name_str - \col - \@@_succ:n \gtmpa$_int \}
\pgfpicture
}

We begin a loop over the columns. The integer $\gtmpa$_int will be the number of the current column. This integer is used for the Tikz nodes.

\int_gset:Nn \gtmpa$_int 1
\bool_if:NTF \g@@$_last_col_found_bool
{ \prg_replicate:nn \{ \int_max:nn \{ \g@@$_col_total_int - 3 \} 0 \}
\prg_replicate:nn \{ \int_max:nn \{ \g@@$_col_total_int - 2 \} 0 \}
{ \omit \int_gincr:N \gtmpa$_int }

The incrementation of the counter $\gtmpa$_int must be done after the $\omit$ of the cell.

\skip_horizontal:N \gtmpa$_skip
\bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition \{ \col@env: - \col - \@@_succ:n \gtmpa$_int \}
\skip_horizontal:N 0.5\arrayrulewidth
}

We create the $\col$ node on the right of the current column.

\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate \{ \col@env: - \col - \@@_succ:n \gtmpa$_int \}
{ \pgfpoint \{ - 0.5 \arrayrulewidth \} \c_zero_dim
\str_if_empty:NF \l_@@_name_str
{ \omit

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With an environment \{Matrix\}, you want to remove the exterior \texttt{\textbackslash arraycolsep} but we don’t know the number of columns (since there is no preamble) and that’s why we can’t put \texttt{\@{}} at the end of the preamble. That’s why we remove a \texttt{\textbackslash arraycolsep} now.
Here is the preamble for the “first column” (if the user uses the key `first-col`):

```latex
\tl_const:Nn \c_@@_preamble_first_col_tl
\{ \}

At the beginning of the cell, we link `\CodeAfter` to a command which do not begin with `\omit` (whereas the standard version of `\CodeAfter` begins with `\omit`).

```latex
\cs_set_eq:NN \CodeAfter \@@_CodeAfter_i:n
\bool_gset_true:N \g_@@_after_col_zero_bool
```

The contents of the cell is constructed in the box \l_@@_cell_box because we have to compute some dimensions of this box.

```latex
\hbox_set:Nw \l_@@_cell_box
\@@_math_toggle_token:
\bool_if:NT \l_@@_small_bool \scriptstyle
```

We insert \l_@@_code_for_first_col_tl... but we don’t insert it in the potential “first row” and in the potential “last row”:

```latex
\bool_lazy_and:nnT
\{ \int_compare_p:nNn \c@iRow > 0 \}
\{ \bool_lazy_or_p:nn
\{ \int_compare_p:nNn \l_@@_last_row_int < 0 \}
\{ \int_compare_p:nNn \c@iRow < \l_@@_last_row_int \}
\}
```

Be careful: despite this letter l the cells of the “first column” are composed in a \hbox_overlap_left:n.  

1 <

```latex
\bool_lazy_or_p:nn
\{ \bool_math_toggle_token:
\hbox_set_end:
\bool_if:NT \g_@@_rotate_bool \@@_rotate_cell_box:
\@@_adjust_size_box:
\@@_update_for_first_and_last_row:
```
We actualise the width of the “first column” because we will use this width after the construction of the array.

\dim_gset:Nn \g_@@_width_first_col_dim
{ \dim_max:nn \dim_g_@@_width_first_col_dim \l_@@_cell_box }

The content of the cell is inserted in an overlapping position.

\hbox_overlap_left:n
\dim_compare:nNnTF \box_wd:N \l_@@_cell_box \c_zero_dim
\@@_node_for_cell:
\box_use_drop:N \l_@@_cell_box
\skip_horizontal:N \l_@@_left_delim_dim
\skip_horizontal:N \l_@@_left_margin_dim
\skip_horizontal:N \l_@@_extra_left_margin_dim
\bool_gset_false:N \g_@@_empty_cell_bool
\skip_horizontal:N -2\col@sep
}

Here is the preamble for the “last column” (if the user uses the key \texttt{last-col}).
\tl_const:Nn \c_@@_preamble_last_col_tl
{ > }

At the beginning of the cell, we link \texttt{CodeAfter} to a command which do not begin with \texttt{omit} (whereas the standard version of \texttt{CodeAfter} begins with \texttt{omit}).
\cs_set_eq:NN \CodeAfter \@@_CodeAfter_i:n

With the flag \texttt{\g_@@_last_col_found_bool}, we will know that the “last column” is really used.
\bool_gset_true:N \g_@@_last_col_found_bool
\int_gincr:N \c@jCol
\int_gset_eq:NN \g_@@_col_total_int \c@jCol

The contents of the cell is constructed in the box \texttt{\l_tmpa_box} because we have to compute some dimensions of this box.
\hbox_set:Nw \l_@@_cell_box
\@@_math_toggle_token:
\bool_if:NT \l_@@_small_bool \scriptstyle

We insert \texttt{\l_@@_code_for_last_col_tl}... but we don’t insert it in the potential “first row” and in the potential “last row”:
\int_compare:nNT \c@iRow > 0
{ \bool_lazy_or:nnT
  \int_compare_p:nNn \l_@@_last_row_int < 0 
  \int_compare_p:nNn \c@iRow < \l_@@_last_row_int 
  { \l_@@_code_for_last_col_tl
    \xglobal \colorlet { nicematrix-last-col } { . } 
  }
}

\begin{codeexample}
\begin{Verbatim}
\end{Verbatim}
\end{codeexample}
We actualise the width of the “last column” because we will use this width after the construction of the array.

\dim_gset:Nn \g_@@_width_last_col_dim
\{ \dim_max:nn \g_@@_width_last_col_dim \{ \box_wd:N \l_@@_cell_box \} \}
\skip_horizontal:N -2\col@sep

The content of the cell is inserted in an overlapping position.
\hbox_overlap_right:n
\{ \dim_compare:nNnT \{ \box_wd:N \l_@@_cell_box \} > \c_zero_dim
\{ \skip_horizontal:N \l_@@_right_delim_dim \skip_horizontal:N \l_@@_right_margin_dim \skip_horizontal:N \l_@@_extra_right_margin_dim \@@_node_for_cell: \}
\} \bool_gset_false:N \g_@@_empty_cell_bool
\}

The environment \{NiceArray\} is constructed upon the environment \{NiceArrayWithDelims\} but, in fact, there is a flag \l_@@_NiceArray_bool. In \{NiceArrayWithDelims\}, some special code will be executed if this flag is raised.
\NewDocumentEnvironment { NiceArray } { }
\{ \bool_set_true:N \l_@@_NiceArray_bool \str_if_empty:NT \g_@@_name_env_str
\{ \str_gset:Nn \g_@@_name_env_str { NiceArray } \} \@@_test_if_math_mode: \NiceArrayWithDelims . . \}
\endNiceArrayWithDelims

We put . and . for the delimiters but, in fact, that doesn’t matter because these arguments won’t be used in \{NiceArrayWithDelims\} (because the flag \l_@@_NiceArray_bool is raised).
\NiceArrayWithDelims . .
\endNiceArrayWithDelims

We create the variants of the environment \{NiceArrayWithDelims\}.
\cs_new_protected:Npn \@@_def_env:nnn #1 #2 #3
\{ \NewDocumentEnvironment { #1 NiceArray } { }
\{ \str_if_empty:NT \g_@@_name_env_str
\{ \str_gset:Nn \g_@@_name_env_str { #1 NiceArray } \} \@@_test_if_math_mode: \NiceArrayWithDelims #2 #3 \}
\endNiceArrayWithDelims \}
\endNiceArrayWithDelims

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The environment \texttt{\textbackslash NiceMatrix} and its variants
\begin{verbatim}
cs_new_protected:Npn \@@_begin_of_NiceMatrix:nn #1 #2
{
bool_set_true:N \l_@@_Matrix_bool
\use:c { #1 NiceArray }
{
*
\int_compare:nNnTF \l_@@_last_col_int < 0
\c@MaxMatrixCols
{ \@@_pred:n \l_@@_last_col_int }
}
{ > \@@_Cell: #2 < \@@_end_Cell: }
}
clist_map_inline:nn { { } , p , b , B , v , V }
{
\NewDocumentEnvironment { #1 NiceMatrix } { ! O { } }
{
\str_gset:Nn \g_@@_name_env_str { #1 NiceMatrix }
\tl_set:Nn \l_@@_type_of_col_tl c
\keys_set:nn { NiceMatrix / NiceMatrix } { ##1 }
\exp_args:Nne \@@_begin_of_NiceMatrix:nn { #1 } \l_@@_type_of_col_tl
}
\use:c { end #1 NiceArray }
}
\end{verbatim}

The following command will be linked to \texttt{\textbackslash NotEmpty} in the environments of \texttt{nicematrix}.
\begin{verbatim}
cs_new_protected:Npn \@@_NotEmpty:
{ \bool_gset_true:N \g_@@_not_empty_cell_bool }
\end{verbatim}

The environments \texttt{\textbackslash NiceTabular} and \texttt{\textbackslash NiceTabular*}
\begin{verbatim}
\NewDocumentEnvironment { NiceTabular } { O { } m ! O { } }
{
\str_gset:Nn \g_@@_name_env_str { NiceTabular }
\keys_set:nn { NiceMatrix / NiceTabular } { #1 , #3 }
\bool_set_true:N \l_@@_NiceTabular_bool
\NiceArray { #2 }
}
\endNiceArray
\NewDocumentEnvironment { NiceTabular* } { m O { } m ! O { } }
{
\str_gset:Nn \g_@@_name_env_str { NiceTabular* }
\dim_set:Nn \l_@@_tabular_width_dim { #1 }
\keys_set:nn { NiceMatrix / NiceTabular } { #2 , #4 }
\bool_set_true:N \l_@@_NiceTabular_bool
\NiceArray { #3 }
}
\endNiceArray
\end{verbatim}

After the construction of the array
\begin{verbatim}
cs_new_protected:Npn \@@_after_array:
{ }
group_begin:
\end{verbatim}

When the option \texttt{last-col} is used in the environments with explicit preambles (like \texttt{\textbackslash NiceArray}, \texttt{pNiceArray}, etc.) a special type of column is used at the end of the preamble in order to compose
the cells in an overlapping position (with \texttt{\hbox\_overlap\_right:n}) but (if \texttt{last-col} has been used), we don’t have the number of that last column. However, we have to know that number for the color of the potential \texttt{\Vdots} drawn in that last column. That’s why we fix the correct value of \texttt{\l@@\_last\_col\_int} in that case.

\begin{verbatim}
\bool_if:NT \g@@\_last\_col\_found\_bool
{ \int_set_eq:NN \l@@\_last\_col\_int \g@@\_col\_total\_int }
\end{verbatim}

If we are in an environment without preamble (like \texttt{\NiceMatrix} or \texttt{pNiceMatrix}) and if the option \texttt{last-col} has been used without value we also fix the real value of \texttt{\l@@\_last\_col\_int}.

\begin{verbatim}
\bool_if:NT \l@@\_last\_col\_without\_value\_bool
{ \int_set_eq:NN \l@@\_last\_col\_int \g@@\_col\_total\_int }
\end{verbatim}

It’s also time to give to \texttt{\l@@\_last\_row\_int} its real value.

\begin{verbatim}
\bool_if:NT \l@@\_last\_row\_without\_value\_bool
{ \int_set_eq:NN \l@@\_last\_row\_int \g@@\_row\_total\_int }
\end{verbatim}

\texttt{\tl_gput\_right:Nx \g@@\_aux\_tl}
\begin{verbatim}
\seq_gset_from_clist:Nn \exp_not:N \c@@\_size\_seq
{ \int_use:N \l@@\_first\_row\_int , \int_use:N \c\_i\_Row , \int_use:N \g@@\_row\_total\_int , \int_use:N \l@@\_first\_col\_int , \int_use:N \c\_j\_Col , \int_use:N \g@@\_col\_total\_int }
\end{verbatim}

We write also the potential content of \texttt{\g@@\_pos\_of\_blocks\_seq} (it will be useful if the command \texttt{\rowcolors} is used with the key \texttt{\respect\_blocks}).

\begin{verbatim}
\seq_if_empty:NT \g@@\_pos\_of\_blocks\_seq
{ \tl_gput\_right:Nx \g@@\_aux\_tl
\seq_gset\_from\_clist:NN \exp_not:N \g@@\_pos\_of\_blocks\_seq
{ \seq_use:Nnnn \g@@\_pos\_of\_blocks\_seq , , , }
}
\end{verbatim}

\begin{verbatim}
\seq_if_empty:NT \g@@\_multicolumn\_cells\_seq
{ \tl_gput\_right:Nx \g@@\_aux\_tl
\seq_gset\_from\_clist:NN \exp_not:N \g@@\_multicolumn\_cells\_seq
{ \seq_use:Nnnn \g@@\_multicolumn\_cells\_seq , , , }
\seq_gset\_from\_clist:NN \exp_not:N \g@@\_multicolumn\_sizes\_seq
{ \seq_use:Nnnn \g@@\_multicolumn\_sizes\_seq , , , }
}
\end{verbatim}

Now, you create the diagonal nodes by using the \texttt{\row} nodes and the \texttt{\col} nodes.

\texttt{\@@\_create\_diag\_nodes:}

By default, the diagonal lines will be parallelized\textsuperscript{61}. There are two types of diagonals lines: the \texttt{\Ddots} diagonals and the \texttt{\Iddots} diagonals. We have to count both types in order to know whether a diagonal is the first of its type in the current \texttt{\NiceArray} environment.

\begin{verbatim}
\bool_if:NT \l@@\_parallelize\_diags\_bool
{ \int_gzero_new:N \g@@\_ddots\_int \int_gzero_new:N \g@@\_iddots\_int
The dimensions \texttt{\g@@\_delta\_x\_one\_dim} and \texttt{\g@@\_delta\_y\_one\_dim} will contain the $\Delta_x$ and $\Delta_y$ of the first \texttt{\Ddots} diagonal. We have to store these values in order to draw the others \texttt{\Ddots}

\textsuperscript{61}It’s possible to use the option \texttt{\parallelize\_diags} to disable this parallelization.
diagonals parallel to the first one. Similarly $\delta_x$ and $\delta_y$ are the $\Delta x$ and $\Delta y$ of the first \Iddots diagonal.

\begin{verbatim}
\dim_gzero_new:N \g_@@_delta_x_one_dim
\dim_gzero_new:N \g_@@_delta_y_one_dim
\dim_gzero_new:N \g_@@_delta_x_two_dim
\dim_gzero_new:N \g_@@_delta_y_two_dim
\end{verbatim}

If the option \texttt{small} is used, the values $\l_@@_radius$ and $\l_@@_inter_dots$ (used to draw the dotted lines created by \hdottedline and \vdotteline and also for all the other dotted lines when line-style is equal to standard, which is the initial value) are changed.

\begin{verbatim}
\bool_if:NT \l_@@_small_bool {
\dim_set:Nn \l_@@_radius { 0.37 pt }
\dim_set:Nn \l_@@_inter_dots { 0.25 em }
\dim_set:Nn \l_@@_xdots_shorten { 0.6 \l_@@_xdots_shorten }
}
\end{verbatim}

Now, we actually draw the dotted lines (specified by \Cdots, \Vdots, etc.).

The following computes the “corners” (made up of empty cells) but if there is no corner to compute, it won’t do anything. The corners are computed in $\l_@@_corners_cells$ which will contain all the cells which are empty (and not in a block) considered in the corners of the array.

\begin{verbatim}
\@@_compute_corners:
\end{verbatim}

The sequence $\g_@@_pos_of_blocks$ must be “adjusted” (for the case where the user have written something like \Block{1-5}).

\begin{verbatim}
\@@_adjust_pos_of_blocks:
\end{verbatim}

The following code is only for efficiency. We determine whether the potential horizontal and vertical rules are “complete”, that is to say drawn in the whole array. We are sure that all the rules will be complete when there is no block, no virtual block (determined by a command such as \Cdots, \Vdots, etc.) and no corners. In that case, we switch to a shortcut version of \@@_vline_i:nn and \@@_hline:nn.

\begin{verbatim}
\bool_lazy_all:nT {
\seq_if_empty_p:N \g_@@_pos_of_blocks_seq
\seq_if_empty_p:N \l_@@_corners_cells_seq
\seq_if_empty_p:N \g_@@_xdots_shorten_seq
\end{verbatim}

Now, the internal code-after and then, the \CodeAfter.
\tikzset
{
  every-picture / .style =
  {
    \overlay ,
    \remember-picture ,
    name-prefix = \@@_env: -
  }
}
\cs_set_eq:NN \line \@@_line
\g_@@_internal_code_after_tl
\tl_gclear:N \g_@@_internal_code_after_tl

When light-syntax is used, we insert systematically a CodeAfter in the flow. Thus, it’s possible to have two instructions \CodeAfter and the second may be in \nicematrix_code_after_tl. That’s why we set Code-after to be no-op now.
\cs_set_eq:NN \CodeAfter \prg_do_nothing:
\seq_gclear:N \g_@@_submatrix_names_seq

We clear the list of the names of the potential \SubMatrix that will appear in the CodeAfter (unfortunately, that list has to be global).
\tl_gclear:N \g_nicematrix_code_after_tl

We compose the code-after in math mode in order to nullify the spaces put by the user between instructions in the code-after.
\% \bool_if:NT \l_@@_NiceTabular_bool \c_math_toggle_token

And here’s the \CodeAfter. Since the \CodeAfter may begin with an “argument” between square brackets of the options, we extract and treat that potential “argument” with the command \nicematrix_CodeAfter_keys:
\exp_last_unbraced:NV \@@_CodeAfter_keys: \g_nicematrix_code_after_tl
\scan_stop:
\% \bool_if:NT \l_@@_NiceTabular_bool \c_math_toggle_token
\tl_gclear:N \g_nicematrix_code_after_tl
\group_end:
\g_nicematrix_code_before_tl is for instructions in the cells of the array such as \rowcolor and \cellcolor (when the key colortbl-like is in force). These instructions will be written on the aux file to be added to the code-before in the next run.
\tl_if_empty:NF \g_nicematrix_code_before_tl
{ 

The command \rowcolor in tabular will in fact use \rectanglecolor in order to follow the behaviour of \rowcolor of colortbl. That’s why there may be a command \rectanglecolor in \nicematrix_code_before_tl. In order to avoid an error during the expansion, we define a protected version of \rectanglecolor.
\cs_set_protected:Npn \rectanglecolor { }
\cs_set_protected:Npn \columncolor { }
\tl_gput_right:Nx \g_@@_aux_tl
{ \tl_gset:Nn \exp_not:N \g_@@_code_before_tl 
{ \exp_not:V \g_nicematrix_code_before_tl } }
\bool_set_true:N \l_@@_code_before_bool
}
\% \bool_if:NT \l_@@_code_before_bool \@@_write_aux_for_cell_nodes:
\str_gclear:N \g_@@_name_env_str
\@0_restore_iRow_jCol:

The command \CT@arc@ contains the instruction of color for the rules of the array.62 This command is used by \CT@arc@ but we use it also for compatibility with colortbl. But we want also to be able

\footnotesize
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62 \eg \color[rgb]{0.5,0.5,0}

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to use color for the rules of the array when \texttt{colortbl} is \textit{not} loaded. That’s why we do the following instruction which is in the patch of the end of arrays done by \texttt{colortbl}.

\begin{verbatim}
\cs_gset_eq:NN \CT@arc@ \@@_old_CT@arc@
\end{verbatim}

The following command will extract the potential options (between square brackets) at the beginning of the \texttt{CodeAfter} (that is to say, when \texttt{CodeAfter} is used, the options of that “command” \texttt{CodeAfter}). Idem for the \texttt{CodeBefore}.

\begin{verbatim}
\NewDocumentCommand \@@_CodeAfter_keys: { O { } } {
    \keys_set:nn { NiceMatrix / CodeAfter } { #1 }
}\end{verbatim}

We remind that the first mandatory argument of the command \texttt{\textbackslash Block} is the size of the block with the special format \texttt{i-j}. However, the user is allowed to omit \texttt{i} or \texttt{j} (or both). This will be interpreted as: the last row (resp. column) of the block will be the last row (resp. column) of the block (without the potential exterior row—resp. column—of the array). By convention, this is stored in \texttt{\g@__pos_of_blocks_seq} (and \texttt{\g@__blocks_seq}) as a number of rows (resp. columns) for the block equal to 100. It’s possible, after the construction of the array, to replace these values by the correct ones (since we know the number of rows and columns of the array).

\begin{verbatim}
\cs_new_protected:Npn \@@_adjust_pos_of_blocks_seq: {
    \seq_gset_map_x:NNn \g@__pos_of_blocks_seq \g@__pos_of_blocks_seq {
        \@@_adjust_pos_of_blocks_seq_i:nnnn ##1 }
}\end{verbatim}

The following command must \textit{not} be protected.

\begin{verbatim}
\cs_new:Npn \@@_adjust_pos_of_blocks_seq_i:nnnn #1 #2 #3 #4 {
    { #1 }
    { #2 }
    { #3 }
    \int_compare:nNnTF { #3 } > { 99 } {
        \int_use:N \c@iRow 
        { #3 }
    }
    \int_compare:nNnTF { #4 } > { 99 } {
        \int_use:N \c@jCol 
        { #4 }
    }
}\end{verbatim}

We recall that, when externalization is used, \texttt{\tikzpicture} and \texttt{\endtikzpicture} (or \texttt{pgfpicture} and \texttt{\endpgfpicture}) must be directly “visible”. That’s why we have to define the adequate version of \texttt{@@_draw_dotted_lines}: whether Tikz is loaded or not (in that case, only PGF is loaded).

\begin{verbatim}
\AtBeginDocument
\begin{verbatim}
\cs_new_protected:Npx \@@_draw_dotted_lines: {
    \c@_pgfortikzpicture_tl \@@_draw_dotted_lines_i:
    \c@_endpgfortikzpicture_tl
}\end{verbatim}
\end{verbatim}

The following command \textit{must} be protected because it will appear in the construction of the command \texttt{@@_draw_dotted_lines:}.

\begin{verbatim}
\cs_new_protected:Npn \@@_draw_dotted_lines_i: {
    \pgfrememberpicturepositiononpagetrue
    \pgf@relevantforpicturesizefalse
    \g@__HVdotsfor_lines_tl \g@__Vdots_lines_tl \g@__Ddots_lines_tl
}\end{verbatim}
We define a new \texttt{pgf} shape for the diag nodes because we want to provide a anchor called .5 for those nodes.

\begin{verbatim}
\pgfdeclareshape { @@_diag_node }
{ 
  \savedanchor { \five }
  { 
    \dim_gset_eq:NN \pgf@x \l_tmpa_dim
    \dim_gset_eq:NN \pgf@y \l_tmpb_dim
  }
  \anchor { 5 } { \five }
  \anchor { center } { \pgfpointorigin }
}
\end{verbatim}

\begin{verbatim}
\cs_new_protected:Npn \@@_write_aux_for_cell_nodes:
{ 
  \pgfpicture
  \pgfrememberpicturepositiononpagetrue
  \pgf@relevantforpicturesizefalse
  \int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
  { 
    \int_step_inline:nnn \l_@@_first_col_int \g_@@_col_total_int
    { 
      \cs_if_exist:cT { pgf @ sh @ ns @ \@@_env: - ##1 - ####1 }
      { 
        \pgfscope
        \pgftransformshift
        { \pgfpointanchor { \@@_env: - ##1 - ####1 } { north~west } }
        \pgfnode
        { rectangle }
        { center }
        { 
          \hbox
          { \pgfsys@markposition { \@@_env: - ##1 - ####1 - NW } }
        }
        \endpgfscope
      }
    }
  }{ 
  \endpgfscope
}{ 
}\end{verbatim}
\begin{macrocode}
\end{macrocode}
\bigskip
The following command creates the diagonal nodes (in fact, if the matrix is not a square matrix, not all the nodes are on the diagonal).
\begin{macrocode}
\cs_new_protected:Npn \@@_create_diag_nodes:
{ \pgfpicture
\pgfrememberpicturepositiononpagetrue
\int_step_inline:nn { \int_max:nn \c@iRow \c@jCol }
{ \@@_qpoint:n { col - \int_min:nn { ##1 } { \c@jCol + 1 } } \dim_set_eq:NN \l_tmpa_dim \pgf@x
\@@_qpoint:n { row - \int_min:nn { ##1 } { \c@iRow + 1 } } \dim_set_eq:NN \l_tmpb_dim \pgf@y
\@@_qpoint:n { col - \int_min:nn { ##1 + 1 } { \c@jCol + 1 } } \dim_set_eq:NN \l_tmpc_dim \pgf@x
\@@_qpoint:n { row - \int_min:nn { ##1 + 1 } { \c@iRow + 1 } } \dim_set_eq:NN \l_tmpd_dim \pgf@y
\pgftransformshift { \pgfpoint \l_tmpa_dim \l_tmpb_dim }
\pgfnode { \@@_diag_node } { center } { } { \@@_env: - ##1 } { }
\str_if_empty:NF \l_@@_name_str { \pgfnodealias { \l_@@_name_str - ##1 } { \@@_env: - ##1 } }
}
\endpgfpicture}

Now, \l_l_tmpa_dim and \l_l_tmpb_dim become the width and the height of the node (of shape \@@_diag_node) that we will construct.
\begin{macrocode}
\dim_set:Nn \l_l_tmpa_dim { ( \l_l_tmpc_dim - \l_l_tmpa_dim ) / 2 }
\dim_set:Nn \l_l_tmpb_dim { ( \l_l_tmpd_dim - \l_l_tmpb_dim ) / 2 }
\pgfnode { \@@_diag_node } { center } { } { \@@_env: - #1 } { }
\str_if_empty:NF \l_@@_name_str { \pgfnodealias { \l_@@_name_str - \int_use:N \l_tmpa_int } { \@@_env: - \int_use:N \l_tmpa_int } \pgfnodealias { \l_@@_name_str - last } { \@@_env: - last } }
\endpgfpicture}

Now, the last node. Of course, that is only a coordinate because there is not \textit{.5} anchor for that node.
\begin{macrocode}
\int_set:Nn \l_l_tmpa_int { \int_max:nn \c@iRow \c@jCol + 1 }
\@@_qpoint:n { row - \int_min:nn { \l_l_tmpa_int } { \c@iRow + 1 } } \dim_set_eq:NN \l_l_tmpc_dim \pgf@y
\@@_qpoint:n { col - \int_min:nn { \l_l_tmpa_int } { \c@jCol + 1 } } \dim_set_eq:NN \l_l_tmpd_dim \pgf@y
\pgfcoordinate { \@@_env: - \int_use:N \l_l_tmpa_int } { \pgfpoint \pgf@x \l_l_tmpa_dim }
\pgfnodealias { \@@_env: - last } { \@@_env: - \int_use:N \l_l_tmpa_int }
\str_if_empty:NF \l_@@_name_str { \pgfnodealias { \l_@@_name_str - \int_use:N \l_l_tmpa_int } { \@@_env: - \int_use:N \l_l_tmpa_int } \pgfnodealias { \l_@@_name_str - last } { \@@_env: - last } }
\endpgfpicture
\end{macrocode}

We draw the dotted lines

A dotted line will be said \textit{open} in one of its extremities when it stops on the edge of the matrix and \textit{closed} otherwise. In the following matrix, the dotted line is closed on its left extremity and open on

its right.

\[
\begin{pmatrix}
a + b + c & a + b & a \\
a & a + b & a + b + c
\end{pmatrix}
\]

The command \texttt{\textbackslash _find_extremities_of_line:nnnn} takes four arguments:

- the first argument is the row of the cell where the command was issued;
- the second argument is the column of the cell where the command was issued;
- the third argument is the \textit{x}-value of the orientation vector of the line;
- the fourth argument is the \textit{y}-value of the orientation vector of the line.

This command computes:

- \texttt{\textbackslash _initial\_i\_int} and \texttt{\textbackslash _initial\_j\_int} which are the coordinates of one extremity of the line;
- \texttt{\textbackslash _final\_i\_int} and \texttt{\textbackslash _final\_j\_int} which are the coordinates of the other extremity of the line;
- \texttt{\textbackslash _initial\_open\_bool} and \texttt{\textbackslash _final\_open\_bool} to indicate whether the extremities are open or not.

First, we declare the current cell as “dotted” because we forbid intersections of dotted lines.

Initialization of variables.

We will do two loops: one when determining the initial cell and the other when determining the final cell. The boolean \texttt{\textbackslash _stop\_loop\_bool} will be used to control these loops. In the first loop, we search the “final” extremity of the line.

We test if we are still in the matrix.
If we are outside the matrix, we have found the extremity of the dotted line and it’s an open extremity.

We do a step backwards.

If we are in the matrix, we test whether the cell is empty. If it’s not the case, we stop the loop because we have found the correct values for $l_{\text{\texttt{final}}_i \text{\texttt{int}}}$ and $l_{\text{\texttt{final}}_j \text{\texttt{int}}}$. 

If the case is empty, we declare that the cell as non-empty. Indeed, we will draw a dotted line and the cell will be on that dotted line. All the cells of a dotted line have to be marked as “dotted” because we don’t want intersections between dotted lines. We recall that the research of the extremities of the lines are all done in the same TeX group (the group of the environment), even though, when the extremities are found, each line is drawn in a TeX group that we will open for the options of the line.

For $l_{\text{\texttt{initial}}_i \text{\texttt{int}}}$ and $l_{\text{\texttt{initial}}_j \text{\texttt{int}}}$ the programmation is similar to the previous one.
\bool_do_until:Nn \l_@@_stop_loop_bool
{
  \int_sub:Nn \l_@@_initial_i_int { #3 }
  \int_sub:Nn \l_@@_initial_j_int { #4 }
  \bool_set_false:N \l_@@_initial_open_bool
  \int_compare:nNnTF \l_@@_initial_i_int < \l_@@_row_min_int
  {
    \int_compare:nNnTF { #3 } = 1
    { \bool_set_true:N \l_@@_initial_open_bool }
    { \int_compare:nNnT \l_@@_initial_j_int = \l_@@_col_min_int -1 }
    { \bool_set_true:N \l_@@_initial_open_bool }
  }
  { }
  \int_compare:nNnTF \l_@@_initial_j_int < \l_@@_col_min_int
  { }
  { \int_compare:nNnT \l_@@_initial_j_int > \l_@@_col_max_int
    { \int_compare:nNnT { #4 } = -1 }
    { \bool_set_true:N \l_@@_initial_open_bool }
  }
  { }
  \bool_if:NTF \l_@@_initial_open_bool
  { \int_add:Nn \l_@@_initial_i_int { #3 }
    \int_add:Nn \l_@@_initial_j_int { #4 }
    \bool_set_true:N \l_@@_stop_loop_bool
  }
  { \cs_if_exist:cTF
    { \l_@@_dotted_int \int_use:N \l_@@_initial_i_int - \int_use:N \l_@@_initial_j_int
      { \bool_set_true:N \l_@@_stop_loop_bool }
    { \cs_set:cpn
      { \l_@@_dotted_int \int_use:N \l_@@_initial_i_int - \int_use:N \l_@@_initial_j_int
        { }
    }
  }
\bool_if:NTF \l_@@_initial_open_bool
{ \int_add:Nn \l_@@_initial_i_int { #3 }
  \int_add:Nn \l_@@_initial_j_int { #4 }
  \bool_set_true:N \l_@@_stop_loop_bool
}
{ }
};
We remind the rectangle described by all the dotted lines in order to respect the corresponding virtual “block” when drawing the horizontal and vertical rules.

The following command \textit{(when it will be written)} will set the four counters \texttt{\l_@@_row_min_int}, \texttt{\l_@@_row_max_int}, \texttt{\l_@@_col_min_int} and \texttt{\l_@@_col_max_int} to the intersections of the submatrices which contains the cell of row \#1 and column \#2. As of now, it’s only the whole array (excepted exterior rows and columns).

We do a loop over all the submatrices specified in the code-before. We have stored the position of all those submatrices in \texttt{\g_@@_submatrix_seq}.

#1 and #2 are the numbers of row and columns of the cell where the command of dotted line (ex.: \texttt{\Vdots}) has been issued. #3, #4, #5 and #6 are the specification (in \textit{i} and \textit{j}) of the submatrix where are analysing.

We do a loop over all the submatrices specified in the code-before. We have stored the position of all those submatrices in \texttt{\g_@@_submatrix_seq}.

#1 and #2 are the numbers of row and columns of the cell where the command of dotted line (ex.: \texttt{\Vdots}) has been issued. #3, #4, #5 and #6 are the specification (in \textit{i} and \textit{j}) of the submatrix where are analysing.
\cs_new_protected:Npn \@@_set_initial_coords_from_anchor:n #1
\{ \pgfpointanchor \{
\@@_env:\ - \int_use:N \l_@@_initial_i_int
- \int_use:N \l_@@_initial_j_int
\}
\{ #1 \}
\@@_set_initial_coords: \}
\cs_new_protected:Npn \@@_set_final_coords_from_anchor:n #1
\{ \pgfpointanchor \{ \@@_env:\ - \int_use:N \l_@@_final_i_int
- \int_use:N \l_@@_final_j_int
\}
\{ #1 \}
\@@_set_final_coords: \}
\cs_new_protected:Npn \@@_open_x_initial_dim:
\{ \dim_set_eq:NN \l_@@_x_initial_dim \c_max_dim
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
\{ \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - \int_use:N \l_@@_initial_j_int \}
\{ \pgfpointanchor \{ \@@_env:\ - ##1 - \int_use:N \l_@@_initial_j_int \}
\{ west \}
\dim_set:Nn \l_@@_x_initial_dim\ \dim_min:nn \l_@@_x_initial_dim \pgf@x \}
\}
\}
\cs_new_protected:Npn \@@_open_x_final_dim:
\{ \dim_set:Nn \l_@@_x_final_dim \c_max_dim
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
\{ \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - \int_use:N \l_@@_final_j_int \}
\{ \pgfpointanchor \{ \@@_env:\ - ##1 - \int_use:N \l_@@_final_j_int \}
\{ east \}
\dim_set:Nn \l_@@_x_final_dim\ \dim_max:nn \l_@@_x_final_dim \pgf@x \}
\}
\}
\cs_new_protected:Npn \@@_open_x_final_dim:
\{ \dim_set_eq:NN \l_@@_x_final_dim \c_max_dim
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
\{ \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - \int_use:N \l_@@_final_j_int \}
\{ \pgfpointanchor \{ \@@_env:\ - ##1 - \int_use:N \l_@@_final_j_int \}
\{ east \}
\dim_set:Nn \l_@@_x_final_dim\ \dim_max:nn \l_@@_x_final_dim \pgf@x \}
\}
\}

If, in fact, all the cells of the columns are empty (no PGF/Tikz nodes in those cells).

\dim_compare:nNnT \l_@@_x_initial_dim = \c_max_dim
\{ \@@_qpoint:n \{ col - \int_use:N \l_@@_initial_j_int \}
\dim_set_eq:NN \l_@@_x_initial_dim \pgf@x \dim_add:Nn \l_@@_x_initial_dim \col@sep \}
\}
\cs_new_protected:Npn \@@_open_x_final_dim:
\{ \dim_set:Nn \l_@@_x_final_dim \c_max_dim
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
\{ \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - \int_use:N \l_@@_final_j_int \}
\{ \pgfpointanchor \{ \@@_env:\ - ##1 - \int_use:N \l_@@_final_j_int \}
\{ east \}
\dim_set:Nn \l_@@_x_final_dim\ \dim_max:nn \l_@@_x_final_dim \pgf@x \}
\}
\}

If, in fact, all the cells of the columns are empty (no PGF/Tikz nodes in those cells).
\dim_compare:nNnT \l_@@_x_final_dim = { - \c_max_dim }
{
  \@@_qpoint:n { col - \@@_succ:n \l_@@_final_j_int }
  \dim_set_eq:NN \l_@@_x_final_dim \pgf@x
  \dim_sub:Nn \l_@@_x_final_dim \col@sep
}

The first and the second arguments are the coordinates of the cell where the command has been
issued. The third argument is the list of the options.

\cs_new_protected:Npn \@@_draw_Ldots:nnn #1 #2 #3
{
  \@@_adjust_to_submatrix:nn { #1 } { #2 }
  \cs_if_free:cT { @@_dotted _ #1 - #2 }
  {
    \@@_find_extremities_of_line:nnnn { #1 } { #2 } 0 1
  }
  \int_compare:nNnTF { #1 } = 0
  { \color { nicematrix-first-row } }
  {
  \int_compare:nNnT { #1 } = \l_@@_last_row_int
  { \color { nicematrix-last-row } }
  }
  \keys_set:nn { NiceMatrix / xdots } { #3 }
  \tl_if_empty:VF \l_@@_xdots_color_tl { \color { \l_@@_xdots_color_tl } }
  \@@_actually_draw_Ldots:
}

The previous command may have changed the current environment by marking some cells as “dotted”,
but, fortunately, it is outside the group for the options of the line.

\cs_new_protected:Npn \@@_actually_draw_Ldots:
{
  \bool_if:NTF \l_@@_initial_open_bool
  { \@@_open_x_initial_dim:
    \@@_qpoint:n { row - \int_use:N \l_@@_initial_i_int - base }
    \dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
  }
  { \@@_set_initial_coords_from_anchor:n { base~east } }
  \bool_if:NTF \l_@@_final_open_bool
  { \@@_open_x_final_dim:
    \@@_qpoint:n { row - \int_use:N \l_@@_final_i_int - base }

The command \@@_actually_draw_Ldots: has the following implicit arguments:

- \l_@@_initial_i_int
- \l_@@_initial_j_int
- \l_@@_initial_open_bool
- \l_@@_final_i_int
- \l_@@_final_j_int
- \l_@@_final_open_bool.

The following function is also used by \Hdotsfor.

\cs_new_protected:Npn \@@_actually_draw_Ldots:
{
  \bool_if:NTF \l_@@_initial_open_bool
  { \@@_open_x_initial_dim:
    \@@_qpoint:n { row - \int_use:N \l_@@_initial_i_int - base }
    \dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
  }
  { \@@_set_initial_coords_from_anchor:n { base~east } }
  \bool_if:NTF \l_@@_final_open_bool
  { \@@_open_x_final_dim:
    \@@_qpoint:n { row - \int_use:N \l_@@_final_i_int - base }

130
We raise the line of a quantity equal to the radius of the dots because we want the dots really “on”
the line of texte. Of course, maybe we should not do that when the option line-style is used (?).

The first and the second arguments are the coordinates of the cell where the command has been
issued. The third argument is the list of the options.

The previous command may have changed the current environment by marking some cells as “dotted”,
but, fortunately, it is outside the group for the options of the line.

The command \@@_actually_draw_Cdots: has the following implicit arguments:

- \l_@@_initial_i_int
- \l_@@_initial_j_int
- \l_@@_initial_open_bool
- \l_@@_final_i_int
- \l_@@_final_j_int
- \l_@@_final_open_bool.
The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.

The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.

\begin{verbatim}
\cs_new_protected:Npn \@@_draw_Vdots:nnn #1 #2 #3
{ \@@_adjust_to_submatrix:nn { #1 } { #2 } \cs_if_free:cT { @@ _ dotted _ #1 - #2 } { \@@_find_extremities_of_line:nnnn { #1 } { #2 } 1 0 132
\end{verbatim}
\int_compare:nNnTF \l_@@_last_col_int \l_@@_last_col_int
\keys_set:nn { NiceMatrix / xdots } \l_@@_xdots_color_tl
\@@_actually_draw_Vdots:
\group_end:

The command \@@_actually_draw_Vdots: has the following implicit arguments:

- \l_@@_initial_i_int
- \l_@@_initial_j_int
- \l_@@_initial_open_bool
- \l_@@_final_i_int
- \l_@@_final_j_int
- \l_@@_final_open_bool.

The following function is also used by \Vdotsfor.
\cs_new_protected:Npn \@@_actually_draw_Vdots:
\bool_set_false:N \l_tmpa_bool
First the case when the line is closed on both ends.
\bool_lazy_or:nnF \l_@@_initial_open_bool \l_@@_final_open_bool
{ \@@_set_initial_coords_from_anchor:n { south~west }
\@@_set_final_coords_from_anchor:n { north~west }
\bool_set:Nn \l_tmpa_bool { \dim_compare_p:nNn \l_@@_x_initial_dim \l_@@_x_final_dim }
}

Now, we try to determine whether the column is of type c or may be considered as if.
\bool_if:NTF \l_@@_initial_open_bool
\@@_open_y_initial_dim:
\{ \@@_set_initial_coords_from_anchor:n { south } \}
\bool_if:NTF \l_@@_final_open_bool
\@@_open_y_final_dim:
\{ \@@_set_final_coords_from_anchor:n { north } \}
\bool_if:NTF \l_@@_initial_open_bool
\{ \bool_if:NTF \l_@@_final_open_bool
\{ \\dim_compare_p:nNn \l_@@_x_initial_dim \l_@@_x_final_dim \}

We may think that the final user won’t use a “last column” which contains only a command \Vdots. However, if the \Vdots is in fact used to draw, not a dotted line, but an arrow (to indicate the number of rows of the matrix), it may be really encountered.
\int_compare:nNnT \l_@@_last_col_int \l_@@_last_col_int > \{ \l_@@_last_col_int \}
\int_compare:nNnT \l_@@_initial_j_int = \g_@@_col_total_int
{
\dim_set_eq:NN \l_\@\_right_margin_dim \l_@@_right_margin_dim
\dim_add:Nn \l_\@\_right_margin_dim \l_@@_extra_right_margin_dim
\dim_add:Nn \l_@@_x_initial_dim \l_\@\_right_margin_dim
\dim_add:Nn \l_@@_x_final_dim \l_\@\_x_initial_dim
}
\bool_if:NTF \l_@@_final_open_bool
{ \dim_set_eq:NN \l_@@_x_final_dim \l_@@_x_initial_dim
}{
\@@_draw_line:
}
Now the case where both extremities are closed. The first conditional tests whether the column is of type \texttt{c} or may be considered as if.
\dim_compare:nNnF \l_@@_x_initial_dim = \l_@@_x_final_dim
{ \dim_set:Nn \l_@@_x_initial_dim
{ \bool_if:NTF \l_tmpa_bool \dim_min:nn \dim_max:nn \l_@@_x_initial_dim \l_@@_x_final_dim
\dim_set_eq:NN \l_@@_x_final_dim \l_@@_x_initial_dim
}
}
\@@_draw_line:

For the diagonal lines, the situation is a bit more complicated because, by default, we parallelize the diagonals lines. The first diagonal line is drawn and then, all the other diagonal lines are drawn parallel to the first one.
The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.
\cs_new_protected:Npn \@@_draw_Ddots:nnn #1 #2 #3
{ \@@_adjust_to_submatrix:nn { #1 } { #2 }
\cs_if_free:cT { \@@_dotted_#1-#2 }
{ \@@_find_extremities_of_line:nnnn { #1 } { #2 } 1 1
The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.
\group_begin:
\keys_set:nn { \NiceMatrix / \xdots } { #3 }
\tl_if_empty:VF \l_@@_xdots_color_tl { \color { \l_@@_xdots_color_tl }
\@@_actually_draw_Ddots:
\group_end:
}
The command \texttt{\@@_actually_draw_Ddots:} has the following implicit arguments:
\begin{itemize}
\item \l_@@_initial_i_int
\item \l_@@_initial_j_int
\item \l_@@_initial_open_bool
\item \l_@@_final_i_int
\end{itemize}
\begin{verbatim}
\l_@@_final_j_int
\l_@@_final_open_bool.
\cs_new_protected:Npn \@@_actually_draw_Ddots:
\{
  \bool_if:NTF \l_@@_initial_open_bool
  { \@@_open_y_initial_dim:
    \dim_set_eq:NN \l_@@_x_initial_dim \pgf@x
  \}
  \bool_if:NTF \l_@@_final_open_bool
  { \@@_open_y_final_dim:
    \dim_set_eq:NN \l_@@_x_final_dim \pgf@x
  }
\}

\bool_if:NTF \l_@@_parallelize_diags_bool
  { \int_gincr:N \g_@@_ddots_int
    \int_compare:nNnTF \g_@@_ddots_int = 1
      \dim_gset:Nn \g_@@_delta_x_one_dim { \l_@@_x_final_dim - \l_@@_x_initial_dim }
      \dim_gset:Nn \g_@@_delta_y_one_dim { \l_@@_y_final_dim - \l_@@_y_initial_dim }
    \}
  { \dim_set:Nn \l_@@_y_final_dim { \l_@@_y_initial_dim + ( \l_@@_x_final_dim - \l_@@_x_initial_dim ) * \dim_ratio:nn \g_@@_delta_y_one_dim \g_@@_delta_x_one_dim }
    \@@_draw_line:
  }

\begin{verbatim}
\end{verbatim}
\end{verbatim}

We have retrieved the coordinates in the usual way (they are stored in \l_@@_x_initial_dim, etc.). If the parallelization of the diagonals is set, we will have (maybe) to adjust the fourth coordinate.
\begin{verbatim}
\bool_if:NTF \l_@@_parallelize_diags_bool
\{ \int_gincr:N \g_@@_ddots_int
  \int_compare:nNnTF \g_@@_ddots_int = 1
    \dim_gset:Nn \g_@@_delta_x_one_dim { \l_@@_x_final_dim - \l_@@_x_initial_dim }
    \dim_gset:Nn \g_@@_delta_y_one_dim { \l_@@_y_final_dim - \l_@@_y_initial_dim }
  \}
\end{verbatim}

We test if the diagonal line is the first one (the counter \g_@@_ddots_int is created for this usage).
\begin{verbatim}
\int_compare:nNnTF \g_@@_ddots_int = 1
\end{verbatim}

If the diagonal line is the first one, we have no adjustment of the line to do but we store the $\Delta_x$ and the $\Delta_y$ of the line because these values will be used to draw the others diagonal lines parallels to the first one.
\begin{verbatim}
\begin{verbatim}
\end{verbatim}
\end{verbatim}

If the diagonal line is not the first one, we have to adjust the second extremity of the line by modifying the coordinate \l_@@_x_initial_dim.
\begin{verbatim}
\begin{verbatim}
\end{verbatim}
\end{verbatim}

We draw the \textbackslash idots diagonals in the same way. The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.
\begin{verbatim}
\cs_new_protected:Npn \@@_draw_Iddots:nnn #1 #2 #3
\{ \@@_adjust_to_submatrix:nn { #1 } { #2 }
\cs_if_free:cT { @@_ dotted _ #1 - #2 }
\cs_if_free:cT { @@_ dotted _ #1 - #2 }
\cs_if_free:cT { @@_ dotted _ #1 - #2 }
\end{verbatim}

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The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.

\group_begin:
  \keys_set:nn { NiceMatrix / xdots } { #3 }
  \t_if_empty:VF \l_@@_xdots_color_tl { \color { \l_@@_xdots_color_tl } }
\@_actually_draw_Iddots:
  \group_end:

The command \@_actually_draw_Iddots: has the following implicit arguments:

- \l_@@_initial_i_int
- \l_@@_initial_j_int
- \l_@@_initial_open_bool
- \l_@@_final_i_int
- \l_@@_final_j_int
- \l_@@_final_open_bool.

\cs_new_protected:Npn \@@_actually_draw_Iddots:
{ \bool_if:NTF \l_@@_initial_open_bool
  { \@@_open_y_initial_dim:
    \@@_open_x_initial_dim:
  } \bool_if:NTF \l_@@_final_open_bool
  { \@@_open_y_final_dim:
    \@@_open_x_final_dim:
  } \bool_if:NT \l_@@_parallelize_diags_bool
  { \int_gincr:N \g_@@_iddots_int
    \int_compare:nNnTF \g_@@_iddots_int = 1
      { \dim_gset:Nn \g_@@_delta_x_two_dim \l_@@_x_final_dim - \l_@@_x_initial_dim
        \dim_gset:Nn \g_@@_delta_y_two_dim \l_@@_y_final_dim - \l_@@_y_initial_dim
      } \dim_set:Nn \l_@@_y_final_dim
      { \l_@@_y_initial_dim +
        ( \l_@@_x_final_dim - \l_@@_x_initial_dim ) * \dim_ratio:nn \g_@@_delta_y_two_dim \g_@@_delta_x_two_dim
      } } \@@_draw_line: }

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The actual instructions for drawing the dotted lines with Tikz

The command \@@_draw_line: should be used in a \{pgfpicture\}. It has six implicit arguments:

- \l_@@_x_initial_dim
- \l_@@_y_initial_dim
- \l_@@_x_final_dim
- \l_@@_y_final_dim
- \l_@@_initial_open_bool
- \l_@@_final_open_bool

\cs_new_protected:Npn \@@_draw_line:
{
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\tl_if_eq:NNTF \l_@@_xdots_line_style_tl \c_@@_standard_tl
\@@_draw_standard_dotted_line:
\@@_draw_non_standard_dotted_line:
}\)

We have to do a special construction with \exp_args:NV to be able to put in the list of options in the correct place in the Tikz instruction.

\cs_new_protected:Npn \@@_draw_non_standard_dotted_line:
{
\begin { scope }
\exp_args:No \@@_draw_non_standard_dotted_line:n
{ \l_@@_xdots_line_style_tl , \l_@@_xdots_color_tl }
\end { scope }
\cs_generate_variant:Nn \@@_draw_non_standard_dotted_line:nnn { n V V }
\)

We have used the fact that, in PGF, un color name can be put directly in a list of options (that’s why we have put directly \l_@@_xdots_color_tl).

The argument of \@@_draw_non_standard_dotted_line:n is, in fact, the list of options.

\cs_new_protected:Npn \@@_draw_non_standard_dotted_line:n #1
{
\@@_draw_non_standard_dotted_line:nVV
{ #1 }
\l_@@_xdots_up_tl
\l_@@_xdots_down_tl
}
\)

\cs_new_protected:Npn \@@_draw_non_standard_dotted_line:nnn #1 #2 #3
{
\draw
[ #1 ,
  shorten-> = \l_@@_xdots_shorten_dim ,
  shorten<- = \l_@@_xdots_shorten_dim ,
]
( \l_@@_x_initial_dim , \l_@@_y_initial_dim )
-- node [ sloped , above ] { $ \scriptstyle #2 $ }
node [ sloped , below ] { $ \scriptstyle #3 $ }
( \l_@@_x_final_dim , \l_@@_y_final_dim ) ;
\end { scope }
}
\)
\cs_generate_variant:Nn \@@_draw_non_standard_dotted_line:nnn { n V V }

Be careful: We can’t put \texttt{\c_math_toggle_token} instead of \texttt{\$} in the following lines because we are in the contents of Tikz nodes (and they will be \texttt{rescanned} if the Tikz library \texttt{babel} is loaded).

\end_input
The command \@@_draw_standard_dotted_line: draws the line with our system of dots (which gives a dotted line with real round dots).

The dimension \l_@@_l_dim is the length \( \ell \) of the line to draw. We use the floating point reals of the L3 programming layer to compute this length.
It seems that, during the first compilations, the value of $\dim_{\text{l\_dim}}$ may be erroneous (equal to zero or very large). We must detect these cases because they would cause errors during the drawing of the dotted line. Maybe we should also write something in the aux file to say that one more compilation should be done.

\bool_lazy_or:nnF
\dim_compare_p:nNn { \dim_abs:n \dim_{\text{l\_dim}} } > \c_{\text{max\_l\_dim}} \dim_compare_p:nNn \dim_{\text{l\_dim}} = \c_{\text{zero\_dim}} \group_end:
\dim_const:Nn \dim_{\text{max\_l\_dim}} { 50 \text{ cm} }
\cs_new_protected:Npn \@@_draw_standard_dotted_line_i:
\bool_if:NTF \l_{\text{initial\_open\_bool}} \bool_if:NTF \l_{\text{final\_open\_bool}}
\int_set:Nn \l_{\text{tmpa\_int}} { \dim_ratio:nn \dim_{\text{l\_dim}} \dim_{\text{l\_inter\_dots\_dim}}} \int_set:Nn \l_{\text{tmpa\_int}} { \dim_ratio:nn { \dim_{\text{l\_dim}} - \dim_{\text{xdots\_shorten\_dim}}} \dim_{\text{l\_inter\_dots\_dim}}} \int_set:Nn \l_{\text{tmpa\_int}} { \dim_ratio:nn { \dim_{\text{l\_dim}} - 2 \dim_{\text{xdots\_shorten\_dim}}} \dim_{\text{l\_inter\_dots\_dim}}} \bool_if:NTF \l_{\text{final\_open\_bool}} \bool_if:NTF \l_{\text{final\_open\_bool}}
\int_set:Nn \l_{\text{tmpa\_int}} { \dim_ratio:nn \dim_{\text{tmpa\_dim}}} \dim_set:Nn \l_{\text{tmpa\_dim}} { ( \dim_{\text{l\_final\_dim}} - \dim_{\text{l\_initial\_dim}}) * \dim_{\text{ratio:nn}} \dim_{\text{l\_inter\_dots\_dim}} \dim_{\text{l\_dim}}} \dim_set:Nn \l_{\text{tmpb\_dim}} { ( \dim_{\text{l\_final\_dim}} - \dim_{\text{l\_initial\_dim}}) * \dim_{\text{ratio:nn}} \dim_{\text{l\_inter\_dots\_dim}} \dim_{\text{l\_dim}}}
The length $\ell$ is the length of the dotted line. We note $\Delta$ the length between two dots and $n$ the number of intervals between dots. We note $\delta = \frac{\ell}{2}(\ell - n\Delta)$. The distance between the initial extremity of the line and the first dot will be equal to $k \cdot \delta$ where $k = 0, 1$ or $2$. We first compute this number $k$ in $\l_{\text{tmpb_int}}$.

In the loop over the dots, the dimensions $\l_{\text{x_initial_dim}}$ and $\l_{\text{y_initial_dim}}$ will be used for the coordinates of the dots. But, before the loop, we must move until the first dot.

User commands available in the new environments

The commands $\@@_{\text{Ldots}}$, $\@@_{\text{Cdots}}$, $\@@_{\text{Vdots}}$, $\@@_{\text{Ddots}}$ and $\@@_{\text{Iddots}}$ will be linked to $\texttt{Ldots}$, $\texttt{Cdots}$, $\texttt{Vdots}$, $\texttt{Ddots}$ and $\texttt{Iddots}$ in the environments $\{\texttt{NiceArray}\}$ (the other environments of $\texttt{nicematrix}$ rely upon $\{\texttt{NiceArray}\}$).

The syntax of these commands uses the character _ as embellishment and thats' why we have to insert a character _ in the arg spec of these commands. However, we don't know the future catcode of _ in the main document (maybe the user will use underscore, and, in that case, the catcode is 13 because underscore activates _). That's why these commands will be defined in a $\texttt{AtBeginDocument}$ and the arg spec will be rescanned.
Despite its name, the following set of keys will be used for \Ddots but also for \Iddots.

The command \@@_Hspace: will be linked to \hspace in \{NiceArray\}.

The command \@@_Hdotsfor will be linked to \Hdotsfor in \{NiceArrayWithDelims\}. Tikz nodes are created also in the implicit cells of the \Hdotsfor (maybe we should modify that point).
This command must not be protected since it begins with \texttt{\textbackslash multicolumn}.

```latex
\cs_new:Npn \@@_Hdotsfor:
{ \bool_lazy_and:nnTF
   { \int_compare_p:nNn \c@jCol = 0 } \int_compare_p:nNn \l_@@_first_col_int = 0
   { \bool_if:NTF \g_@@_after_col_zero_bool
     { \multicolumn { 1 } { c } { } \@@_Hdotsfor_i
     } \multicolumn { 1 } { c } { }
   \@@_Hdotsfor_i
   }
}
```

The command \texttt{\@@_Hdotsfor_i} is defined with \texttt{\textbackslash NewDocumentCommand} because it has an optional argument. Note that such a command defined by \texttt{\textbackslash NewDocumentCommand} is protected and that’s why we have put the \texttt{\textbackslash multicolumn} before (in the definition of \texttt{\@@_Hdotsfor:}).

```latex\AtBeginDocument
{ \tl_set:Nn \l_@@_argspec_tl { O { } m O { } E { _ ^ } { { } { } } }
\tl_set_rescan:Nno \l_@@_argspec_tl { } \l_@@_argspec_tl
\exp_args:NNV \NewDocumentCommand \@@_Hdotsfor_i \l_@@_argspec_tl
{ \tl_gput_right:Nx \g_@@_HVdotsfor_lines_tl \@@_Hdotsfor:nnnn
{ \int_use:N \c@iRow }
{ \int_use:N \c@jCol }
{ #2 }
{ #1 , #3 ,
down = \exp_not:n { #4 },
up = \exp_not:n { #5 }
}
\prg_replicate:nn { #2 - 1 } { \& \multicolumn { 1 } { c } { } }
}
```

End of \texttt{\AtBeginDocument}.

```latex
\cs_new_protected:Npn \@@_Hdotsfor:nnnn \#1 \#2 \#3 \#4
{ \bool_set_false:N \l_@@_initial_open_bool
\bool_set_false:N \l_@@_final_open_bool
\int_set:Nn \l_@@_initial_i_int { #1 }
\int_set_eq:NN \l_@@_final_i_int \l_@@_initial_i_int
```

For the row, it’s easy.

```latex\int_set:Nn \l_@@_initial_i_int { #1 }
\int_set_eq:NN \l_@@_final_i_int \l_@@_initial_i_int
```

For the column, it’s a bit more complicated.

```latex\int_compare:nNnTF \#2 = 1
{ \int_set:Nn \l_@@_initial_j_int 1
\bool_set_true:N \l_@@_initial_open_bool
```
We declare all the cells concerned by the $\Hdotsfor$ as “dotted” (for the dotted lines created by
$\Cdots$, $\Ldots$, etc., this job is done by $\@@\find\extremities\of\line:\nnnn$). This declaration
is done by defining a special control sequence (to nil).

\begin{verbatim}
\int_step_inline:nnn { #2 } { #2 + #3 - 1 } { \cs_set:cpn { @@ _ dotted _ #1 - ##1 } { } }
\end{verbatim}

\AtBeginDocument
\begin{verbatim}
\tl_set:Nn \l_@@_argspec_tl { O { } m O { } E { _ ^ } { { } { } } }
\tl_set_rescan:Nno \l_@@_argspec_tl { } \l_@@_argspec_tl
\exp_args:NNV \NewDocumentCommand \@@_Vdotsfor: \l_@@_argspec_tl
\begin{verbatim}
\tl_gput_right:Nx \g_@@_HVdotsfor_lines_tl
\end{verbatim}
\end{document}

\begin{Verbatim}
\{ #1 , \#3 ,
    \color{nicematrix-first-col}
    \color{nicematrix-last-col}
\}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-first-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-last-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-first-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-last-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-first-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-last-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-first-col} \}
\end{Verbatim}

\begin{Verbatim}
\{ \color{nicematrix-last-col} \}
\end{Verbatim}
We declare all the cells concerned by the \Vdots as “dotted” (for the dotted lines created by \Cdots, \ldots, etc., this job is done by \@_find_extremities_of_line). This declaration is done by defining a special control sequence (to nil).

\int_step_inline:nnn { #1 } { #1 + #3 - 1 } 
\{ \cs_set:cpn { @@ _ dotted - ##1 - #2 } { } \}

The command \@@_rotate: will be linked to \rotate in \{NiceArrayWithDelims\}.
\cs_new_protected:Npn \@@_rotate: { \bool_gset_true:N \g_@@_rotate_bool }

The command \line accessible in code-after

In the \CodeAfter, the command \@@_line:nn will be linked to \line. This command takes two arguments which are the specifications of two cells in the array (in the format $i-j$) and draws a dotted line between these cells.

First, we write a command with an argument of the format $i-j$ and applies the command \int_eval:n to $i$ and $j$; this must not be protected (and is, of course fully expandable).63

\cs_new:Npn \@@_double_int_eval:n #1-#2 \q_stop 
{ \int_eval:n { #1 } - \int_eval:n { #2 } }

With the following construction, the command \@@_double_int_eval:n is applied to both arguments before the application of \@@_line_i:nn (the construction uses the fact the \@@_line_i:nn is protected and that \@@_double_int_eval:n is fully expandable).

\AtBeginDocument
\begin{verbatim}
\tl_set:Nn \l_@@_argspec_tl { O { } m m ! O { } E { _ ^ } { { } { } } }
\tl_set_rescan:Nno \l_@@_argspec_tl { } \l_@@_argspec_tl
\exp_args:NNV \NewDocumentCommand \@@_line \l_@@_argspec_tl 
{ \group_begin:
  \keys_set:nn { NiceMatrix / xdots } { #1 , #4 , down = #5 , up = #6 }
  \tl_if_empty:VF \l_@@_xdots_color_tl { \color { \l_@@_xdots_color_tl } }
  \use:e
    { \@@_line_i:nn { \@@_double_int_eval:n #2 \q_stop }
      { \@@_double_int_eval:n #3 \q_stop }
    }
  \group_end:
}
\cs_new_protected:Npn \@@_line_i:nn #1 #2 
{ \bool_set_false:N \l_@@_initial_open_bool
  \bool_set_false:N \l_@@_final_open_bool
  \bool_if:nTF
    { \cs_if_free_p:c { pgf @ sh @ ns @ \@@_env: - #1 } ||
      \cs_if_free_p:c { pgf @ sh @ ns @ \@@_env: - #2 } }
  { \@@_line_i:nn }
}
\cs_new_protected:Npn \@@_line_i:nn \l_@@_initial_open_bool \l_@@_final_open_bool 
{ \bool_if:nTF
  \{ \cs_if_free_p:c { pgf @ sh @ ns @ \@@_env: - #1 }
    \} ||
  \cs_if_free_p:c { pgf @ sh @ ns @ \@@_env: - #2 }
}
\end{verbatim}

\footnote{Indeed, we want that the user may use the command \line in \CodeAfter with LaTeX counters in the arguments — with the command \value.}
We recall that, when externalization is used, \tikzpicture and \endtikzpicture (or \pgfpicture and \endpgfpicture) must be directly “visible” and that why we do this static construction of the command \@@_draw_line_ii:.

\begin{verbatim}
c_@@_pgfortikzpicture_tl \@@_draw_line_iii:nn { #1 } { #2 } 
c_@@_endpgfortikzpicture_tl
\end{verbatim}

The following command must be protected (it’s used in the construction of \@@_draw_line_ii:nn).

\begin{verbatim}
cs_new_protected:Npn \@@_draw_line_iii:nn #1 #2 
  {\pgfrememberpicturepositiononpagetrue \pgfpointshapeborder { \@@_env: - #1 } { \@@_qpoint:n { #2 } } \dim_set_eq:NN \l_@@_x_initial_dim \pgf@x \dim_set_eq:NN \l_@@_y_initial_dim \pgf@y \pgfpointshapeborder { \@@_env: - #2 } { \@@_qpoint:n { #1 } } \dim_set_eq:NN \l_@@_x_final_dim \pgf@x \dim_set_eq:NN \l_@@_y_final_dim \pgf@y \@@_draw_line:
  }
\end{verbatim}

The commands \Ldots, \Cdots, \Vdots, \Ddots, and \Iddots don’t use this command because they have to do other settings (for example, the diagonal lines must be parallelized).

\section*{Colors of cells, rows and columns}

We want to avoid the thin white lines that are shown in some PDF viewers (eg: with the engine MuPDF used by SumatraPDF). That’s why we try to draw rectangles of the same color in the same instruction \pgfusepath { fill } (and they will be in the same instruction fill—coded f—in the resulting PDF).

The commands \@@_rowcolor, \@@_columncolor and \@@_rectanglecolor (which are linked to \rowcolor, \columncolor and \rectanglecolor before the execution of the code-before) don’t directly draw the corresponding rectangles. Instead, they store their instructions color by color:

- A sequence \g_@@_colors_seq will be built containing all the colors used by at least one of these instructions. Each color may be prefixed by it color model (eg: [gray]{0.5}).

- For the color whose index in \g_@@_colors_seq is equal to \i, a list of instructions which use that color will be constructed in the token list \g_@@_color_\i_tl. In that token list, the instructions will be written using \@@_rowcolor:n, \@@_columncolor:n and \@@_rectanglecolor:nn (corresponding of \@@_rowcolor, \@@_columncolor and \@@_rectanglecolor).

bigskip #1 is the color and #2 is an instruction using that color. Despite its name, the command \@@_add_to_color_seq doesn’t only add a color to \g_@@_colors_seq: it also updates the corresponding token list \g_@@_color_\i_tl. We add in a global way because the final user may use the instructions such as \cellcolor in a loop of pgffor in the \CodeBefore (and we recall that a loop of pgffor is encapsulated in a group).
First, we look for the number of the color and, if it’s found, we store it in \l_tmpa_int. If the color is not present in \l@@colors_seq, \l_tmpa_int will remain equal to 0.
\int_zero:N \l_tmpa_int
\seq_map_indexed_inline:Nn \g@@colors_seq
{ \tl_if_eq:nnT { #1 } { ##2 } { \int_set:Nn \l_tmpa_int { ##1 } } }
\int_compare:nNnTF \l_tmpa_int = \c_zero_int
First, the case where the color is a new color (not in the sequence).
\seq_gput_right:Nn \g@@colors_seq { #1 }
\tl_gset:cx { g@@color _ \seq_count:N \g@@colors_seq _ tl } { #2 }
Now, the case where the color is not a new color (the color is in the sequence at the position \l_tmpa_int).
{ \tl_gput_right:cx { g@@color _ \int_use:N \l_tmpa_int _tl } { #2 } }
\cs_generate_variant:Nn \@@add_to_colors_seq:nn { x n }
The macro \@@actually_color: will actually fill all the rectangles, color by color (using the sequence \l@@colors_seq and all the token lists of the form \l@@color_i_tl).
\cs_new_protected:Npn \@@actually_color:
{ \pgfpicture \pgf@relevantforpicturesizefalse 
\seq_map_indexed_inline:Nn \g@@colors_seq
{ \color ##2
\use:c { g@@color _ ##1 _tl }
\tl_gclear:c { g@@color _ ##1 _tl }
\pgfusepath { fill }
}
\endpgfpicture }
\cs_set_protected:Npn \@@cut_on_hyphen:w #1-#2\q_stop
{ \tl_set:Nn \l_tmpa_tl { #1 }
\tl_set:Nn \l_tmpb_tl { #2 }
}
Here is an example: \@@rowcolor {red!15} {1,3,5-7,10-}
\NewDocumentCommand \@@rowcolor { O { } m m }
{ \tl_if_blank:nF { #2 }
\@@add_to_colors_seq:xn
{ \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } }
\@@rowcolor:n { #3 }
}
\cs_new_protected:Npn \@@rowcolor:n #1
{ \tl_set:Nn \l@@rows_tl { #1 }
\tl_set:Nn \l@@cols_tl { - }
\\@@cartesian_path: takes in two implicit arguments: \l@@cols_tl and \l@@rows_tl.
\\\@@cartesian_path:
Here an example: \
\@_columncolor:nn {red!15} {1,3,5-7,10-} 
\NewDocumentCommand \@_columncolor { O{ } m m } 
{ \tl_if_blank:nF { #2 } 
{ \@@_add_to_colors_seq:xn 
{ \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } } 
{ \@@_columncolor:n { #3 } } 
} 
\cs_new_protected:Npn \@@_columncolor:n #1 
{ \tl_set:Nn \l_@@_rows_tl { - } \tl_set:Nn \l_@@_cols_tl { #1 } 
\@@_cartesian_path: 
}\@@_columncolor:n #1 
{ \tl_set:Nn \l_@@_rows_tl { - } \tl_set:Nn \l_@@_cols_tl { #1 } 
Here is an example: \@@_rectanglecolor{red!15}{2-3}{5-6} 
\NewDocumentCommand \@_rectanglecolor { O{ } m m m } 
{ \tl_if_blank:nF { #2 } 
{ \@@_add_to_colors_seq:xn 
{ \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } } 
{ \@@_rectanglecolor:nnn { #3 } { #4 } { 0 pt } } 
} 
\cs_new_protected:Npn \@@_rectanglecolor:nnn #1 #2 #3 
{ \@@_cut_on_hyphen:w #1 \q_stop \tl_clear_new:N \l_tmpc_tl \tl_clear_new:N \l_tmpd_tl \tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl \tl_set_eq:NN \l_tmpd_tl \l_tmpb_tl \@@_cut_on_hyphen:w #2 \q_stop \tl_set:Nx \l_@@_rows_tl { \l_tmpc_tl - \l_tmpa_tl } \tl_set:Nx \l_@@_cols_tl { \l_tmpd_tl - \l_tmpb_tl } 
\@@_cartesian_path:n takes in two implicit arguments: \l_@@_cols_tl and \l_@@_rows_tl. 
\@@_cartesian_path:n { #3 } 
}\@@_cartesian_path:n 
The command \@@_cartesian_path: takes in two implicit arguments: \l_@@_cols_tl and \l_@@_rows_tl.
The last argument is the radius of the corners of the rectangle. 
\NewDocumentCommand \@_roundedrectanglecolor { O{ } m m m m } 
{ \tl_if_blank:nF { #2 } 
{ \@@_add_to_colors_seq:xn 
{ \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } } 
{ \@@_rectanglecolor:nnn { #3 } { #4 } { #5 } } 
} 
\cs_new_protected:Npn \@@_rectanglecolor:nnn #1 #2 #3 
{ \@@_cut_on_hyphen:w #1 \q_stop \tl_clear_new:N \l_tmpc_tl \tl_clear_new:N \l_tmpd_tl \tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl \tl_set_eq:NN \l_tmpd_tl \l_tmpb_tl \@@_cartesian_path:n takes in two implicit arguments: \l_@@_cols_tl and \l_@@_rows_tl. 
\@@_cartesian_path:n { #3 } 
}
Here is an example:

```latex
\NewDocumentCommand \@@_cellcolor { O { } m m }{
  \clist_map_inline:nn { #3 } { \@@_rectanglecolor [ #1 ] { #2 } { ##1 } { ##1 } }
}
\NewDocumentCommand \@@_chessboardcolors { O { } m m }{
  \int_step_inline:nn { \int_use:N \c@iRow } {
    \int_step_inline:nn { \int_use:N \c@jCol } {
      \int_if_even:nTF { ####1 + ##1 } {
        \@@_cellcolor [ #1 ] { #2 } { ##1 - ####1 } } { \@@_cellcolor [ #1 ] { #3 } { ##1 - ####1 } }
    }
  }
}\keys_define:nn { NiceMatrix / arraycolor } { except-corners .code:n = \@@_error:n { key except-corners } }
\NewDocumentCommand \@@_arraycolor { O { } m O { } }{
  \keys_set:nn { NiceMatrix / arraycolor } { #3 }
  \@@_rectanglecolor [ #1 ] { #2 } { 1 - 1 }{ \int_use:N \c@iRow - \int_use:N \c@jCol }
}\keys_define:nn { NiceMatrix / rowcolors }{
  respect-blocks .bool_set:N = \l_@@_respect_blocks_bool ,
  respect-blocks .default:n = true ,
  cols .tl_set:N = \l_@@_cols_tl ,
  restart .bool_set:N = \l_@@_rowcolors_restart_bool ,
  restart .default:n = true ,
  unknown .code:n = \@@_error:n { Unknown-key-for-rowcolors }
}\NewDocumentCommand \@@_rowcolors { O { } m m m O { } }{
  \keys_set:nn { NiceMatrix / rowcolors } { #5 }
  \group_begin: \tl_clear_new:N \l_@@_cols_tl \tl_set:Nn \l_@@_cols_tl { - } \keys_set:nn { NiceMatrix / rowcolors } { \#5 }
}
```

The command \@@_arraycolor (linked to \arraycolor at the beginning of the \CodeBefore) will color the whole tabular (excepted the potential exterior rows and columns). The third argument is a optional argument which a list of pairs key-value.

The command \rowcolors (accessible in the \CodeBefore) is inspired by the command \rowcolors of the package xcolor (with the option table). However, the command \rowcolors of nicematrix has not the optional argument of the command \rowcolors of xcolor. Here is an example: \rowcolors{1}{blue!10}{[respect-blocks]. #1 (optional) is the color space ; #2 is a list of intervals of rows ; #3 is the first color ; #4 is the second color ; #5 is for the optional list of pairs key-value.

The group is for the options.
The boolean \l_tmpa_bool will indicate whereas we are in a row of the first color or of the second color.

\bool_set_true:N \l_tmpa_bool
\bool_if:NT \l_@@_respect_blocks_bool
\(){
We don’t want to take into account a block which is completely in the “first column” of (number 0) or in the “last column” and that’s why we filter the sequence of the blocks (in a the sequence \l_tmpa_seq).
\seq_set_eq:NN \l_tmpb_seq \g_@@_pos_of_blocks_seq
\seq_set_filter:NNn \l_tmpa_seq \l_tmpb_seq
\{ \00_not_in_exterior_p:nnnn #1 \}
}\}
\pgfpicture
\pgf@relevantforpicturesizefalse
\clist_map_inline:nn { #2 }
\{ \tl_set:Nn \l_tmpa_tl { ##1 } \tl_if_in:NnTF \l_tmpa_tl { - } \{ \00_cut_on_hyphen:w ##1 \q_stop \} \{ \tl_set:Nx \l_tmpb_tl { \int_use:N \c@iRow } \}
The counter \l_tmpa_int will be the index of the loop.
\int_set:Nn \l_tmpa_int \l_tmpa_tl
\bool_if:NT \l_@@_rowcolors_restart_bool
\{ \bool_set_true:N \l_tmpa_bool \}
\bool_set:Nn \l_tmpa_bool { \int_if_odd_p:n { \l_tmpa_tl } }\int_zero_new:N \l_tmpc_int
\int_set:NNn \l_tmpb_int \l_tmpa_int
\int_do_until:nNnn \l_tmpa_int > \l_tmpc_int
\}
We will compute in \l_tmpb_int the last row of the “block”.
\int_set_eq:NN \l_tmpa_int \l_tmpb_seq
\bool_if:NT \l_@@_rowcolors_restart_bool
\{ \bool_set_true:N \l_tmpa_bool \}
\bool_set:NN \l_tmpa_seq \l_tmpb_seq
\{ \00_intersect_our_row_p:nnnn #1 \}
\seq_map_inline:Nn \l_tmpb_seq { \@@_rowcolors_i:nnnn ###1 }\tl_set:Nx \l_@@_rows_tl { \int_use:N \l_tmpa_int - \int_use:N \l_tmpb_int }
\bool_if:NTF \l_tmpa_bool
\{ \tl_if_blank:nF { #3 } \tl_if_empty:nTF { #1 } \color
\{ \color [ #1 ] \}
\}
The command \@@_cartesian_path: takes in two implicit arguments: \l_@@_cols_tl and \l_@@_rows_tl.
\@@_cartesian_path:
\pgfusepath { fill }
\bool_set_false:N \l_tmpa_bool
\}
\bool_set_false:N \l_tmpa_bool
\}
\tl_if_blank:nF { #4 }
}
The command \@@_cartesian_path: takes in two implicit arguments: \l_@@_cols_tl and \l_@@_row_tl.

\@@_cartesian_path:
\pgfusepath { fill }
\bool_set_true:N \l_tmpa_bool
\int_set:Nn \l_tmpa_int { \l_tmpb_int + 1 }
\endpgfpicture
\group_end:
\cs_new_protected:Npn \@@_rowcolors_i:nnnn #1 #2 #3 #4
{ \int_compare:nNnT { #3 } > \l_tmpb_int
{ \int_set:Nn \l_tmpb_int { #3 } }
}

The following command return true when the block intersects the row \l_tmpa_int.
\prg_new_conditional:Nnn \@@_intersect_our_row:nnnn p
{ \bool_if:nTF
{ \int_compare_p:nNn { #1 <= \l_tmpa_int } && \int_compare_p:nNn { \l_tmpa_int <= #3 } }
\prg_return_true:
\prg_return_false:
}

The following command uses two implicit arguments: \l_@@_rows_tl and \l_@@_cols_tl which are specifications for a set of rows and a set of columns. It creates a path but does not fill it. It must be filled by another command after. The argument is the radius of the corners. We define below a command \@@_cartesian_path: which corresponds to a value 0 pt for the radius of the corners. This command is in particular used in \@@_rectanglecolor:nnn (used in \@@_rectanglecolor, itself used in \@@_cellcolor).

\cs_new_protected:Npn \@@_cartesian_path:n #1
{ \bool_lazy_and:nnT
{ ! \seq_if_empty_p:N \l_@@_corners_cells_seq }
{ \dim_compare_p:Nn { #1 } = \c_zero_dim }
{ \@@_expand_clist:NN \l_@@_cols_tl \c@jCol
\@@_expand_clist:NN \l_@@_rows_tl \c@iRow
}
We begin the loop over the columns.

\begin{verbatim}
\list_map_inline:Nn \l_@@_cols_tl
  \tl_set:Nn \l_tmpa_tl { ##1 }
  \tl_if_in:NnTF \l_tmpa_tl { - }
  { \@@_cut_on_hyphen:w ##1 \q_stop }
  { \@@_cut_on_hyphen:w ##1 - ##1 \q_stop }
  \bool_lazy_or:nnT
    \tl_if_blank_p:V \l_tmpa_tl
    \str_if_eq_p:Vn \l_tmpa_tl { * }
    \tl_set:Nn \l_tmpa_tl { 1 }
  \bool_lazy_or:nnT
    \tl_if_blank_p:V \l_tmpb_tl
    \str_if_eq_p:Vn \l_tmpb_tl { * }
    \tl_set:Nx \l_tmpb_tl { \int_use:N \c@jCol }
  \int_compare:nNnT \l_tmpb_tl > \c@jCol
  { \tl_set:Nx \l_tmpb_tl { \int_use:N \c@jCol }
  \l_tmpc_tl
    \tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl
    \int_compare:nNnTF \l_@@_first_col_int = \l_tmpa_tl
    { \dim_set:Nn \l_tmpc_dim { \pgf@x - 0.5 \arrayrulewidth } }
    { \dim_set:Nn \l_tmpc_dim { \pgf@x + 0.5 \arrayrulewidth } }
  \@@_qpoint:n { col - \l_tmpa_tl }
  \int_compare:nNnTF \l_@@_first_col_int = \l_tmpa_tl
  { \dim_set:Nn \l_tmpc_dim { \pgf@x - 0.5 \arrayrulewidth } }
  { \dim_set:Nn \l_tmpc_dim { \pgf@x + 0.5 \arrayrulewidth } }
  \dim_set:Nn \l_tmpa_dim { \pgf@x + 0.5 \arrayrulewidth }
\end{verbatim}

\l_tmpc_tl\ will contain the number of column.

\begin{verbatim}
\list_map_inline:Nn \l_@@_rows_tl
  \tl_set:Nn \l_tmpa_tl { ####1 }
  \tl_if_in:NnTF \l_tmpa_tl { - }
  { \@@_cut_on_hyphen:w ####1 \q_stop }
  { \@@_cut_on_hyphen:w ####1 - ####1 \q_stop }
  \tl_if_empty:NT \l_tmpa_tl { \tl_set:Nn \l_tmpa_tl { 1 } }
  \tl_if_empty:NT \l_tmpb_tl
    \tl_set:Nx \l_tmpb_tl { \int_use:N \c@iRow }
  \int_compare:nNnT \l_tmpb_tl > \c@iRow
    \seq_if_in:NxF \l_@@_corners_cells_seq
      \l_tmpa_tl \l_tmpc_tl
    { \@@_qpoint:n { row - \l_tmpa_tl }
      \dim_set:Nn \l_tmpa_dim { \pgf@y + 0.5 \arrayrulewidth }
      \@@_qpoint:n { row - \l_tmpc_tl }
      \dim_set:Nn \l_tmpb_dim { \pgf@y + 0.5 \arrayrulewidth }
      \pgfsetcornersarced { \pgfpoint { #1 } { #1 } }
      \pgfpathrectanglecorners
      \pgfpoint \l_tmpc_dim \l_tmpd_dim
      \pgfpoint \l_tmpa_dim \l_tmpb_dim
    }
\end{verbatim}

Now, the numbers of both rows are in \l_tmpa_tl and \l_tmpb_tl.

\begin{verbatim}
\list_map_inline:Nn \l_@@_rows_tl
  \tl_set:Nn \l_tmpa_tl { ###1 }
  \tl_if_in:NnTF \l_tmpa_tl { - }
  { \@@_cut_on_hyphen:w ###1 \q_stop }
  \tl_if_empty:NT \l_tmpa_tl { \tl_set:Nn \l_tmpa_tl { 1 } }
  \tl_if_empty:NT \l_tmpb_tl
    \tl_set:Nx \l_tmpb_tl { \int_use:N \c@iRow }
  \int_compare:nNnT \l_tmpb_tl > \c@iRow
    \seq_if_in:NxF \l_@@_corners_cells_seq
      \l_tmpa_tl \l_tmpc_tl
    { \@@_qpoint:n { row - \l_tmpa_tl }
      \dim_set:Nn \l_tmpa_dim { \pgf@y + 0.5 \arrayrulewidth }
      \@@_qpoint:n { row - \l_tmpc_tl }
      \dim_set:Nn \l_tmpb_dim { \pgf@y + 0.5 \arrayrulewidth }
      \pgfsetcornersarced { \pgfpoint { #1 } { #1 } }
      \pgfpathrectanglecorners
      \pgfpoint \l_tmpc_dim \l_tmpd_dim
      \pgfpoint \l_tmpa_dim \l_tmpb_dim
    }
\end{verbatim}

The following command corresponds to a radius of the corners equal to 0 pt. This command is used by the commands \@@_rowcolors, \@@_columncolor and \@@_rowcolor:n (used in \@@_rowcolor).

\begin{verbatim}
\cs_new_protected:Npn \@@_cartesian_path: { \@@_cartesian_path:n { 0 pt } }
\end{verbatim}

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The following command will be used only with \_@@_cols_tl and \c@jCol (first case) or with \_@@_rows_tl and \c@iRow (second case). For instance, with \_@@_cols_tl equal to 2,4-6,8-* and \c@jCol equal to 10, the clist \_@@_cols_tl will be replaced by 2,4,5,6,8,9,10.

\cs_new_protected:Npn \@@_expand_clist:NN #1 #2
\clist_set_eq:NN \l_tmpa_clist #1
\clist_clear:N #1
\clist_map_inline:Nn \l_tmpa_clist
{\tl_set:Nn \l_tmpa_tl { ##1 }
\tl_if_in:NnTF \l_tmpa_tl { - } { \@@_cut_on_hyphen:w ##1 \q_stop }
\tl_if_blank_p:V \l_tmpa_tl { \str_if_eq_p:Vn \l_tmpa_tl { * } { \tl_set:Nn \l_tmpa_tl { 1 } }
\bool_lazy_or:nnT { \tl_if_blank_p:V \l_tmpb_tl { \str_if_eq_p:Vn \l_tmpb_tl { * } { \tl_set:Nx \l_tmpb_tl { \int_use:N #2 } }
\int_compare:nNnT \l_tmpb_tl > #2 { \tl_set:Nx \l_tmpb_tl { \int_use:N #2 } }
\int_step_inline:nnn \l_tmpa_tl \l_tmpb_tl
{ \clist_put_right:Nn #1 { ####1 } }
} }
}

When the user uses the key colortbl-like, the following command will be linked to \cellcolor in the tabular.

\NewDocumentCommand \@@_cellcolor_tabular { O { } m }
{\peek_remove_spaces:n
{\tl_gput_right:Nx \g_nicematrix_code_before_tl
\cellcolor [ #1 ] { \exp_not:n { #2 } }
{ \int_use:N \c@iRow \int_use:N \c@jCol }
}}

When the user uses the key colortbl-like, the following command will be linked to \rowcolor in the tabular.

\NewDocumentCommand \@@_rowcolor_tabular { O { } m }
{\peek_remove_spaces:n
{\tl_gput_right:Nx \g_nicematrix_code_before_tl
\rectanglecolor [ #1 ] { \exp_not:n { #2 } }
{ \int_use:N \c@iRow - \int_use:N \c@jCol }
}}

\NewDocumentCommand \@@_columncolor_preamble { O { } m }
{\peek_remove_spaces:n
{\tl_gput_right:Nx \g_nicematrix_code_before_tl
\rectanglecolor [ #1 ] { \exp_not:n { #2 } }
{ \int_use:N \c@jCol - \int_use:N \c@iRow }
}}

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With the following line, we test whether the cell is the first one we encounter in its column (don’t forget that some rows may be incomplete).

\[
\texttt{int\_compare:nNnT} \ \texttt{c@jCol} > \texttt{g@@_col\_total\_int}
\]

You use \texttt{gput\_left} because we want the specification of colors for the columns drawn before the specifications of color for the rows (and the cells). Be careful: maybe this is not effective since we have an analyze of the instructions in the \texttt{CodeBefore} in order to fill color by color (to avoid the thin white lines).

\[
\texttt{tl\_gput\_left:Nx} \ \texttt{g\_nicematrix\_code\_before\_tl}
\]

\[
\texttt{exp\_not:N} \ \texttt{columncolor} [ \ #1 ]
\]

\[
\texttt{exp\_not:n} \ { \#2} \ \texttt{\{ \int\_use:N} \ \texttt{c@jCol} \}
\]

The vertical rules

We give to the user the possibility to define new types of columns (with \texttt{newcolumntype} of \texttt{array}) for special vertical rules (\textit{e.g.} rules thicker than the standard ones) which will not extend in the potential exterior rows of the array.

We provide the command \texttt{\OnlyMainNiceMatrix} in that goal. However, that command must be no-op outside the environments of \texttt{nicematrix} (and so the user will be allowed to use the same new type of column in the environments of \texttt{nicematrix} and in the standard environments of \texttt{array}). That’s why we provide first a global definition of \texttt{\OnlyMainNiceMatrix}.

\[
\texttt{\cs\_set\_eq:NN} \ \texttt{\OnlyMainNiceMatrix} \ \texttt{\use:n}
\]

Another definition of \texttt{\OnlyMainNiceMatrix} will be linked to the command in the environments of \texttt{nicematrix}. Here is that definition, called \texttt{\@@\_OnlyMainNiceMatrix:n}.

\[
\texttt{\cs\_new\_protected:Npn} \ \texttt{\@@\_OnlyMainNiceMatrix:n} \ #1
\]

The following command will be executed in the \texttt{internal\_code\_after}. The rule will be drawn \textit{before} the column \#1 (that is to say on the left side). \#2 is the number of consecutive occurrences of 1.
The following test is for the case where the user don’t use all the columns specified in the preamble of the environment (for instance, a preamble of |c|c|c| but only two columns used).

\int_compare:nNnT { #1 } < \{ \c@jCol + 2 \}
{ \pgfpicture \@@_vline_i:nn { #1 } { #2 } \endpgfpicture }
\cs_new_protected:Npn \@@_vline_i:nn #1 #2
{ \l_tmpa_tl is the number of row and \l_tmpb_tl the number of column. When we have found a row corresponding to a rule to draw, we note its number in \l_tmpc_tl.
\tl_set:Nx \l_tmpb_tl { #1 }
\tl_clear_new:N \l_tmpc_tl
\int_step_variable:nNn \c@iRow \l_tmpa_tl
{ The boolean \g_tmpa_bool indicates whether the small vertical rule will be drawn. If we find that it is in a block (a real block, created by \textbackslash Block or a virtual block corresponding to a dotted line, created by \textbackslash Dots, \textbackslash Vdots, etc.), we will set \g_tmpa_bool to false and the small vertical rule won’t be drawn.
\bool_gset_true:N \g_tmpa_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
{ \@@_test_vline_in_block:nnnn ##1 }
\seq_map_inline:Nn \g_@@_pos_of_xdots_seq
{ \@@_test_vline_in_block:nnnn ##1 }
\seq_map_inline:Nn \g_@@_pos_of_stroken_blocks_seq
{ \@@_test_vline_in_stroken_block:nnnn ##1 }
\clist_if_empty:NF \l_@@_corners_clist
\@@_test_in_corner_v:
\bool_if:NTF \g_tmpa_bool
{ \tl_if_empty:NT \l_tmpc_tl
\tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl }
{ \tl_if_empty:NF \l_tmpc_tl
\@@_vline_ii:nnnn { #1 } { #2 } \l_tmpc_tl { \int_eval:n { \l_tmpa_tl - 1 } }
\tl_clear:N \l_tmpc_tl }
\tl_clear:N \l_tmpc_tl
\bool_if:NTF \g_tmpa_bool
{ \tl_if_empty:NT \l_tmpc_tl
\tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl }
}
\tl_if_empty:NF \l_tmpc_tl
{ \@@_vline_i:nnnn { #1 } { #2 } \l_tmpc_tl { \int_eval:n { \l_tmpa_tl - 1 } }
\tl_clear:N \l_tmpc_tl }
\tl_clear:N \l_tmpc_tl
\cs_new_protected:Npn \@@_test_in_corner_v:
\int_compare:nNnTF \l_tmpb_tl = { \@@_succ:n \c@jCol } 
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_tmpb_tl 
{ \int_compare:nNnTF \l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}
}

\cs_new_protected:Npn \@@_vline_ii:nnnn #1 #2 #3 #4 
{ \pgfrememberpicturepositionontrue \pgf@relevantforpicturesizefalse 
\@@_qpoint:n \l_tmpa_dim \pgf@y 
\@@_qpoint:n \l_tmpb_dim \pgf@x 
\@@_qpoint:n \l_tmpc_dim \pgf@y 
\bool_lazy_all:nT 
\l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}

\cs_new_protected:Npn \@@_vline_ii:nnnn #1 #2 #3 #4 
{ \pgfrememberpicturepositionontrue \pgf@relevantforpicturesizefalse 
\@@_qpoint:n \l_tmpa_dim \pgf@y 
\@@_qpoint:n \l_tmpb_dim \pgf@x 
\@@_qpoint:n \l_tmpc_dim \pgf@y 
\bool_lazy_all:nT 
\l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}

\cs_new_protected:Npn \@@_vline_ii:nnnn #1 #2 #3 #4 
{ \pgfrememberpicturepositionontrue \pgf@relevantforpicturesizefalse 
\@@_qpoint:n \l_tmpa_dim \pgf@y 
\@@_qpoint:n \l_tmpb_dim \pgf@x 
\@@_qpoint:n \l_tmpc_dim \pgf@y 
\bool_lazy_all:nT 
\l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}

#1 is the number of the column; #2 is the number of vertical rules to draw (with potentially a color between); #3 and #4 are the numbers of the rows between which the rule has to be drawn.

\cs_new_protected:Npn \@@_vline_ii:nnnn #1 #2 #3 #4 
{ \pgfrememberpicturepositionontrue \pgf@relevantforpicturesizefalse 
\@@_qpoint:n \l_tmpa_dim \pgf@y 
\@@_qpoint:n \l_tmpb_dim \pgf@x 
\@@_qpoint:n \l_tmpc_dim \pgf@y 
\bool_lazy_all:nT 
\l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}

\cs_new_protected:Npn \@@_vline_ii:nnnn #1 #2 #3 #4 
{ \pgfrememberpicturepositionontrue \pgf@relevantforpicturesizefalse 
\@@_qpoint:n \l_tmpa_dim \pgf@y 
\@@_qpoint:n \l_tmpb_dim \pgf@x 
\@@_qpoint:n \l_tmpc_dim \pgf@y 
\bool_lazy_all:nT 
\l_tmpb_tl = 1 
{ \bool_set_false:N \g_tmpa_bool }
{ \seq_if_in:NxT 
\l_@corners_cells_seq 
\l_tmpa_tl - \l_@pred:n \l_tmpb_tl 
\bool_set_false:N \g_tmpa_bool }
}
The following command draws a complete vertical rule in the column \#1 (#2 is the number of consecutive rules specified by the number of | in the preamble). This command will be used if there is no block in the array (and the key \texttt{corners} is not used).

\cs_new_protected:Npn \@@_vline_i_complete:nn #1 #2
\{ \@@_vline_ii:nnnn { #1 } { #2 } 1 \{ \int_use:N \c@iRow \} \}

The command \texttt{\@@_draw_vlines:} draws all the vertical rules excepted in the blocks, in the virtual blocks (determined by a command such as \texttt{\Cdots}) and in the corners (if the key \texttt{corners} is used).

\cs_new_protected:Npn \@@_draw_vlines:
\{ \int_step_inline:nnn
\{ \bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool } 1 2 \}
\{ \bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool } { \@@_succ:n \c@jCol } \c@jCol \}
\{ \tl_if_eq:NnF \l_@@_vlines_clist { all } { \clist_if_in:NnT \l_@@_vlines_clist { ##1 } } { \@@_vline:nn { ##1 } 1 } \}
\}

The horizontal rules

The following command will be executed in the \texttt{internal-code-after}. The rule will be drawn \textit{before} the row \#1. \#2 is the number of consecutive occurrences of \texttt{\Hline}.

\cs_new_protected:Npn \@@_hline:nn #1 #2
\{ \pgfpicture
\@@_hline_i:nn { #1 } { #2 }
\endpgfpicture
\}

\cs_new_protected:Npn \@@_hline_i:nn #1 #2
\{ \tl_set:Nn \l_tmpa_tl { #1 }
\tl_clear_new:N \l_tmpc_tl
\int_step_variable:nNn \c@jCol \l_tmpb_tl
\}

\tl_if_eq:NnF \l_@@_vlines_clist { all } { \clist_if_in:NnT \l_@@_vlines_clist { ##1 } } { \@@_vline:nn { ##1 } 1 } \}
\}

The boolean \texttt{\g_tmpa_bool} indicates whether the small horizontal rule will be drawn. If we find that it is in a block (a real block, created by \texttt{\Block} or a virtual block corresponding to a dotted line, created by \texttt{\Cdots}, \texttt{\Vdots}, etc.), we will set \texttt{\g_tmpa_bool} to \texttt{false} and the small horizontal rule won't be drawn.

\bool_gset_true:N \g_tmpa_bool

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We keep in memory that we have a rule to draw.

\begin{verbatim}
\tl_if_empty:NT \l_tmpc_tl
\{ \tl_set_eq:NN \l_tmpc_tl \l_tmpb_tl \}
\tl_if_empty:NT \l_tmpc_tl
\{ \@@_hline_ii:nnnn \}
\tl_clear:N \l_tmpc_tl
\tl_if_empty:NT \l_tmpc_tl
\{ \@@_hline_ii:nnnn \}
\tl_clear:N \l_tmpc_tl
\cs_new_protected:Npn \@@_test_in_corner_h:
\{ \int_compare:nNnTF \l_tmpa_tl = { \@@_succ:n \c@iRow } \}
\seq_if_in:NxT \l_@@_corners_cells_seq
\{ \@@_pred:n \l_tmpa_tl - \l_tmpb_tl \}
\bool_set_false:N \g_tmpa_bool
\}
\seq_if_in:NxT \l_@@_corners_cells_seq
\{ \int_compare:nNnTF \l_tmpa_tl = 1 \}
\bool_set_false:N \g_tmpa_bool
\}
\end{verbatim}
#1 is the number of the row; #2 is the number of horizontal rules to draw (with potentially a color between); #3 and #4 are the number of the columns between which the rule has to be drawn.

The command `@@_draw_hlines` draws all the horizontal rules excepted in the blocks (even the virtual drawn determined by commands such as \texttt{\textbackslash{}Cdots} and in the corners (if the key \texttt{corners} is used).
The command \@@_Hline: will be linked to \Hline in the environments of \nicematrix.

The argument of the command \@@_Hline_i:n is the number of successive \Hline found.

The key hvlines

The following command tests whether the current position in the array (given by \l_tmpa_tl for the row and \l_tmpb_tl for the column) would provide an horizontal rule towards the right in the block delimited by the four arguments #1, #2, #3 and #4. If this rule would be in the block (it must not be drawn), the boolean \l_tmpa_bool is set to false.

The same for vertical rules.
The key corners

When the key `corners` is raised, the rules are not drawn in the corners. Of course, we have to compute the corners before we begin to draw the rules.

The sequence `\l_@@_corners_cells_seq` will be the sequence of all the empty cells (and not in a block) considered in the corners of the array.

Even if the user has used the key `corners` (or the key `hvlines-except-corners`), the list of cells in the corners may be empty.

You write on the aux file the list of the cells which are in the (empty) corners because you need that information in the `\CodeBefore` since the commands which color the rows, columns and cells must not color the cells in the corners.
“Computing a corner” is determining all the empty cells (which are not in a block) that belong to that corner. These cells will be added to the sequence \_corners_cells_seq.

The six arguments of \_compute_a_corner:nnnnnn are as follow:

- #1 and #2 are the number of row and column of the cell which is actually in the corner;
- #3 and #4 are the steps in rows and the step in columns when moving from the corner;
- #5 is the number of the final row when scanning the rows from the corner;
- #6 is the number of the final column when scanning the columns from the corner.

For the explanations and the name of the variables, we consider that we are computing the left-upper corner.

First, we try to determine which is the last empty cell (and not in a block: we won’t add that precision any longer) in the column of number 1. The flag \_tmpa_bool will be raised when a non-empty cell is found.

Now, you determine the last empty cell in the row of number 1.

Now, we loop over the rows.
We treat the row number \#1 with another loop.
\bool_set_false:N \l_tmpa_bool
\int_step_inline:nnnn { #2 } { #4 } \l_@@_last_empty_column_int
{ \@@_test_if_cell_in_a_block:nn { ##1 } { ####1 }
\bool_lazy_or:nnTF
\l_tmpb_bool
{ \cs_if_exist_p:c{ pgf @ sh @ ns @ \@@_env: - ##1 - ####1 }
}
{ \bool_set_true:N \l_tmpa_bool }
{ \bool_if:NF \l_tmpa_bool
{ \int_set:Nn \l_@@_last_empty_column_int { ####1 }
\seq_put_right:Nn \l_@@_corners_cells_seq { ##1 - ####1 }
}
}
}

The following macro tests whether a cell is in (at least) one of the blocks of the array (or in a cell with a \diagbox).
The flag \l_tmpb_bool will be raised if the cell \#1-\#2 is in a block (or in a cell with a \diagbox).
\cs_new_protected:Npn \@@_test_if_cell_in_a_block:nn #1 #2
{ \int_set:Nn \l_tmpa_int { #1 }
\int_set:Nn \l_tmpb_int { #2 }
\bool_set_false:N \l_tmpb_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
{ \@@_test_if_cell_in_block:nnnnnnn \l_tmpa_int \l_tmpb_int ##1 }
}
\cs_new_protected:Npn \@@_test_if_cell_in_block:nnnnnnn #1 #2 #3 #4 #5 #6
{ \int_compare:nNnT { #3 } < { \@@_succ:n { #1 } }
{ \int_compare:nNnT { #1 } < { \@@_succ:n { #2 } }
{ \int_compare:nNnT { #4 } < { \@@_succ:n { #5 } }
{ \int_compare:nNnT { #2 } < { \@@_succ:n { #6 } }
{ \bool_set_true:N \l_tmpb_bool }
}
}
}

The commands to draw dotted lines to separate columns and rows
These commands don’t use the normal nodes, the medium nor the large nodes. They only use the\col nodes and the \row nodes.

**Horizontal dotted lines**
The following command must *not* be protected because it’s meant to be expanded in a \noalign.
\noalign { \\skip_vertical:N 2 \l_@@_radius_dim }
\\@_hdottedline_i:
}

On the other side, the following command should be protected.
\cs_new_protected:Npn \@@_hdottedline_i:
{
\tl_gput_right:Nx \g_@@_internal_code_after_tl
{ \@@_hdottedline:n { \int_use:N \c@iRow } }
}

We write in the code-after the instruction that will actually draw the dotted line. It's not possible to draw this dotted line now because we don't know the length of the line (we don't even know the number of columns).
\AtBeginDocument
{
\We recall that, when externalization is used, \tikzpicture and \endtikzpicture (or \pgfpicture and \endpgfpicture) must be directly “visible”. That's why we construct now a version of \@@_hdottedline:n with the right environment (\begin{pgfpicture}\end{pgfpicture} or \begin{tikzpicture}...\end{tikzpicture}).
\cs_new_protected:Npx \@@_hdottedline:n #1
{
\bool_set_true:N \exp_not:N \l_@@_initial_open_bool
\bool_set_true:N \exp_not:N \l_@@_final_open_bool
\c_@@_pgfortikzpicture_tl
\@@_hdottedline_i:n { #1 }
\c_@@_endpgfortikzpicture_tl
}

The following command must be protected since it is used in the construction of \@@_hdottedline:n.
\cs_new_protected:Npn \@@_hdottedline_i:n #1
{
\pgfrememberpicturepositiononpagefalse
\\@_qpoint:n { row - #1 }
\We do a translation par \(-\l_@@_radius_dim\) because we want the dotted line to have exactly the same position as a vertical rule drawn by “|” (considering the rule having a width equal to the diameter of the dots).
\dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
\dim_sub:Nn \l_@@_y_initial_dim \l_@@_radius_dim
\dim_set_eq:NN \l_@@_y_final_dim \l_@@_y_initial_dim

The dotted line will be extended if the user uses margin (or left-margin and right-margin). The aim is that, by standard the dotted line fits between square brackets (\hline doesn’t).\begin{bNiceMatrix}
1 & 2 & 3 & 4 \\
\hline
1 & 2 & 3 & 4 \\
\hdottedline
1 & 2 & 3 & 4
\end{bNiceMatrix}
But, if the user uses margin, the dotted line extends to have the same width as a \hline.\begin{bNiceMatrix}[margin]
1 & 2 & 3 & 4 \\
\hline
1 & 2 & 3 & 4 \\
\hdottedline
1 & 2 & 3 & 4
\end{bNiceMatrix}
We do a reduction by \arraycolsep for the environments with delimiters (and not for the other).

\bool_if:NTF \l_@@_NiceArray_bool \c_zero_dim \arraycolsep
  \pgf@x +
\dim_set:Nn \l_@@_x_initial_dim
\@@_qpoint:n { col - \@@_succ:n \c@jCol }
\dim_set:Nn \l_@@_x_final_dim
\@@_qpoint:n { col - \@@_succ:n \c@jCol }
\pgf@x -
\dim_gadd:Nn \l_@@_x_initial_dim \arraycolsep
\bool_if:NTF \l_@@_NiceArray_bool \c_zero_dim \arraycolsep
  \pgf@x +
\dim_gsub:Nn \l_@@_x_final_dim \arraycolsep
For reasons purely aesthetic, we do an adjustment in the case of a rounded bracket. The correction by 0.5 \l_@@_inter_dots_dim is ad hoc for a better result.
\tl_if_eq:NnF \g_@@_left_delim_tl ( \dim_gadd:Nn \l_@@_x_initial_dim \l_@@_inter_dots_dim )
\tl_if_eq:NnF \g_@@_right_delim_tl ) \dim_gsub:Nn \l_@@_x_final_dim \l_@@_inter_dots_dim
Up to now, we have no option to control the style of the lines drawn by \hdottedline and the specifier “:” in the preamble. That’s why we impose the style standard.
\tl_set_eq:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl
\@@_draw_line:
Vertical dotted lines
\cs_new_protected:Npn \@@_vdottedline:n #1
\bool_set_true:N \l_@@_initial_open_bool
\bool_set_true:N \l_@@_final_open_bool
\pgfrememberpicturepositiononpagetrue
\@@_qpoint:n { col - \int_eval:n { #1 + 1 } }
\tl_if_eq:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl
\@@_vdottedline_i:n { #1 }
\pgfpicture
\@@_vdottedline_i:n { #1 }
\endpgfpicture
\CS@arc@
\pgfrememberpicturepositiononpagetrue
\@@_qpoint:n { col - \int_eval:n { #1 + 1 } }
The command \CT@arc@ is a command of colortbl which sets the color of the rules in the array. The package nicematrix uses it even if colortbl is not loaded.
We do a translation par -$\backslash_@@_radius_dim$ because we want the dotted line to have exactly the same position as a vertical rule drawn by “|” (considering the rule having a width equal to the diameter of the dots).

4997 \dim_set:Nn \l_@@_x_initial_dim { \pgf@x - \l_@@_radius_dim }
4998 \dim_set:Nn \l_@@_x_final_dim { \pgf@x - \l_@@_radius_dim }
4999 \@@_qpoint:n { row - 1 }

We arbitrary decrease the height of the dotted line by a quantity equal to $\l_@@_inter_dots_dim$ in order to improve the visual impact.

5000 \dim_set:Nn \l_@@_y_initial_dim { \pgf@y - 0.5 \l_@@_inter_dots_dim }
5001 \@@_qpoint:n { row - \@@_succ:n \c@iRow }
5002 \dim_set:Nn \l_@@_y_final_dim { \pgf@y + 0.5 \l_@@_inter_dots_dim }

Up to now, we have no option to control the style of the lines drawn by \hdottedline and the specifier “:” in the preamble. That’s why we impose the style standard.

5003 \tl_set_eq:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl
5004 \@@_draw_line:

The environment \texttt{\{NiceMatrixBlock\}}

The following flag will be raised when all the columns of the environments of the block must have the same width in “auto” mode.

5006 \bool_new:N \l_@@_block_auto_columns_width_bool

Up to now, there is only one option available for the environment \texttt{\{NiceMatrixBlock\}}.

5007 \keys_define:nn { NiceMatrix / NiceMatrixBlock } { auto-columns-width .code:n =
5008 { \bool_set_true:N \l_@@_block_auto_columns_width_bool
5009 \dim_gzero_new:N \g_@@_max_cell_width_dim
5010 \bool_set_true:N \l_@@_auto_columns_width_bool
5011 }
5012 \NewDocumentEnvironment { NiceMatrixBlock } { ! O { } } { auto-columns-width .code:n =
5013 { \bool_set_true:N \l_@@_block_auto_columns_width_bool
5014 \dim_gzero_new:N \g_@@_max_cell_width_dim
5015 \keys_set:nn { NiceMatrix / NiceMatrixBlock } { \l_@@_block_auto_columns_width_bool = false }{ \bool_if:NT \l_@@_block_auto_columns_width_bool
5016 { \cs_if_exist:cT { @@_max_cell_width_ \int_use:N \g_@@_NiceMatrixBlock_int }
5017 { \exp_args:NNc \dim_set:Nn \l_@@_columns_width_dim { @@_max_cell_width_ \int_use:N \g_@@_NiceMatrixBlock_int }
5018 } }
5019 }
5020 }
5021

At the end of the environment \texttt{\{NiceMatrixBlock\}}, we write in the main .aux file instructions for the column width of all the environments of the block (that’s why we have stored the number of the first environment of the block in the counter $\l_@@_first_env_block_int$).

5030 { \bool_if:NT \l_@@_block_auto_columns_width_bool
5031 { \iow_shipout:Nn \@mainaux \ExplSyntaxOn
5032 \iow_shipout:Nx \@mainaux
5033 \ExplSyntaxOff
5034 \iow_shipout:Nx \@mainaux
5035 }

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The extra nodes

First, two variants of the functions \texttt{\texttt{dim}min:nn} and \texttt{\texttt{dim}max:nn}.

\begin{verbatim}
\cs_generate_variant:Nn \dim_min:nn { v n }
\cs_generate_variant:Nn \dim_max:nn { v n }
\end{verbatim}

The following command is called in \texttt{\@@usearrayboxwithnotes_c}: just before the construction of the blocks (if the creation of medium nodes is required, medium nodes are also created for the blocks and that construction uses the standard medium nodes).

\begin{verbatim}
\cs_new_protected:Npn \@@create_extra_nodes:
{ 
\bool_if:nTF \l_@@medium_nodes_bool
{ 
\bool_if:NTF \l_@@large_nodes_bool
\@@create_medium_and_large_nodes:
\@@create_medium_nodes:
} 
\bool_if:NT \l_@@large_nodes_bool \@@create_large_nodes: }
\end{verbatim}

We have three macros of creation of nodes: \texttt{\@@create_medium_nodes:}, \texttt{\@@create_large_nodes:} and \texttt{\@@create_medium_and_large_nodes:}.

We have to compute the mathematical coordinates of the “medium nodes”. These mathematical coordinates are also used to compute the mathematical coordinates of the “large nodes”. That’s why we write a command \texttt{\@@computations_for_medium_nodes:} to do these computations.

The command \texttt{\@@computations_for_medium_nodes:} must be used in a \texttt{\{pgfpicture\}}.

For each row \(i\), we compute two dimensions \(l_{\@@row_i} \text{min} \text{dim}\) and \(l_{\@@row_i} \text{max} \text{dim}\). The dimension \(l_{\@@row_i} \text{min} \text{dim}\) is the minimal \(y\)-value of all the cells of the row \(i\). The dimension \(l_{\@@row_i} \text{max} \text{dim}\) is the maximal \(y\)-value of all the cells of the row \(i\).

Similarly, for each column \(j\), we compute two dimensions \(l_{\@@column_j} \text{min} \text{dim}\) and \(l_{\@@column_j} \text{max} \text{dim}\). The dimension \(l_{\@@column_j} \text{min} \text{dim}\) is the minimal \(x\)-value of all the cells of the column \(j\). The dimension \(l_{\@@column_j} \text{max} \text{dim}\) is the maximal \(x\)-value of all the cells of the column \(j\).

Since these dimensions will be computed as maximum or minimum, we initialize them to \(\texttt{c} \text{max} \text{dim}\) or \(-\texttt{c} \text{max} \text{dim}\).
We begin the two nested loops over the rows and the columns of the array.

\int_step_variable:nnNn \l_@@_first_row_int \g_@@_row_total_int \@@_i:
\int_step_variable:nnNn \l_@@_first_col_int \g_@@_col_total_int \@@_j:

If the cell \((i-j)\) is empty or an implicit cell (that is to say a cell after implicit ampersands \&) we don’t update the dimensions we want to compute.

\cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - \@@_i: - \@@_j: \}

We retrieve the coordinates of the anchor south west of the (normal) node of the cell \((i-j)\). They will be stored in \texttt{\pgf@x} and \texttt{\pgf@y}.

\pgfpointanchor { \@@_env: - \@@_i: - \@@_j: } { south west }
\dim_set:cn { \l_@@_row_\@@_i: _min_dim } { \dim_min:vn { \l_@@_row_\@@_i: _min_dim } \pgf@y }
\seq_if_in:NxF \g_@@_multicolumn_cells_seq { \@@_i: - \@@_j: } {
\dim_set:cn { \l_@@_column_\@@_j: _min_dim } { \dim_min:vn { \l_@@_column_\@@_j: _min_dim } \pgf@x }
}

We retrieve the coordinates of the anchor north east of the (normal) node of the cell \((i-j)\). They will be stored in \texttt{\pgf@x} and \texttt{\pgf@y}.

\pgfpointanchor { \@@_env: - \@@_i: - \@@_j: } { north east }
\dim_set:cn { \l_@@_row_\@@_i: _max_dim } { \dim_max:vn { \l_@@_row_\@@_i: _max_dim } \pgf@y }
\seq_if_in:NxF \g_@@_multicolumn_cells_seq { \@@_i: - \@@_j: } {
\dim_set:cn { \l_@@_column_\@@_j: _max_dim } { \dim_max:vn { \l_@@_column_\@@_j: _max_dim } \pgf@x }
}

Now, we have to deal with empty rows or empty columns since we don’t have created nodes in such rows and columns.

\int_step_variable:nnNn \l_@@_first_row_int \g_@@_row_total_int \@@_i:
\int_step_variable:nnNn \l_@@_first_col_int \g_@@_col_total_int \@@_j:
Here is the command \@@_create_medium_nodes: . When this command is used, the “medium nodes”
are created.
\cs_new_protected:Npn \@@_create_medium_nodes: 
{ \begin{pgfpicture} \pgfrememberpicturepositiononpagetrue \pgf@relevantforpicturesizefalse \@@_computations_for_medium_nodes: \endpgfpicture }

Now, we can create the “medium nodes”. We use a command \@@_create_nodes: because this
command will also be used for the creation of the “large nodes”.
\tl_set:Nn \l_@@_suffix_tl { -medium } \@@_create_nodes: \endpgfpicture

The command \@@_create_large_nodes: must be used when we want to create only the “large
nodes” and not the medium ones. However, the computation of the mathematical coordinates
of the “large nodes” needs the computation of the mathematical coordinates of the “medium
nodes”. Hence, we use first \@@_computations_for_medium_nodes: and then the command
\@@_computations_for_large_nodes:.
\cs_new_protected:Npn \@@_create_large_nodes: 
{ \begin{pgfpicture} \pgfrememberpicturepositiononpagetrue \pgf@relevantforpicturesizefalse \@@_computations_for_medium_nodes: \@@_computations_for_large_nodes: \tl_set:Nn \l_@@_suffix_tl { -large } \@@_create_nodes: \endpgfpicture }

For “large nodes”, the exterior rows and columns don’t interfere. That’s why the loop over the columns
will start at 1 and stop at \c@jCol (and not \g_@@_col_total_int ). Idem for the rows.
\cs_new_protected:Npn \@@_create_medium_and_large_nodes: 
{ \begin{pgfpicture} \pgfrememberpicturepositiononpagetrue \pgf@relevantforpicturesizefalse \@@_computations_for_medium_nodes: \@@_computations_for_large_nodes: \tl_set:Nn \l_@@_suffix_tl { -medium } \@@_create_nodes: \@@_computations_for_large_nodes: \tl_set:Nn \l_@@_suffix_tl { -large } \@@_create_nodes: \endpgfpicture }

\textsuperscript{64}If we want to create both, we have to use \@@_create_medium_and_large_nodes:
We have to change the values of all the dimensions \texttt{l_row}_{i} \texttt{min_dim}, \texttt{l_row}_{i} \texttt{max_dim}, \texttt{l_column}_{j} \texttt{min_dim} and \texttt{l_column}_{j} \texttt{max_dim}.

\begin{verbatim}
\int_step_variable:nNn \{ c@iRow - 1 \} \@@_i:
\{ \dim_set:cn \{ l_@@_row_ \@@_i: _ min _ dim \}
\{ \dim_use:c \{ l_@@_row_ \@@_i: _ min _ dim \} + \dim_use:c \{ l_@@_row_ \@@_succ:n \@@_i: _ max _ dim \}
\}/ 2
\dim_set_eq:cc \{ l_@@_row_ \@@_i: _ succ:n \@@_max_dim \}
\{ l_@@_row_ \@@_i: _ min_dim \}
\}
\int_step_variable:nNn \{ c@jCol - 1 \} \@@_j:
\{ \dim_set:cn \{ l_@@_column_ \@@_j: _ max _ dim \}
\{ \dim_use:c \{ l_@@_column_ \@@_j: _ max _ dim \} + \dim_use:c \{ l_@@_column_ \@@_succ:n \@@_j: _ min _ dim \}
\}/ 2
\dim_set_eq:cc \{ l_@@_column_ \@@_j: _ succ:n \@@_min_dim \}
\{ l_@@_column_ \@@_j: _ max_dim \}
\}
\end{verbatim}

Here, we have to use \texttt{\textbackslash dim_sub:cn} because of the number 1 in the name.

\begin{verbatim}
\dim_sub:cn
\{ l_@@_column_ 1 _ min _ dim \}
\l_@@_left_margin_dim
\dim_add:cn
\{ l_@@_column_ \int_use:N \c@jCol _ max _ dim \}
\l_@@_right_margin_dim
\}
\end{verbatim}

The command \texttt{\textbackslash @@_create_nodes:} is used twice: for the construction of the “medium nodes” and for the construction of the “large nodes”. The nodes are constructed with the value of all the dimensions \texttt{l_row}_{i} \texttt{min_dim}, \texttt{l_row}_{i} \texttt{max_dim}, \texttt{l_column}_{j} \texttt{min_dim} and \texttt{l_column}_{j} \texttt{max_dim}. Between the construction of the “medium nodes” and the “large nodes”, the values of these dimensions are changed.

The function also uses \texttt{\textbackslash l_@@_suffix_tl} (-medium or -large).

\begin{verbatim}
\cs_new_protected:Npn \@@_create_nodes:
\{ \int_step_variable:nnNn \l_@@_first_row_int \g_@@_row_total_int \@@_i:
\{ \int_step_variable:nnNn \l_@@_first_col_int \g_@@_col_total_int \@@_j:
\{ \@@_pgf_rect_node:nnnn
\{ \l_@@_env: - \@@_i: - \@@_j: \l_@@_suffix_tl \}
\{ \dim_use:c \{ l_@@_column_ \@@_j: _ min_dim \} \}
\{ \dim_use:c \{ l_@@_row_ \@@_i: _ min_dim \} \}
\{ \dim_use:c \{ l_@@_column_ \@@_j: _ max_dim \} \}
\{ \dim_use:c \{ l_@@_row_ \@@_i: _ max_dim \} \}
\str_if_empty:NF \l_@@_name_str
\{ pgfnodealias
\{ \l_@@_name_str - \@@_i: - \@@_j: \l_@@_suffix_tl \}
\}
\end{verbatim}
Now, we create the nodes for the cells of the \texttt{\multicolumn}. We recall that we have stored in \texttt{\g_@@_multicolumn_cells_seq} the list of the cells where a \texttt{\multicolumn\{n\}\{...\}\{...\}} with $n>1$ was issued and in \texttt{\g_@@_multicolumn_sizes_seq} the correspondent values of $n$.

\begin{verbatim}
\seq_mapthread_function:NNN \g_@@_multicolumn_cells_seq \g_@@_multicolumn_sizes_seq \@@_node_for_multicolumn:nn
\end{verbatim}

The command \texttt{\@@_node_for_multicolumn:nn} takes two arguments. The first is the position of the cell where the command \texttt{\multicolumn\{n\}\{...\}\{...\}} was issued in the format $i$-$j$ and the second is the value of $n$ (the length of the “multi-cell”).

\begin{verbatim}
\cs_new_protected:Npn \@@_extract_coords_values: #1 - #2 \q_stop
{ \cs_set_nopar:Npn \@@_i: { #1 } \cs_set_nopar:Npn \@@_j: { #2 } }
\end{verbatim}

The blocks

The code deals with the command \texttt{\Block}. This command has no direct link with the environment \texttt{\NiceMatrixBlock}. The options of the command \texttt{\Block} will be analyzed first in the cell of the array (and once again when the block will be put in the array). Here is the set of keys for the first pass.

\begin{verbatim}
\keys_define:nn { NiceMatrix / Block / FirstPass }
{ l .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl l , l .value_forbidden:n = true , r .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl r , r .value_forbidden:n = true , c .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl c , c .value_forbidden:n = true , L .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl l , L .value_forbidden:n = true , R .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl r , R .value_forbidden:n = true , C .code:n = \tl_set:Nn \l_@@_hpos_of_block_tl c ,}
\end{verbatim}

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The following command `\@_Block:` will be linked to `\Block` in the environments of `nicematrix`. We define it with `\NewExpandableDocumentCommand` because it has an optional argument between `<` and `>` (for TeX instructions put before the math mode of the label and before the beginning of the small array of the block). It’s mandatory to use an expandable command.

\begin{verbatim}
\NewExpandableDocumentCommand \@@_Block: { O { } m D < > { } m }
{ If the first mandatory argument of the command (which is the size of the block with the syntax i-j) has not be provided by the user, you use 1-1 (that is to say a block of only one cell).
\peek_remove_spaces:n
{ \tl_if_blank:nTF { #2 } { \@@_Block_i 1-1 \q_stop } { \@@_Block_i #2 \q_stop } { #1 } { #3 } { #4 } }
}
\end{verbatim}

With the following construction, we extract the values of i and j in the first mandatory argument of the command.

\begin{verbatim}
\cs_new:Npn \@@_Block_i #1-#2 \q_stop { \@@_Block_ii:nnnnn { #1 } { #2 } { #3 } { #4 } { #5 } }
\end{verbatim}

Now, the arguments have been extracted: #1 is i (the number of rows of the block), #2 is j (the number of columns of the block), #3 is the list of key-values, #4 are the tokens to put before the math mode and the beginning of the small array of the block and #5 is the label of the block.

\begin{verbatim}
\cs_new_protected:Npn \@@_Block_ii:nnnnn #1 #2 #3 #4 #5
{ We recall that #1 and #2 have been extracted from the first mandatory argument of `\Block` (which is of the syntax i-j). However, the user is allowed to omit i or j (or both). We detect that situation by replacing a missing value by 100 (it’s a convention: when the block will actually be drawn these values will be detected and interpreted as maximal possible value according to the actual size of the array).
\bool_lazy_or:nnTF
{ \tl_if_blank:nF { #1 } }
{ \str_if_eq_p:nn { #1 } { * } }
{ \int_set:Nn \l_tmpa_int { 100 } }
{ \int_set:Nn \l_tmpa_int { #1 } }
\bool_lazy_or:nnTF
{ \tl_if_blank:nF { #2 } }
{ \str_if_eq_p:nn { #2 } { * } }
{ \int_set:Nn \l_tmpb_int { 100 } }
{ \int_set:Nn \l_tmpb_int { #2 } }
}
\end{verbatim}

If the block is mono-column.

\begin{verbatim}
\bool_lazy_or:nTF \l_tmpb_int = 1
{ \tl_if_empty:NTF \l_@@_cell_type_tl }
{ \tl_set:Nn \l_@@_hpos_of_block_tl c }
{ \tl_set_eq:NN \l_@@_hpos_of_block_tl \l_@@_cell_type_tl }
{ \tl_set:Nn \l_@@_hpos_of_block_tl c }
\end{verbatim}

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The value of \l_@hpos_of_block_tl may be modified by the keys of the command Block that we will analyze now.

\keys_set_known:nn { NiceMatrix / Block / FirstPass } { #3 }
\tl_set:Nx \l_ttmpa_tl
\{ { \int_use:N \c@iRow } { \int_use:N \c@jCol } { \int_eval:n { \c@iRow + \l_ttmpa_int - 1 } } { \int_eval:n { \c@jCol + \l_ttmpb_int - 1 } } \}

Now, \l_ttmpa_tl contains an “object” corresponding to the position of the block with four components, each of them surrounded by curly brackets: \{imin\}(jmin\}(imax\}(jmax).

If the block is mono-column or mono-row, we have a special treatment. That’s why we have two macros: \@@_Block_iv:nnnnn and \@@_Block_v:nnnnn (the five arguments of those macros are provided by curryfication).

\bool_if:nTF
\{ \int_compare_p:nNn { \l_ttmpa_int } = 1 || \int_compare_p:nNn { \l_ttmpb_int } = 1 \}
&& \tl_if_empty_p:n { #5 }
\exp_args:Nxx \@@_Block_iv:nnnnn \{ \l_ttmpa_int \} { \l_ttmpb_int } { #3 } { #4 } { #5 }

The following macro is for the case of a Block which is mono-row or mono-column (or both). In that case, the content of the block is composed right now in a box (because we have to take into account the dimensions of that box for the width of the current column or the height and the depth of the current row). However, that box will be put in the array after the construction of the array (by using \pgf).

\cs_new_protected:Npn \@@_Block_iv:nnnnn \#1 \#2 \#3 \#4 \#5
\{ \int_gincr:N \g_@@_block_box_int \cs_set_protected_nopar:Npn \diagbox ##1 ##2
\{ \tl_gput_right:Nx \g_@@_internal_code_after_tl
\{ \int_use:N \c@iRow \} { \int_use:N \c@jCol } { \int_eval:n { \c@iRow + \#1 - 1 } } { \int_eval:n { \c@jCol + \#2 - 1 } } \exp_not:n { ##1 } { \exp_not:n { ##2 } }\}
\box_gclear_new:c
\{ \g_@@_ actually_diagbox:nnnnnn \}
\tl_gput_right:Nx \g_@@_internal_code_after_tl
\{ \g_@@_actually_diagbox:nnnnnn \}
\box_gclear_new:c
\{ \g_@@_block_box_int \int_use:N \g_@@_block_box_int \}
\box_gset:cn
\{ \g_@@_block_box_int \int_use:N \g_@@_block_box_int \}
\}

For a mono-column block, if the user has specified a color for the column in the preamble of the array, we want to fix that color in the box we construct. We do that with \set@color and not \color_ensure_current: (in order to use \color_ensure_current: safely, you should load l3backend before the \documentclass with \RequirePackage{expl3}).
If the block is mono-row, we use \texttt{g@@row_style_tl} even it has yet been used in the beginning of the cell where the command \texttt{Block} has been issued because we want to be able to take into account a potential instruction of color of the font in \texttt{g@@row_style_tl}.

If the box is rotated (the key \texttt{rotate} may be in the previous \texttt{#4}), the tabular used for the content of the cell will be constructed with a format \texttt{c}. In the other cases, the tabular will be constructed with a format equal to the key of position of the box. In other words: the alignment internal to the tabular is the same as the external alignment of the tabular (that is to say the position of the block in its zone of merged cells).

If we are in a mono-column block, we take into account the width of that block for the width of the column.
If we are in a mono-row block, we take into account the height and the depth of that block for the height and the depth of the row.

\int_compare:nNnT { #1 } = 1
{
\dim_gset:Nn \g_@@_blocks_ht_dim
{ \dim_max:nn \g_@@_blocks_ht_dim
 \box_ht:c
{ \g_@@_block_box \int_use:N \g_@@_block_box_int_box }
}
\dim_gset:Nn \g_@@_blocks_dp_dim
{ \dim_max:nn \g_@@_blocks_dp_dim
 \box_dp:c
{ \g_@@_block_box \int_use:N \g_@@_block_box_int_box }
}
\seq_gput_right:Nx \g_@@_blocks_seq
{ \l_tmpa_tl
{ \exp_not:n { #3 } \l_@@_hpos_of_block_tl }
\exp_not:n
{ \case { \bool_if:NTF \l_@@_NiceTabular_bool
{ \group_begin:
\cs_set:Npn \arraystretch { 1 }
\dim_set_eq:NN \extrarowheight \c_zero_dim
\l_@@_hpos_of_block_tl
\exp_not:n { #3 } \l_@@_hpos_of_block_tl
\group_end:
\arraystretch \l_@@_hpos_of_block_tl
\l_@@_hpos_of_block_tl
\exp_not:n
{ \case { \l_tmpa_tl
{ \exp_not:n { #3 } }
\exp_not:n
{ \bool_if:NTF \l_@@_NiceTabular_bool
{ \group_begin:
\cs_set:Npn \arraystretch { 1 }
\dim_set_eq:NN \extrarowheight \c_zero_dim
\l_@@_hpos_of_block_tl
\exp_not:n { #3 } \l_@@_hpos_of_block_tl
\group_end:
\arraystretch \l_@@_hpos_of_block_tl
\l_@@_hpos_of_block_tl

In the list of options #3, maybe there is a key for the horizontal alignment (l, r or c). In that case, that key has been read and stored in \l_@@_hpos_of_block_tl. However, maybe there were no key of the horizontal alignment and that’s why we put a key corresponding to the value of \l_@@_hpos_of_block_tl, which is fixed by the type of current column.

The following macro is for the standard case, where the block is not mono-row and not mono-column. In that case, the content of the block is not composed right now in a box. The composition in a box will be done further, just after the construction of the array.

\cs_new_protected:Npn \@@_Block_v:nnnnn #1 #2 #3 #4 #5
{ \seq_gput_right:Nx \g_@@_blocks_seq
{ \l_tmpa_tl
{ \exp_not:n { #3 } \l_@@_hpos_of_block_tl
\exp_not:n
{ \case { \bool_if:NTF \l_@@_NiceTabular_bool
{ \group_begin:
\cs_set:Npn \arraystretch { 1 }
\dim_set_eq:NN \extrarowheight \c_zero_dim
\l_@@_hpos_of_block_tl
\exp_not:n { #3 } \l_@@_hpos_of_block_tl
\group_end:
\arraystretch \l_@@_hpos_of_block_tl
\l_@@_hpos_of_block_tl
\exp_not:n
{ \case { \l_tmpa_tl
{ \exp_not:n { #3 } }
\exp_not:n
{ \bool_if:NTF \l_@@_NiceTabular_bool
{ \group_begin:
\cs_set:Npn \arraystretch { 1 }
\dim_set_eq:NN \extrarowheight \c_zero_dim
\l_@@_hpos_of_block_tl
\exp_not:n { #3 } \l_@@_hpos_of_block_tl
\group_end:
\arraystretch \l_@@_hpos_of_block_tl
\l_@@_hpos_of_block_tl

If the box is rotated (the key \rotate may be in the previous #4), the tabular used for the content of the cell will be constructed with a format c. In the other cases, the tabular will be constructed with a format equal to the key of position of the box. In other words: the alignment internal to the tabular is the same as the external alignment of the tabular (that is to say the position of the block in its zone of merged cells).
We recall that the options of the command \Block are analyzed twice: first in the cell of the array and once again when the block will be put in the array after the construction of the array (by using PGF).

\keys_define:nn { NiceMatrix / Block / SecondPass }{
The command \@@_draw_blocks: will draw all the blocks. This command is used after the construction of the array. We have to revert to a clean version of \ialign because there may be tabulars in the \Block instructions that will be composed now.

\cs_new_protected:Npn \@@_draw_blocks:
\begin{Verbatim}
\cs_set_eq:NN \ialign \@@_old_ialign:
\seq_map_inline:Nn \g_@@_blocks_seq { \@@_Block_iv:nnnnnn ##1 }
\end{Verbatim}
\cs_new_protected:Npn \@@_Block_iv:nnnnnn #1 #2 #3 #4 #5 #6
\begin{Verbatim}
\int_zero_new:N \l_@@_last_row_int
\int_zero_new:N \l_@@_last_col_int
\end{Verbatim}

The integer \l_@@_last_row_int will be the last row of the block and \l_@@_last_col_int its last column.

\int_compare:nNnTF { \l_@@_last_row_int } > { 99 }
\begin{Verbatim}
\int_set_eq:NN \l_@@_last_row_int \c@iRow
\int_set:Nn \l_@@_last_row_int { #3 }
\end{Verbatim}
\int_compare:nNnTF { \l_@@_last_col_int } > { 99 }
\begin{Verbatim}
\int_set_eq:NN \l_@@_last_col_int \c@jCol
\int_set:Nn \l_@@_last_col_int { #4 }
\end{Verbatim}
\int_compare:nNnTF \l_@@_last_col_int > \g_@@_col_total_int
\begin{Verbatim}
\int_compare:nTF { \l_@@_last_col_int <= \g_@@_static_num_of_col_int }
\begin{Verbatim}
{ \msg_error:nnnn { nicematrix } { Block-too-large-2 } { #1 } { #2 }
\@@_msg_redirect_name:nn { Block-too-large-2 } { none }
\group_begin:
\globaldefs = 1
\@@_msg_redirect_name:nn { columns-not-used } { none }
\group_end:
}
\end{Verbatim}
\end{Verbatim}
\int_compare:nTF \l_@@_last_row_int > \g_@@_row_total_int
\begin{Verbatim}
{ \int_compare:nNnTF \l_@@_last_row_int > \g_@@_row_total_int
\end{Verbatim}
The sequence of the positions of the blocks will be used when drawing the rules (in fact, there is also \texttt{\multicolumn} and \texttt{\diagbox} in that sequence).

The group is for the keys.

\begin{verbatim}
\group_begin:
\keys_set:nn { NiceMatrix / Block / SecondPass } { #5 }
\bool_if:NT \l_@@_hvlines_block_bool { \tl_gput_right:Nx \g_nicematrix_code_after_tl {
    \@@_hvlines_block:nnn { \exp_not:n { #5 } } { #1 - #2 } { \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}
\tl_if_empty:NF \l_@@_draw_tl { \tl_gput_right:Nx \g_nicematrix_code_after_tl {
    \@@_stroke_block:nnn { \exp_not:n { #5 } } { #1 - #2 } { \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}\seq_gput_right:Nn \g_@@_pos_of_stroken_blocks_seq { { #1 } { #2 } { #3 } { #4 } }
}\clist_if_empty:NF \l_@@_borders_clist { \tl_gput_right:Nx \g_nicematrix_code_after_tl {
    \@@_stroke_borders_block:nnn { \exp_not:n { #5 } } { #1 - #2 } { \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}\tl_if_empty:NF \l_@@_fill_tl { \exp_last_unbraced:NV \@@_extract_brackets \l_@@_fill_tl \q_stop \exp_not:N \roundedrectanglecolor [ \l_tmpa_tl ] { \exp_not:V \l_tmpb_tl } { #1 - #2 } { \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int } { \dim_use:N \l_@@_rounded_corners_dim }
}
}\end{verbatim}

The command \texttt{\@@\_extract\_brackets} will extract the potential specification of color space at the beginning of \texttt{\l_@@\_fill\_tl} and store it in \texttt{\l\_tmpa\_tl} and store the color itself in \texttt{\l\_tmpb\_tl}.

\begin{verbatim}
\exp_last_unbraced:NV \@@_extract_brackets \l_@@_fill_tl \q_stop
\tl_gput_right:Nx \g_nicematrix_code_before_tl { \exp_not:N \roundedrectanglecolor [ \l_tmpa_tl ] { \exp_not:N \l_tmpb_tl } { #1 - #2 } { \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int } { \dim_use:N \l_@@_rounded_corners_dim }
\end{verbatim}
Let’s consider the following \texttt{\verb|NiceTabular|}. Because of the instruction \verb|!{\hspace{1cm}}| in the preamble which increases the space between the columns (by adding, in fact, that space to the previous column, that is to say the second column of the tabular), we will create \textit{two} nodes relative to the block: the node \texttt{1-1-block} and the node \texttt{1-1-block-short}.

\begin{NiceTabular}{cc!{\hspace{1cm}}c}
\Block{2-2}{our block} & & one \\
 & & two \\
three & four & five \\
six & seven & eight \\
\end{NiceTabular}

We highlight the node \texttt{1-1-block} and \texttt{1-1-block-short}.

The construction of the node corresponding to the merged cells.
We construct the node for the block with the name (#1-#2-block).
The function \@pgf_rect_node:nnnnn takes in as arguments the name of the node and the four
coordinates of two opposite corner points of the rectangle.

\begin{pgfscope}
\@@_pgf_rect_node:nnnnn
\{ \@@_env: - #1 - #2 - block \}
\l_tmpb_dim \l_tmpa_dim \l_tmpd_dim \l_tmpc_dim
\end{pgfscope}

Now, we create the “short node” which, in general, will be used to put the label (that is to say
the content of the node). However, if one the keys L, C or R is used (that information is provided by the
boolean \l_@@_hpos_of_block_cap_bool), we don’t need to create that node since the normal node
is used to put the label.

\bool_if:NF \l_@@_hpos_of_block_cap_bool
{ \dim_set_eq:NN \l_tmpb_dim \c_max_dim

The short node is constructed by taking into account the \textit{contents} of the columns involved in at least
one cell of the block. That’s why we have to do a loop over the rows of the array.

\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
{ }

We recall that, when a cell is empty, no (normal) node is created in that cell. That’s why we test the
existence of the node before using it.

\cs_if_exist:cT
{ \pgf @ sh @ ns @ \@@_env: - ##1 - #2 }
{ 
\seq_if_in:NnF \g_@@_multicolumn_cells_seq { ##1 - #2 }
{ 
\pgfpointanchor { \@@_env: - ##1 - #2 } { west }
\dim_set:Nn \l_tmpb_dim { \dim_min:nn \l_tmpb_dim \pgf@x }
}
}

If all the cells of the column were empty, \l_tmpb_dim has still the same value \c_max_dim. In that
case, you use for \l_tmpb_dim the value of the position of the vertical rule.

\dim_compare:nNnT \l_tmpb_dim = \c_max_dim
{ \@@_qpoint:n { col - #2 }
\dim_set_eq:NN \l_tmpb_dim \pgf@x
}
\dim_set:Nn \l_tmpd_dim { - \c_max_dim }
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
{ \cs_if_exist:cT
{ \pgf @ sh @ ns @ \@@_env: - ##1 - \int_use:N \l_@@_last_col_int }
{ 
\seq_if_in:NnF \g_@@_multicolumn_cells_seq { ##1 - #2 }
{ 
\pgfpointanchor
{ \@@_env: - ##1 - \int_use:N \l_@@_last_col_int }
{ east }
\dim_set:Nn \l_tmpd_dim { \dim_max:nn \l_tmpd_dim \pgf@x }
}
}
\dim_compare:nNnT \l_tmpd_dim = \c_max_dim
{ \@@_qpoint:n { col - \@@_succ:n { \l_@@_last_col_int } }
\dim_set_eq:NN \l_tmpd_dim \pgf@x
}
\@@_pgf_rect_node:nnnnn

\end{document}
If the creation of the “medium nodes” is required, we create a “medium node” for the block. The function \@@_pgf_rect_node:nnn takes in as arguments the name of the node and two PGF points.

\bool_if:NT \l_@@_medium_nodes_bool
\@@_pgf_rect_node:nnn
\pgfpointanchor \@@_env: - #1 - #2 - medium
\pgfpointanchor \@@_env: - #1 - #2 - medium
\pgftransformshift { \pgfpoint \pgf@x \l_tmpa_dim }

Now, we will put the label of the block beginning with the case of a Block of one row.

\int_compare:nNnTF { #1 } = { #3 }
\int_compare:nNnTF { #1 } = 0
\int_compare:nNnT { #1 } = \l_@@_last_row_int
\l_@@_code_for_first_row_tl
\int_compare:nNnT { #1 } = \l_@@_last_col_int - medium
\l_@@_code_for_last_row_tl

If the block has only one row, we want the label of the block perfectly aligned on the baseline of the row. That’s why we have constructed a \pgfcoordinate on the baseline of the row, in the first column of the array. Now, we retrieve the y-value of that node and we store it in \l_tmpa_dim.

\pgfextracty \l_tmpa_dim \@@_qpoint:n { row - #1 - base }

We retrieve (in \pgf@x) the x-value of the center of the block.

\pgfpointanchor \@@_env: - #1 - #2 - block
\bool_if:NF \l_@@_hpos_of_block_cap_bool { - short }
\str_case:Vn \l_@@_hpos_of_block_tl
\l_@@_hpos_of_block_tl
\pgftransformshift \pgfpoint \pgf@x \l_tmpa_dim
\pgfset { inner-sep = \c_zero_dim }

We put the label of the block which has been composed in \l_@@_cell_box.
If the number of rows is different of 1, we will put the label of the block by using the short node (the label of the block has been composed in \l_@@_cell_box).

If we are in the first column, we must put the block as if it was with the key r.

\int_compare:nNnT { #2 } = 0
\tl_set:Nn \l_@@_hpos_of_block_tl r
\bool_if:nN \g_@@_last_col_found_bool
{ \int_compare:nNnT { #2 } = \g_@@_col_total_int
  \tl_set:Nn \l_@@_hpos_of_block_tl l
}
\pgftransformshift
{ \pgfpointanchor
{ \@@_env: - #1 - #2 - block
\bool_if:NF \l_@@_hpos_of_block_cap_bool { - short }
}{ \str_case:Vn \l_@@_hpos_of_block_tl
  \str_case:Vn \l_@@_hpos_of_block_tl
  \str_case:Vn \l_@@_hpos_of_block_tl
  c { center }
  l { west }
  r { east }
}
}{ \box_use_drop:N \l_@@_cell_box } { } { }
endpgfpicture
\group_end:

\NewDocumentCommand \@@_extract_brackets { O { } }
{ \tl_set:Nn \l_tmpa_tl { #1 }
  \@@_store_in_tmpb_tl
\cs_new_protected:Npn \@@_store_in_tmpb_tl #1 \q_stop
{ \tl_set:Nn \l_tmpb_tl { #1 } }
\endpgfpicture
\group_end:

The first argument of \@@_stroke_block:nnn is a list of options for the rectangle that you will stroke. The second argument is the upper-left cell of the block (with, as usual, the syntax i-j) and the third is the last cell of the block (with the same syntax).
\cs_new_protected:Npn \@@_stroke_block:nnn \#1 \#2 \#3
If the user has used the key `color` of the command \texttt{Block} without value, the color fixed by \texttt{arrayrulecolor} is used.

If the user has used the key `color` of the command \texttt{Block} without value, the color fixed by \texttt{arrayrulecolor} is used.

We can’t use \texttt{pgfusepathqstroke} because of the key rounded-corners.

Here is the set of keys for the command \texttt{\_\_\_stroke_block:nnn}.

The first argument of \texttt{\_\_\_hvlines_block:nnn} is a list of options for the rules that we will draw.
The second argument is the upper-left cell of the block (with, as usual, the syntax $i$-$j$) and the third is the last cell of the block (with the same syntax).

```latex
\cs_new_protected:Npn \@@_hvlines_block:nnn #1 #2 #3
\{ \dim_set_eq:NN \l_@@_line_width_dim \arrayrulewidth
\keys_set_known:nn \{ NiceMatrix / BlockBorders \} \{ #1 \}
\@@_cut_on_hyphen:w \#2 \q_stop
\tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl
\tl_set_eq:NN \l_tmpd_tl \l_tmpb_tl
\@@_cut_on_hyphen:w \#3 \q_stop
\tl_set_eq:NN \l_tmpa_tl \l_tmpa_tl + 1
\tl_set_eq:NN \l_tmpb_tl \l_tmpb_tl + 1
\pgfpicture
\pgfreememberpicturepositiononpagetrue
\pgfrelevantforpicturesizefalse
\CT@arc@
\pgfsetlinewidth \l_@@_line_width_dim
\beginpgfpicture
\@@_qpoint:n \row - \l_tmpa_tl \dim_set_eq:NN \l_tmpa_dim \pgf@y
\@@_qpoint:n \row - \l_tmpc_tl \dim_set_eq:NN \l_tmpb_dim \pgf@y
\int_step_inline:nnn \l_tmpd_tl \l_tmpb_tl
{ \@@_qpoint:n \col - \l_tmpa_tl \pgfpathmoveto \pgfpoint \pgf@x \l_tmpa_dim
\pgfpathlineto \pgfpoint \pgf@x \l_tmpb_dim
\pgfusepathqstroke }
\endpgfpicture
\}
\endpgfpicture
\}
\endpgfpicture
```

The first argument of \@@_stroke_borders_block:nnn is a list of options for the borders that you will stroke. The second argument is the upper-left cell of the block (with, as usual, the syntax $i$-$j$) and the third is the last cell of the block (with the same syntax).

```latex
\cs_new_protected:Npn \@@_stroke_borders_block:nnn #1 #2 #3
\{ \dim_set_eq:NN \l_@@_line_width_dim \arrayrulewidth
\keys_set_known:nn \{ NiceMatrix / BlockBorders \} \{ #1 \}
\dim_compare:nNnTF \l_@@_rounded_corners_dim > \c_zero_dim
{ \@@_error:n \{ borders\_forbidden \}
\clist_map_inline:Nn \l_@@_borders_clist
{ \clist_if_in:nnF \{ top , bottom , left , right \} \{ ##1 \}
\@@_error:nn \{ bad\_border \} \{ ##1 \}
}
\@@_cut_on_hyphen:w \#2 \q_stop
\tl_set_eq:NN \l_tmpc_tl \l_tmpa_tl
\beginpgfpicture
\pgfreememberpicturepositiononpagetrue
\pgfrelevantforpicturesizefalse
\CT@arc@
\pgfsetlinewidth \l_@@_line_width_dim
\beginpgfpicture
\@@_qpoint:n \col - \l_tmpa_tl \dim_set_eq:NN \l_tmpa_dim \pgf@x + 0.5 \arrayrulewidth
\@@_qpoint:n \col - \l_tmpc_tl \dim_set_eq:NN \l_tmpb_dim \pgf@x - 0.5 \arrayrulewidth
\int_step_inline:nnn \l_tmpc_tl \l_tmpa_tl
{ \@@_qpoint:n \row - \l_tmpa_tl \pgfpathmoveto \pgfpoint \l_tmpa_dim \pgf@y
\pgfpathlineto \pgfpoint \l_tmpb_dim \pgf@y
\pgfusepathqstroke }
\endpgfpicture
\}
\endpgfpicture
```

First, the vertical rules.

Now, the horizontal rules.
The following command is used to stroke the left border and the right border. The argument \texttt{#1} is the number of column (in the sense of the \texttt{col} node).

\begin{verbatim}
\cs_new_protected:Npn \@@_stroke_vertical:n #1
\{
  \@@_qpoint:n \l_tmpc_tl
  \dim_set:Nn \l_tmpb_dim { \pgf@y + 0.5 \l_@@_line_width_dim }
  \@@_qpoint:n \l_tmpa_tl
  \dim_set:Nn \l_tmpc_dim { \pgf@y + 0.5 \l_@@_line_width_dim }
  \@@_qpoint:n { #1 }
  \pgfpathmoveto { \pgfpoint \pgf@x \l_tmpb_dim }
  \pgfpathlineto { \pgfpoint \pgf@x \l_tmpc_dim }
  \pgfusepathqstroke
\}
\end{verbatim}

The following command is used to stroke the top border and the bottom border. The argument \texttt{#1} is the number of row (in the sense of the \texttt{row} node).

\begin{verbatim}
\cs_new_protected:Npn \@@_stroke_horizontal:n #1
\{
  \@@_qpoint:n \l_tmpd_tl
  \clist_if_in:NnTF \l_@@_borders_clist { left }
    { \dim_set:Nn \l_tmpa_dim { \pgf@x - 0.5 \l_@@_line_width_dim } }
    { \dim_set:Nn \l_tmpa_dim { \pgf@x + 0.5 \l_@@_line_width_dim } }
  \@@_qpoint:n \l_tmpb_tl
  \dim_set:Nn \l_tmpb_dim { \pgf@x + 0.5 \l_@@_line_width_dim }
  \@@_qpoint:n { #1 }
  \pgfpathmoveto { \pgfpoint \l_tmpa_dim \pgf@y }
  \pgfpathlineto { \pgfpoint \l_tmpb_dim \pgf@y }
  \pgfusepathqstroke
\}
\end{verbatim}

Here is the set of keys for the command \texttt{\@@_strokeBorders_block:nnn}.

\begin{verbatim}
\keys_define:nn { NiceMatrix / BlockBorders }
\{
  borders .clist_set:N = \l_@@_borders_clist ,
  rounded-corners .dim_set:N = \l_@@_rounded_corners_dim ,
  rounded-corners .default:n = 4 pt ,
  line-width .dim_set:N = \l_@@_line_width_dim
\}
\end{verbatim}

The following command will be used if the key \texttt{tikz} has been used for the command \texttt{Block}. The arguments \texttt{#1} and \texttt{#2} are the coordinates of the first cell and \texttt{#3} and \texttt{#4} the coordinates of the last cell of the block. \texttt{#5} is a comma-separated list of the Tikz keys used with the path.
How to draw the dotted lines transparently

Automatic arrays

We will extract the potential keys \( l \), \( r \) and \( c \) and pass the other keys to the environment \{NiceArrayWithDelims\}.

The group is for the protection of \( l_\text{@type_of_col} \).
We put \{ \} before \#6 to avoid a hasty expansion of a potential \arabic{iRow} at the beginning of the row which would result in an incorrect value of that iRow (since iRow is incremented in the first cell of the row of the \halign).

We define also a command \AutoNiceMatrix similar to the environment \{NiceMatrix\}.

The redefinition of the command \dotfill

First, we insert \@@_dotfill (which is the saved version of \dotfill) in case of use of \dotfill "internally" in the cell (e.g. \hbox to 1cm {\dotfill}).
Now, if the box if not empty (unfortunately, we can’t actually test whether the box is empty and that’s why we only consider it’s width), we insert \@@_dotfill (which is the saved version of \dotfill) in the cell of the array, and it will extend, since it is no longer in \l_@@_cell_box.

The command \diagbox

The command \diagbox will be linked to \diagbox:nn in the environments of nicematrix.

We put the cell with \diagbox in the sequence \g_@@_pos_of_blocks_seq because a cell with \diagbox must be considered as non empty by the key corners.

The command \diagbox is also redefined locally when we draw a block.

The first four arguments of \@@_actually_diagbox:nnnnnn correspond to the rectangle (=block) to slash (we recall that it’s possible to use \diagbox in a \Block). The two other are the elements to draw below and above the diagonal line.

The command \CT@arc@ is a command of colortbl which sets the color of the rules in the array. The package nicematrix uses it even if colortbl is not loaded.
The keyword \CodeAfter

The \CodeAfter (inserted with the key code-after or after the keyword \CodeAfter) may always begin with a list of pairs key-value between square brackets. Here is the corresponding set of keys.

\keys_define:nn { NiceMatrix }
{
  CodeAfter / rules .inherit:n = NiceMatrix / rules ,
  CodeAfter / sub-matrix .inherit:n = NiceMatrix / sub-matrix
}
\keys_define:nn { NiceMatrix / CodeAfter }
{
  sub-matrix .code:n = \keys_set:nn { NiceMatrix / sub-matrix } { #1 } ,
  sub-matrix .value_required:n = true ,
  delimiters / color .tl_set:N = \l_@@_delimiters_color_tl ,
  delimiters / color .value_required:n = true ,
  rules .code:n = \keys_set:nn { NiceMatrix / rules } { #1 } ,
  rules .value_required:n = true ,
  unknown .code:n = \@@_error:n { Unknown-key-for-CodeAfter }
}

In fact, in this subsection, we define the user command \CodeAfter for the case of the “normal syntax”. For the case of “light-syntax”, see the definition of the environment \@@-light-syntax on p. 110.

In the environments of nicematrix, \CodeAfter will be linked to \@@_CodeAfter:. That macro must not be protected since it begins with \omit.

\cs_new:Npn \@@_CodeAfter: { \omit \@@_CodeAfter_i:n }

However, in each cell of the environment, the command \CodeAfter will be linked to the following command \@@_CodeAfter_i:n which do not begin with \omit (and thus, the user will be able to use \CodeAfter without error and without the need to prefix by \omit).

We have to catch everything until the end of the current environment (of nicematrix). First, we go until the next command \end.

\cs_new_protected:Npn \@@_CodeAfter_i:n #1 \end
{
 \tl_gput_right:Nn \g_nicematrix_code_after_tl { #1 }
 \@@_CodeAfter_ii:n
}

We catch the argument of the command \end (in #1).

\cs_new_protected:Npn \@@_CodeAfter_ii:i:n #1
{
 \str_if_eq:eeTF \@currenvir { #1 } { \end { #1 } }
}
If this is not the \end we are looking for, we put those tokens in \g_nicematrix_code_after_tl and we go on searching for the next command \end with a recursive call to the command \@@_CodeAfter:n.

\begin{verbatim}
\tl_gput_right:Nn \g_nicematrix_code_after_tl { \end { #1 } }
\@@_CodeAfter_i:n
\end{verbatim}

The delimiters in the preamble

The command \@@_delimiter:nnn will be used to draw delimiters inside the matrix when delimiters are specified in the preamble of the array. It does not concern the exterior delimiters added by \{NiceArrayWithDelims\} (and \{pNiceArray\}, \{pNiceMatrix\}, etc.). A delimiter in the preamble of the array will write an instruction \@@_delimiter:nnn in the \g@@_internal_code_after_tl (and also potentially add instructions in the preamble provided to \array in order to add space between columns).

The first argument is the type of delimiter (\( , [, \{, ] \text{ or } \} \)). The second argument is the number of columns. The third argument is a boolean equal to \c_true_bool (resp. \c_false_true) when the delimiter must be put on the left (resp. right) side.

\begin{verbatim}
\cs_new_protected:Npn \@@_delimiter:nnn #1 #2 #3
{ \pgfpicture
  \pgfrememberpicturepositiononpagetrue
  \pgf@relevantforpicturesizefalse
  \l_@@_y_initial_dim and \l_@@_y_final_dim will be the y-values of the extremities of the delimiter we will have to construct.
  \@@_qpoint:n { row - 1 }
  \dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
  \@@_qpoint:n { row - \@@_succ:n \c@iRow }
  \dim_set_eq:NN \l_@@_y_final_dim \pgf@y
  \bool_if:nTF { #3 } { \dim_set_eq:NN \l_tmpa_dim \c_max_dim } { \dim_set:Nn \l_tmpa_dim { - \c_max_dim } }
  \int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
  { \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - #2 \}
    { \pgfpointanchor { \@@_env: - ##1 - #2 } { \bool_if:nTF { #3 } { west } { east } } \dim_set:Nn \l_@@_tmpa_dim \pgf@x }
  }
  \pgfnode
\end{verbatim}

We will compute in \l_tmpa_dim the x-value where we will have to put our delimiter (on the left side or on the right side).

\begin{verbatim}
\bool_if:nTF { #3 }
{ \dim_set_eq:NN \l_tmpa_dim \c_max_dim }
{ \dim_set:Nn \l_tmpa_dim { - \c_max_dim } }
\int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int
{ \cs_if_exist:cT \{ pgf @ sh @ ns @ \@@_env: - ##1 - #2 \}
  { \pgfpointanchor { \@@_env: - ##1 - #2 } { \bool_if:nTF { #3 } { west } { east } } \dim_set:Nn \l_@@_tmpa_dim \pgf@x }
}
\end{verbatim}

Now we can put the delimiter with a node of PGF.

\begin{verbatim}
\pgfset { inner-sep = \c_zero_dim }
\dim_zero:N \nulldelimiterspace
\pgftransformshift
{ \pgfpoint
  { \l_@@_tmpa_dim }
  { ( \l_@@_y_initial_dim + \l_@@_y_final_dim + \arrayrulewidth ) / 2 }
}
\pgfnode
\end{verbatim}
Here is the content of the PGF node, that is to say the delimiter, constructed with its right size.

\nullfont
\c_math_toggle_token
\tl_if_empty:NF \l_@@_delimiters_color_tl
{ \color { \l_@@_delimiters_color_tl } }
\bool_if:nTF { #3 } { \left #1 } { \left . }
vcenter
{ }
{ }
\endpgfpicture

The command \SubMatrix

\keys_define:nn { NiceMatrix / sub-matrix }
{ extra-height .dim_set:N = \l_@@_submatrix_extra_height_dim ,
extra-height .value_required:n = true ,
left-xshift .dim_set:N = \l_@@_submatrix_left_xshift_dim ,
left-xshift .value_required:n = true ,
right-xshift .dim_set:N = \l_@@_submatrix_right_xshift_dim ,
right-xshift .value_required:n = true ,
xshift .meta:n = { left-xshift = #1, right-xshift = #1 } ,
xshift .value_required:n = true ,
delimiters / color .tl_set:N = \l_@@_delimiters_color_tl ,
delimiters / color .value_required:n = true ,
slim .bool_set:N = \l_@@_submatrix_slim_bool ,
slim .default:n = true ,
hlines .clist_set:N = \l_@@_submatrix_hlines_clist ,
hlines .default:n = all ,
vlines .clist_set:N = \l_@@_submatrix_vlines_clist ,
vlines .default:n = all ,
vlines .meta:n = { hlines, vlines } ,
vlines .value_forbidden:n = true ,
}
\keys_define:nn { NiceMatrix / SubMatrix }
{ SubMatrix .inherit:n = NiceMatrix / sub-matrix ,
CodeAfter / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
NiceMatrix / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
NiceArray / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
pNiceArray / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
NiceMatrixOptions / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
}
The following keys set is for the command \SubMatrix itself (not the tuning of \SubMatrix that can be done elsewhere).
\keys_define:nn { NiceMatrix / SubMatrix }
{ 

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In the internal \texttt{\textbackslash{code-after}} and in the \texttt{\textbackslash{CodeAfter}} the following command \texttt{\textbackslash{\textbackslash@@ SubMatrix}} will be linked to \texttt{\textbackslash{SubMatrix}}.

- \texttt{#1} is the left delimiter;
- \texttt{#2} is the upper-left cell of the matrix with the format \texttt{i-j};
- \texttt{#3} is the lower-right cell of the matrix with the format \texttt{i-j};
- \texttt{#4} is the right delimiter;
- \texttt{#5} is the list of options of the command;
- \texttt{#6} is the potential subscript;
- \texttt{#7} is the potential superscript.
For explanations about the construction with rescanning of the preamble, see the documentation for the user command \Cdots.

\AtBeginDocument

\tl_set:Nn \l_@@_argspec_tl { m m m m O { } E { _ ^ } { } { } { } }
\tl_set_rescan:Nno \l_@@_argspec_tl { } \l_@@_argspec_tl
\exp_args:NNV \NewDocumentCommand \@@_SubMatrix \l_@@_argspec_tl
{\peek_remove_spaces:n { \@@_sub_matrix:nnnnnnn { #1 } { #2 } { #3 } { #4 } { #5 } { #6 } { #7 } }}
\cs_new_protected:Npn \@@_sub_matrix:nnnnnnn #1 #2 #3 #4 #5 #6 #7
{\group_begin:
The four following token lists correspond to the position of the \SubMatrix.
\tl_clear_new:N \l_@@_first_i_tl
\tl_clear_new:N \l_@@_first_j_tl
\tl_clear_new:N \l_@@_last_i_tl
\tl_clear_new:N \l_@@_last_j_tl
The command \@@_cut_on_hyphen:w cuts on the hyphen an argument of the form $i$-$j$. The value of $i$ is stored in \l_tmpa_tl and the value of $j$ is stored in \l_tmpb_tl.
\@@_cut_on_hyphen:w #2 \q_stop
\tl_set_eq:NN \l_@@_first_i_tl \l_tmpa_tl
\tl_set_eq:NN \l_@@_first_j_tl \l_tmpb_tl
\@@_cut_on_hyphen:w #3 \q_stop
\tl_set_eq:NN \l_@@_last_i_tl \l_tmpa_tl
\tl_set_eq:NN \l_@@_last_j_tl \l_tmpb_tl
\bool_lazy_or:nnTF { \int_compare_p:nNn \l_@@_last_i_tl > \g_@@_row_total_int }{ \int_compare_p:nNn \l_@@_last_j_tl > \g_@@_col_total_int }{ \@@_error:n { SubMatrix~too~large } }
\str_clear_new:N \l_@@_submatrix_name_str
\keys_set:nn { NiceMatrix / SubMatrix } { #5 }
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfset { inner~sep = \c_zero_dim }
\dim_set_eq:NN \l_@@_x_initial_dim \c_max_dim
\dim_set:Nn \l_@@_x_final_dim { - \c_max_dim }
The last value of \int_step_inline:nnn is provided by currification.
\bool_if:NTF \l_@@_submatrix_slim_bool { \int_step_inline:nnn \l_@@_first_i_tl \l_@@_last_i_tl }{ \int_step_inline:nnn \l_@@_first_row_int \g_@@_row_total_int }
\cs_if_exist:cT { pgf @ sh @ ns @ \@@_env: - ##1 - \l_@@_first_j_tl }{ \pgfpointanchor { \@@_env: - ##1 - \l_@@_first_j_tl } { west } \dim_set:Nn \l_@@_x_initial_dim { \dim_min:nn \l_@@_x_initial_dim \pgf@x } }
\cs_if_exist:cT { pgf @ sh @ ns @ \@@_env: - ##1 - \l_@@_last_j_tl }{ \pgfpointanchor { \@@_env: - ##1 - \l_@@_last_j_tl } { east } \dim_set:Nn \l_@@_x_final_dim { \dim_max:nn \l_@@_x_final_dim \pgf@x } }
\dim_compare:nNnTF \l_@@_x_initial_dim = \c_max_dim
{ \@@_error:nn { impossible-delimiter } { left } }
{ \dim_compare:nNnTF \l_@@_x_final_dim = \c_max_dim
{ \@@_error:nn { impossible-delimiter } { right } }
{ \@@_sub_matrix_i:nnnn { #1 } { #4 } { #6 } { #7 } }
}
\endpgfpicture

\group_end:

\textbf{#1} is the left delimiter, \textbf{#2} is the right one, \textbf{#3} is the subscript and \textbf{#4} is the superscript.

\cs_new_protected:Npn \@@_sub_matrix_i:nnnn #1 #2 #3 #4
{\@@_qpoint:n { row - \l_@@_first_i_tl - base }
\dim_set:Nn \l_@@_y_initial_dim
{ \pgf@y + ( \box_ht:N \strutbox + \extrarowheight ) * \arraystretch }
\@@_qpoint:n { row - \l_@@_last_i_tl - base }
\dim_set:Nn \l_@@_y_final_dim
{ \pgf@y - ( \box_dp:N \strutbox ) * \arraystretch }
\int_step_inline:nnn \l_@@_first_col_int \g_@@_col_total_int
{ \cs_if_exist:cT
{ pgf @ sh @ ns @ \@@_env: - \l_@@_first_i_tl - ##1 }
{ \pgfpointanchor { \@@_env: - \l_@@_first_i_tl - ##1 } { north }
\dim_max:nn \l_@@_y_initial_dim \pgf@y }
\cs_if_exist:cT
{ pgf @ sh @ ns @ \@@_env: - \l_@@_last_i_tl - ##1 }
{ \pgfpointanchor { \@@_env: - \l_@@_last_i_tl - ##1 } { south }
\dim_min:nn \l_@@_y_final_dim \pgf@y }
}\dim_set:Nn \l_tmpa_dim
{ \l_@@_y_initial_dim - \l_@@_y_final_dim + \l_@@_submatrix_extra_height_dim - \arrayrulewidth }
\dim_set_eq:NN \nulldelimiterspace \c_zero_dim

We will draw the rules in the SubMatrix.

\group_begin:
\pgfsetlinewidth { 1.1 \arrayrulewidth }
\tl_if_empty:NF \l_@@_rules_color_tl
{ \exp_after:wN \@@_set_CT@arc@: \l_@@_rules_color_tl \q_stop }
\CT@arc@

Now, we draw the potential vertical rules specified in the preamble of the environments with the letter fixed with the key \texttt{vlines-in-sub-matrix}. The list of the columns where there is such rule to draw is in \texttt{\g_@@_cols_vlism_seq}.

\seq_map_inline:Nn \g_@@_cols_vlism_seq
{ \int_compare:nNnT \l_@@_first_j_tl < { \texttt{##1} }
{ \int_compare:nNnT \l_@@_first_j_tl < { \texttt{##1} }
{ \texttt{##1} } < { \int_eval:n \l_@@_last_j_tl + 1 } }
{ \texttt{##1} } < { \int_eval:n \l_@@_last_j_tl + 1 } }
}
First, we extract the value of the abscissa of the rule we have to draw.

\[ \@\_qpoint: n \{ \text{col - ##1} \} \]
\[ \text{pgfpathmoveto} \{ \text{pgfpoint} \text{pgf@x} \text{\l\_@@\_y\_initial\_dim} \} \]
\[ \text{pgfpathlineto} \{ \text{pgfpoint} \text{pgf@x} \text{\l\_@@\_y\_final\_dim} \} \]
\[ \text{pgfusepathqstroke} \]

Now, we draw the vertical rules specified in the key \texttt{vlines} of \texttt{SubMatrix}. The last argument of \texttt{\textbackslash int\_step\_inline:nn} or \texttt{\textbackslash clist\_map\_inline:Nn} is given by curryfication.

\[ \text{\texttt{\textbackslash tl\_if\_eq:NnTF \textbackslash l\_@@\_submatrix\_vlines\_clist} \{ \text{all} \}} \]
\[ \{ \text{\texttt{\textbackslash int\_step\_inline:nn} \{ \text{\l\_@@\_last\_j\_tl - \l\_@@\_first\_j\_tl} \}} \]
\[ \{ \text{\texttt{\textbackslash clist\_map\_inline:Nn} \texttt{\textbackslash l\_@@\_submatrix\_vlines\_clist} \}} \]
\[ \{ \text{\texttt{\textbackslash bool\_lazy\_and:mmTF}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn} \{ ##1 \} > 0 \}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn} \{ ##1 \} < \{ \text{\l\_@@\_last\_j\_tl - \l\_@@\_first\_j\_tl + 1} \}} \]
\[ \{ \text{\texttt{\textbackslash @\_qpoint: n \{ \text{col - \texttt{\textbackslash int\_eval:n} \{ ##1 + \l\_@@\_first\_j\_tl} \}}} \]
\[ \text{\texttt{\textbackslash pgfpathmoveto} \{ \text{pgfpoint} \text{pgf@x} \text{\l\_@@\_y\_initial\_dim} \}} \]
\[ \text{\texttt{\textbackslash pgfpathlineto} \{ \text{pgfpoint} \text{pgf@x} \text{\l\_@@\_y\_final\_dim} \}} \]
\[ \text{\texttt{\textbackslash pgfusepathqstroke} \}} \]
\[ \{ \text{\texttt{\textbackslash error:nnn} \{ \text{Wrong\_line\_in\_SubMatrix} \} \{ \text{vertical} \} \{ ##1 \}} \]
\[ \]}

Now, we draw the horizontal rules specified in the key \texttt{hlines} of \texttt{SubMatrix}. The last argument of \texttt{\textbackslash int\_step\_inline:nn} or \texttt{\textbackslash clist\_map\_inline:Nn} is given by curryfication.

\[ \text{\texttt{\textbackslash tl\_if\_eq:NnTF \textbackslash l\_@@\_submatrix\_hlines\_clist} \{ \text{all} \}} \]
\[ \{ \text{\texttt{\textbackslash int\_step\_inline:nn} \{ \text{\l\_@@\_last\_i\_tl - \l\_@@\_first\_i\_tl} \}} \]
\[ \{ \text{\texttt{\textbackslash clist\_map\_inline:Nn} \texttt{\textbackslash l\_@@\_submatrix\_hlines\_clist} \}} \]
\[ \{ \text{\texttt{\textbackslash bool\_lazy\_and:mmTF}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn} \{ ##1 \} > 0 \}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn}} \]
\[ \{ \text{\texttt{\textbackslash int\_compare\_p:nNn} \{ ##1 \} < \{ \text{\l\_@@\_last\_i\_tl - \l\_@@\_first\_i\_tl + 1} \}} \]
\[ \{ \text{\texttt{\textbackslash @\_qpoint: n \{ \text{row - \texttt{\textbackslash int\_eval:n} \{ ##1 + \l\_@@\_first\_i\_tl} \}}} \]
\[ \} \]
\[ \]}

We use a group to protect \texttt{\l\_\_tmpa\_dim} and \texttt{\l\_\_tmpb\_dim}.

\[ \text{\texttt{\textbackslash group\_begin:}} \]

We compute in \texttt{\l\_\_tmpa\_dim} the \textit{x}-value of the left end of the rule.

\[ \text{\texttt{\textbackslash dim\_set:nn} \{ \text{\l\_\_tmpa\_dim} \}} \]
\[ \{ \text{\l\_@@\_x\_initial\_dim - \l\_@@\_submatrix\_left\_xshift\_dim} \} \]
\[ \text{\texttt{\textbackslash str\_case:nn} \{ #1 \}} \]
\[ \{ \text{\texttt{\textbackslash dim\_sub:nn} \texttt{\l\_\_tmpa\_dim} \{ 0.9 \text{~mm} \}} \]
\[ \{ \text{\texttt{\textbackslash dim\_sub:nn} \texttt{\l\_\_tmpa\_dim} \{ 0.2 \text{~mm} \}} \]
\[ \{ \text{\texttt{\textbackslash dim\_sub:nn} \texttt{\l\_\_tmpa\_dim} \{ 0.9 \text{~mm} \}} \]}
\[ \text{\texttt{\textbackslash pgfpathmoveto} \{ \text{pgfpoint} \texttt{\l\_\_tmpa\_dim} \texttt{\pgf@y} \}} \]

We compute in \texttt{\l\_\_tmpb\_dim} the \textit{x}-value of the right end of the rule.

\[ \text{\texttt{\textbackslash dim\_set:nn} \{ \text{\l\_\_tmpb\_dim} \}} \]
\[ \{ \text{\l\_@@\_x\_final\_dim + \l\_@@\_submatrix\_right\_xshift\_dim} \} \]
\[ \text{\texttt{\textbackslash str\_case:nn} \{ #2 \}} \]
\[ \} \]
We use a group to protect \texttt{\l\_\_tmpa\_dim} and \texttt{\l\_\_tmpb\_dim}.
If the key \texttt{name} has been used for the command \texttt{\SubMatrix}, we create a PGF node with that name for the submatrix (this node does not encompass the delimiters that we will put after).

\begin{verbatim}
\str_if_empty:NF \l_@@_submatrix_name_str
{ \@@_pgf_rect_node:nnnn \l_@@_submatrix_name_str
 \l_@@_x_initial_dim \l_@@_y_initial_dim
 \l_@@_x_final_dim \l_@@_y_final_dim
}
\end{verbatim}

The group was for \texttt{\CT@arc@} (the color of the rules).

Now, we deal with the left delimiter. Of course, the environment \texttt{\pgfscope} is for the \texttt{\pgftransformshift}.

\begin{verbatim}
\begin { pgfscope }
\pgftransformshift
 { \pgfpoint
 { \l_@@_x_initial_dim - \l_@@_submatrix_left_xshift_dim }
 { ( \l_@@_y_initial_dim + \l_@@_y_final_dim ) / 2 }
}
\str_if_empty:NTF \l_@@_submatrix_name_str
{ \@@_node_left:nn #1 { } }
{ \@@_node_left:nn #1 { \@@_env: - \l_@@_submatrix_name_str - left } }
\end { pgfscope }
\end{verbatim}

Now, we deal with the right delimiter.

\begin{verbatim}
\begin{pgfscope}
\pgftransformshift
 { \pgfpoint
 { \l_@@_x_final_dim + \l_@@_submatrix_right_xshift_dim }
 { ( \l_@@_y_initial_dim + \l_@@_y_final_dim ) / 2 }
}
\str_if_empty:NTF \l_@@_submatrix_name_str
{ \@@_node_right:nnnn #2 { } { #3 } { #4 } }
{ \@@_node_right:nnnn #2
 { \@@_env: - \l_@@_submatrix_name_str - right } { #3 } { #4 }
}
\end{pgfscope}
\end{verbatim}

In the key \texttt{code} of the command \texttt{\SubMatrix} there may be Tikz instructions. We want that, in these instructions, the $i$ and $j$ in specifications of nodes of the forms $i-j$, row-$i$, col-$j$ and $i|-j$ refer to the number of row and column relative of the current \texttt{\SubMatrix}. That’s why we will patch (locally in the \texttt{\SubMatrix}) the command \texttt{\pgfpointanchor}.

\begin{verbatim}
\cs_set_eq:NN \pgfpointanchor \@@_pgfpointanchor:n
\flag_clear_new:n { nicematrix }
\end{verbatim}

The following command will be linked to \texttt{\pgfpointanchor} just before the execution of the option \texttt{code} of the command \texttt{\SubMatrix}. In this command, we catch the argument \texttt{#1} of \texttt{\pgfpointanchor} and we apply to it the command \texttt{\@@_pgfpointanchor_i:nn} before passing it to the original
\texttt{\textbackslash pgfpointanchor}. We have to act in an expandable way because the command \texttt{\textbackslash pgfpointanchor} is used in names of Tikz nodes which are computed in an expandable way.

\begin{verbatim}
\cs_new_protected:Npn \@@_pgfpointanchor:n #1
{
  \use:e
  { \exp_not:N \@@_old_pgfpointanchor \{ \@@_pgfpointanchor_i:nn \#1 \} }
}

In fact, the argument of \texttt{\textbackslash pgfpointanchor} is always of the form \texttt{\textbackslash a\_command \{ name\_of\_node \}} where \texttt{\textbackslash a\_command} is the name of the Tikz node without the potential prefix and suffix. That's why we catch two arguments and work only on the second by trying (first) to extract an hyphen \texttt{-}.

\begin{verbatim}
\cs_new:Npn \@@_pgfpointanchor_i:nn #1 #2
{
#1 \{ \@@_pgfpointanchor_ii:w #2 - \q_stop \}
}

Since \texttt{\textbackslash seq\_if\_in:N\textbackslash nTF} and \texttt{\textbackslash clist\_if\_in:N\textbackslash nTF} are not expandable, we will use the following token list and \texttt{\textbackslash str\_case:nVTF} to test whether we have an integer or not.

\begin{verbatim}
\tl_const:Nn \c_@@_integers-alist_tl
{
  \{ 1 \} \{ 2 \} \{ 3 \} \{ 4 \} \{ 5 \} \{ 6 \} \{ 7 \} \{ 8 \} \{ 9 \} \{ 10 \} \{ 11 \} \{ 12 \} \{ 13 \} \{ 14 \} \{ 15 \} \{ 16 \} \{ 17 \} \{ 18 \} \{ 19 \} \{ 20 \} \{ 21 \} \{ 22 \} \{ 23 \} \{ 24 \} \{ 25 \} \{ 26 \} \{ 27 \} \{ 28 \} \{ 29 \} \{ 30 \} \{ 31 \} \{ 32 \} \{ 33 \} \{ 34 \} \{ 35 \} \{ 36 \} \{ 37 \} \{ 38 \} \{ 39 \} \{ 40 \} \{ 41 \} \{ 42 \} \{ 43 \} \{ 44 \} \{ 45 \} \{ 46 \} \{ 47 \} \{ 48 \} \{ 49 \} \{ 50 \} \{ 51 \} \{ 52 \} \{ 53 \} \{ 54 \} \{ 55 \} \{ 56 \} \{ 57 \} \{ 58 \} \{ 59 \} \{ 60 \} \{ 61 \} \{ 62 \} \{ 63 \} \{ 64 \} \{ 65 \} \{ 66 \} \{ 67 \} \{ 68 \} \{ 69 \} \{ 70 \} \{ 71 \} \{ 72 \} \{ 73 \} \{ 74 \} \{ 75 \} \{ 76 \} \{ 77 \} \{ 78 \} \{ 79 \} \{ 80 \} \{ 81 \} \{ 82 \} \{ 83 \} \{ 84 \} \{ 85 \} \{ 86 \} \{ 87 \} \{ 88 \} \{ 89 \} \{ 90 \} \{ 91 \} \{ 92 \} \{ 93 \} \{ 94 \} \{ 95 \} \{ 96 \} \{ 97 \} \{ 98 \} \{ 99 \} \{ 100 \} \}
\end{verbatim}

\begin{verbatim}
\cs_new:Npn \@@_pgfpointanchor_ii:w #1-#2 \q_stop
{
  \str_case:nVTF \{ #1 \} \c_@@_integers-alist_tl
  { \flag_raise:n \{ \texttt{nicematrix} \}
    \int_if_even:nTF \{ \flag_height:n \{ \texttt{nicematrix} \} \}
    { \int_eval:n \{ #1 + \l_@@_first_i_tl - 1 \} }
    { \int_eval:n \{ #1 + \l_@@_first_j_tl - 1 \} }
  }
  \{ \flag_raise:n \{ \texttt{nicematrix} \}
    \int_if_even:nTF \{ \flag_height:n \{ \texttt{nicematrix} \} \}
    { \int_eval:n \{ #1 + \l_@@_first_i_tl - 1 \} }
    { \int_eval:n \{ #1 + \l_@@_first_j_tl - 1 \} }
  }
}

If there is no hyphen, that means that the node is of the form of a single number (ex.: 5 or 11). In that case, we are in an analysis which result from a specification of node of the form \texttt{i-\!j}. In that case, the \texttt{i} of the number of row arrives first (and alone) in a \texttt{\textbackslash pgfpointanchor} and, the, the \texttt{j} arrives (alone) in the following \texttt{\textbackslash pgfpointanchor}. In order to know whether we have a number of row of a number of column, we keep track of the number of such treatments by the expandable flag called \texttt{nicematrix}.

\begin{verbatim}
\tl_if_empty:nTF \{ \#2 \}
  \str_case:nVTF \{ \#1 \} \c_@@_integers-alist_tl
  \{ \flag_raise:n \{ \texttt{nicematrix} \}
    \int_if_even:nTF \{ \flag_height:n \{ \texttt{nicematrix} \} \}
    { \int_eval:n \{ #1 + \l_@@_first_i_tl - 1 \} }
    { \int_eval:n \{ #1 + \l_@@_first_j_tl - 1 \} }
  }
  \{ \flag_raise:n \{ \texttt{nicematrix} \}
    \int_if_even:nTF \{ \flag_height:n \{ \texttt{nicematrix} \} \}
    { \int_eval:n \{ #1 + \l_@@_first_i_tl - 1 \} }
    { \int_eval:n \{ #1 + \l_@@_first_j_tl - 1 \} }
  }
}

If there is an hyphen, we have to see whether we have a node of the form \texttt{i-\!j}, \texttt{row-\!i} or \texttt{col-\!j}.

\begin{verbatim}
\@@_pgfpointanchor_iii:w \{ \#1 \} \#2 \q_stop
{
  \@@_pgfpointanchor_ii:w \{ \#1 \} \#2
}
\end{verbatim}

There was an hyphen in the name of the node and that’s why we have to retrieve the extra hyphen we have put (cf. \texttt{\@@_pgfpointanchor_i:nn}).

\begin{verbatim}
\cs_new:Npn \@@_pgfpointanchor_iii:w \#1 \#2 -
{
  \str_case:nM \{ \#1 \}
  \{ \row \} \{ \row - \int_eval:n \{ \#2 + \l_@@_first_i_tl - 1 \} \}
  \{ \col \} \{ \col - \int_eval:n \{ \#2 + \l_@@_first_j_tl - 1 \} \}
\end{verbatim}

\end{verbatim}
Now the case of a node of the form $i-j$.

\begin{verbatim}
\int_eval:n { #1 + \l_@@_first_i_tl - 1 }
- \int_eval:n { #2 + \l_@@_first_j_tl - 1 }
\end{verbatim}

The command \@@_node_left:nn puts the left delimiter with the correct size. The argument #1 is the delimiter to put. The argument #2 is the name we will give to this PGF node (if the key name has been used in \SubMatrix).

\begin{verbatim}
\cs_new_protected:Npn \@@_node_left:nn #1 #2
{ \pgfnode
  { rectangle }
  { east }
  {
    \nullfont
    \c_math_toggle_token
    \tl_if_empty:NF \l_@@_delimiters_color_tl
    { \color { \l_@@_delimiters_color_tl } }
    \left #1
    \vcenter
    {
      \nullfont
      \hrule \@height \l_tmpa_dim
      \@depth \c_zero_dim
      \@width \c_zero_dim
    }
    \right .
    \c_math_toggle_token
  }
  { #2 }
}{ }
\end{verbatim}

The command \@@_node_right:nnn puts the right delimiter with the correct size. The argument #1 is the delimiter to put. The argument #2 is the name we will give to this PGF node (if the key name has been used in \SubMatrix). The argument #3 is the subscript and #4 is the superscript.

\begin{verbatim}
\cs_new_protected:Npn \@@_node_right:nnn #1 #2 #3 #4
{ \pgfnode
  { rectangle }
  { west }
  {
    \nullfont
    \c_math_toggle_token
    \tl_if_empty:NF \l_@@_delimiters_color_tl
    { \color { \l_@@_delimiters_color_tl } }
    \left .
    \vcenter
    {
      \nullfont
      \hrule \@height \l_tmpa_dim
      \@depth \c_zero_dim
      \@width \c_zero_dim
    }
    \right #1
    \tl_if_empty:nF { #3 } { _ { \smash { #3 } } }
    ^ { \smash { #4 } }
    \c_math_toggle_token
  }
  { #2 }
}{ }
\end{verbatim}
We process the options at package loading

We process the options when the package is loaded (with `\usepackage`) but we recommend to use `\NiceMatrixOptions` instead.

We must process these options after the definition of the environment `{NiceMatrix}` because the option `renew-matrix` executes the code `\cs_set_eq:NN \env@matrix \NiceMatrix`.

Of course, the command `\NiceMatrix` must be defined before such an instruction is executed.

The boolean `\g_@@_footnotehyper_bool` will indicate if the option `footnotehyper` is used.

The boolean `\c_@@_footnote_bool` will indicate if the option `footnote` is used, but quickly, it will also be set to `true` if the option `footnotehyper` is used.

Maybe we will completely delete the key ’transparent’ in a future version.
\ProcessKeysOptions { NiceMatrix / Package }

\@@_msg_new:nn { footnote-with-footnotehyper-package }
\{ \You can't use the option 'footnote' because the package footnotehyper has already been loaded. -
\If you want, you can use the option 'footnotehyper' and the footnotes within the environments of nicematrix will be extracted with the tools of the package footnotehyper. \}
\If you go on, the package footnote-won't-be-loaded.
\}

\@@_msg_new:nn { footnotehyper-with-footnote-package }
\{ \You can't use the option 'footnotehyper' because the package footnote has already been loaded. -
\If you want, you can use the option 'footnote' and the footnotes within the environments of nicematrix will be extracted with the tools of the package footnote. \}
\If you go on, the package footnotehyper-won't-be-loaded.
\}

\bool_if:NT \c_@@_footnote_bool
\{ The class beamer has its own system to extract footnotes and that's why we have nothing to do if beamer is used.
\@ifclassloaded { beamer }
\{ \bool_set_false:N \c_@@_footnote_bool 
\}
\@ifpackageloaded { footnotehyper }
\{ \@@_error:n { footnote-with-footnotehyper-package } 
\usepackage { footnote } 
\}
\}

\bool_if:NT \c_@@_footnotehyper_bool
\{ The class beamer has its own system to extract footnotes and that's why we have nothing to do if beamer is used.
\@ifclassloaded { beamer }
\{ \bool_set_false:N \c_@@_footnote_bool 
\}
\@ifpackageloaded { footnote }
\{ \@@_error:n { footnote-with-footnote-package } 
\usepackage { footnotehyper } 
\}
\}
\bool_set_true:N \c_@@_footnote_bool
\}
\}
The flag \c_@@_footnote_bool is raised and so, we will only have to test \c_@@_footnote_bool in order to know if we have to insert an environment {savenotes}.
Error messages of the package

The following message will be deleted when we will delete the key except-corners for the command \arraycolor.

```latex
\@_msg_new:nn { key except-corners }
\{ 
The-key-'except-corners'-has-been-deleted-for-the-command-\token_to_str:N \arraycolor, in-the-\token_to_str:N \CodeBefore.-You-should-instead-use-
the-key-'corners'-in-your-@@_full_name_env:.\}
If-you-go-on,-this-key-will-be-ignored.
\}
\seq_new:N \c_@@_types_of_matrix_seq
\seq_set_from_clist:Nn \c_@@_types_of_matrix_seq {NiceMatrix, pNiceMatrix, bNiceMatrix, vNiceMatrix, BNiceMatrix, VNiceMatrix}
\seq_set_map_x:NNn \c_@@_types_of_matrix_seq \c_@@_types_of_matrix_seq { \tl_to_str:n { #1 } }
```

If the user uses too much columns, the command \@@_error_too_much_cols: is executed. This command raises an error but try to give the best information to the user in the error message. The command \seq_if_in:NVTF is not expandable and that’s why we can’t put it in the error message itself. We have to do the test before the \@@_fatal:n.

```latex
\cs_new_protected:Npn \@@_error_too_much_cols: 
{ \seq_if_in:NVTF \c_@@_types_of_matrix_seq \g_@@_name_env_str 
{ \int_compare:nNnTF \l_@@_last_col_int = { -2 } 
{ \@@_fatal:n { too-much-cols-for-matrix } } 
{ \bool_if:NF \l_@@_last_col_without_value_bool 
{ \@@_fatal:n { too-much-cols-for-matrix-with-last-col } } 
} 
} 
{ \@@_fatal:n { too-much-cols-for-array } } }
```

The following command must not be protected since it’s used in an error message.

```latex
\cs_new:Npn \@@_message_hdotsfor: 
{ \tl_if_empty:VF \g_@@_HVdotsfor_lines_tl 
{ -Maybe-your-use-of-\token_to_str:N \Hdotsfor\ is-incorrect.} }
```

```latex
\@@_msg_new:nn { too-much-cols-for-matrix-with-last-col }
\{ You-try-to-use-more-columns-than-allowed-by-your-
@@_full_name_env:\@@_message_hdotsfor:\ The-maximal-number-of-
columns-is-\int_eval:n { \l_@@_last_col_int - 1 }-(plus-the-
exterior-columns).-This-error-is-fatal. 
\}
```

```latex
\@@_msg_new:nn { too-much-cols-for-matrix }
\{ You-try-to-use-more-columns-than-allowed-by-your-
@@_full_name_env:\@@_message_hdotsfor:\ Recall-that-the-maximal-
number-of-columns-for-a-matrix-is-fixed-by-the-LaTeX-counter-
'MaxMatrixCols'.-Its-actual-value-is-\int_use:N \c@MaxMatrixCols.-
This-error-is-fatal. 
\}
For the following message, remind that the test is not done after the construction of the array but in each row. That’s why we have to put \c@jCol-1 and not \c@jCol.

\@@_msg_new:nn { too-much-cols-for-array }

\{ You-try-to-use-more-columns-than-allowed-by-your-
\@@_full_name_env::\@@_message_hdotsfor:\ The-maximal-number-of-columns-is-
\int_use:N \g_@@_static_num_of_col_int\ -(plus-the-potential-exterior-ones).-
This-error-is-fatal. \}

\@@_msg_new:nn { last-col-not-used }

\{ The-key-'last-col'-is-in-force-but-you-have-not-used-that-last-column-
in-your-\@@_full_name_env:.-However,-you-can-go-on. \}

\@@_msg_new:nn { columns-not-used }

\{ The-preamble-of-your-\@@_full_name_env:: \@\_message_hdotsfor: \int_use:N \g_@@_static_num_of_col_int\ columns-but-you-use-only-\int_use:N \c@jCol.\ You-can-go-on-but-the-columns-you-did-not-used-won't-be-created. \}

\@@_msg_new:nn { in-first-col }

\{ You-can't-use-the-command-#1 in-the-first-column-(number-0)-of-the-array.\ If-you-go-on,-this-command-will-be-ignored. \}

\@@_msg_new:nn { in-last-col }

\{ You-can't-use-the-command-#1 in-the-last-column-(exterior)-of-the-array.\ If-you-go-on,-this-command-will-be-ignored. \}

\@@_msg_new:nn { in-first-row }

\{ You-can't-use-the-command-#1 in-the-first-row-(number-0)-of-the-array.\ If-you-go-on,-this-command-will-be-ignored. \}

\@@_msg_new:nn { in-last-row }

\{ You-can't-use-the-command-#1 in-the-last-row-(exterior)-of-the-array.\ If-you-go-on,-this-command-will-be-ignored. \}

\@@_msg_new:nn { double-closing-delimiter }

\{ You-can't-put-a-second-closing-delimiter-"#1"-just-after-a-first-closing-
delimiter.-This-delimiter-will-be-ignored. \}

\@@_msg_new:nn { delimiter-after-opening }

\{ You-can't-put-a-second-delimiter-"#1"-just-after-a-first-opening-
delimiter.-This-delimiter-will-be-ignored. \}

\@@_msg_new:nn { bad-option-for-line-style }

\{ Since-you-haven't-loaded-Tikz,-the-only-value-you-can-give-to-'line-style'-
is-'standard'.-If-you-go-on,-this-key-will-be-ignored. \}

\@@_msg_new:nn { Unknown-key-for-xdots }

\{ As-for-now,-there-is-only-three-keys-available-here:-'color',-'line-style'-

and 'shorten' (and you try to use '\l_keys_key_str'). If you go on, this key will be ignored.

```latex
\@@_msg_new:nn { Unknown-key-for-RowStyle }
\{ As-for-now, there is only three keys available here: 'cell-space-top-limit', 'cell-space-bottom-limit' and 'cell-space-limits' (and you try to use '\l_keys_key_str'). If you go on, this key will be ignored. \}
```

```latex
\@@_msg_new:nn { Unknown-key-for-rowcolors }
\{ As-for-now, there is only two keys available here: 'cols' and 'respect-blocks' (and you try to use '\l_keys_key_str'). If you go on, this key will be ignored. \}
```

```latex
\@@_msg_new:nn { ampersand-in-light-syntax }
\{ You can't use an ampersand (token_to_str:N &) to separate columns because you have used the key 'light-syntax'. This error is fatal. \}
```

```latex
\@@_msg_new:nn { SubMatrix-too-large }
\{ Your command \token_to_str:N \SubMatrix\ can't be drawn because your matrix is too small. If you go on, this command will be ignored. \}
```

```latex
\@@_msg_new:nn { double-backslash-in-light-syntax }
\{ You can't use \token_to_str:N \\ to separate rows because you have used the key 'light-syntax'. You must use the character '\l_@@_end_of_row_tl' (set by the key 'end-of-row'). This error is fatal. \}
```

```latex
\@@_msg_new:nn { standard-cline-in-document }
\{ The key 'standard-cline' is available only in the preamble. If you go on, this command will be ignored. \}
```

```latex
\@@_msg_new:nn { old-column-type }
\{ The column type '#1' is no longer defined in 'nicematrix'. Since version 5.0, you have to use 'l', 'c' and 'r' instead of 'L', 'C' and 'R'. You can also use the key 'define-L-C-R'. This error is fatal. \}
```

```latex
\@@_msg_new:nn { bad-value-for-baseline }
\{ The value given to 'baseline' (\int_use:N \l_tmpa_int) is not valid. The value must be between \int_use:N \l@@_first_row_int and \int_use:N \g_@@_row_total_int or equal to 't', 'c' or 'b'. If you go on, a value of 1 will be used. \}
```

```latex
\@@_msg_new:nn { Invalid-name-format }
\{ You can't give the name '\l_keys_value_tl' to a \token_to_str:N \SubMatrix. A name must be accepted by the regular expression [A-Za-z][A-Za-z0-9]*. If you go on, this key will be ignored. \}
```

```latex
\@@_msg_new:nn { Wrong-line-in-SubMatrix }
```
You try to draw a line of number '#1' in a \token_to_str:N \SubMatrix\ of your \@@_full_name_env:\ but that number is not valid. If you go on, it will be ignored.

{ impossible-delimiter }
{ It's impossible to draw the #1 delimiter of your \token_to_str:N \SubMatrix\ because all the cells are empty in that column. \bool_if:NT \l_@@_submatrix_slim_bool { Maybe you should try without the key 'slim'. } \}
{ If you go on, this \token_to_str:N \SubMatrix\ will be ignored. }

{ empty-environment }
{ Your \@@_full_name_env:\ is empty. This error is fatal. }

{ Delimiter-with-small }
{ You can't put a delimiter in the preamble of your \@@_full_name_env:\ because the key 'small' is in force.\}
{ This error is fatal. }

{ unknown-cell-for-line-in-CodeAfter }
{ Your command \token_to_str:N \line\{#1\}\{#2\} in the 'code-after' can't be executed because a cell doesn't exist.\}
{ If you go on, this command will be ignored. }

{ Duplicate-name-for-SubMatrix }
{ The name '#1' is already used for a \token_to_str:N \SubMatrix\ in this \@@_full_name_env:\ \}
{ If you go on, this key will be ignored.\}
{ For a list of the names already used, type H <return>. }
{ The names already defined in this \@@_full_name_env:\ are:~}
{ \seq_use:Nnnn \g_@@_submatrix_names_seq { ~and~ } { ,~ } { ~and~ }.

{ r-or-l-with-preamble }
{ You can't use the key 'l_keys_key_str' in your \@@_full_name_env:\ -}
{ You must specify the alignment of your columns with the preamble of your \@@_full_name_env:\ \}
{ If you go on, this key will be ignored. }

{ Hdotsfor-in-col-0 }
{ You can't use \token_to_str:N \Hdotsfor\ in an exterior column of the array. This error is fatal. }

{ bad-corner }
{ #1 is an incorrect specification for a corner (in the keys 'corners' and 'except-corners'). The available values are: NW, SW, NE and SE.\}
{ If you go on, this specification of corner will be ignored. }

{ bad-border }
#1-is-an-incorrect-specification-for-a-border-(in-the-key-
'borders'-of-the-command-'\token_to_str:N \\Block').-The-available-
values-are:left,-right,-top-and-bottom.\`
If-you-go-on,-this-specification-of-border-will-be-ignored.
```
\@@_msg_new:nn { tikz-key-without-tikz }
{ \You-can't-use-the-key-'tikz'-for-the-command-'
\Block'-because-you-have-not-loaded-Tikz.-
If-you-go-on,-this-key-will-be-ignored. }
\@@_msg_new:nn { last-col-non-empty-for-NiceArray }
{ In-the-@@_full_name_env:,\-you-must-use-the-key-
'last-col'-without-value.\`
However,-you-can-go-on-for-this-time-
(the-value-'\l_keys_value_tl'-will-be-ignored). }
\@@_msg_new:nn { last-col-non-empty-for-NiceMatrixOptions }
{ In-NiceMatrixoptions,\-you-must-use-the-key-
'last-col'-without-value.\`
However,-you-can-go-on-for-this-time-
(the-value-'\l_keys_value_tl'-will-be-ignored). }
\@@_msg_new:nn { Block-too-large-1 }
{ You-try-to-draw-a-block-in-the-cell-#1-#2-of-your-matrix-but-the-matrix-is-
too-small-for-that-block. \`
If-you-go-on,this-block-and-maybe-others-will-be-ignored. }
\@@_msg_new:nn { Block-too-large-2 }
{ The-preamble-of-your-@@_full_name_env:\ announces-\int_use:N \\g_@@_static_num_of_col_int\ columns-but-you-use-only-\int_use:N \c@jCol\ and-that's-why-a-block-
specified-in-the-cell-#1-#2-can't-be-drawn.-You-should-add-some-ampersands-
(&)-at-the-end-of-the-first-row-of-your-
@@_full_name_env:.\`
If-you-go-on,this-block-and-maybe-others-will-be-ignored. }
\@@_msg_new:nn { unknown-column-type }
{ The-column-type-'#1'-in-your-@@_full_name_env:\ is-unknown. \`
This-error-is-fatal. }
\@@_msg_new:nn { tabularnote-forbidden }
{ \You-can't-use-the-command-\token_to_str:N\tabularnote-
in-a-@@_full_name_env:.\This-command-is-available-only-in-
\{NiceTabular\},\{NiceArray\}-and-\{NiceMatrix\}. \`
If-you-go-on,-this-command-will-be-ignored. }
\@@_msg_new:nn { borders-forbidden }
{ \You-can't-use-the-key-'borders'-of-the-command-\token_to_str:N \Block\ because-the-option-'rounded-corners'-
is-in-force-with-a-non-zero-value.\`
If-you-go-on,-this-key-will-be-ignored. }
206
You can't use the key 'tabular/bottomrule' because you haven't loaded 'booktabs'.
If you go on, this key will be ignored.

You can't use the command \tabularnote because you haven't loaded 'enumitem'.
If you go on, this command will be ignored.

You have used 'last-row=\int_use:N \l_@@_last_row_int' but your \\ seems to have \int_use:N \c@iRow \ rows.
If you go on, the value of \int_use:N \c@iRow \ will be used for last row. You can avoid this problem by using 'last-row=' without value (more compilations might be necessary).

Environments of nicematrix can't be nested. This error is fatal.

The \\ can be used only in math mode (and not in \vcenter). This error is fatal.

The value of key '\l_keys_key_str' must be of length 1.
If you go on, it will be ignored.

The available keys are (in alphabetic order): b, borders, c, draw, fill, hvlines, l, line-width, rounded-corners, r, t, and tikz.

The latter is for the command \line.

The available keys are (in alphabetic order): delimiters/color, rules (with the subkeys 'color' and 'width'), sub-matrix (several subkeys), and xdots (several subkeys).

The latter is for the command \line.
The key '\l_keys_key_str' is unknown. If you go on, this key will be ignored. For a list of the available keys in the SubMatrix command, type H <return>.

{ The available keys are (in alphabetic order): 'delimiters/color', 'extra-height', 'hlines', 'hvlines', 'left-xshift', 'name', 'right-xshift', 'rules' (with the subkeys 'color' and 'width'), 'slim', 'vlines' and 'xshift' (which sets both 'left-xshift' and 'right-xshift'). }\@@_msg_new:nnn { Unknown key for notes }

{ The key '\l_keys_key_str' is unknown. If you go on, it will be ignored. For a list of the available keys about notes, type H <return>. }\@@_msg_new:nnn { Unknown key for NiceMatrixOptions }

{ The key '\l_keys_key_str' is unknown for the command \token_to_str:N \NiceMatrixOptions. If you go on, it will be ignored. For a list of the principal available keys, type H <return>. }\@@_msg_new:nnn { Unknown key for -Note }
hvlines,~
last-col,-
last-row,-
left-margin,-
letter-for-dotted-lines,-
light-syntax,-
notes-(several-subkeys),-
nullify-dots,-
renew-dots,-
renew-matrix,-
right-margin,-
rules-(with-the-subkeys-"color"-and-"width"),-
small,-
sub-matrix-(several-subkeys),
vlines,-
xdots-(several-subkeys).
}

\@@_msg_new:nnn { Unknown-key-for-NiceArray }
{
The-key-\l_keys_key_str'-is-unknown-for-the-environment-
\{NiceArray\}. \\ If-you-go-on,-it-will-be-ignored. \\ For-a-list-of-the-*principal*-available-keys,-type-H<-return>.
}
{
The-available-keys-are-(in-alphabetic-order):-b,-
c,-
cell-space-bottom-limit,-
cell-space-limits,-
cell-space-top-limit,-
code-after,-
code-for-first-col,-
code-for-first-row,-
code-for-last-col,-
code-for-last-row,-
colorthtl-like,-
columns-width,-
corners,-
create-extra-nodes,-
create-medium-nodes,-
create-large-nodes,-
delimiters/color,-
extra-left-margin,-
extra-right-margin,-
first-col,-
first-row,-
hlines,-
fvlines,-
last-col,-
last-row,-
left-margin,-
light-syntax,-
name,-
notes/bottomrule,-
notes/para,-
nullify-dots,-
renew-dots,-
right-margin,-
rules-(with-the-subkeys-"color"-and-"width"),-
small,-
t,-

This error message is used for the set of keys \texttt{NiceMatrix}/\texttt{NiceMatrix} and \texttt{NiceMatrix}/\texttt{pNiceArray} (but not by \texttt{NiceMatrix}/\texttt{NiceArray} because, for this set of keys, there is also the keys \texttt{t}, \texttt{c} and \texttt{b}).

\begin{verbatim}
\@@_msg_new:nnn { Unknown-key-for-NiceMatrix }
\{ 
The-key-`\l_keys_key_str'-is-unknown-for-the-
\@@_full_name_env:. \}
If-you-go-on,-it-will-be-ignored. \}
For-a-list-of-the-*principal*-available-keys,-type-H<return>.
\}
{ The-available-keys-are-(in-alphabetic-order):
  b,-
baseline,-
c,-
cell-space-bottom-limit,-
cell-space-limits,-
cell-space-top-limit,-
code-after,-
code-for-first-col,-
code-for-first-row,-
code-for-last-col,-
code-for-last-row,-
colortbl-like,-
columns-width,-
corners,-
create-extra-nodes,-
create-medium-nodes,-
create-large-nodes,-
delimiters-(several-subkeys),-
extra-left-margin,-
extraright-margin,-
first-col,-
first-row,-
hlines,-
hylines,-
l,-
last-col,-
last-row,-
left-margin,-
light-syntax,-
name,-
nullify-dots,-
r,-
renew-dots,-
right-margin,-
rules-(with-the-subkeys-`color'-and-`width'),-
small,-
t,-
vlines,-
xdots/color,-
xdots/shorten-and-
xdots/line-style.
\}
\@@_msg_new:nnn { Unknown-key-for-NiceTabular }
\{ 
The-key-`\l_keys_key_str'-is-unknown-for-the-environment-
\end{verbatim}
If you go on, it will be ignored.
For a list of the *principal* available keys, type \H<return>.

The available keys are (in alphabetic order):
- b,
- baseline,
- c,
- cell-space-bottom-limit,
- cell-space-limits,
- cell-space-top-limit,
- code-after,
- code-for-first-col,
- code-for-first-row,
- code-for-last-col,
- code-for-last-row,
- colortbl-like,
- columns-width,
- corners,
- create-extra-nodes,
- create-medium-nodes,
- create-large-nodes,
- extra-left-margin,
- extra-right-margin,
- first-col,
- first-row,
- hlines,
- hlines,
- last-col,
- last-row,
- left-margin,
- light-syntax,
- name,
- notes/bottomrule,
- notes/para,
- nullify-dots,
- renew-dots,
- right-margin,
- rules-(with-the-subkeys-'color'-and-'width'),
- t,
- tabularnote,
- vlines,
- xdots/color,
- xdots/shorten-and-
- xdots/line-style.

The name '\\l_keys_value_tl' is already used and you shouldn't use
the same environment name twice. You can go on, but,
maybe, you will have incorrect results especially
if you use 'columns-width=auto'. If you don't want to see this
message again, use the key 'allow-duplicate-names' in-
'token_to_str:N \NiceMatrixOptions'.
For a list of the names already used, type \H<return>.

The names already defined in this document are:
\seq_use:Nnnn \g_@@_names_seq { and } { , } { and }.

The name '\\l_keys_value_tl' is already used and you shouldn't use
the same environment name twice. You can go on, but,
maybe, you will have incorrect results especially
if you use 'columns-width=auto'. If you don't want to see this
message again, use the key 'allow-duplicate-names' in-
'token_to_str:N \NiceMatrixOptions'.
For a list of the names already used, type \H<return>.

The names already defined in this document are:
\seq_use:Nnnn \g_@@_names_seq { -and } { } { -and }.
19 History

The successive versions of the file nicematrix.sty provided by TeXLive are available on the SVN server of TeXLive:
https://www.tug.org/svn/texlive/trunk/Master/texmf-dist/tex/latex/nicematrix/nicematrix.sty

Changes between versions 1.0 and 1.1

The dotted lines are no longer drawn with Tikz nodes but with Tikz circles (for efficiency). Modification of the code which is now twice faster.

Changes between versions 1.1 and 1.2

New environment `{NiceArray}` with column types L, C and R.

Changes between version 1.2 and 1.3

New environment `{pNiceArrayC}` and its variants.
Correction of a bug in the definition of `{BNiceMatrix}`, `{vNiceMatrix}` and `{vNiceMatrix}` (in fact, it was a typo).
Options are now available locally in `{pNiceMatrix}` and its variants.
The names of the options are changed. The old names were names in “camel style”.

Changes between version 1.3 and 1.4

The column types w and W can now be used in the environments `{NiceArray}`, `{pNiceArrayC}` and its variants with the same meaning as in the package `array`.
New option `columns-width` to fix the same width for all the columns of the array.

Changes between version 1.4 and 2.0

The versions 1.0 to 1.4 of nicematrix were focused on the continuous dotted lines whereas the version 2.0 of nicematrix provides different features to improve the typesetting of mathematical matrices.

Changes between version 2.0 and 2.1

New implementation of the environment `{pNiceArrayRC}`. With this new implementation, there is no restriction on the width of the columns.
The package nicematrix no longer loads mathtools but only amsmath.
Creation of “medium nodes” and “large nodes”.
Changes between version 2.1 and 2.1.1

Small corrections: for example, the option `code-for-first-row` is now available in the command `\NiceMatrixOptions`.
Following a discussion on TeX StackExchange\(^{65}\), Tikz externalization is now deactivated in the environments of the package `nicematrix`\(^{66}\).

Changes between version 2.1.2 and 2.1.3

When searching the end of a dotted line from a command like `\Cdots` issued in the “main matrix” (not in the exterior column), the cells in the exterior column are considered as outside the matrix. That means that it’s possible to do the following matrix with only a `\Cdots` command (and a single `\Vdots`).

$$
\begin{pmatrix}
C_j \\
0 & \cdots & 0 \\
0 & a & 0 \\
\end{pmatrix}
L_i
$$

Changes between version 2.1.3 and 2.1.4

Replacement of some options `\{ {} \}` in commands and environments defined with `xparse` by `! \{ {} \}` (because a recent version of `xparse` introduced the specifier `!` and modified the default behaviour of the last optional arguments).

Changes between version 2.1.4 and 2.1.5

Compatibility with the classes `revtex4-1` and `revtex4-2`.
Option `allow-duplicate-names`.

Changes between version 2.1.5 and 2.2

Possibility to draw horizontal dotted lines to separate rows with the command `\hdottedline` (similar to the classical command `\hline` and the command `\hdashline` of `arydshln`).
Possibility to draw vertical dotted lines to separate columns with the specifier `|` in the preamble (similar to the classical specifier `|` and the specifier `:` of `arydshln`).

Changes between version 2.2 and 2.2.1

Improvement of the vertical dotted lines drawn by the specifier `:` in the preamble.
Modification of the position of the dotted lines drawn by `\hdottedline`.

Changes between version 2.2.1 and 2.3

Compatibility with the column type `S` of `siunitx`.
Option `hlines`.

---


\(^{66}\)Before this version, there was an error when using `nicematrix` with Tikz externalization. In any case, it’s not possible to externalize the Tikz elements constructed by `nicematrix` because they use the options `overlay` and `remember picture`.

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Changes between version 2.3 and 3.0

Modification of \Hdots for. Now \Hdots erases the \vlines (of “|”) as \hdots for does.
Composition of exterior rows and columns on the four sides of the matrix (and not only on two sides) with the options \textit{first-row, last-row, first-col and last-col}.

Changes between version 3.0 and 3.1

Command \Block to draw block matrices.
Error message when the user gives an incorrect value for last-row.
A dotted line can no longer cross another dotted line (excepted the dotted lines drawn by \cdottedline, the symbol “;” (in the preamble of the array) and \line in code-after).
The starred versions of \Cdots, \Ldots, etc. are now deprecated because, with the new implementation, they become pointless. These starred versions are no longer documented.
The vertical rules in the matrices (drawn by “|”) are now compatible with the color fixed by \texttt{colortbl}.
Correction of a bug: it was not possible to use the colon “;” in the preamble of an array when \texttt{pdflatex} was used with \texttt{french-babel} (because \texttt{french-babel} activates the colon in the beginning of the document).

Changes between version 3.1 and 3.2 (and 3.2a)

Option \texttt{small}.

Changes between version 3.2 and 3.3

The options \texttt{first-row, last-row, first-col and last-col} are now available in the environments \texttt{\{NiceMatrix\}, \{pNiceMatrix\}, \{bNiceMatrix\}, etc.}
The option \texttt{columns-width=auto} doesn’t need any more a second compilation.
The options \texttt{renew-dots, renew-matrix and transparent} are now available as package options (as said in the documentation).
The previous version of \texttt{nicematrix} was incompatible with a recent version of \texttt{expl3} (released 2019/09/30). This version is compatible.

Changes between version 3.3 and 3.4

Following a discussion on \TeX\ StackExchange\textsuperscript{67}, optimization of Tikz externalization is disabled in the environments of \texttt{nicematrix} when the class \texttt{standalone} or the package \texttt{standalone} is used.

Changes between version 3.4 and 3.5

Correction on a bug on the two previous versions where the \texttt{code-after} was not executed.

Changes between version 3.5 and 3.6

\LaTeX\ counters \texttt{iRow and jCol} available in the cells of the array.
Addition of \texttt{\normalbaselines} before the construction of the array: in environments like \texttt{\{align\}} of \texttt{amsmath} the value of \texttt{\baselineskip} is changed and if the options \texttt{first-row and last-row} were used in an environment of \texttt{nicematrix}, the position of the delimiters was wrong.
A warning is written in the \texttt{.log} file if an obsolete environment is used.
There is no longer artificial errors \texttt{Duplicate-name} in the environments of \texttt{amsmath}.

\textsuperscript{67}cf. \url{tex.stackexchange.com/questions/510841/nicematrix-and-tikz-external-optimize}

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Changes between version 3.6 and 3.7

The four “corners” of the matrix are correctly protected against the four codes: `code-for-first-col`, `code-for-last-col`, `code-for-first-row` and `code-for-last-row`. New command `\pAutoNiceMatrix` and its variants (suggestion of Christophe Bal).

Changes between version 3.7 and 3.8

New programmation for the command `\Block` when the block has only one row. With this programmation, the vertical rules drawn by the specifier “|” at the end of the block is actually drawn. In previous versions, they were not because the block of one row was constructed with `\multicolumn`. An error is raised when an obsolete environment is used.

Changes between version 3.8 and 3.9

New commands `\NiceMatrixLastEnv` and `\OnlyMainNiceMatrix`. New options `create-medium-nodes` and `create-large-nodes`.

Changes between version 3.9 and 3.10

New option `light-syntax` (and `end-of-row`). New option `dotted-lines-margin` for fine tuning of the dotted lines.

Changes between versions 3.10 and 3.11

Correction of a bug linked to `first-row` and `last-row`.

Changes between versions 3.11 and 3.12

Command `\rotate` in the cells of the array. Options `vlines`, `hlines` and `hvlines`. Option `baseline` pour `\{NiceArray\}` (not for the other environments).
The name of the Tikz nodes created by the command `\Block` has changed: when the command has been issued in the cell $i$-$j$, the name is $i$-$j$-block and, if the creation of the “medium nodes” is required, a node $i$-$j$-block-medium is created.
If the user tries to use more columns than allowed by its environment, an error is raised by nicematrix (instead of a low-level error).
The package must be loaded with the option `obsolete-environments` if we want to use the deprecated environments.

Changes between versions 3.12 and 3.13

The behaviour of the command `\rotate` is improved when used in the “last row”. The option `dotted-lines-margin` has been renamed in `xdots/shorten` and the options `xdots/color` and `xdots/line-style` have been added for a complete customisation of the dotted lines.
In the environments without preamble (`\{NiceMatrix\}`, `\pNiceMatrix`, etc.), it’s possible to use the options 1 (=L) or r (=R) to specify the type of the columns.
The starred versions of the commands `\Cdots`, `\Ldots`, `\Vdots`, `\Ddots` and `\Iddots` are deprecated since the version 3.1 of nicematrix. Now, one should load `nicematrix` with the option `starred-commands` to avoid an error at the compilation.
The code of `nicematrix` no longer uses Tikz but only PGF. By default, Tikz is not loaded by `nicematrix`. 

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Changes between versions 3.13 and 3.14
Correction of a bug (question 60761504 on stackoverflow).
Better error messages when the user uses & or \ when light-syntax is in force.

Changes between versions 3.14 and 3.15
It’s possible to put labels on the dotted lines drawn by \Ldots, \Cdots, \Vdots, \Ddots, \Iddots, \Hdots for and the command \line in the code-after with the tokens _ and ^.
The option baseline is now available in all the environments of nicematrix. Before, it was available only in \{NiceArray\}.
New keyword \CodeAfter (in the environments of nicematrix).

Changes between versions 3.15 and 4.0
New environment \{NiceTabular\}
Commands to color cells, rows and columns with a perfect result in the PDF.

Changes between versions 4.0 and 4.1
New keys cell-space-top-limit and cell-space-bottom-limit
New command \diagbox
The key hvline don’t draw rules in the blocks (commands \Block) and in the virtual blocks corresponding to the dotted lines.

Changes between versions 4.1 and 4.2
It’s now possible to write \begin{pNiceMatrix}a\&b\c\&d\end{pNiceMatrix}^2 with the expected result.

Changes between versions 4.2 and 4.3
The horizontal centering of the content of a \Block is correct even when an instruction such as \{\qquad\} is used in the preamble of the array.
It’s now possible to use the command \Block in the “last row”.

Changes between versions 4.3 and 4.4
New key hvlines-except-corners.

Changes between versions 4.4 and 5.0
Use of the standard column types l, c and r instead of L, C and R.
It’s now possible to use the command \diagbox in a \Block.
Command \tabularnote

Changes between versions 5.0 and 5.1
The vertical rules specified by | in the preamble are not broken by \hline\hline (and other).
Environment \{NiceTabular*\}
Command \Ddots similar to \Hdots
The variable \g_nicematrix_code_after_tl is now public.
Changes between versions 5.1 and 5.2

The vertical rules specified by | or || in the preamble respect the blocks.
Key respect-blocks for \rowcolors (with a s) in the code-before.
The variable \g_nicematrix_code_before_tl is now public.
The key baseline may take in as value an expression of the form line-i to align the \hline in the row i.
The key hvlines-except-corners may take in as value a list of corners (eg: NW,SE).

Changes between versions 5.2 and 5.3

Keys c, r and l for the command \Block.
It’s possible to use the key draw-first with \Ddots and \Iddots to specify which dotted line will
be drawn first (the other lines will be drawn parallel to that one if parallelization is activated).

Changes between versions 5.3 and 5.4

Key tabularnote.
Different behaviour for the mono-column blocks.

Changes between versions 5.4 and 5.5

The user must never put \omit before \CodeAfter.
Correction of a bug: the tabular notes \tabularnotes were not composed when present in a block
(except a mono-column block).

Changes between versions 5.5 and 5.6

Different behaviour for the mono-row blocks.
New command \NotEmpty.

Changes between versions 5.6 and 5.7

New key delimiters-color
Keys fill, draw and line-width for the command \Block.

Changes between versions 5.7 and 5.8

Keys cols and restart of the command \rowcolors in the code-before.
Modification of the behaviour of \ in the columns of type p, m or b (for a behaviour similar to the
environments of array).
Better error messages for the command \Block.

Changes between versions 5.8 and 5.9

Correction of a bug: in the previous versions, it was not possible to use the key line-style for the
continuous dotted lines when the Tikz library babel was loaded.
New key cell-space-limits.

Changes between versions 5.9 and 5.10

New command \SubMatrix available in the \CodeAfter.
It’s possible to provide options (between brackets) to the keyword \CodeAfter.
A (non fatal) error is raised when the key transparent, which is deprecated, is used.
Changes between versions 5.10 and 5.11

It's now possible, in the `code-before` and in the `\CodeAfter`, to use the syntax `|(i-|j)` for the Tikz node at the intersection of the (potential) horizontal rule number `i` and the (potential) vertical rule number `j`.

Changes between versions 5.11 and 5.12

Keywords `\CodeBefore` and `\Body` (alternative syntax to the key `code-before`).
New key `delimiters/max-width`.
New keys `hlines`, `vlines` and `hvlines` for the command `\SubMatrix` in the `\CodeAfter`.
New key `rounded-corners` for the command `\Block`.

Changes between versions 5.12 and 5.13

New command `\arraycolor` in the `\CodeBefore` (with its key `except-corners`).
New key `borders` for the command `\Block`.
New command `\Hline` (for horizontal rules not drawn in the blocks).
The keys `vlines` and `hlines` takes in as value a (comma-separated) list of numbers (for the rules to draw).

Changes between versions 5.13 and 5.14

Nodes of the form `(1.5)`, `(2.5)`, `(3.5)`, etc.
Keys `t` and `b` for the command `\Block`.
Key `corners`.

Changes between versions 5.14 and 5.15

Key `hvlines` for the command `\Block`.
The commands provided by `nicematrix` to color cells, rows and columns don’t color the cells which are in the “corners” (when the key `corner` is used).
It’s now possible to specify delimiters for submatrices in the preamble of an environment.
The version 5.15b is compatible with the version 3.0+ of `siunitx` (previous versions were not).

Changes between versions 5.15 and 5.16

It’s now possible to use the cells corresponding to the contents of the nodes (of the form `i-j`) in the `\CodeBefore` when the key `create-cell-nodes` of that `\CodeBefore` is used. The medium and the large nodes are also available if the corresponding keys are used.

Changes between versions 5.16 and 5.17

The key `define-L-C-R` (only available at load-time) now raises a (non fatal) error (that key will probably be deleted in a future version of `nicematrix`).
Keys `L`, `C` and `R` for the command `\Block`.
Key `hvlines-except-borders`.
It’s now possible to use a key `l`, `r` or `c` with the command `\pAutoNiceMatrix` (and the similar ones).

Changes between versions 5.17 and 5.18

New command `\RowStyle`
Changes between versions 5.18 and 5.19

New key TikZ for the command \Block.

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