The amsopn package

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1 Introduction

The amsopn package provides a command \DeclareMathOperator for defining new ‘math operator names’ similar to the standard function names \sin, \lim, \max, etc.

Standard file identification.

\NeedsTeXFormat{LaTeX2e}% LaTeX 2.09 can’t be used (nor non-LaTeX)
[1994/12/01]% LaTeX date must December 1994 or later
\ProvidesPackage{amsopn}[2021/08/26 v2.02 operator names]

What \nolimits does is keep a \limits typed by the user from having any effect. This is used for operator names whose standard usage is never to have limits.

\nolimits{} & \@ifnextchar\limits{\nolimits\@gobble}{\nolimits}

In operator names, it is sometimes desired to have text-mode punctuation characters such as *-/\'. Because the body of an operator name is set in math mode, these few punctuation characters will not come out right (wrong symbol and/or wrong spacing). The purpose of \newmcodes is to make them act like their normal text versions.

Where practical, we use decimal numbers to cut down main mem usage (“not needed). Use \Umathcodedefnum with xetex and LuaTeX to avoid problems using \mathcode if – has already been defined using \Umathcode.

\begingroup \catcode`\"=12
\ifx\Umathcode\@undefined
\gdef\newmcodes{\mathcode`\'39\mathcode`\*42\mathcode`\."613A%
Define \std@minus for \relbar use; otherwise there are problems with arrows constructed with \relbar.
\ifnum\mathcode`\-=45 \else
\mathchardef\std@minus\mathcode`\-\relax
\fi
\mathcode`\-45\mathcode`\/47\mathcode`\:"603A\relax}

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\else
\gdef\newmcodes@{\mathcode`\*39\mathcode`\+42\mathcode`.613A%
  \ifnum\Umathcodenum`-=45 \else
    \Umathcharnumdef\std@minus\Umathcodenum`-\relax
  \fi
  \mathcode`-45\mathcode`/47\mathcode`.603A\relax}
\fi
\endgroup

The command \operatorname prints its argument as a ‘math operator’ like \sin or \det, with proper font and spacing.
\DeclareRobustCommand{\operatorname}{\@ifstar{\qopname\newmcodes@ m}{\qopname\newmcodes@ o}}

In the interior of the \mathop we need a null object (we choose a zero kern for minimum waste of main mem) in order to guard against the case where \#3 is a single letter; \TeX will seize it and center it on the math axis if there is nothing else inside the \mathop atom.
\DeclareRobustCommand{\qopname}{\mathop{#1\kern\z@\operator@font#3}\csname n#2limits@\endcsname}

\DeclareMathOperator

The command \DeclareMathOperator defines the first argument to be an operator name whose text is the second argument. The star form means that the operator name should take limits (like \max or \lim).
\newcommand{\DeclareMathOperator}{\@ifstar{\@declmathop m}{\@declmathop o}}

In the basic set of operator names (below) we did not use \DeclareRobustCommand because of the hash table cost. But we use it here to minimize the chances of trouble, since we are producing a user-defined command.
\long\def\declmathop#1#2#3{\@ifdefinable{#2}{\DeclareRobustCommand{#2}{\qopname\newmcodes@#1{#3}}}\}
\@onlypreamble{\DeclareMathOperator}
\def\arccos{\qopname\relax o{arccos}}
\def\arcsin{\qopname\relax o{arcsin}}
\def\arctan{\qopname\relax o{arctan}}
\def\arg{\qopname\relax o{arg}}
\def\cos{\qopname\relax o{cos}}
\def\cosh{\qopname\relax o{cosh}}
\def\cot{\qopname\relax o{cot}}
\def\coth{\qopname\relax o{coth}}
\def\csc{\qopname\relax o{csc}}
\def\deg{\qopname\relax o{deg}}
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\def\det{\qopname\relax m{det}}
\def\dim{\qopname\relax o{dim}}
\def\exp{\qopname\relax o{exp}}
\def\gcd{\qopname\relax m{gcd}}
\def\hom{\qopname\relax o{hom}}
\def\inf{\qopname\relax m{inf}}
\def\injlim{\qopname\relax m{inj\,,\,lim}}
\def\ker{\qopname\relax o{ker}}
\def\lg{\qopname\relax o{lg}}
\def\lim{\qopname\relax m{lim}}
\def\liminf{\qopname\relax m{lim\,,\,inf}}
\def\limsup{\qopname\relax m{lim\,,\,sup}}
\def\ln{\qopname\relax o{ln}}
\def\log{\qopname\relax o{log}}
\def\max{\qopname\relax m{max}}
\def\min{\qopname\relax m{min}}
\def\Pr{\qopname\relax m{Pr}}
\def\projlim{\qopname\relax m{proj\,lim}}
\def\sec{\qopname\relax o{sec}}
\def\sin{\qopname\relax o{sin}}
\def\sinh{\qopname\relax o{sinh}}
\def\sup{\qopname\relax m{sup}}
\def\tan{\qopname\relax o{tan}}
\def\tanh{\qopname\relax o{tanh}}

\operatorfont

This command is provided to allow the document styles to decide in which
way math operators like ‘max’ or ‘log’ are typeset. The default is to set them
in ⟨math group⟩ zero of the current math version. The original name was
\operatorfont, retained for compatibility; the second name was added to
make it more accessible so that users can call this font for use in special con-
structs that are not ordinary operator names but conceptually related.

\def\operatorfont{\mathgroup\symoperators}
\def\operatorfont{\operatorfont}

For backwards compatibility we keep this old command name for the time
being:
\def\operatorwithlimits{\operatorname*}

These macros use \mathpalettes so that they will change size in script and
scriptscript styles, though it’s hard to imagine they will ever be used there (the
arrows, particularly, look bad in subscript sizes). Notice that the use of \ex@
means that the vertical spacing may not be optimal in script and scriptscript
sizes. Unfortunately \TeX{} provides no easy way to do math mode vertical spacing
that varies with current math style like mu units.
\def\varlim@#1#2{%
  \vtop{\noalign{\vskip\ex@\vskip\ex@}%
    \begin{array}{cc}
      |\vrule height0ex\hfil| #1\hfil |\hfil\vrule width0ex
    \end{array}%
    \noalign{\vskip\ex@\vskip\ex@}%
    \noalign{\vskip\ex@\vskip\ex@}%
    \noalign{\vskip\ex@\vskip\ex@}%
    \noalign{\vskip\ex@\vskip\ex@}%
%}
\def\varinjlim{%
  \mathop{\mathpalette\varlim@{\rightarrowfill@\textstyle}}\nmlimits@}
\def\varprojlim{%
  \mathop{\mathpalette\varlim@{\leftarrowfill@\textstyle}}\nmlimits@}
\def\varliminf{\mathop{\mathpalette\varliminf@{}}\nmlimits@}
\def\varliminf@#1{\@@underline{\vrule\@depth.2\ex\@width\z@
    \hbox{$#1\m@th\operator@font lim$}}}
\def\varlimsup{\mathop{\mathpalette\varlimsup@{}}\nmlimits@}
\def\varlimsup@#1{\@@overline{\hbox{$#1\m@th\operator@font lim$}}}
\let\nmlimits@\displaylimits
\DeclareOption{namelimits}{\let\nmlimits@\displaylimits}
\DeclareOption{nonamelimits}{\let\nmlimits@\nolimits}
\ProcessOptions\relax

If we don’t load the amsgen package then the use of \ex in \varlim will lead to trouble.
\RequirePackage{amsgen}\relax

The usual \endinput to ensure that random garbage at the end of the file doesn’t get copied by docstrip.
\endinput