The letterswitharrows package

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This package provides math-mode commands for setting left and right arrows over mathematical symbols, so that the arrows dynamically scale with the symbols. Here is a sample:

$$\vec{s} \leq \overleftarrow{t} \in \vec{U}_{\overleftarrow{r}} \qquad \left|\overrightarrow{AB}\right| = \left|\overleftarrow{AB}\right| \qquad A \overleftarrow{\langle\rangle} B$$

While it is possible to set arrows over longer strings of symbols, the focus lies on single characters.

Only PDF output is supported. Output to PS is implemented, but rarely tested. For a wider range of formats there is pgf-based output.

1 Usage

The package provides the general-purpose `\arrowoverset` command, as well as some sets of predefined shorthand commands.

1.1 Presets

The presets are selected by passing them as options to the `presets` package option. For instance, to define the `abc` and the `vec-cev` sets of commands you would load the package like so:

```
\usepackage[presets={abc,vec-cev}]{letterswitharrows}
```

By default, the `abc`, `ABC` and `cAcBcC` presets are loaded.

`abc` Passing `abc` to the `presets` option allows you to use the `\v`⟨*char*⟩, `\`⟨*char*⟩`v`, and `\v`⟨*char*⟩`v` commands for all the lower-case letters `a` through `z` except for `v`.

`\v<char>`
`\<char>v`
`\vleft`
`\vright`
`\v<char>v`

For the letter `v` the commands `\vleft` and `\vright` are provided.

$$\vec{a}, \overrightarrow{b}, \vec{c}, \overleftarrow{d}, \overleftarrow{m}, F_{\overleftarrow{t}}$$

```
\[ \va, \vb, \vc, \dv, \vmv, F_\tv \]
```

`ABC` Passing `ABC` to the `presets` option allows you to use the `\v`⟨*CHAR*⟩, `\`⟨*CHAR*⟩`v`, and `\v`⟨*CHAR*⟩`v` commands for all the upper-case letters `A` through `Z`.

\v<CHAR>
\<CHAR>v

$$\overrightarrow{A}, \overrightarrow{B}, \overrightarrow{C}, \overleftarrow{D}, \overleftrightarrow{E}, F_{\overrightarrow{G}}$$

```
\[ \vA, \vB, \vC, \Dv, \vEv, F_\Gv \]
```

cAcBcC Passing `cAcBcC` to the `presets` option allows you to use the `\vc`⟨*CHAR*⟩, `\c`⟨*CHAR*⟩`v`, and `\vc`⟨*CHAR*⟩`v` commands for all the upper-case letters `A` through `Z` to set arrows over `\mathcal`-letters.

\vc<CHAR>
\c<CHAR>v

$$\overrightarrow{\mathcal{A}}, \overrightarrow{\mathcal{B}}, \overrightarrow{\mathcal{C}}, \overleftarrow{\mathcal{D}}, \overleftrightarrow{\mathcal{E}}, F_{\overrightarrow{\mathcal{G}}}$$

```
\[ \vcA, \vcB, \vcC, \cDv, \vcEv, F_\cGv \]
```

vec-cev Passing `vec-cev` to the `presets` option (re)defines the `\vec`, `\cev`, and `\vecev` commands.

\vec
\cev

Unlike the other commands these do not automatically consume subsequent subscripts or `'` tokens.

$$\vec{\mathbf{x}} := \overleftarrow{AB}$$

```
\[ \vec{\mathbf{x}} := \cev{AB}\]
```

1.2 The `\arrowoverset` command

\arrowoverset `\arrowoverset` [⟨*xoffset*⟩] [⟨*xscale*⟩] [⟨*yoffset*⟩] {⟨*math*⟩}
\arrowoverset* `\arrowoverset*` [⟨*xoffset*⟩] [⟨*xscale*⟩] [⟨*yoffset*⟩] {⟨*math*⟩}

This command sets a right (or left if `\arrowoverset*` is used) arrow over ⟨*math*⟩. The base length of the arrow is the width of the ⟨*math*⟩ multiplied by ⟨*xscale*⟩, which must be specified as a fraction ⟨*num*⟩/⟨*denom*⟩. The arrow is offset by ⟨*xoffset*⟩ to the right, which must be a math skip expression, and by ⟨*yoffset*⟩ to the top, which must be a skip expression.

This command consumes subsequent subscripts or up to two primes `'`. The former does not affect the length of the arrow.

1.3 Other package options

pgf If you specify the `pgf` option, every arrow is drawn as a `pgfpicture`. This requires the `pgf` package. Double arrows are not implemented in pgf mode.

TEXhackers note: You can set up custom arrow drawing code by redefining `\__jmt_lwa_arrow_draw:nnn`. The command is expected to draw an arrow with its head at the current position. Its length should be `#1` and it should be drawn at a font size of `#2`pt. If `#3` is `-` if the arrow should point rightwards and empty otherwise.

linewidth Specifying `linewidth=<value>` as a package option allows you to adjust the line width of the arrows to adjust for the weigth of the maths font you are using. The default value is `linewidth=0.3`.

`tweaks` Specifying the `tweaks` option applies per-letter scaling adjustments to some of the single-letter shorthands. This is enabled by default. These are specific to Latin Modern Math and subject to be changed on a whim. If you wish a more stable behaviour specify `tweaks=false`. This documentation uses `tweaks=false`.

2 Implementation

```
\NeedsTeXFormat{LaTeX2e}
\RequirePackage{expl3}
\ProvidesExplPackage {letterswitharrows} {2024/10/31} {} {Draw arrows over math letters.}
\RequirePackage{xparse,l3keys2e,mathtools}
% TODO: I just use mathtools for mathrlap; replace.

⟨@@=jmt_lwa⟩
\msg_new:nnn {letterswitharrows} {pdf-only} {Only~pdf~output~is~supported.}
\AtBeginDocument{
  \sys_if_output_pdf:F {
    \msg_warning:nn {letterswitharrows} {pdf-only}
  }
}
```

The drawing code.

__jmt_lwa_arrow_draw_special:nnn
__jmt_lwa_arrow_draw_double:nn
__jmt_lwa_arrow_draw_pgf:nnn
__jmt_lwa_arrow_left:nn
__jmt_lwa_arrow_right:nn
__jmt_lwa_arrow_double:nn

```
\cs_new:Nn \__jmt_lwa_arrow_draw_special:nnn % length, font size, sign
{
  \sys_if_output_pdf:TF {
    \tex_special:D {pdf:~
      q~
      1~J~1~j~
      1~0~0~\dim_to_decimal:n{#3#2pt/10}~0~0~cm~
      \fp_use:c{g__jmt_lwa_line_width}~w~
      q~
      \dim_to_decimal:n{#3#2pt/10}~0~0~1~0~0~cm~
      1~0~0~1~-1~0~cm~
      0~1~m~
      .25~0~1~0~1~0~c~
      1~0~.25~0~0~-1~c~
      S~
      Q~
      Q~
      q~
      0~0~m~
      -1~0~0~1~0~0~cm~
      \fp_use:c{g__jmt_lwa_line_width}~w~
      \dim_to_decimal:n{#3#1}~0~l~S~
      Q
    }
  } {
    \tex_special:D {"~
      1~setlinecap~1~setlinejoin~
      1~0~0~\dim_to_decimal:n{#3#2pt/10}~0~0~6~array~astore~concat~
      \fp_use:c{g__jmt_lwa_line_width}~setlinewidth~
      gsave~
```

```
      \dim_to_decimal:n{#3#2pt/10}~0~0~1~0~0~6~array~astore~concat~
      1~0~0~1~-1~0~6~array~astore~concat~
      0~1~moveto~
      .25~0~1~0~1~0~curveto~
      1~0~.25~0~0~-1~curveto~
      stroke~
      grestore~
      0~0~moveto~
      -1~0~0~1~0~0~6~array~astore~concat~
      \dim_to_decimal:n{#3#1}~0~lineto~stroke
    }
  }
}


% TODO
% \tl_new:N \g__jmt_lwa_pgf_arrow_style_tl
% \tl_set:Nn \g__jmt_lwa_pgf_arrow_style_tl
%  {Computer~Modern~Rightarrow[width=#2pt*2/10,length=#2pt/10,sharp]}

\cs_new:Nn \__jmt_lwa_arrow_draw_pgf:nnn {
  \begin{pgfpicture}
    \pgfsetlinewidth{#2pt*\fp_use:c{g__jmt_lwa_line_width}/10}
    \pgfsetarrowsstart
      {Computer~Modern~Rightarrow[width=#2pt*2/10,length=#2pt/10,sharp]}
    % \pgfsetarrowsstart{\tl_use:N \g__jmt_lwa_pgf_arrow_style_tl}
    \pgfpathmoveto{\pgfpointorigin}
    \pgfpathlineto{\pgfpoint{-#3#1}{0cm}}
    \pgfusepath{stroke}
    \pgfresetboundingbox
  \end{pgfpicture}
}

\cs_new_eq:NN \__jmt_lwa_arrow_draw:nnn \use_none:nnn


\cs_new:Nn \__jmt_lwa_arrow_draw_double:nn
{
    \tex_special:D {pdf:~
        q~
        1~J~1~j~
        1~0~0~\dim_to_decimal:n{#2pt/10}~0~0~cm~
        \fp_use:c{g__jmt_lwa_line_width}~w~
        q~
        \dim_to_decimal:n{#2pt/10}~0~0~1~0~0~cm~
        1~0~0~1~-1~0~cm~
        0~1~m~
        .25~0~1~0~1~0~c~
        1~0~.25~0~0~-1~c~
        S~
        Q~
        0~0~m~
        -1~0~0~1~0~0~cm~
        \dim_to_decimal:n{#1}~0~l~S~
```

```
        \dim_to_decimal:n{#2pt/10}~0~0~1~\dim_to_decimal:n{#1}~0~cm~
        1~0~0~1~-1~0~cm~
        0~1~m~
        .25~0~1~0~1~0~c~
        1~0~.25~0~0~-1~c~
        S~
        Q
    }
}


\cs_new:Nn \__jmt_lwa_arrow_right:nn {
  \skip_horizontal:n {#1}
  \__jmt_lwa_arrow_draw:nnn {#1} {#2} {}
}

\cs_new:Nn \__jmt_lwa_arrow_left:nn {
  \__jmt_lwa_arrow_draw:nnn {#1} {#2} {-}
  \skip_horizontal:n {#1}
}

\cs_new:Nn \__jmt_lwa_arrow_double:nn {
  \skip_horizontal:n {#1}
  \__jmt_lwa_arrow_draw_double:nn {#1} {#2}
}

```

(*End of definition for* `\__jmt_lwa_arrow_draw_special:nnn` *and others.*)

The core functions.

`\__jmt_lwa_arrow_overset_style:Nnncnnn`
`\__jmt_lwa_arrow_overset:nnnnn`

```
\cs_new:Npn \__jmt_lwa_arrow_overset_style:Nnncnnn #1#2#3#4#5#6#7 {
  \hbox_set:Nn \l_tmpa_box {$\m@th#1#3$}
  \dim_set:Nn \l_tmpa_dim {#2 pt/10}
  \vbox:n {
    \tex_lineskiplimit:D = \maxdimen
    \tex_baselineskip:D = 0pt
    \tex_tabskip:D = 0pt
    \tex_lineskip:D = \dim_eval:n {\l_tmpa_dim * 3/2 + #7}
    \tex_halign:D { ## \tex_cr:D
      \skip_horizontal:n {\l_tmpa_dim / 2}
      $
        \m@th
        #1
        \tex_mskip:D \muskip_eval:n {#5}
        \use:c {#4} {\dim_eval:n{\box_wd:N \l_tmpa_box * #6}} {#2}
      $
      \tex_cr:D
      \box_use_drop:N \l_tmpa_box
      \tex_cr:D
    }
  }
}

\cs_new:Nn \__jmt_lwa_arrow_overset:nnnnn { % content, direction, xoffset, scale, yoffset
```

```
  \mathchoice {
    \__jmt_lwa_arrow_overset_style:Nnncnnn
      \displaystyle {\tf@size} {#1} {__jmt_lwa_arrow_#2:nn} {#3} {#4} {#5}
  } {
    \__jmt_lwa_arrow_overset_style:Nnncnnn
      \textstyle {\tf@size} {#1} {__jmt_lwa_arrow_#2:nn} {#3} {#4} {#5}
  } {
    \__jmt_lwa_arrow_overset_style:Nnncnnn
      \scriptstyle {\sf@size} {#1} {__jmt_lwa_arrow_#2:nn} {#3} {#4} {#5}
  } {
    \__jmt_lwa_arrow_overset_style:Nnncnnn
      \scriptscriptstyle {\ssf@size} {#1} {__jmt_lwa_arrow_#2:nn} {#3} {#4} {#5}
  }
}
```

(*End of definition for* `\__jmt_lwa_arrow_overset_style:Nnncnnn` *and* `\__jmt_lwa_arrow_overset:nnnnn`.)

`\__jmt_lwa_arrow_overset:w`
`\arrowoverset`

```
\cs_new_protected:Npn \__jmt_lwa_arrow_overset:w {
  \c_group_begin_token
  \__jmt_lwa_arrow_overset_aux:w
}

\cs_new:Nn \__jmt_lwa_bool_convert:n {
    \IfBooleanTF {#1} {\c_true_bool} {\c_false_bool}
}

% This exp_args is necessary because _ generates the wrong token in expl3 syntax
\exp_args:NNx \NewDocumentCommand \__jmt_lwa_arrow_overset_aux:w
  {s s O{0mu} O{1} O{0ex} m t' e{\char_generate:nn {95}{8}} t'} {
  \__jmt_lwa_arrow_overset:nnnnn
    {
      #6
      \exp_args:Nf\bool_if:nT{\__jmt_lwa_bool_convert:n{#7} || \__jmt_lwa_bool_convert:n{#9}}
          \c_math_superscript_token {
            \scriptscriptstyle\IfBooleanT{#7}{\prime}\IfBooleanT{#9}{\prime}
        }
      } % TODO: Better positioning etc?
      \exp_args:Nf\IfValueT{\use:n#8} {
        \c_math_subscript_token {
          \mathrlap{#8}
        }
      }
    }
    {\IfBooleanTF{#1}{\IfBooleanTF{#2}{double}{left}}{right}}
    {#3} {#4} {#5}

  \exp_args:Nf\IfValueTF{\use:n#8}{
    % TODO: Better way to do this? This is all kinds of wrong.
    \hphantom{\c_math_subscript_token{#8}}
  } {}
  \c_group_end_token
}
\cs_set_eq:NN \arrowoverset \__jmt_lwa_arrow_overset:w
```

Replacements for hyperref bookmarks.

```
\AtBeginDocument{
  \@ifpackageloaded{hyperref}{
    \pdfstringdefDisableCommands{
      % Why does this only work with Expandable?
      \DeclareExpandableDocumentCommand \__jmt_lwa_arrow_overset:w {s o o o m} {
      \ifpdfstringunicode
        {#5 \IfBooleanTF{#1}{\unichar{"20D6}}{\unichar{"20D7}}}
        {#5}
      }
    }
  }{}
}
```

(*End of definition for* `\__jmt_lwa_arrow_overset:w` *and* `\arrowoverset`. *This function is documented on page 2.*)

Package option handling.

`\g__jmt_lwa_tweak_shortcuts_bool`
`\g__jmt_lwa_selected_presets_prop`
`\__jmt_lwa_arrow_draw:nnn`

```
\bool_new:N \g__jmt_lwa_tweak_shortcuts_bool
\prop_new:N \g__jmt_lwa_selected_presets_prop
\keys_define:nn {letterswitharrows} {
  mode .choice:,
  mode / special .code:n = {
    \cs_set_eq:NN \__jmt_lwa_arrow_draw:nnn \__jmt_lwa_arrow_draw_special:nnn
  },
  mode / pgf .code:n = {
    \RequirePackage{pgf}
    \ExplSyntaxOff\usepgflibrary{arrows.meta}\ExplSyntaxOn
    \cs_set_eq:NN \__jmt_lwa_arrow_draw:nnn \__jmt_lwa_arrow_draw_pgf:nnn
  },
  mode .initial:n = {special},
  pgf .meta:n = {mode = pgf},
  presets .multichoices:nn = {abc, ABC, cAcBcC, vec-cev} {
    \int_compare:nNnTF \l_keys_choice_int = 1 {
      \prop_gclear:N \g__jmt_lwa_selected_presets_prop
    } {}
    \prop_gput:NVn \g__jmt_lwa_selected_presets_prop \l_keys_choice_tl {}
  },
  presets .initial:n = {abc, ABC, cAcBcC},
  tweaks .bool_set:N = \g__jmt_lwa_tweak_shortcuts_bool,
  tweaks .initial:n = {true},
  linewidth .fp_set:N = \g__jmt_lwa_line_width,
  linewidth .initial:n = {.3},
}
\ProcessKeysPackageOptions{letterswitharrows}
```

(*End of definition for* `\g__jmt_lwa_tweak_shortcuts_bool`, `\g__jmt_lwa_selected_presets_prop`, *and* `\__jmt_lwa_arrow_draw:nnn`.)

`\v<char>`
`\<char>v`
`\vleft`
`\vright`
`\v<char>v`

```
\prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {abc} {
  \int_step_inline:nnn {1} {26} {
    \int_compare:nNnTF {#1} = {22} {
      \cs_new:cpx {vright} {
```

```
        \exp_not:N\__jmt_lwa_arrow_overset:w{v}
      }
      \cs_new:cpx {vleft} {
        \exp_not:N\__jmt_lwa_arrow_overset:w*{v}
      }
      \cs_new:cpx {vvv} {
        \exp_not:N\__jmt_lwa_arrow_overset:w**{v}
      }
    } {
      \cs_new:cpx {v\int_to_alph:n{#1}} {
        \exp_not:N\__jmt_lwa_arrow_overset:w{\int_to_alph:n{#1}}
      }
      \cs_new:cpx {\int_to_alph:n{#1}v} {
        \exp_not:N\__jmt_lwa_arrow_overset:w*{\int_to_alph:n{#1}}
      }
      \cs_new:cpx {v\int_to_alph:n{#1}v} {
        \exp_not:N\__jmt_lwa_arrow_overset:w**{\int_to_alph:n{#1}}
      }
    }
  }
} {}
```

(*End of definition for* `\v<char>` *and others. These functions are documented on page* 1.)

`\v<CHAR>`
`\<CHAR>v`
`\v<CHAR>v`

```
\prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {ABC} {
  \int_step_inline:nnn {1} {26} {
    \cs_new:cpx {v\int_to_Alph:n{#1}} {
      \exp_not:N\__jmt_lwa_arrow_overset:w{\int_to_Alph:n{#1}}
    }
    \cs_new:cpx {\int_to_Alph:n{#1}v} {
      \exp_not:N\__jmt_lwa_arrow_overset:w*{\int_to_Alph:n{#1}}
    }
    \cs_new:cpx {v\int_to_Alph:n{#1}v} {
      \exp_not:N\__jmt_lwa_arrow_overset:w**{\int_to_Alph:n{#1}}
    }
  }
} {}
```

(*End of definition for* `\v<CHAR>`, `\<CHAR>v`, *and* `\v<CHAR>v`. *These functions are documented on page* 2.)

`\vc<CHAR>`
`\c<CHAR>v`
`\vc<CHAR>v`

```
\prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {cAcBcC} {
  \int_step_inline:nnn {1} {26} {
    \cs_new:cpx {vc\int_to_Alph:n{#1}} {
      \exp_not:N\__jmt_lwa_arrow_overset:w{\exp_not:N\mathcal{\int_to_Alph:n{#1}}}
    }
    \cs_new:cpx {c\int_to_Alph:n{#1}v} {
      \exp_not:N\__jmt_lwa_arrow_overset:w*{\exp_not:N\mathcal{\int_to_Alph:n{#1}}}
    }
    \cs_new:cpx {vc\int_to_Alph:n{#1}v} {
      \exp_not:N\__jmt_lwa_arrow_overset:w**{\exp_not:N\mathcal{\int_to_Alph:n{#1}}}
    }
  }
```

```
} {}
```

(*End of definition for* `\vc<CHAR>`, `\c<CHAR>v`, *and* `\vc<CHAR>v`. *These functions are documented on page 2.*)

`\vec`
`\cev`
`\vecev`

```
\prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {vec-cev} {
  \RenewDocumentCommand \vec {m} {
    \__jmt_lwa_arrow_overset:w {#1} \scan_stop:
  }
  \DeclareDocumentCommand \cev {m} {
    \__jmt_lwa_arrow_overset:w* {#1} \scan_stop:
  }
  \DeclareDocumentCommand \vecev {m} {
    \__jmt_lwa_arrow_overset:w** {#1} \scan_stop:
  }
} {}
```

(*End of definition for* `\vec`, `\cev`, *and* `\vecev`. *These functions are documented on page 2.*)

Some personal-preference tweaks.

```
\bool_if:NTF \g__jmt_lwa_tweak_shortcuts_bool {
    \prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {ABC} {
        \int_step_inline:nnn {1} {26} {
            \cs_set:cpx {v\int_to_Alph:n{#1}} {
                \exp_not:N\__jmt_lwa_arrow_overset:w[2.5mu][8/10]{\int_to_Alph:n{#1}}
            }
            \cs_set:cpx {\int_to_Alph:n{#1}v} {
                \exp_not:N\__jmt_lwa_arrow_overset:w*[2.5mu][7/10]{\int_to_Alph:n{#1}}
            }
            \cs_set:cpx {v\int_to_Alph:n{#1}v} {
                \exp_not:N\__jmt_lwa_arrow_overset:w**[1.5mu][9/10]{\int_to_Alph:n{#1}}
            }
        }
        \cs_set:cpn {vS} {
            \__jmt_lwa_arrow_overset:w[3mu][7/10]{S}
        }
        \cs_set:cpn {vSv} {
            \__jmt_lwa_arrow_overset:w**[2mu][9/10]{S}
        }
        \cs_set:cpn {vT} {
            \__jmt_lwa_arrow_overset:w[2mu][8/10]{T}
        }
        \cs_set:cpn {Tv} {
            \__jmt_lwa_arrow_overset:w*[1mu][8/10]{T}
        }
        \cs_set:cpn {vU} {
            \__jmt_lwa_arrow_overset:w[2mu][7/10]{U}
        }
        \cs_set:cpn {Uv} {
            \__jmt_lwa_arrow_overset:w*[2mu][7/10]{U}
        }
        \cs_set:cpn {vUv} {
            \__jmt_lwa_arrow_overset:w**[1.5mu][8/10]{U}
        }
```

```
        \cs_set:cpn {vV} {
            \__jmt_lwa_arrow_overset:w[2.5mu][7/10]{V}
        }
        \cs_set:cpn {Vv} {
            \__jmt_lwa_arrow_overset:w*[2mu][7/10]{V}
        }
        \cs_set:cpn {vX} {
            \__jmt_lwa_arrow_overset:w[3mu][7/10]{X}
        }
        \cs_set:cpn {vY} {
            \__jmt_lwa_arrow_overset:w[2mu][8/10]{Y}
        }
        \cs_set:cpn {Yv} {
            \__jmt_lwa_arrow_overset:w*[2mu][7/10]{Y}
        }
    } {}
    \prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {cAcBcC} {
        \int_step_inline:nnn {1} {26} {
            \cs_set:cpx {vc\int_to_Alph:n{#1}} {
                \exp_not:N\__jmt_lwa_arrow_overset:w[1mu][9/10]{\exp_not:N\mathcal{\int_to_Al
            }
            \cs_set:cpx {c\int_to_Alph:n{#1}v} {
                \exp_not:N\__jmt_lwa_arrow_overset:w*[1.5mu][8/10]{\exp_not:N\mathcal{\int_to
            }
        }
    } {}
    \prop_if_in:NnTF \g__jmt_lwa_selected_presets_prop {abc} {
        \cs_new:cpn {vell} {
            \__jmt_lwa_arrow_overset:w{\ell}
        }
        \cs_new:cpn {ellv} {
            \__jmt_lwa_arrow_overset:w*{\ell}
        }
        \cs_new:cpn {vellv} {
            \__jmt_lwa_arrow_overset:w**{\ell}
        }
    } {}
} {}
```

Change History