- Proper argmin and argmax:

```
\begin{align*}
  &\arg\min_x (2x^2 - 3x + 5) \\
  &\argmin_x (2x^2 - 3x + 5)
\end{align*}
```

$$\arg\min_x(2x^2 - 3x + 5)$$
$$\operatorname*{argmin}_x(2x^2 - 3x + 5)$$

- For summations with wide subscripts...

```
\begin{align*}
  A &= \sum_{i, j \in B_{ij}} X_i^j\\
  A &= \sum_{\mathclap{i, j \in B_{ij}}} X_i
\end{align*}
```

$$A = \sum_{i,j \in B_{ij}} X_i^j$$
$$A = \sum_{i,j \in B_{ij}} X_i$$

- When you want to center math within a box whose width is specified by other math.

```
$aaabbbccc$\\
$aaa\phantomword[c]{bbb}{Q}ccc$
```

$aaabbbccc$
$aaa\ Q\ ccc$

- A customizable vector symbol. Macros should use this.

```
\CMvector[symbol=\leftarrow]{X} \quad
\CMvector[symbol=\leftarrow, pre=\Large\textcolor{red}, ]{X} \quad
\CMvector[symbol=\leftarrow, post=*]{X} \quad
\CMvector[symbol=\leftarrow, raise=1.8]{X}
```

$\overleftarrow{X}$ $\overleftarrow{X}$ $\overleftarrow{X}^*$ $\overleftarrow{X}$

- Although `\leftharpoonup` and `\rightharpoonup` exist, there is no left-right harpoon. Here is a customized version that combines the ones that do exist. The spacing is hardcoded and probably will only look good with certain fonts.

```
$\leftharpoonup \: \leftrightharpoonup \: \rightharpoonup$
```

$\leftharpoonup\ \leftrightharpoonup\ \rightharpoonup$

- Convenience functions that use `\CMvector`.

```
\CMlarrow{X} \: \CMlrarrow{X} \: \CMrarrow{X} \\
\CMlharpoon{X} \: \CMlrharpoon{X} \: \CMrharpoon{X} \\
```

$\overleftarrow{X}$ $\overleftrightarrow{X}$ $\overrightarrow{X}$
$\overleftarrow{X}$ $\overleftrightarrow{X}$ $\overrightarrow{X}$

- A macro that defines specialized vector symbols that make use of Python index notation and has clean support for the vector direction, depending on what notation you want to use.

```
\CMIndexedSymbol{MS}{X}
\[\begin{matrix}
\MS      & \MS[3]     & \MS[3][5]     & \MS[][5]     & \MS[5][]     \\
\MS(<)  & \MS(<)[3] & \MS(<)[3][5] & \MS(<)[][5] & \MS(<)[5][] \\
\MS(>)  & \MS(>)[3] & \MS(>)[3][5] & \MS(>)[][5] & \MS(>)[5][] \\
\MS(<>) & \MS(<>)[3] & \MS(<>)[3][5] & \MS(<>)[][5] & \MS(<>)[5][] \\
\end{matrix}\]

\CMIndexedSymbol[arrow]{MS}{X}
\[\begin{matrix}
\MS      & \MS[3]     & \MS[3][5]     & \MS[][5]     & \MS[5][]     \\
\MS(<)  & \MS(<)[3] & \MS(<)[3][5] & \MS(<)[][5] & \MS(<)[5][] \\
\MS(>)  & \MS(>)[3] & \MS(>)[3][5] & \MS(>)[][5] & \MS(>)[5][] \\
\MS(<>) & \MS(<>)[3] & \MS(<>)[3][5] & \MS(<>)[][5] & \MS(<>)[5][] \\
\end{matrix}\]
```

$$\begin{matrix}
X & X_3 & X_{3:5} & X_{:5} & X_{5:} \\
\overleftarrow{X} & \overleftarrow{X}_3 & \overleftarrow{X}_{3:5} & \overleftarrow{X}_{:5} & \overleftarrow{X}_{5:} \\
\overrightarrow{X} & \overrightarrow{X}_3 & \overrightarrow{X}_{3:5} & \overrightarrow{X}_{:5} & \overrightarrow{X}_{5:} \\
\overleftrightarrow{X} & \overleftrightarrow{X}_3 & \overleftrightarrow{X}_{3:5} & \overleftrightarrow{X}_{:5} & \overleftrightarrow{X}_{5:}
\end{matrix}$$

$$\begin{matrix}
X & X_3 & X_{3:5} & X_{:5} & X_{5:} \\
\overleftarrow{X} & \overleftarrow{X}_3 & \overleftarrow{X}_{3:5} & \overleftarrow{X}_{:5} & \overleftarrow{X}_{5:} \\
\vec{X} & \vec{X}_3 & \vec{X}_{3:5} & \vec{X}_{:5} & \vec{X}_{5:} \\
\overleftrightarrow{X} & \overleftrightarrow{X}_3 & \overleftrightarrow{X}_{3:5} & \overleftrightarrow{X}_{:5} & \overleftrightarrow{X}_{5:}
\end{matrix}$$

- Typically, you'll want to set up a few of these for regular use:

```
% Put this in preamble somewhere
\CMIndexedSymbol[harpoon]{MS}{X}
\CMIndexedSymbol[harpoon]{ms}{x}
\CMSuperIndexedSymbol[arrow]{FCS}{S}{+}

% Some familiar commands
\newcommand{\BiInfinity}{\MS(<>)}
\newcommand{\biinfinity}{\ms(<>)}
\newcommand{\Past}{\MS(<)}
\newcommand{\past}{\ms(<)}
\newcommand{\Future}{\MS(>)}
\newcommand{\future}{\ms(>)}

% Now we can use them
\begin{displaymath}
\begin{matrix}
  \BiInfinity & \biinfinity & \Past & \past & \Future & \future \\
  \FCS[0] & \FCS(>)[3] & \MS[0][3] & \past[3] & \MS(<>)[3] & \Future[3]
\end{matrix}
\end{displaymath}
```

$$\begin{matrix}
\overleftrightharpoon{X} & \overleftrightharpoon{x} & \overleftharpoon{X} & \overleftharpoon{x} & \overrightharpoon{X} & \overrightharpoon{x} \\
S_0^+ & \vec{S}_3^+ & X_{0:3} & \overleftharpoon{x}_3 & \overleftrightharpoon{X}_3 & \vec{X}_3
\end{matrix}$$

- Notation for single symbol, range of symbols. Two different options for semi-infinite sequences. If you might be using bi-infinite sequences, it is recommended you use the second option for semi-infinite sequences.

```
\CMIndexedSymbol[harpoon]{MS}{X}
\begin{align*}
  \MS        &&& \text{symbol}\\
  \MS[t]     &&& \text{symbol at time } t\\
  \MS[-1][3] &&& \MS[-1] \MS[0] \MS[1] \MS[2]\\
  &&&\\
  \MS[][3]   &&& \cdots \MS[0] \MS[1] \MS[2] \\
  \MS[3][]   &&& \MS[3] \MS[4] \MS[5] \cdots\\
  &&&\\
  \MS(<)[3]  &&& \cdots \MS[0] \MS[1] \MS[2] \\
  \MS(>)[3]  &&& \MS[3] \MS[4] \MS[5] \cdots\\
  \MS(<>)[3] &&& \MS(<)[3]\MS(>)[3]
\end{align*}
```

$$
\begin{array}{ll}
X & \text{symbol} \\
X_t & \text{symbol at time } t \\
X_{-1:3} & X_{-1}X_0X_1X_2 \\
\\
X_{:3} & \cdots X_0X_1X_2 \\
X_{3:} & X_3X_4X_5\cdots \\
\\
\overleftarrow{X}_3 & \cdots X_0X_1X_2 \\
\overrightarrow{X}_3 & X_3X_4X_5\cdots \\
\overleftrightarrow{X}_3 & \overleftarrow{X}_3\overrightarrow{X}_3
\end{array}
$$