Make `cmvec.sty` available to your LaTeX installation. A simple way to do this is to copy `cmvec.sty` into the same directory as your source LaTeX document. Then, add the following to your preamble:

```
\usepackage{cmvec}
```

The `cmvec` package provides a number of macros, but mostly, there are only two that you will need:

1. `\CMIndexedSymbol[arrowtype]{macroname}{symbol}`
2. `\CMSuperIndexedSymbol[arrowtype]{macroname}{symbol}{superscript}`

Each of these macros defines a macro `\macroname` that supports left, right, and leftright vector symbols and also provides Python-like indexing. These commands can be used anywhere in the document, but typically, one should declare them just once in the preamble. Valid arrowtypes are: `arrow` and `harpoon`; the default value is `harpoon`. The macro that is defined by this command supports the following syntax:

```
\macroname(direction)[start][end]
```

All three options `(direction)`, `[start]` `[end]` are optional. Valid directions are `<`, `>`, `<>` for left, right, and leftright directions. This is best explained through example:

```
% Define the indexed symbol
\CMIndexedSymbol[harpoon]{MS}{X}

% Now use it
$\begin{matrix*}[l]
\MS & \MS[0] & \MS[0][L] & \MS[][L] & \MS[L][]\\
\MS(<) & \MS(>) & \MS(<>) & \MS(<)[0] & \MS(<>)[t]
\end{matrix*}$
```

$$\begin{matrix} X & X_0 & X_{0:L} & X_{:L} & X_{L:} \\ \overleftarrow{X} & \overrightarrow{X} & \overleftrightarrow{X} & \overleftarrow{X}_0 & \overleftrightarrow{X}_t \end{matrix}$$

Note that practically one will choose to use the indexing notation (as in $X_{a:b}$) or the vector notation, but not both (with exception to adding a time index for a semi-infinite sequence).

Suppose you plan on indexing both X and Y, then you define both:

```
\CMIndexedSymbol{MSi}{X} % input
\CMIndexedSymbol{MSo}{Y} % output
$\lim_{L \to \infty} I[ \MSi[0][L] : \MSo[0][L] ] \stackrel{?}{=} I[ \MSi(<)[t] : \MSo(>)[t]]$
```

$\lim_{L\to\infty} I[X_{0:L} : Y_{0:L}] \stackrel{?}{=} I[\overleftrightarrow{X}_t : \overrightarrow{Y}_t]$

It may also be helpful to freeze arrow directions to certain macro names:

```
\CMIndexedSymbol{MS}{X}
\CMIndexedSymbol{ms}{x}
\newcommand{\Past}{\MS(<)}
\newcommand{\past}{\ms(<)}
\newcommand{\Future}{\MS(>)}
\newcommand{\future}{\ms(>)}
\begin{align*}
\Past[0] &= \cdots \MS[-3] \MS[-2] \MS[-1] &
\Future[0] &= \MS[0] \MS[1] \MS[2] \cdots \\
\past[0] &= \cdots \ms[-3] \ms[-2] \ms[-1] &
\future[0] &= \ms[0] \ms[1] \ms[2] \cdots \\
\end{align*}
```

$$\begin{aligned} \overleftarrow{X}_0 &= \cdots X_{-3}X_{-2}X_{-1} & \overrightarrow{X}_0 &= X_0X_1X_2\cdots \\ \overleftarrow{x}_0 &= \cdots x_{-3}x_{-2}x_{-1} & \overrightarrow{x}_0 &= x_0x_1x_2\cdots \end{aligned}$$

That's pretty much it.

The package defines a number of other lower-level commands that *might* be of more general use, but probably not. These are described now.

- 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*}
```

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

- 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} \\
```

$\overleftarrow{X}$ $\overleftrightarrow{X}$ $\overrightarrow{X}$
$\overleftharpoon{X}$ $\overleftrightharpoon{X}$ $\overrightharpoon{X}$

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

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

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

- 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}
```

$$\begin{matrix}
\overleftrightarrow{X} & \overleftrightarrow{x} & \overleftarrow{X} & \overleftarrow{x} & \vec{X} & \vec{x} \\
S_{0}^{+} & \vec{S}_{3}^{+} & X_{0:3} & \overleftarrow{x}_{3} & \overleftrightarrow{X}_{3} & \vec{X}_{3}
\end{matrix}$$

- 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*}
```

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

$\mathrm{A} \underset{k_2}{\overset{k_1}{\rightleftharpoons}} \mathrm{B}$