

strdiag – typesetting string diagrams

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The file `strdiag.tex` contains macros for typesetting string diagrams used in quantum groups or categorical quantum information. The macros are based on `TikZ`. So, to use `strdiag`, one has to install `TikZ` first. Then, one can write in plain \TeX

```
\input tikz
\input partmac
```

For \LaTeX users, I've prepared the file `strdiag.sty`, which includes `PGF` automatically, so it is sufficient to write

```
\usepackage{strdiag}
```

This is still work in progress, I am happy for any sort of comments and suggestions.

1 Basic usage

1.1 Predefined diagrams

The following macros are defined

<code>\Dcup</code>		<code>\Dcap</code>		<code>\Did</code>		<code>\Dcross</code>	
<code>\Rcap</code>		<code>\Lcap</code>		<code>\Fid</code>	\uparrow	<code>\Bid</code>	\downarrow

1.2 Strings
















The central macro of this package is `\Diagram{<data>}`, which essentially opens a `TikZ` picture and sets the coordinates. You can use any `TikZ` macros you want inside `<data>`. As an example, the `\Dcap` macro is defined by

```
\Diagram{
  \draw (1,0) .. controls +(up:0.5) and +(up:0.5) .. (2,0);
}
```

1.3 Boxes

There are two similar macros to typeset morphisms, namely `\Dmor{<shape>}<in>/<out> (<x>,<y>)` and `\DMor{<shape>}[<in>/<out>] (<x>,<y>) {<label>}`.

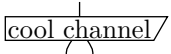
Here, `<shape>` can be one of

<code>circ</code>		<code>bcirc</code>		<code>square</code>	
<code>vec</code>		<code>covec</code>		<code>map</code>	
<code>mapC</code>		<code>mapT</code>		<code>mapA</code>	
<code>selfC</code>		<code>selfT</code>		<code>selfA</code>	
<code>selfCR</code>		<code>selfTR</code>		<code>selfAR</code>	

The data `<x>` and `<y>` are the coordinates of the box. The value `y = 0.5` should correspond to the middle of the line.

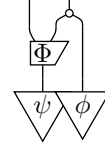
The data `<in>` and `<out>` can be numbers standing for the number of inputs and outputs. This part of declaration is optional. If you skip it, there will be no strings attached to the box. Using `\Dmor`, the endpoints of the inputs and outputs will be placed at distance $\Delta y = 0.5$ (if the box is placed at `y = 0.5`, then the inputs are at `y = 0` and outputs at `y = 1`). The distance is $\Delta y = 1$ if you use `\DMor`. The inputs and outputs are spaced by the distance $\Delta x = 1$.

The extra parameter `<label>` of `\DMor` stands for a text that should be placed inside a box. So that in total, you can type

`\Diagram{\DMor{map}2/1 (0,0.5) {cool channel}}` for 

You can of course have more than one box in a diagram and you can combine them with simple lines drawn by the TikZ `\draw` command to obtain something like


```
\Diagram{
  \DMor{vec}0/1 (0,-1.5) {$\psi$}
  \DMor{vec}0/1 (1.5,-1.5) {$\phi$}
  \DMor{map}1/2 (0,.5) {$\Phi$}
  \Dmor{circ}2/1 (1,2)
  \draw (1.5,-.5) - (1.5,1.5);
  \draw (-.5,1.5) - (-.5,2.5);
}
```



There is also a shorthand for drawing single spiders: `\spider{\langle in \rangle / \langle out \rangle}` stands for

`\Diagram{\Dmor{bcirc}\langle in \rangle / \langle out \rangle (1,0.5)}.`


Similarly works `\wsipder` just using `circ` instead of `bcirc`.

So, for instance, `\spider{3/2}` creates .

1.4 Arrows

Considering the `\Dmor` and `\DMor` macros, one can replace `\langle in \rangle / \langle out \rangle` by `[\langle in \rangle / \langle out \rangle]`, where `\langle in \rangle` and `\langle out \rangle` are not numbers, but strings of characters from the following list

- > outgoing arrow
- < incoming arrow
- a string without arrow
- 0 no string
- . three dots

In the same way, you can use `\spider[\langle in \rangle / \langle out \rangle]` or `\wsipder[\langle in \rangle / \langle out \rangle]`. So, for instance, you can write `\wsipder[<>0-/->.]` to obtain .

We also define new TikZ string styles `mid arrow` and `late arrow` to add arrows in the middle of a string. As an example, let us use the above to arrowise the example from the previous section. Note that if you want to avoid doubling the arrows within one string, you have to pay special attention and it becomes unfortunately rather less straightforward.

```
\Diagram{
  \DMor{vec}[>] (0,-1.5) {$\psi$}
  \DMor{vec}[>] (1.5,-1.5) {$\phi$}
  \DMor{map}1/2 (0,.5) {$\Phi$}
  \Dmor{circ}[>-/<] (1,2)
  \draw[mid arrow] (1.5,1.5) - (1.5,-.5);
  \draw[mid arrow] (-.5,1.5) - (-.5,2.5);
}
```

