Strands package

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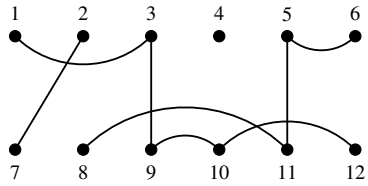
```
\usepackage[<options>]{strands}
```

1 The \vpartition macro

Use the macro \vpartition to draw a set partition in the partition monoid C_n as

```
\vpartition[<options>]{<sorted blocks>}
```

where <sorted blocks> are the blocks, separated by commas, entered as blocks of a set partition of $\{\pm 1, \ldots, \pm n\}$. The positive numbers correspond to the dots above and the negative numbers correspond to the dots below. For instance:




```
\vpartition{{1,3,-3,-4,-6},{6,5,-5,-2},{-1,2}}
```

Note that the dots are connected in the order as the numbers appear on the blocks. So, if we change the position of numbers it will output a different representation.

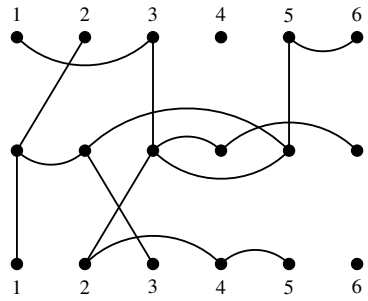
The options <options> are entered as <option>=<value> and defined as follows:

- bend: Integer number to manage the bend of brackets. Default value is 45.
- bulla: Use 1 to draw bullets from 1 to n above, otherwise use 0. Default value is 1.
- bullb: Use 1 to draw bullets from -1 to $-n$ below, otherwise use 0. Default value is 1.
- floor: Nonnegative float number setting where the picture starts to be drawn. So it starts at floor∗height. Default value is 0.

- `font`: Nonnegative float number setting the size of the font labelling the dots. Default value is 0.7.
- `height`: Positive float number setting the height of the picture. Default value is 1.
- `labelver`: Space between dots and labels. Default value is 0.2.
- `labelhor`: Additional space between labels (only for signed labels). Default value is 0.03.
- `norma`: Positive float number to normalize the height above `floor` with other pictures. Default value is 0.
- `normb`: Negative float number to normalize the height below `floor` with other pictures. Default value is 0.
- `nstr`: Positive integer defining the number of strands. This value is used only if it is bigger than the self computed value.
- `reflect`: Use 1 to mirror the brackets connections vertically, otherwise use 0. Default value is 0.
- `rotate`: Integer number to rotate the picture. Default value is 0.
- `scale`: Positive float number to scale the picture. Default value is 1.
- `strwidth`: Positive float number to set the width of the strands. Default value is 0.7.
- `tkzpic`: Use 1 to add the `tikzpicture` environment automatically, otherwise use 0. Default value is 1. Note that options `rotate` and `scale` will not work if `tkzpic` is 0 and they should be set with the environment.
- `type`: Number in $\{0, \pm 1, 2, \pm 3, \pm 4, 5\}$ to set the labels of the dots. Default value is 3. Each number is defined as follows:
  - (0) Use 0 to put no labels.
  - (2) Use 2 to put labels from 1 to n above and below and use 1 or -1 to remove the labels below or above respectively.
  - (3) Use 3 to put labels from 1 to n above and labels from $n+1$ to $2n$ below. Use -3 to remove the labels above.
  - (4) Use 4 to put labels from 1 to n above and labels from $1'$ to n' below. Use -4 to remove the labels above.
  - (5) Use 5 to put signed labels from $-n$ to n with n an even number.
- `width`: Positive float number to set the width between horizontal dots. Default value is 0.6.

Most of the options defined above can be set as global options in the `\usepackage` macro.

Below a more complex example:



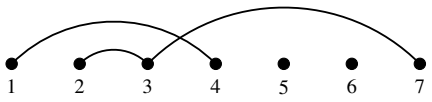

```
\begin{tikzpicture}[scale=1.5]
        \vpartition[
                bullb=0,
                floor=1,
                tkzpic=0,
                type=1
        ]{{1,3,-3,-4,-6},{6,5,-5,-2},{-1,2}}
        \vpartition[
                nstr=6,
                tkzpic=0,
                type=-1
        ]{{-1,1,2,-3},{5,3,-2,-4,-5}}
\end{tikzpicture}
```

1.1 The `\arcpartition` macro

Use the macro `\arcpartition` to draw the graph of a set partition of $\{1,\dots,n\}$ as

```
\arcpartition[<options>]{<sorted blocks>}
```

where `<sorted blocks>` are the blocks, separated by commas. This macro is constructed from `\vpartition`, so its behavior is similar. For instance:




```
\arcpartition{{1,4},{2,3,7}}
```

The options <options> come from \vpartition, so most of them are defined in the same way, these are: bend, floor, font, labelver, lavelhor, norma, normb, rotate, scale, strwidth, tkzpic and width. However, the following options work different:

- bull: Use 1 to draw bullets from 1 to n. Otherwise use 0. Default value is 1.
- num: Positive integer defining the number of dots. This value is used only if it is bigger than the self computed value.
- type: Use 1 to put labels from 1 to n, otherwise use 0. Default value is 1.

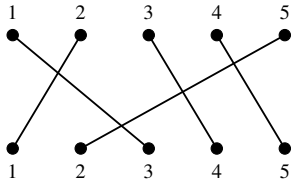
Most of the options can be set as global options in the \usepackage macro.

1.2 The \permutation macro

Use the macro \permutation to draw permutations in the partition monoid as

```
\permutation[<options>]{<permutation images>}
```

where <permutation images> is the list of images of 1 to n under the permutation, separated by commas. This macro is constructed from \vpartition, so its behavior is similar. For instance:




```
\permutation{3,1,4,5,2}
```

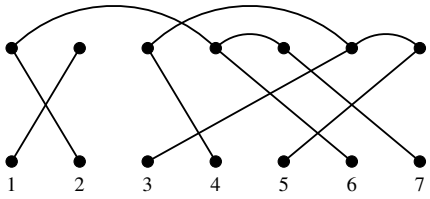
The options <options> come from \vpartition, so they are defined in the same way, these are: bulla, bullb, floor, font, height, labelver, lavelhor, norma, normb, nstr, rotate, scale, strwidth, tkzpic, type and width.

1.3 The \tiedpair macro

Use the macro \tiedpair to draw a permutation with a set partition of $[n]$ above as

```
\tiedpair{<permutation>}{<set partition>}
```

where <permutation> works as in \permutation and <set partition> works as in \arcpartition macro. This macro is constructed from the mentioned ones, so its behavior is similar. For instance:




```
\tiedpair{2,1,4,6,7,3,5}{{1,4,5},{3,6,7}}
```

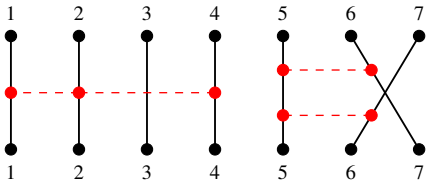
The options <options> come from \vpartition, so they are defined in the same way, these are: bend, bulla, bullb, floor, font, height, labelver, lavelhor, norma, normb, nstr, rotate, scale, strwidth, tkzpic, type and width. However, there is an additional option named above which is 1 by default and can be changed to 0 to put the set partition below.

1.4 The \tie macro

Use the macro \tie inside a tikzpicture environment to draw a tie with some other picture as

```
\tie[<options>]{<dots>}
```

where <dots> is the list of dots where this tie is connected. Each dot can be entered as a number k defining the horizontal position inside the width or as a pair $\{k,h\}$ where h is its vertical position respect to height. For instance:




```
\begin{tikzpicture}[scale=1.5]
        \permutation[tkzpic=0]{1,2,3,4,5,7,6}
        \tie{1,2,4}
        \tie{{5,0.7},{6.3,0.7}}
        \tie{{5,0.3},{6.3,0.3}}
\end{tikzpicture}
```

The options <options> are defined as follows:

- bend: Integer number to manage the bend of the tie. Default value is 0.
- bull: Use 1 to draw the connection bullets, otherwise use 0. Default value is 1.
- color: Set the color of the ties. Default value is red.
- floor: Nonnegative float number setting where the main picture starts to be drawn. Default value is 0.
- height: Positive float number setting the height of the main picture. Default value is 1.
- snake: Use true to set the snake style, otherwise use false. Default value is false.
- snakeamp: Set the amplitude of the snakes. Use with snake option. Default value is 1.
- snakends: Set the length of the snake ends. Use with snake option. Default value is 0.
- snakelen: Set the snake of each snake cycle. Use with snake option. Default value is 3.
- style: Set the style of the tie (solid, dashed, dotted). Default value is dashed.
- tieheight: Positive float number setting the vertical position of dots if these were entered as a single number. Default value is 0.5.
- tiewidth: Positive float number setting the width of the line representing a tie. Default value is 0.5.
- width: Positive float number setting the width between horizontal dots of the main picture. Default value is 0.6.

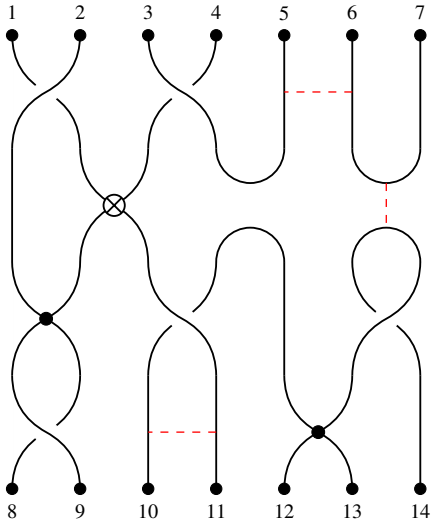
Most of the options can be set as global options in the \usepackage macro.

2 The \strands macro

Use the macro \strands to draw braid-like objects as a product of generators as

```
\strands[<options>]{<generators>}
```

where `<generators>` is a list of generators `ai` separated by elements in $\{*, -\}$. Use $*$ to put the next generator in the following floor and $-$ otherwise. For instance:




```
\strands{p1-n3-e5*v2-t4-f6*s1-n3-p6*n1-e3-s5}
```

See a more complex picture at the end of this section. Note that it is similar to the known Braid Package with different options.

The characters defining each type of generator can be changed in the `\usepackage` macro:

- `gencharposbraid`: Classic positive braid generator. Default value is p.
- `gencharnegbraid`: Classic negative braid generator. Default value is n.
- `gencharvirtual`: Virtual braid generator. Default value is v.
- `gencharsingular`: Singular braid generator. Default value is s.
- `genchartangle`: Tangle generator. Default value is t.
- `genchartie`: Tie generator. Default value is e.
- `genchartiedtangle`: Tied tangle generator. Default value is f.

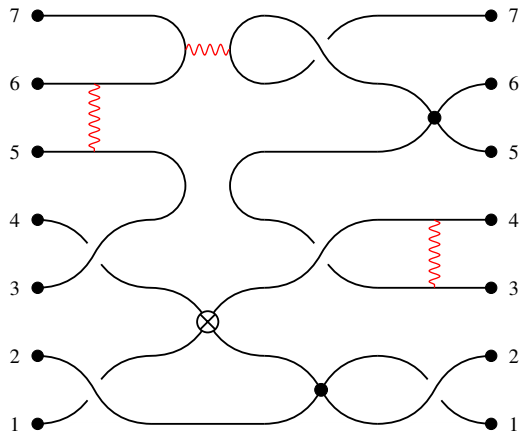
The options `<options>` for this macro are defined as follows:

- `bendbraid`: Manage the bend of the braid generators.
- `bendtangle`: Manage the bend of the tangle generators.
- `bulla`: Use 1 to draw the bullets above, otherwise use 0.
- `bullb`: Use 1 to draw the bullets below, otherwise use 0.

- `direction`: Direction in which the generators appear. Default is 1.
- `floor`: Manage the floor where the picture starts.
- `font`: Manage the font of the labels.
- `height`: Height of the picture.
- `labelver`: Vertical space between labels and bullets.
- `labelhor`: Additional horizontal space between labels.
- `rotate`: Rotate angle of the picture.
- `nstr`: Number of strands.
- `scale`: Scale the picture.
- `strwidth`: Width of the strands.
- `tiebull`: Use 1 to put bullets on ties ends, otherwise use 0. Default value is 0.
- `tiecolor`: Manage the color of the ties. Default value is `red`.
- `tieheight`: Manage the vertical position of ties respect to each generator.
- `tiesnake`: Use `true` to snake the ties, otherwise use `false`. Default value is false.
- `tiesnakeamp`: Manage the amplitude of the snakes.
- `tiesnakends`: Length of the ends of snakes.
- `tiesnakelen`: Length of snakes cycles.
- `tiestyle`: Manage the style of ties (`solid`,`dashed`,`dotted`). Default value is `dashed`.
- `tiewidth`: Width of the ties.
- `tkzpic`: Use 1 to add the `tikzpicture` environment automatically, otherwise use 0. Default value is 1.
- `type`: Manage the type of labels as in `\vpartition`.
- `width`: Width between dots.

Most of the options can be set as global options in the `\usepackage` macro.

Here another example:




```
\strands[
        rotate=90,
        tiesnake=true,
        tiesnakeamp=2,
        tiesnakelen=4,
        tiestyle=solid,
        type=2
]{p1-n3-e5*v2-t4-f6*s1-n3-p6*n1-e3-s5}
```

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