

The `sankey` package

Draw Sankey diagrams via TikZ

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Abstract

The `sankey` package provides macros and environments to build *Sankey diagrams*¹, i.e. *flow diagrams* in which the width of the arrows is proportional to the flow rate. The initial idea for the first implementation came out from [this question](#) on [TeX.StackExchange](#).

This manual contains three parts: [User manual](#) (p.1), [Examples](#) (p.22) and [Installation & Implementation](#) (p.43).

Note: the `sankey.dtx` and `sankey.ins` files are attachments of the current PDF document.

Part I

User manual

Contents

1	Preamble	2
2	The <code>sankeydiagram</code> environment	2
3	Sankey diagram options	2
3.1	Keys to choose the scale	3
3.2	Keys to define rotate offset	3
3.3	Keys to define drawing parameters	3
3.4	Keys to choose drawing styles	4
3.5	Keys to define new <i>start</i> and <i>end</i> styles	4
3.6	The <i>debug</i> key	4

¹https://en.wikipedia.org/wiki/Sankey_diagram

4	Sankey nodes and flows	5
4.1	Create Sankey nodes	5
4.1.1	Choose default parameters	6
4.1.2	Create starting and ending nodes via macros	6
4.1.3	Create starting and ending nodes via options	7
4.2	Retrieve information from Sankey nodes	8
4.3	Move nodes	8
4.3.1	Macro to move straight (forward or backward)	9
4.3.2	Macro to turn forward or backward	10
4.3.3	Macros to turn left (forward or backward)	11
4.3.4	Macros to turn right (forward or backward)	13
4.4	Links between nodes	15
4.4.1	Comparison between <code>outin</code> and <code>dubins</code> paths	16
4.4.2	Examples of <code>dubins</code> paths	17
4.5	Pure filling/drawing macros	18
4.6	Forked node	19
4.6.1	Create and fork a Sankey node	19
4.6.2	Fork a Sankey node	20
5	Miscellaneous	20
5.1	The <code>debug</code> layer	20
5.2	The <code>dubins</code> TikZ library	20
5.3	How to duplicate a Sankey node	21
5.4	How to define new start and end styles	21
6	Todo	21

1 Preamble

To use the `sankey` package, insert the following line in your preamble:

```
\usepackage{sankey}
```

Note: the `sankey` package requires automatically the `xparse`, `etoolbox`, `xfp` and `tikz` packages, and the `calc`, `decorations.markings` and `dubins` (cf. 5.2 on page 20) TikZ libraries.

2 The `sankeydiagram` environment

Env `sankeydiagram`

A `sankeydiagram` environment nested in a `tikzpicture` environment activates the `sankey` macros:

```
\begin{tikzpicture}
  \begin{sankeydiagram}[... options ...]
    ... sankey macros ...
  \end{sankeydiagram}
\end{tikzpicture}
```

3 Sankey diagram options

The `sankey` package uses `pgfkeys` to set options via `key=value` pairs with default path `/sankey` (and `/sankey/node` parameters for Sankey node parameters).

The options can be defined via the optional argument of the `sankeydiagram` environment:

```
\begin{sankeydiagram}[debug=true]
  \sankeynode{name=a,quantity=1,angle=0,at={0,0}}
\end{sankeydiagram}
```

`\sankeyset` The options can also be modified via the `\sankeyset` macro:

```
\begin{sankeydiagram}
  \sankeyset{debug=true}
  \sankeynode{name=a,quantity=1,angle=0,at={0,0}}
\end{sankeydiagram}
```

The options can be temporarily modified for a single macro:

```
\begin{sankeydiagram}
  \sankeynode[debug=true]{name=a,quantity=1,angle=0,at={0,0}}
\end{sankeydiagram}
```

At the beginning of each Sankey diagram, all options are initialized with initial values then the `every diagram` style is applied.

Key `every diagram` `/sankey/every diagram` (initially: `empty`)

This style is installed at beginning of each Sankey diagram.

For instance, to use a ratio of 5mm/10 by default (instead of 1cm/10) for all Sankey diagrams, add the following line:

```
\sankeyset{every diagram/.style={ratio=5mm/10}}
```

3.1 Keys to choose the scale

The scale or ratio of the Sankey diagram is the ratio between the `ratio length` and the `ratio quantity`.

Key `ratio quantity` `/sankey/ratio quantity=<number>` (initially: `10`)

Quantity (in units of flow) to define ratio. The `<number>` can be any math expression.

Key `ratio length` `/sankey/ratio length=<distance>` (initially: `1cm`)

Distance (a graphical distance) to define scale.

Key `ratio` `/sankey/ratio=<distance>/<number>` (initially: `1cm/10`)

Fix the ratio to `<distance>/<number>`.

The initial ratio is 1 cm/10 units.

Note: the `sankey` package uses the `xfp` package to evaluate all math expressions that use quantities (in units of flow). You can therefore use quantities of a very large or very small order of magnitude. In contrast, for graphic distances, the `sankey` package uses the `pgfmath` package (all calculations must not exceed ± 16383.99999).

3.2 Keys to define rotate offset

Key `rotate` `/sankey/rotate=<angle>` (initially: `0`)

The `rotate` key stores an offset angle applied to all Sankey nodes. This is useful when using the `rotate` option within a `tikzpicture` or a `scope`. This TikZ option is only applied to coordinates and not to TikZ nodes (remember that Sankey nodes are TikZ nodes). It's up to the author to keep the `rotate` option of the `tikzpicture` and that of the `sankeydiagram` synchronous.

3.3 Keys to define drawing parameters

Key `minimum radius` `/sankey/minimum radius=<distance>` (initially: `5mm`)

The minimum radius used by `\sankeyturn` and `\sankeydubins`.

Key `outin steps` `/sankey/outin steps=<integer>` (initially: `10`)

Number of steps used by the `\sankeyoutin` macro to simulate flow lanes with constant width.

3.4 Keys to choose drawing styles

Key `fill/.style` `/sankey/fill/.style=<style>` (initially: `line width=0pt,fill=white`)

This TikZ style is used to *fill* all sankey paths.

Key `draw/.style` `/sankey/draw/.style=<style>` (initially: `draw=black,line width=.4pt`)

This TikZ style is used to *draw* all sankey paths.

Key `start style` `/sankey/start style=<style name>` (initially: `none`)

There are three predefined *start* styles: `none`, `simple`, `arrow`.

Key `end style` `/sankey/end style=<style name>` (initially: `none`)

There are three predefined *end* styles: `none`, `simple`, `arrow`.

3.5 Keys to define new *start* and *end* styles

Key `new start style` `/sankey/new start style={<name>}{<fill path>}{<draw path>}`

Define the new start style named `<name>` with its `<fill path>` and its `<draw path>`.

Key `new end style` `/sankey/new end style={<name>}{<fill path>}{<draw path>}`

Define the new end style named `<name>` with its `<fill path>` and its `<draw path>`.

The `<fill path>` and the `<draw path>` are build in a TikZ scope where the origin is the center of the current Sankey node (its name is accessible via `\name`) and the coordinate system is rotated by its orientation.

3.6 The *debug* key

Key `debug` `/sankey/debug=<boolean>` (default: `true`) (initially: `false`)

To debug a sankey diagram.

4 Sankey nodes and flows

4.1 Create Sankey nodes

`\sankeynode` [*options*] {*node parameters*}

`\sankeynode` The `\sankeynode` macro defines a Sankey node. The *options* can be any Sankey diagram keys. To define a Sankey node, you must provide a *name*, a *quantity* and an *angle* as *node parameters*.

Key	<code>name</code>	<code>/sankey/node parameters/name=<name></code>	(initially: <code>0,0</code>)
		The <i>name</i> of the new Sankey node (and the associated TikZ node).	
Key	<code>quantity</code>	<code>/sankey/node parameters/quantity=<quantity></code>	
		The quantity (in flow unit) of the new Sankey node. The <i>quantity</i> can be any math expression.	
Key	<code>angle</code>	<code>/sankey/node parameters/angle=<angle></code>	
		The orientation of the flow (0 points to the right) of the new Sankey node.	
Key	<code>at</code>	<code>/sankey/node parameters/at=<at></code>	(initially: <code>0,0</code>)
		The position of the new Sankey node (a TikZ coordinate <i>without</i> round brackets or parentheses).	
Key	<code>anchor</code>	<code>/sankey/node parameters/anchor=<anchor></code>	(initially: <code>center</code>)
		Specify the anchor of the Sankey node. Possible values are <code>center</code> , <code>left</code> or <code>right</code> .	
Key	<code>as</code>	<code>/sankey/node parameters/as=<name></code>	
		Copy the <i>name</i> , the <i>quantity</i> , the <i>angle</i> and the <i>position</i> of the Sankey node named <i>name</i> .	

A Sankey node is also a Tikz node but with only three anchors: `left`, `center` and `right`²:



```

\begin{tikzpicture}
  \begin{sankeydiagram}[debug]
    \sankeynode{name=a,quantity=10}
    \sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right}

    \foreach \nodename/\pos in {a/left,b/below left,c/above}{
      \foreach \ancname in {left,center,right}{
        \node[node font=\ttfamily\footnotesize,\pos=1mm of \nodename.\ancname,
          inner sep=0pt,rotate=\sankeygetnodeorient{\nodename},anchor=east]
          {\ancname\vphantom{g}};
        \fill[black] (\nodename.\ancname) circle(1pt);
      }
    }
  \end{sankeydiagram}
\end{tikzpicture}

```

4.1.1 Choose default parameters

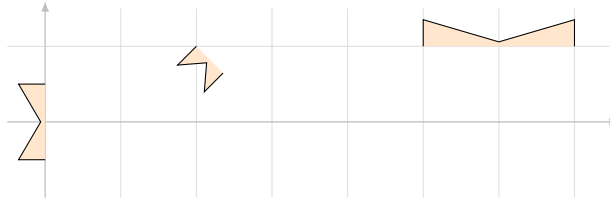
Key `every node/.style` `/sankey/every node/.style={⟨node parameters⟩}` (initially: `empty`)

The `⟨node parameters⟩` defined by the `every node` style is installed at the creation of every Sankey node.

4.1.2 Create starting and ending nodes via macros

`\sankeynodestart[⟨options⟩]{⟨node parameters⟩}`

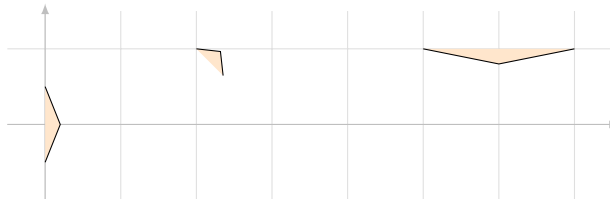
`\sankeynodestart` The `\sankeynodestart` creates and fills/draws a starting Sankey node:



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,fill/.style={fill=orange!20}]
    \sankeynodestart{name=a,quantity=10}
    \sankeynodestart{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeynodestart{name=c,quantity=20,angle=-90,at={5,1},anchor=right}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeynodeend[⟨options⟩]{⟨node parameters⟩}`

`\sankeynodeend` The `\sankeynodeend` creates and fills/draws an ending Sankey node:



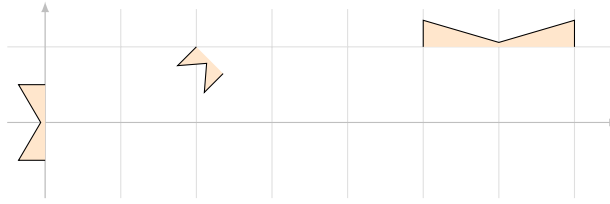
```
\begin{tikzpicture}
  \begin{sankeydiagram}[end style=simple,fill/.style={fill=orange!20}]
    \sankeynodeend{name=a,quantity=10}
    \sankeynodeend{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeynodeend{name=c,quantity=20,angle=-90,at={5,1},anchor=right}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.1.3 Create starting and ending nodes via options

Key start

/sankey/node parameters/**start**=*(boolean)* (default: **true**)(initially: **false**)

The `\sankeynode` macro acts as the `\sankeynodestart` macro if you add the **start** option to its options.

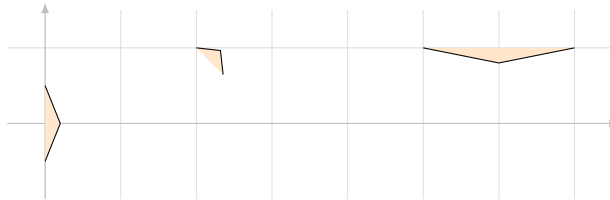


```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,fill/.style={fill=orange!20}]
    \sankeynode{name=a,quantity=10,start}
    \sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left,start}
    \sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right,start}
  \end{sankeydiagram}
\end{tikzpicture}
```

Key end

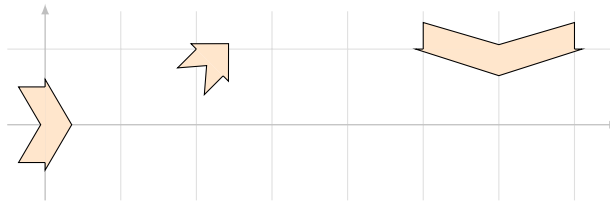
/sankey/node parameters/**end**=*(boolean)* (default: **true**)(initially: **false**)

The `\sankeynode` macro acts as the `\sankeynodeend` macro if you add the **end** option to its options.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[end style=simple,fill/.style={fill=orange!20}]
    \sankeynode{name=a,quantity=10,end}
    \sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left,end}
    \sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right,end}
  \end{sankeydiagram}
\end{tikzpicture}
```

Although rarely necessary, you can mix these two parameters:



```
\begin{tikzpicture}
  \begin{sankeydiagram}
    \sankeyset{
      end style=arrow,
      start style=arrow,
      fill/.style={fill=orange!20}
    }
    \sankeynode{name=a,quantity=10,start,end}
    \sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left,start,end}
    \sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right,start,end}
  \end{sankeydiagram}
\end{tikzpicture}
```

²In fact, to be able to use the TikZ `fit` library, the **north**, **north east** and **north west** anchors exist and are equal to **left**, the **east** and **west** anchors exist and are equal to **center** and the **south**, **south east** and **south west** anchors exist and are equal to **right**.

4.2 Retrieve information from Sankey nodes

`\sankeygetnodeqty{<node name>}`

`\sankeygetnodeqty` The expandable command `\sankeygetnodeqty` returns the quantity assigned to the Sankey node named `<node name>`.

`\sankeyqtypolen{<quantity>}`

`\sankeyqtypolen` The expandable `\sankeyqtypolen` macro converts `<quantity>` to graphical length using the current ratio.

`\sankeygetnodeorient{<node name>}`

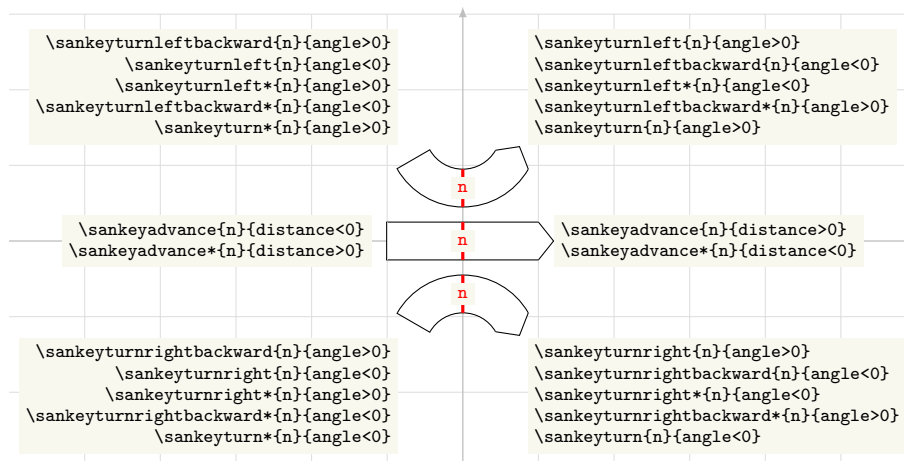
`\sankeygetnodeorient` The expandable command `\sankeygetnodeorient` returns the angle (orientation) assigned to the Sankey node named `<node name>`.

4.3 Move nodes

All the macros of this section move a Sankey node and fill/draw a portion of the Sankey flow. Then the previous position of the Sankey node is accessible via the `-old` suffix (i.e. if you move the `a` node, its previous position is the `a-old` node).

The starred version of each of these macros moves in the opposite direction to their non-starred version.

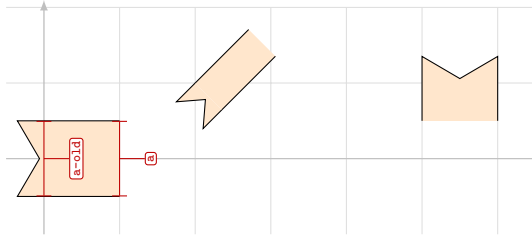
Except for the `\sankeyturn` macro, a negative value (distance or angle) moves in the opposite direction (the `\sankeyturn` macro is an exception: a negative angle turns right while a positive value turns left).



4.3.1 Macro to move straight (forward or backward)

`\sankeyadvance` [*options*] {*node name*} {*distance*}

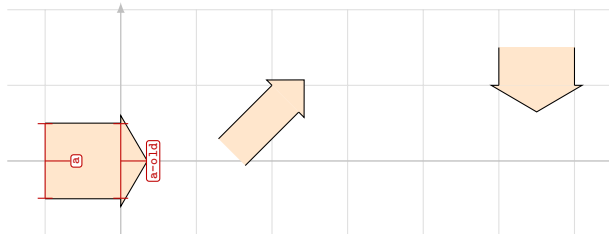
`\sankeyadvance` The `\sankeyadvance` moves the sankey node straight ahead and fills/draws this portion of the sankey path. A positive *distance* moves forward while a negative *distance* moves backward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,fill/.style={fill=orange!20}]
    \sankeynodestart{name=a,quantity=10}
    \sankeyadvance{a}{1cm}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeynodestart{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyadvance{b}{1cm}
    \sankeynodestart{name=c,quantity=10,angle=-90,at={5,1},anchor=right}
    \sankeyadvance{c}{5mm}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyadvance*` [*options*] {*node name*} {*distance*}

`\sankeyadvance*` The `\sankeyadvance*` moves the sankey node straight back and fills/draws this portion of the sankey path. A positive *distance* moves backward while a negative *distance* moves forward.

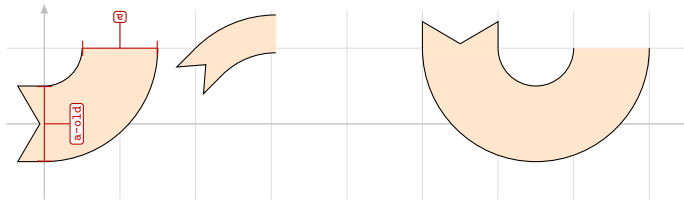


```
\begin{tikzpicture}
  \begin{sankeydiagram}[end style=arrow,fill/.style={fill=orange!20}]
    \sankeynodeend{name=a,quantity=10}
    \sankeyadvance*{a}{1cm}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeynodeend{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyadvance*{b}{1cm}
    \sankeynodeend{name=c,quantity=10,angle=-90,at={5,1},anchor=right}
    \sankeyadvance*{c}{5mm}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.3.2 Macro to turn forward or backward

`\sankeyturn` [*options*] {*node name*} {*angle*}

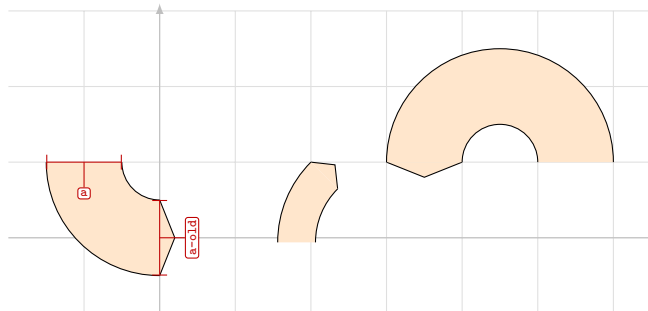
`\sankeyturn` The `\sankeyturn` macro moves the sankey node by turning to one side or the other and fills/draws this portion of the sankey path. A *positive* *angle* turns left while a *negative* *angle* turns right.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,fill/.style={fill=orange!20}]
    \sankeynodestart{name=a,quantity=10}
    \sankeyturn{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeynodestart{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyturn[minimum radius=1cm]{b}{-45}
    \sankeynodestart{name=c,quantity=10,angle=-90,at={5,1},anchor=right}
    \sankeyturn{c}{180}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturn*` [*options*] {*node name*} {*angle*}

`\sankeyturn*` The `\sankeyturn*` macro moves the sankey node backward by turning right or left and fills/draws this portion of the sankey path. A *positive* *angle* turns left while a *negative* *angle* turns right.

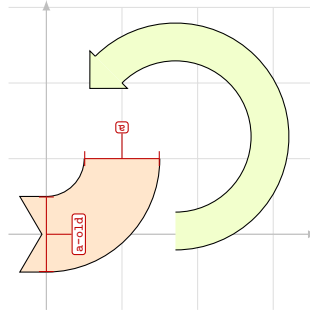


```
\begin{tikzpicture}
  \begin{sankeydiagram}[end style=simple,fill/.style={fill=orange!20}]
    \sankeynodeend{name=a,quantity=10}
    \sankeyturn*{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeynodeend{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyturn*[minimum radius=1cm]{b}{-45}
    \sankeynodeend{name=c,quantity=10,angle=-90,at={3,1},anchor=right}
    \sankeyturn*{c}{180}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.3.3 Macros to turn left (forward or backward)

`\sankeyturnleft` [*options*] {*node name*} {*angle*}

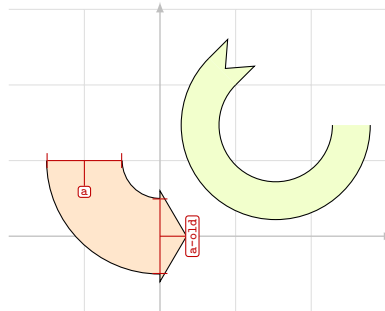
`\sankeyturnleft` The `\sankeyturnleft` macro moves the sankey node by turning left and fills/draws this portion of the sankey path. A *positive* *angle* turns forward while a *negative* *angle* turns backward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodestart{name=a,quantity=10}
    \sankeyturnleft{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodeend{name=b,quantity=5,angle=-135,at={1,2},anchor=left}
    \sankeyturnleft[minimum radius=1cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnleft*` [*options*] {*node name*} {*angle*}

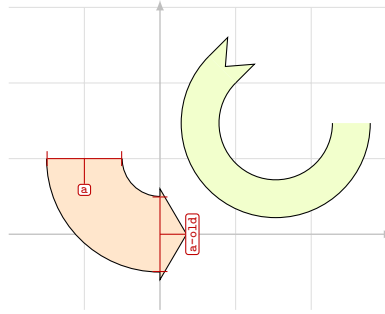
`\sankeyturnleft*` The `\sankeyturnleft*` macro moves the sankey node backward by turning left and fills/draws this portion of the sankey path. A *positive* *angle* turns backward while a *negative* *angle* turns forward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodeend{name=a,quantity=10}
    \sankeyturnleft*{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodestart{name=b,quantity=5,angle=-135,at={1,2},anchor=left}
    \sankeyturnleft*[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnleftbackward` [*options*] {*node name*} {*angle*}

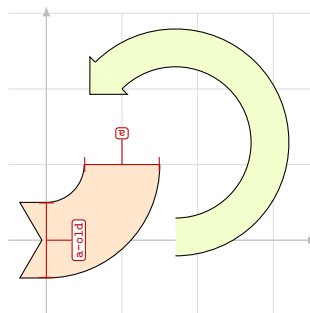
`\sankeyturnleftbackward` The `\sankeyturnleftbackward` macro moves the sankey node backward by turning left and fills/draws this portion of the sankey path. A *positive* *angle* turns backward while a *negative* *angle* turns forward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodeend{name=a,quantity=10}
    \sankeyturnleftbackward{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodestart{name=b,quantity=5,angle=-135,at={1,2},anchor=left}
    \sankeyturnleftbackward[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnleftbackward*` [*options*] {*node name*} {*angle*}

`\sankeyturnleftbackward*` The `\sankeyturnleftbackward*` macro moves the sankey node by turning left and fills/draws this portion of the sankey path. A *positive* *angle* turns forward while a *negative* *angle* turns backward.

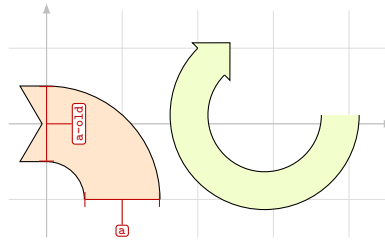


```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodestart{name=a,quantity=10}
    \sankeyturnleftbackward*{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodeend{name=b,quantity=5,angle=-135,at={1,2},anchor=left}
    \sankeyturnleftbackward*[minimum radius=1cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.3.4 Macros to turn right (forward or backward)

`\sankeyturnright` [*options*] {*node name*} {*angle*}

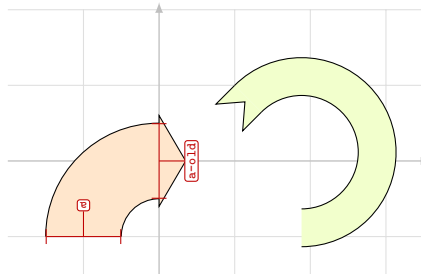
`\sankeyturnright` The `\sankeyturnright` macro moves the sankey node by turning right and fills/draws this portion of the sankey path. A *positive* *angle* turns forward while a *negative* *angle* turns backward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodestart{name=a,quantity=10}
    \sankeyturnright[fill/.style={fill=orange!20}]{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodeend{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyturnright[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnright*` [*options*] {*node name*} {*angle*}

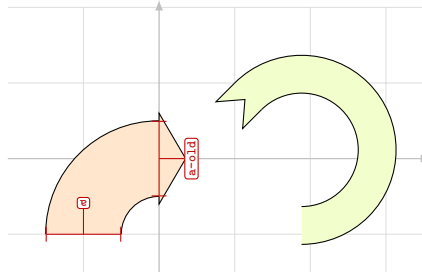
`\sankeyturnright*` The `\sankeyturnright*` macro moves the sankey node backward by turning right and fills/draws this portion of the sankey path. A *positive* *angle* turns backward while a *negative* *angle* turns forward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodeend{name=a,quantity=10}
    \sankeyturnright*[fill/.style={fill=orange!20}]{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodestart{name=b,quantity=5,angle=45,at={1,1},anchor=left}
    \sankeyturnright*[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnrightbackward` [*options*] {*node name*} {*angle*}

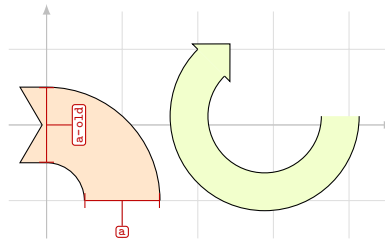
`\sankeyturnrightbackward` The `\sankeyturnrightbackward` macro moves the sankey node backward by turning right and fills/draws this portion of the sankey path. A *positive* *angle* turns backward while a *negative* *angle* turns forward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodeend{name=a,quantity=10}
    \sankeyturnrightbackward[fill/.style={fill=orange!20}]{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodestart{name=b,quantity=5,angle=45,at={1,1},anchor=left}
    \sankeyturnrightbackward[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

`\sankeyturnrightbackward*` [*options*] {*node name*} {*angle*}

`\sankeyturnrightbackward*` The `\sankeyturnrightbackward*` macro moves the sankey node forward by turning right and fills/draws this portion of the sankey path. A *positive* *angle* turns forward while a *negative* *angle* turns backward.



```
\begin{tikzpicture}
  \begin{sankeydiagram}[start style=arrow,end style=arrow]
    \sankeyset{fill/.style={fill=orange!20}}
    \sankeynodestart{name=a,quantity=10}
    \sankeyturnrightbackward*[fill/.style={fill=orange!20}]{a}{90}
    \sankeynode[debug]{as=a}
    \sankeynode[debug]{as=a-old}
    \sankeyset{fill/.style={fill=lime!20}}
    \sankeynodeend{name=b,quantity=5,angle=45,at={2,1},anchor=left}
    \sankeyturnrightbackward*[minimum radius=.75cm]{b}{-225}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.4 Links between nodes

The macros described in this section fill/draw a lane between two Sankey nodes.

Note: since Sankey nodes are oriented, linking **A** node to **B** node does not produce the same result as linking **B** node to **A** node!

`\sankeyoutin[<options>]{<node A>}{<node B>}`

`\sankeyoutin` The `\sankeyoutin` macro fills/draws a lane from *<node A>* to *<node B>* using a Bézier curve with regular steps (10 steps by default) to simulate constant width lane.

The constant width and the minimum curvature are *not* guaranteed!

`\sankeydubins[<options>]{<node A>}{<node B>}`

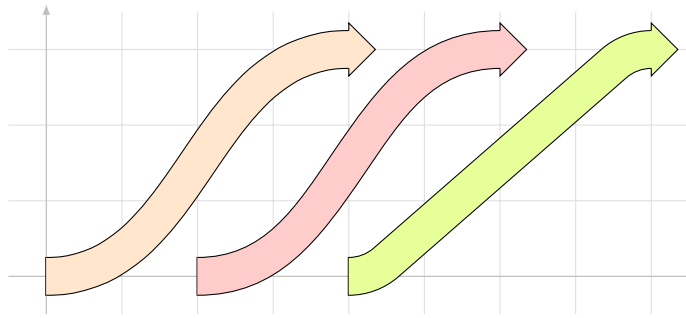
`\sankeydubins` The `\sankeydubins` macro fills/draws a lane between *<node A>* and *<node B>* using a Dubins path³.

The constant width and the minimum curvature are guaranteed.

³https://en.wikipedia.org/wiki/Dubins_path

4.4.1 Comparison between outin and dubins paths

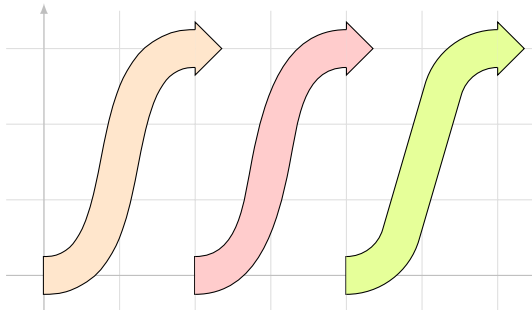
The following diagrams compare outin path with 10 steps (orange), outin path with 2 steps (red) and dubins path (lime) in various positions.



```
\begin{tikzpicture}
\begin{sankeydiagram}[start style=simple,end style=arrow]
\sankeyset{fill/.style={fill=orange!20}}
\sankeynodestart{name=a,quantity=5}
\sankeynodeend{name=b,at={4,3},quantity=5}
\sankeyoutin{a}{b}

\sankeyset{fill/.style={fill=red!20}}
\sankeynodestart{name=a,at={2,0},quantity=5}
\sankeynodeend{name=b,at={6,3},quantity=5}
\sankeyoutin[outin steps=2]{a}{b}

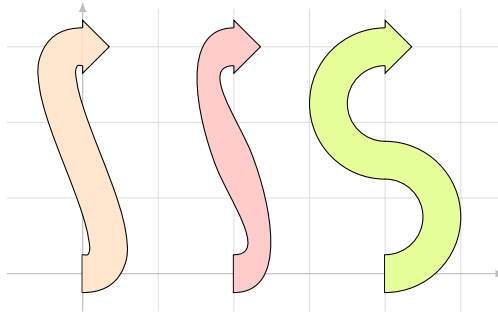
\sankeyset{fill/.style={fill=lime!40}}
\sankeynodestart{name=a,at={4,0},quantity=5}
\sankeynodeend{name=b,at={8,3},quantity=5}
\sankeydubins[minimum radius=5mm]{a}{b}
\end{sankeydiagram}
\end{tikzpicture}
```



```
\begin{tikzpicture}
\begin{sankeydiagram}[start style=simple,end style=arrow]
\sankeyset{fill/.style={fill=orange!20}}
\sankeynodestart{name=a,quantity=5}
\sankeynodeend{name=b,at={2,3},quantity=5}
\sankeyoutin{a}{b}

\sankeyset{fill/.style={fill=red!20}}
\sankeynodestart{name=a,at={2,0},quantity=5}
\sankeynodeend{name=b,at={4,3},quantity=5}
\sankeyoutin[outin steps=2]{a}{b}

\sankeyset{fill/.style={fill=lime!40}}
\sankeynodestart{name=a,at={4,0},quantity=5}
\sankeynodeend{name=b,at={6,3},quantity=5}
\sankeydubins[minimum radius=5mm]{a}{b}
\end{sankeydiagram}
\end{tikzpicture}
```

```

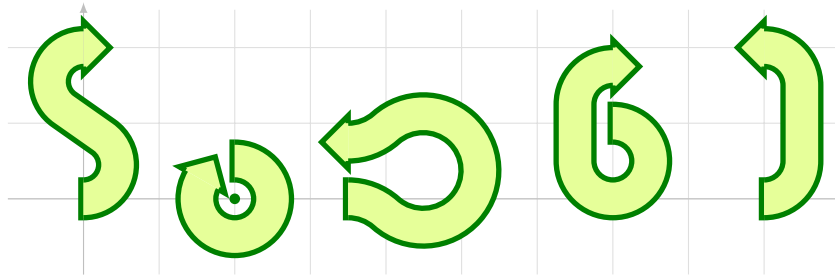
\begin{tikzpicture}
\begin{sankeydiagram}[start style=simple,end style=arrow]
\sankeyset{fill/.style={fill=orange!20}}
\sankeynodestart{name=a,quantity=5}
\sankeynodeend{name=b,at={0,3},quantity=5}
\sankeyoutin{a}{b}

\sankeyset{fill/.style={fill=red!20}}
\sankeynodestart{name=a,at={2,0},quantity=5}
\sankeynodeend{name=b,at={2,3},quantity=5}
\sankeyoutin[outin steps=2]{a}{b}

\sankeyset{fill/.style={fill=lime!40}}
\sankeynodestart{name=a,at={4,0},quantity=5}
\sankeynodeend{name=b,at={4,3},quantity=5}
\sankeydubins[minimum radius=5mm]{a}{b}
\end{sankeydiagram}
\end{tikzpicture}

```

4.4.2 Examples of dubins paths



```

\begin{tikzpicture}
\begin{sankeydiagram}[start style=simple,end style=arrow]
\sankeyset{
fill/.style={fill=lime!40},
draw/.style={draw=green!50!black,line width=2pt},
}

\sankeynodestart{name=a,quantity=5}
\sankeynodeend{name=b,at={0,2},quantity=5}
\sankeydubins[minimum radius=2mm]{a}{b}

\fill[green!50!black] (2,0) coordinate (c) circle(2pt);
\sankeynodestart{name=a,at={[\shift={(c)}]90:5mm},quantity=5}
\sankeynodeend{name=b,at={[\shift={(c)}]150:5mm},angle=60,quantity=5}
\sankeydubins[minimum radius=2.5mm]{a}{b}

\sankeynodestart{name=a,at={3.5,0},quantity=5}
\sankeynodeend{name=b,at={3.5,.75},angle=-180,quantity=5}
\sankeydubins[minimum radius=5mm]{a}{b}

\sankeynodestart{name=a,at={7,1},quantity=5}
\sankeynodeend{name=b,at={7,1.75},quantity=5}
\sankeydubins[minimum radius=2.5mm]{a}{b}

\sankeynodestart{name=a,at={9,0},quantity=5}
\sankeynodeend{name=b,at={9,2},angle=180,quantity=5}
\sankeydubins[minimum radius=2.5mm]{a}{b}
\end{sankeydiagram}
\end{tikzpicture}

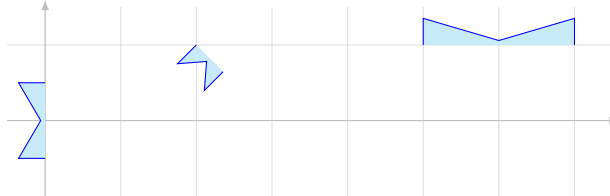
```

```
\end{sankeydiagram}
\end{tikzpicture}
```

4.5 Pure filling/drawing macros

```
\sankeystart[<options>]{<name>}
```

`\sankeystart` The `\sankeystart` fills/draws a starting extremity attached to the preexisting Sankey node `<name>`:

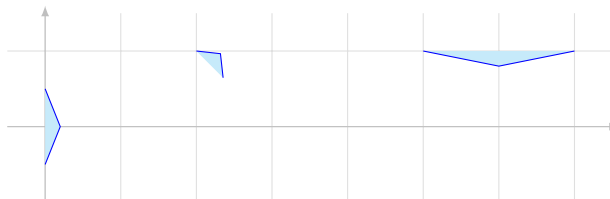


```
\begin{tikzpicture}
\begin{sankeydiagram}
[start style=arrow,fill/.style={fill=cyan!20},draw/.style={draw=blue}]
\sankeynode{name=a,quantity=10}
\sankeystart{a}
\sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left}
\sankeystart{b}
\sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right}
\sankeystart{c}
\end{sankeydiagram}
\end{tikzpicture}
```

```
\sankeyend[<options>]{<name>}
```

`\sankeyend` The `\sankeyend` fills/draws an ending extremity attached to the preexisting Sankey node `<name>`:

```
\begin{tikzpicture}
\begin{sankeydiagram}
[end style=simple,fill/.style={fill=cyan!20},draw/.style={draw=blue}]
\sankeynode{name=a,quantity=10}
\sankeyend{a}
\sankeynode{name=b,quantity=5,angle=45,at={2,1},anchor=left}
\sankeyend{b}
\sankeynode{name=c,quantity=20,angle=-90,at={5,1},anchor=right}
\sankeyend{c}
\end{sankeydiagram}
\end{tikzpicture}
```



4.6 Forked node

4.6.1 Create and fork a Sankey node

When creating a new Sankey node, the `forked` and `fork anchor` keys allow to fork the node directly *and* to anchor it on an anchor of a forked subnode.

Key `forked`

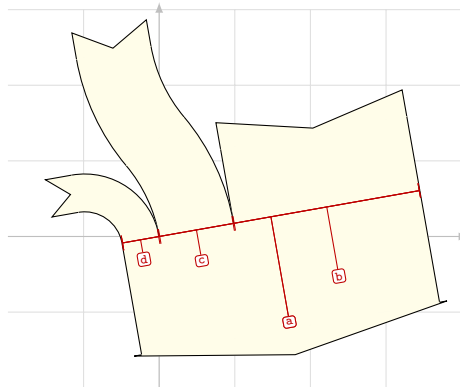
```
/sankey/node parameters/forked={\quantity/name pairs}
```

The `\quantity/name pairs` is a comma separated list of `quantity/name` pairs (one for each subnode, from left to right). The sum of all quantities *must* be equal to the quantity of the new node to fork.

Key `fork anchor`

```
/sankey/node parameters/fork anchor=\node.anchor
```

An anchor belonging to the new node *or* belonging to a subnode (the anchor name must be prefixed by the name of the node). *Note:* when a `fork anchor` key is supplied, the `anchor` key is ignored (with a *warning* message).



```
\begin{tikzpicture}
  \begin{sankeydiagram}
    \sankeyset{
      start style=arrow,end style=arrow,
      fill/.style={fill=yellow!10,line width=0pt,draw=yellow!10}
    }

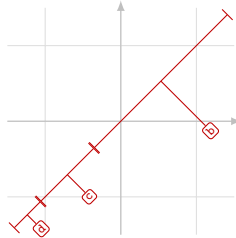
    \sankeynode[debug]{
      name=a,quantity=40,angle=-80,
      forked={25/b,10/c,5/d},
      fork anchor=c.right,
    }

    \sankeyadvance*b}{1cm}
    \sankeyturn*[minimum radius=2cm]{c}{-30}
    \sankeyturn*[minimum radius=2cm]{c}{30}
    \sankeyturn*[minimum radius=5mm]{d}{-90}
    \sankeyadvance{a}{1.5cm}
    \foreach \nodename in {b,c,d}{ \sankeystart{\nodename} }
    \sankeyend{a}
  \end{sankeydiagram}
\end{tikzpicture}
```

4.6.2 Fork a Sankey node

`\sankeyfork[<options>]{<name>}{<quantity/name pairs>}`

`\sankeyfork` The `\sankeyfork` macro splits the preexisting Sankey node named *<name>* in a list of new Sankey subnodes. The *<quantity/name pairs>* is a comma separated list of *quantity/name* pairs, one for each subnode from left to right. The sum of all quantities *must* be equal to the quantity of the node to fork.



```
\begin{tikzpicture}
  \begin{sankeydiagram}
    \sankeynode{name=a,quantity=40,angle=-45}
    \sankeyfork[debug]{a}{25/b,10/c,5/d}
    \path (a.left) rectangle (a.right); % create a bounding box
  \end{sankeydiagram}
\end{tikzpicture}
```

5 Miscellaneous

5.1 The debug layer

The options `debug` key uses the `sankeydebug` layer to draw above the `main` TikZ layer (via `\pgfsetlayers`, the `sankey` package installs four layers: `background`, `main`, `foreground`, `sankeydebug`).

The four following styles define how to display debug information:

```
\sankeyset{
  debug color/.style={/utils/exec={\colorlet{debug color}{#1}}},
  % debug color used by all debug macros
  debug color=red!75!black,
  % debug line between left and right anchors
  debug line/.style={overlay,draw=debug color,|-|},
  % debug line between center and label
  debug normal/.style={overlay,draw=debug color},
  % debug node label
  debug label/.style={
    overlay,
    draw,
    font=\ttfamily\tiny,
    text=debug color,text opacity=1,
    inner sep=.1em,
    fill=white,fill opacity=1,
    rounded corners=.1em,
    node contents={\name},
  },
}
```

5.2 The dubins TikZ library

The `sankey` package uses the `dubins` TikZ library (the `tikzlibrarydubins.code.tex` file) to compute Dubins paths. The documentation for this library does not yet exist.

5.3 How to duplicate a Sankey node

```
\sankeynodealias{<origname>}{<clonename>}
```

`\sankeynodealias` The `\sankeynodealias` macro clones the Sankey node named `<origname>` into the Sankey node named `<clonename>`.

So, you can clone a Sankey node via two methods:

```
\sankeynode{name=a,quantity=10}  
\sankeynode{as=a,name=b}
```

```
\sankeynode{name=a,quantity=10}  
\sankeynodealias{a}{b}
```

5.4 How to define new start and end styles

Here are the definitions of the `arrow` styles:

```
\sankeyset{  
  %% arrow style  
  new start style={arrow}{  
    (\name.left) -- ++(-10pt,0)  
    -- ([xshift=-10pt/6]\name.center)  
    -- ([xshift=-10pt]\name.right)  
    -- (\name.right) -- cycle  
  }{  
    (\name.left) -- ++(-10pt,0)  
    -- ([xshift=-10pt/6]\name.center)  
    -- ([xshift=-10pt]\name.right)  
    -- (\name.right)  
  },  
  new end style={arrow}{  
    (\name.left) -- ([yshift=1mm]\name.left)  
    -- ([xshift=10pt]\name.center)  
    -- ([yshift=-1mm]\name.right) -- (\name.right) -- cycle  
  }{  
    (\name.left) -- ([yshift=1mm]\name.left)  
    -- ([xshift=10pt]\name.center)  
    -- ([yshift=-1mm]\name.right) -- (\name.right)  
  },  
}
```

6 Todo

- Document the `dubins` TikZ library.
- Add a tutorial.
- Add examples with cycle(s).

This manual contains three parts: [User manual](#) (p.1), [Examples](#) (p.22) and [Installation & Implementation](#) (p.43).

Part II

Examples

Contents

7 List of Figures	22
8 Simple example	23
9 Energy diagram	25
10 Example from question on TeX.se	28
11 Reproduction of an example from Google Charts documentation	32
11.1 Variation	34
12 Very nice example – Nadieh Bremer creation	38

7 List of Figures

1 Simple example	23
2 Energy diagram	25
3 Example from TeX.se question	28
4 Reproduction of an example from Google Charts documentation . . .	32
5 Reproduction of an example from Google Charts documentation – variation using the <code>rotate</code> key.	35
6 Very nice example – Nadieh Bremer’s creation	39

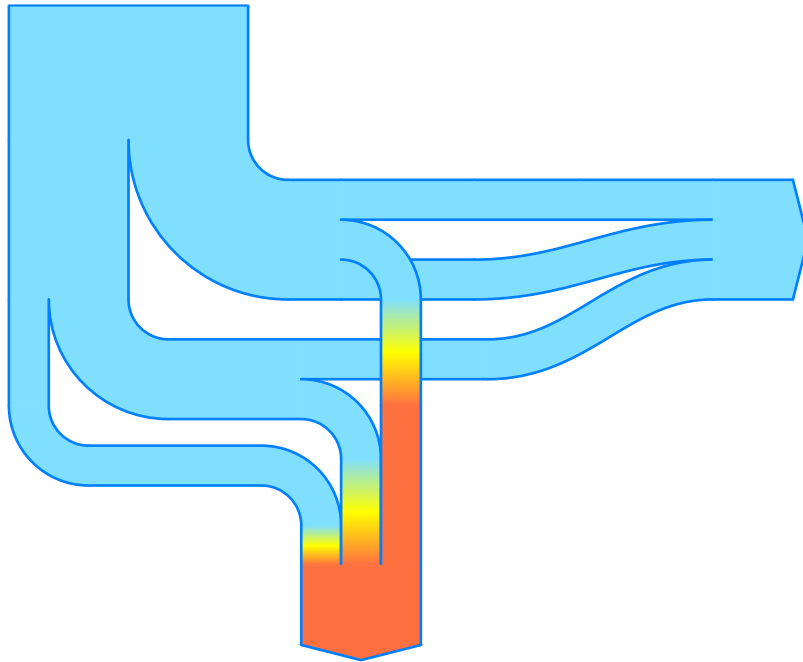


Figure 1: Simple example

8 Simple example

See figure 1. The `sankey-example1.tex` file contains the following code and is an attachment of the current PDF document.

```

\begin{tikzpicture}
  \begin{sankeydiagram}%[debug]
    \colorlet{cold}[rgb]{cyan!75!blue!50!white}
    \colorlet{hot}[rgb]{red!50!orange!75!white}
    \sankeyset{
      ratio=90pt/6,minimum radius=15pt,
      start style=simple,end style=simple,
      draw/.style={
        draw=blue!50!cyan,
        line width=1pt,line cap=round,line join=round,
      },
      cold/.style={
        fill/.style={
          draw=cold,line width=0pt,fill=cold,
        },
      },
      cold to hot/.style={
        fill/.style={
          fill=none,top color=cold,
          bottom color=hot,middle color=yellow,
        },
      },
      hot/.style={
        fill/.style={
          draw=hot,line width=0pt,fill=hot,
        },
      },
    }

    \sankeyset{cold}
    \sankeynodestart{name=p0,at={100,0},angle=-90,quantity=6}
    \sankeyadvance{p0}{50pt}
    \sankeyfork{p0}{3/p1,3/p2}
    \sankeyturnleft{p1}{90}
    \sankeyadvance{p1}{20pt}
    \sankeyadvance{p2}{60pt}
    \sankeyfork{p2}{2/p3,1/p4}
    \sankeyturnleft{p3}{90}
  
```

```

\sankeyadvance{p3}{50pt}
\sankeyfork{p3}{1/p5,1/p6}
\sankeyadvance{p5}{70pt}
\sankeyfork{p1}{1/p7,1/p8,1/p9}
\sankeyadvance{p7}{50pt}
\sankeyadvance{p9}{50pt}
\sankeyadvance{p4}{40pt}
\sankeyturnleft{p4}{90}
\sankeyadvance{p4}{65pt}
\sankeyadvance{p7}{40pt}
\sankeynode{
  name=p11,at={[shift={(50pt,-15pt)}}p7},quantity=3,
  forked={1/p7a,1/p9a,1/p5a},
}
\sankeyoutin{p7}{p7a}
\sankeyoutin{p9}{p9a}
\sankeyoutin{p5}{p5a}
\sankeyadvance{p11}{30pt}
\sankeyend{p11}
\sankeyturnright{p8}{90}
\sankeyturnright{p6}{90}
\sankeyturnright{p4}{90}
\sankeyset{hot}
\sankeyadvance[cold to hot]{p8}{40pt}
\sankeynode{
  name=p10,at={[shift={(-15pt,-60pt)}}p8},angle=-90,quantity=3,
  forked={1/p8a,1/p6a,1/p4a},
}
\sankeyoutin[cold to hot]{p4}{p4a}
\sankeyoutin[cold to hot]{p6}{p6a}
\sankeyoutin{p8}{p8a}
\sankeyadvance{p10}{30pt}
\sankeyend{p10}
\end{sankeydiagram}
\end{tikzpicture}

```

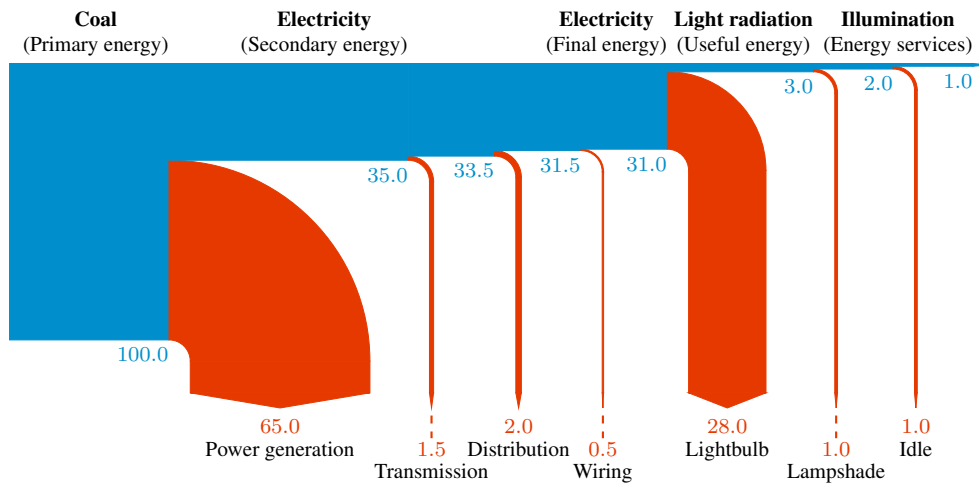



Figure 2: Energy diagram

9 Energy diagram

This example comes from [IB Physics Blog](#) by Kyu Won Shim.

See figure 2. The `sankey-example-energy.tex` file contains the following code and is an attachment of the current PDF document.

```

\begin{tikzpicture}
  % font choice
  \renewcommand\rmdefault{txr}\rmfamily\footnotesize
  \sisetup{
    round-mode=places,
    round-precision=1,
    add-decimal-zero,
    round-pad=true,
  }
  \begin{sankeydiagram}
    \colorlet{energy}{blue!30!cyan!80!black}
    \colorlet{lost energy}{red!50!orange!90!black}
    \sankeyset{
      ratio=13em/100,
      minimum radius=1em,
      start style=simple,end style=simple,
      draw/.style={draw=none,line width=0},
      energy/.style={
        fill/.style={
          draw=energy,
          line width=0,
          fill=energy,
        }
      },
      lost energy/.style={
        fill/.style={
          draw=lost energy,
          line width=0,
          fill=lost energy,
        }
      }
    }
  }
}

\newcommand\abovelabel[2]{ % valname, label
  \node[anchor=south east,align=center,inner xsep=0] at (#1.left) {#2};
}

\newcommand\energylabel[1]{ % valname
  \node[anchor=north east,text=energy,inner xsep=0] at (#1.right)
  {\num{\sankeygetnodeqty{#1}}};
}

```

```

\newcommand\lostenergylabel[2]{ % valname, label
  \node[anchor=north,text=lost energy] at ([yshift=-2.5mm]#1.center)
    (value)
    {\num{\sankeygetnodeqty{#1}}};
  \node[anchor=north,inner sep=0,align=center] at (value.south) {#2};
}

\newcommand\lostenergylabelbottom[2]{ % valname, label
  \draw[draw=lost energy,dashed,thick]
    ([yshift=-3mm]#1.center) coordinate (#1) -- ([yshift=-3mm]#1.center);
  \lostenergylabel{#1}{#2}
}

\sankeynode{name=Co,quantity=100.0}
\path (Co.right) ++(0,-7mm) coordinate (c);

\newcommand\turnandstop[2]{ % valname, label
  \begingroup
  \sankeyset{lost energy}
  \sankeyturnright{#1}{90}
  \sankeynode{as=#1,name=#1-stop,at={#1 |- c}}
  \sankeyoutin{#1}{#1-stop}
  \sankeynode{as=#1-stop,name=#1}
  \sankeyend{#1}
  \lostenergylabel{#1}{#2}
  \endgroup
}

\newcommand\turnandstopbottom[2]{ % valname, label
  \begingroup
  \sankeyset{lost energy}
  \sankeyturnright{#1}{90}
  \sankeynode{as=#1,name=#1-stop,at={#1 |- c}}
  \sankeyoutin{#1}{#1-stop}
  \sankeynode{as=#1-stop,name=#1}
  \sankeyend{#1}
  \lostenergylabelbottom{#1}{#2}
  \endgroup
}

\def\hshift{6.25em}

\sankeyadvance[energy]{Co}{1.2*\hshift}
\abovelabel{Co}{\textbf{Coal}\(Primary energy)}
\energylabel{Co}
\sankeyfork{Co}{35/E11,65/Pg}
\turnandstop{Pg}{Power generation}

\sankeyadvance[energy]{E11}{1.8*\hshift}
\abovelabel{E11}{\textbf{Electricity}\(Secondary energy)}
\energylabel{E11}
\sankeyfork{E11}{33.5/E12,1.5/Tr}
\turnandstopbottom{Tr}{Transmission}

\sankeyadvance[energy]{E12}{.65*\hshift}
\energylabel{E12}
\sankeyfork{E12}{31.5/E13,2.0/Di}
\turnandstop{Di}{Distribution}

\sankeyadvance[energy]{E13}{.65*\hshift}
\energylabel{E13}
\sankeyfork{E13}{31.0/E14,0.5/Wi}
\turnandstopbottom{Wi}{Wiring}

\sankeyadvance[energy]{E14}{.65*\hshift}
\abovelabel{E14}{\textbf{Electricity}\(Final energy)}
\energylabel{E14}
\sankeyfork{E14}{3.0/Lr1,28.0/Lb}

```

```

\turnandstop{Lb}{Lightbulb}

\sankeyadvance[energy]{Lr1}{1.1*\hshift}
\abovelabel{Lr1}{\textbf{Light radiation}}\(\text{Useful energy})}
\energylabel{Lr1}
\sankeyfork{Lr1}{2.0/Lr2,1.0/Ls}
\turnandstopbottom{Ls}{Lampshade}

\sankeyadvance[energy]{Lr2}{.6*\hshift}
\energylabel{Lr2}
\sankeyfork{Lr2}{1.0/I1,1.0/Id}
\turnandstop{Id}{Idle}

\sankeyadvance[energy]{I1}{.6*\hshift}
\abovelabel{I1}{\textbf{Illumination}}\(\text{Energy services})}
\energylabel{I1}
\sankeyend[energy]{I1}
\end{sankeydiagram}
\end{tikzpicture}

```

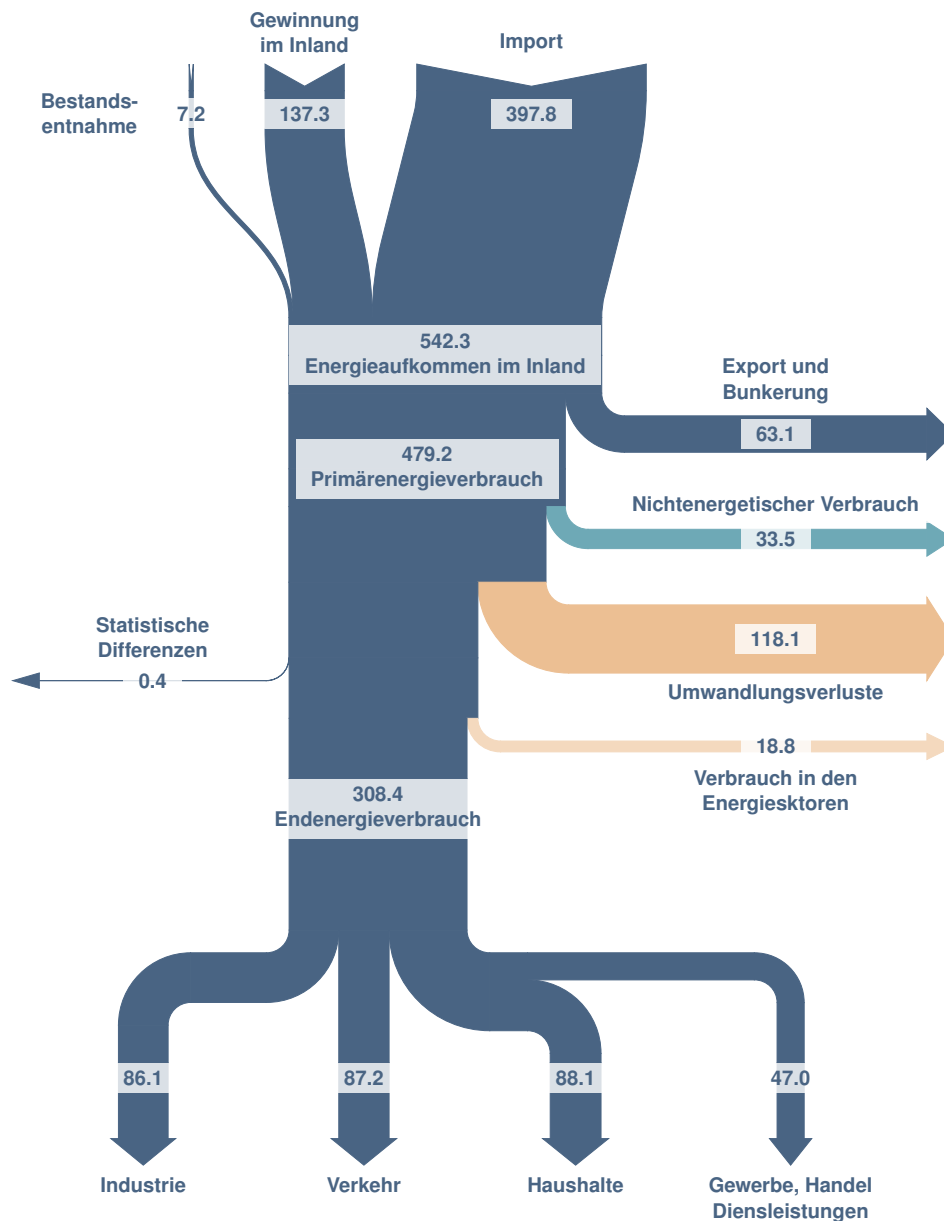


Figure 3: Example from TeX.se question

10 Example from question on TeX.se

This example came from [this question](#) on [TeX.StackExchange](#).

See figure 3. The `sankey-example2.tex` file contains the following code and is an attachment of the current PDF document.

```

\begin{tikzpicture}
  \renewcommand*\sfdefault{txss}

  \begin{sankeydiagram} %[debug]
    \sankeyset{
      ratio=4cm/524.3,
      minimum radius=3mm,
      start style=arrow,
      end style=arrow,
      fill/.style={
        line width=0pt,
        fill=cyan!50!blue!50!black,
        draw=cyan!50!blue!50!black,
      },
      draw/.style={draw=none},
      every node/.style={angle=-90},
    }
  \end{sankeydiagram}

```

```

\sankeynodestart{name=B,at={-.5,0},quantity=7.2}
\coordinate[below=1mm of B.center] (B label);
\sankeyadvance{B}{5mm}
\sankeynodestart{name=GI,at={1,0},quantity=137.3}
\coordinate[below=1mm of GI.center] (GI label);
\sankeyadvance{GI}{5mm}
\sankeynodestart{name=I,at={4,0},quantity=397.8}
\coordinate[below=1mm of I.center] (I label);
\sankeynode{
  name=EI,at={2.86,-3},quantity=542.3,
  forked={397.8/Ia,137.3/GIa,7.2/Ba}
}
\sankeydubins[minimum radius=1.2cm]{I}{Ia}
\sankeyoutin{GI}{GIa}
\sankeyoutin{B}{Ba}
\sankeyadvance{EI}{5mm}
\coordinate (EI label) at (EI);
\sankeyadvance{EI}{5mm}
\sankeyfork{EI}{63.1/EB,479.2/P}

\sankeyturnleft{EB}{90}
\sankeyadvance{EB}{4cm}
\coordinate (EB label) at ($(EB)!.5!(EB-old)$);
\sankeyend{EB}

\sankeyadvance{P}{10mm}
\coordinate (P label) at (P);
\sankeyadvance{P}{5mm}

\sankeyfork{P}{33.5/NV,445.7/P-NV}

{
  \colorlet{NV color}{cyan!80!lime!50!gray}
  \sankeyset{fill/.append style={fill=NV color,draw=NV color}}
  \sankeyturnleft{NV}{90}
  \sankeynode{as=NV,name=NV2,at=NV -| EB}
  \sankeyoutin{NV}{NV2}
  \coordinate (NV label) at (NV -| EB label);
  \sankeyend{NV2}
}

\sankeyadvance{P-NV}{10mm}
\sankeyfork{P-NV}{118.1/U,327.6/P-NV-U}

{
  \sankeyset{
    fill/.style={fill=orange!70!gray!50,draw=orange!70!gray!50}
  }
  \sankeyturnleft{U}{90}
  \sankeynode{as=U,name=U2,at=U -| EB}
  \sankeyoutin{U}{U2}
  \coordinate (U label) at (U -| EB label);
  \sankeyend{U2}
}

\sankeyadvance{P-NV-U}{10mm}
\sankeyfork{P-NV-U}{327.2/P-NV-U-SD,0.4/SD}

{
  \sankeyturnright{SD}{90}
  \sankeyadvance{SD}{15mm}
  \coordinate (SD label) at (SD);
  \sankeyadvance{SD}{15mm}
  \sankeyend{SD}
}

\sankeyadvance{P-NV-U-SD}{8mm}
\sankeyfork{P-NV-U-SD}{18.8/VE,308.4/E}

```

```

{
  \sankeyset{fill/.append style={orange!70!gray!30}}
  \sankeyturnleft{VE}{90}
  \sankeynode{as=VE,name=VE2,at=VE -| EB}
  \sankeyoutin{VE}{VE2}
  \coordinate (VE label) at (VE -| EB label);
  \sankeyend{VE2}
}

\sankeyadvance{E}{8mm}
\coordinate (E label) at (E);
\sankeyadvance{E}{20mm}
\sankeyfork{E}{135.1/H+GHD,87.2/V,86.1/In}

\sankeyturnright{In}{90}
\sankeyadvance{In}{10mm}
\sankeyturnleft{In}{90}
\sankeyadvance{In}{5mm}
\coordinate (In label) at (In);
\sankeyadvance{In}{10mm}
\sankeyend{In}

\sankeynode{as=V,name=V2,at=V|-In label}
\sankeyoutin{V}{V2}
\coordinate (V label) at (V2);
\sankeyadvance{V2}{10mm}
\sankeyend{V2}

\sankeyturnleft{H+GHD}{90}
\sankeyadvance{H+GHD}{5mm}
\sankeyfork{H+GHD}{47.0/GHD,88.1/H}

\sankeyturnright{H}{90}
\sankeynode{as=H,name=H2,at=H|-In label}
\sankeyoutin{H}{H2}
\coordinate (H label) at (H2);
\sankeyadvance{H2}{10mm}
\sankeyend{H2}

\sankeyadvance{GHD}{30mm}
\sankeyturnright{GHD}{90}
\sankeynode{as=GHD,name=GHD2,at=GHD|-In label}
\sankeyoutin{GHD}{GHD2}
\coordinate (GHD label) at (GHD2);
\sankeyadvance{GHD2}{10mm}
\sankeyend{GHD2}
\end{sankeydiagram}

% labels
\tikzset{
  label/.style={
    fill=white,fill opacity=.8,text opacity=1,
    inner sep=1mm,
    text=cyan!50!blue!50!black,
    inner xsep=2mm,
    font=\sffamily\bfseries\footnotesize,
    align=center,
  },
}
\node[label,anchor=north] (B label) at (B label) {7.2};
\node[label,left=1mm of B label] {Bestands-\entnahme};
\node[label,anchor=north] at (GI label) {137.3};
\node[label,above=5mm of GI label] {Gewinnung\im Inland};
\node[label,anchor=north] at (I label) {397.8};
\node[label,above=5mm of I label] {Import};

\node[label] at (EI label) {542.3\ ENERGIEAUFKOMMEN IM INLAND};

```

```

\node[label,anchor=center] (EB label) at (EB label) {63.1};
\node[label,above=1mm of EB label] {Export und\\Bunkerung};

\node[label] at (P label) {479.2\\Primärenergieverbrauch};

\node[label,anchor=center] (NV label) at (NV label) {33.5};
\node[label,above=0mm of NV label] {Nichtenergetischer Verbrauch};

\node[label,anchor=center] (U label) at (U label) {118.1};
\node[label,below=3mm of U label] {Umwandlungsverluste};

\node[label,anchor=center] (SD label) at (SD label) {0.4};
\node[label,above=0mm of SD label] {Statistische\\Differenzen};

\node[label,anchor=center] (VE label) at (VE label) {18.8};
\node[label,below=0mm of VE label] {Verbrauch in den\\Energiesktoren};

\node[label,anchor=north] (E label) at (E label)
{308.4\\Endenergieverbrauch};

\node[label,anchor=north] (In label) at (In label) {86.1};
\node[label,anchor=north,below=1cm of In label] {Industrie};

\node[label,anchor=north] (V label) at (V label) {87.2};
\node[label,anchor=north,below=1cm of V label] {Verkehr};

\node[label,anchor=north] (H label) at (H label) {88.1};
\node[label,anchor=north,below=1cm of H label] {Haushalte};

\node[label,anchor=north] (GHD label) at (GHD label) {47.0};
\node[label,anchor=north,below=1cm of GHD label]
{Gewerbe, Handel\\Dienstleistungen};
\end{tikzpicture}

```

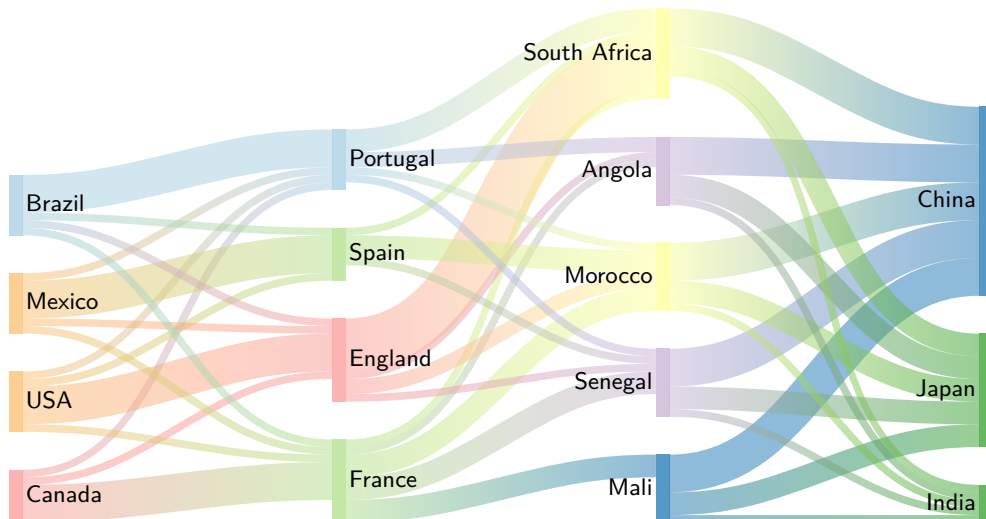


Figure 4: Reproduction of an example from Google Charts documentation

11 Reproduction of an example from Google Charts documentation

This example is a reproduction of an example of Google Charts Documentation⁴.

See figure 4. The `sankey-example3.tex` file contains the following code and is an attachment of the current PDF document.

```

\begin{tikzpicture}
  \begin{sankeydiagram} %[debug]
    \sffamily
    \sankeyset{
      ratio=1cm/10,
      outin steps=2,
      draw/.style={draw=none,line width=0pt},
      color/.style={fill/.style={fill=#1,fill opacity=.75}},
      shade/.style 2 args={fill/.style={left color=#1,
        right color=#2,fill opacity=.5}},
      % colors
      @define HTML color/.code args={#1/#2}{\definecolor{#1}{HTML}{#2}},
      @define HTML color/.list={
        cyan/a6cee3,lime/b2df8a,red/fb9a99,orange/fdbf6f,
        violet/cab2d6,yellow/ffff99,blue/1f78b4,green/33a02c
      },
      % colors of countries
      @let country color/.code args={#1/#2}{\colorlet{#1}[rgb]{#2}},
      @let country color/.list={
        CA/red,US/orange,MX/orange,BR/cyan,FR/lime,GB/red,
        SP/lime,PT/cyan,ML/blue,SN/violet,MA/yellow,
        AO/violet,ZA/yellow,IN/green,JP/green,CN/blue
      },
    }
    \def\vdist{5mm}
    \def\hwidth{.5em}
    \def\hdist{4.1cm}

    \sankeynode{name=CA,quantity=7}
    \sankeynode{name=US,quantity=8,at={ [yshift=\vdist] CA.left },anchor=right}
    \sankeynode{name=MX,quantity=8,at={ [yshift=\vdist] US.left },anchor=right}
    \sankeynode{name=BR,quantity=8,at={ [yshift=\vdist] MX.left },anchor=right}

    \foreach \country in {CA,US,MX,BR}{
      \sankeyadvance[color=\country]{\country}{\hwidth}
    }
  \end{sankeydiagram}
\end{tikzpicture}

```

⁴<https://developers.google.com/chart/interactive/docs/gallery/sankey>


```

\sankeyfork{CA}{1/CA-to-PT,1/CA-to-GB,5/CA-to-FR}
\sankeyfork{US}{1/US-to-PT,1/US-to-SP,5/US-to-GB,1/US-to-FR}
\sankeyfork{MX}{1/MX-to-PT,5/MX-to-SP,1/MX-to-GB,1/MX-to-FR}
\sankeyfork{BR}{5/BR-to-PT,1/BR-to-SP,1/BR-to-GB,1/BR-to-FR}

\sankeynode{name=FR,quantity=11,
  at={ [xshift=\hdist]CA.right},anchor=right}
\sankeynode{name=GB,quantity=11,
  at={ [yshift=\vdist]FR.left},anchor=right}
\sankeynode{name=SP,quantity=7,
  at={ [yshift=\vdist]GB.left},anchor=right}
\sankeynode{name=PT,quantity=8,
  at={ [yshift=\vdist]SP.left},anchor=right}

\sankeyfork{FR}
{1/FR-from-BR,1/FR-from-MX,1/FR-from-US,5/FR-from-CA,3/FR-from-00}
\sankeyfork{GB}
{1/GB-from-BR,1/GB-from-MX,5/GB-from-US,1/GB-from-CA,3/GB-from-00}
\sankeyfork{SP}{1/SP-from-BR,5/SP-from-MX,1/SP-from-US}
\sankeyfork{PT}{5/PT-from-BR,1/PT-from-MX,1/PT-from-US,1/PT-from-CA}

\foreach \country in {FR,GB,SP,PT}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

\sankeyfork{FR}{1/FR-to-ZA,1/FR-to-AO,3/FR-to-MA,3/FR-to-SN,3/FR-to-ML}
\sankeyfork{GB}{7/GB-to-ZA,1/GB-to-AO,2/GB-to-MA,1/GB-to-SN}
\sankeyfork{SP}{1/SP-to-ZA,3/SP-to-MA,1/SP-to-SN,2/SP-to-00}
\sankeyfork{PT}{3/PT-to-ZA,2/PT-to-AO,1/PT-to-MA,1/PT-to-SN,1/PT-to-00}

\sankeynode{name=ML,quantity=9,
  at={ [xshift=\hdist]FR.right},anchor=right}
\sankeynode{name=SN,quantity=9,
  at={ [yshift=\vdist]ML.left},anchor=right}
\sankeynode{name=MA,quantity=9,
  at={ [yshift=\vdist]SN.left},anchor=right}
\sankeynode{name=AO,quantity=9,
  at={ [yshift=\vdist]MA.left},anchor=right}
\sankeynode{name=ZA,quantity=12,
  at={ [yshift=\vdist]AO.left},anchor=right}

\sankeyfork{ML}{3/ML-from-FR,6/Mail-from-00}
\sankeyfork{SN}
{1/SN-from-PT,1/SN-from-SP,1/SN-from-GB,3/SN-from-FR,3/SN-from-00}
\sankeyfork{MA}{1/MA-from-PT,3/MA-from-SP,2/MA-from-GB,3/MA-from-FR}
\sankeyfork{AO}{2/AO-from-PT,1/AO-from-GB,1/AO-from-FR,5/AO-from-00}
\sankeyfork{ZA}{3/ZA-from-PT,1/ZA-from-SP,7/ZA-from-GB,1/ZA-from-FR}

\foreach \country in {ML,SN,MA,AO,ZA}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

\sankeyfork{ML}{5/ML-to-CN,3/ML-to-JP,1/ML-to-IN}
\sankeyfork{SN}{5/SN-to-CN,3/SN-to-JP,1/SN-to-IN}
\sankeyfork{MA}{5/MA-to-CN,3/MA-to-JP,1/MA-to-IN}
\sankeyfork{AO}{5/AO-to-CN,3/AO-to-JP,1/AO-to-IN}
\sankeyfork{ZA}{5/ZA-to-CN,3/ZA-to-JP,1/ZA-to-IN,3/ZA-to-00}

\sankeynode{name=IN,quantity=5,
  at={ [xshift=\hdist]ML.right},anchor=right}
\sankeynode{name=JP,quantity=15,
  at={ [yshift=\vdist]IN.left},anchor=right}
\sankeynode{name=CN,quantity=25,
  at={ [yshift=\vdist]JP.left},anchor=right}

\sankeyfork{IN}
{1/IN-from-ZA,1/IN-from-AO,1/IN-from-MA,1/IN-from-SN,1/IN-from-ML}
\sankeyfork{JP}
{3/JP-from-ZA,3/JP-from-AO,3/JP-from-MA,3/JP-from-SN,3/JP-from-ML}

```

```

\sankeyfork{CN}
{5/CN-from-ZA,5/CN-from-AO,5/CN-from-MA,5/CN-from-SN,5/CN-from-ML}

\foreach \country in {IN,JP,CN}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

\foreach \startcountry/\countries in {
  CA/{PT,GB,FR},    US/{PT,SP,GB,FR},    MX/{PT,SP,GB,FR},
  BR/{PT,SP,GB,FR}, FR/{ML,SN,MA,AO,ZA}, GB/{SN,MA,AO,ZA},
  SP/{SN,MA,ZA},    PT/{SN,MA,AO,ZA},    ML/{IN,JP,CN},
  SN/{IN,JP,CN},    MA/{IN,JP,CN},    AO/{IN,JP,CN},
  ZA/{IN,JP,CN}}
{
  \foreach \endcountry in \countries {
    \sankeyoutin[shade={\startcountry}]{\endcountry}
    {\startcountry-to-\endcountry}{\endcountry-from-\startcountry}
  }
}

\foreach \country/\countryname in {CA/Canada, US/USA, MX/Mexico,
BR/Brazil, FR/France, GB/England, SP/Spain, PT/Portugal}
{
  \node[anchor=west,inner sep=.1em,font=\small]
  at (\country) {\countryname\phantom{Ag}};
}

\foreach \country/\countryname in {
  ML/Mali, SN/Senegal, MA/Morocco, AO/Angola,
  ZA/South Africa, IN/India, JP/Japan, CN/China}
{
  \node[anchor=east,inner sep=.1em,font=\small]
  at (\country-old) {\countryname\phantom{Ag}};
}
\end{sankeydiagram}
\end{tikzpicture}

```

11.1 Variation

Here is a variation of the previous example using the `rotate` key.

See figure 5 on the next page. The `sankey-example3-variation.tex` file contains the following code and is an attachment of the current PDF document.

```

\begin{tikzpicture}[rotate=-90]
  \begin{sankeydiagram}[rotate=-90]
    \sffamily
    \sankeyset{
      ratio=1.7cm/10,
      outin steps=2,
      start style=arrow,
      end style=simple,
      draw/.style={draw=white,line width=.4pt},
      color/.style={fill/.style={fill=#1,fill opacity=.75}},
      shade/.style 2 args={fill/.style={
        fill=none,line width=0,
        top color=#1,bottom color=#2,
        middle color=#1!50!#2!50!white,
        fill opacity=.75}},
      % colors
      @define HTML color/.code args={#1/#2}{\definecolor{#1}{HTML}{#2}},
      @define HTML color/.list={
        cyan/a6cee3,lime/b2df8a,red/fb9a99,orange/fdbf6f,
        violet/cab2d6,yellow/ffff99,blue/1f78b4,green/33a02c
      },
      % colors of countries
      @let country color/.code args={#1/#2}{\colorlet{#1}[rgb]{#2}},
      @let country color/.list={
        CA/red,US/orange,MX/lime,BR/violet,FR/yellow,GB/blue,

```

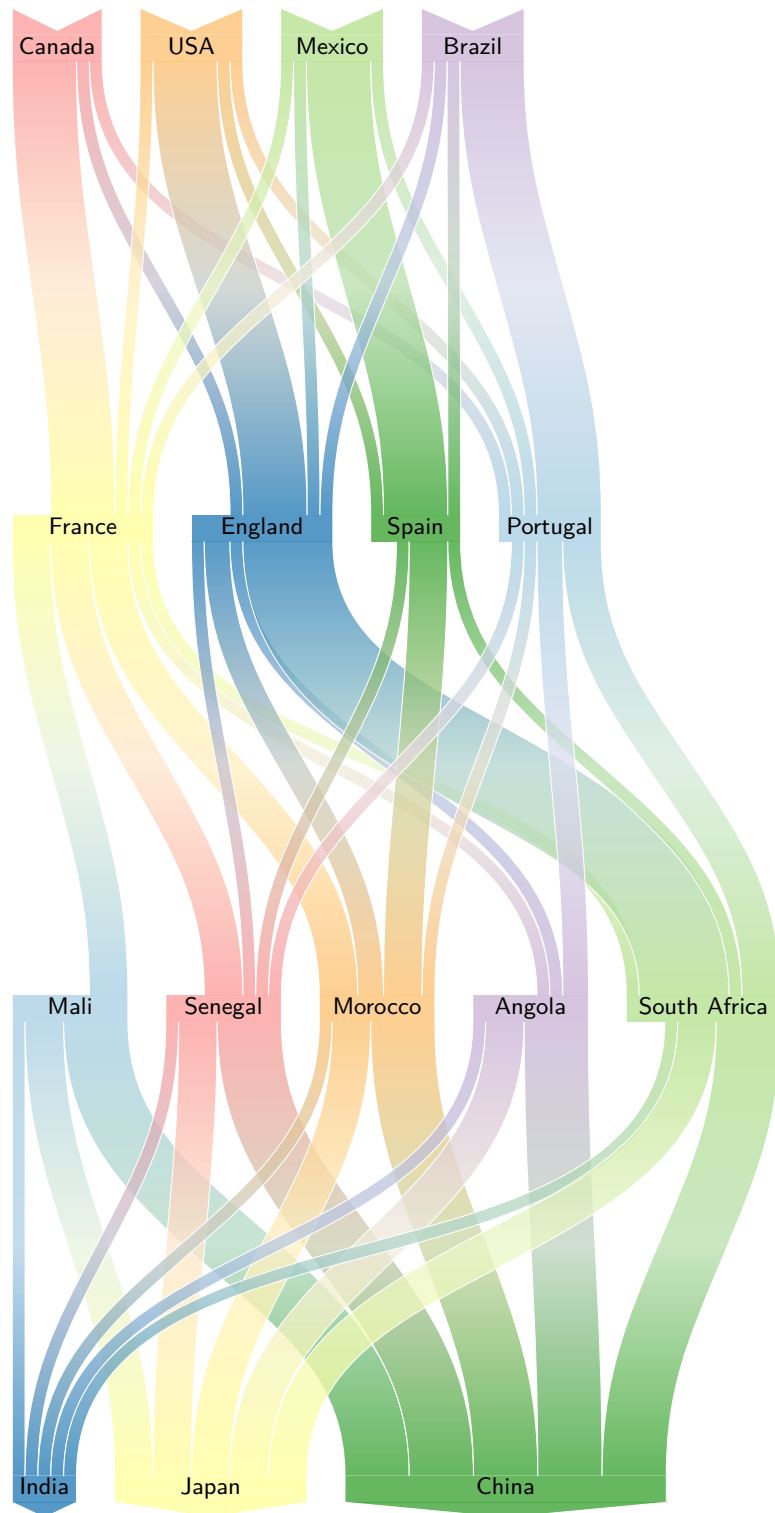


Figure 5: Reproduction of an example from Google Charts documentation – variation using the `rotate` key.

```

    SP/green,PT/cyan,ML/cyan,SN/red,MA/orange,
    AO/violet,ZA/lime,IN/blue,JP/yellow,CN/green
  },
}
\def\vdist{5mm}
\def\hwidth{1em}
\def\hdist{6cm}

\sankeynode{name=CA,quantity=7}
\sankeynode{name=US,quantity=8,at={ [yshift=\vdist]CA.left},anchor=right}
\sankeynode{name=MX,quantity=8,at={ [yshift=\vdist]US.left},anchor=right}
\sankeynode{name=BR,quantity=8,at={ [yshift=\vdist]MX.left},anchor=right}

\foreach \country in {CA,US,MX,BR}{
  \sankeystart[color=\country]{\country}
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

\sankeyfork{CA}{1/CA-to-PT,1/CA-to-GB,5/CA-to-FR}
\sankeyfork{US}{1/US-to-PT,1/US-to-SP,5/US-to-GB,1/US-to-FR}
\sankeyfork{MX}{1/MX-to-PT,5/MX-to-SP,1/MX-to-GB,1/MX-to-FR}
\sankeyfork{BR}{5/BR-to-PT,1/BR-to-SP,1/BR-to-GB,1/BR-to-FR}

\sankeynode{name=FR,quantity=11,
  at={ [xshift=\hdist]CA.right},anchor=right}
\sankeynode{name=GB,quantity=11,
  at={ [yshift=\vdist]FR.left},anchor=right}
\sankeynode{name=SP,quantity=7,
  at={ [yshift=\vdist]GB.left},anchor=right}
\sankeynode{name=PT,quantity=8,
  at={ [yshift=\vdist]SP.left},anchor=right}

\sankeyfork{FR}
{1/FR-from-BR,1/FR-from-MX,1/FR-from-US,5/FR-from-CA,3/FR-from-00}
\sankeyfork{GB}
{1/GB-from-BR,1/GB-from-MX,5/GB-from-US,1/GB-from-CA,3/GB-from-00}
\sankeyfork{SP}{1/SP-from-BR,5/SP-from-MX,1/SP-from-US}
\sankeyfork{PT}{5/PT-from-BR,1/PT-from-MX,1/PT-from-US,1/PT-from-CA}

\foreach \country in {FR,GB,SP,PT}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

\sankeyfork{FR}{1/FR-to-ZA,1/FR-to-AO,3/FR-to-MA,3/FR-to-SN,3/FR-to-ML}
\sankeyfork{GB}{7/GB-to-ZA,1/GB-to-AO,2/GB-to-MA,1/GB-to-SN}
\sankeyfork{SP}{1/SP-to-ZA,3/SP-to-MA,1/SP-to-SN,2/SP-to-00}
\sankeyfork{PT}{3/PT-to-ZA,2/PT-to-AO,1/PT-to-MA,1/PT-to-SN,1/PT-to-00}

\sankeynode{name=ML,quantity=9,
  at={ [xshift=\hdist]FR.right},anchor=right}
\sankeynode{name=SN,quantity=9,
  at={ [yshift=\vdist]ML.left},anchor=right}
\sankeynode{name=MA,quantity=9,
  at={ [yshift=\vdist]SN.left},anchor=right}
\sankeynode{name=AO,quantity=9,
  at={ [yshift=\vdist]MA.left},anchor=right}
\sankeynode{name=ZA,quantity=12,
  at={ [yshift=\vdist]AO.left},anchor=right}

\sankeyfork{ML}{3/ML-from-FR,6/ML-from-00}
\sankeyfork{SN}
{1/SN-from-PT,1/SN-from-SP,1/SN-from-GB,3/SN-from-FR,3/SN-from-00}
\sankeyfork{MA}{1/MA-from-PT,3/MA-from-SP,2/MA-from-GB,3/MA-from-FR}
\sankeyfork{AO}{2/AO-from-PT,1/AO-from-GB,1/AO-from-FR,5/AO-from-00}
\sankeyfork{ZA}{3/ZA-from-PT,1/ZA-from-SP,7/ZA-from-GB,1/ZA-from-FR}

\foreach \country in {ML,SN,MA,AO,ZA}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
}

```

```

\sankeyfork{ML}{5/ML-to-CN,3/ML-to-JP,1/ML-to-IN}
\sankeyfork{SN}{5/SN-to-CN,3/SN-to-JP,1/SN-to-IN}
\sankeyfork{MA}{5/MA-to-CN,3/MA-to-JP,1/MA-to-IN}
\sankeyfork{AO}{5/AO-to-CN,3/AO-to-JP,1/AO-to-IN}
\sankeyfork{ZA}{5/ZA-to-CN,3/ZA-to-JP,1/ZA-to-IN,3/ZA-to-00}

\sankeynode{name=IN,quantity=5,
  at={ [xshift=\hdist]ML.right},anchor=right}
\sankeynode{name=JP,quantity=15,
  at={ [yshift=\vdist]IN.left},anchor=right}
\sankeynode{name=CN,quantity=25,
  at={ [yshift=\vdist]JP.left},anchor=right}

\sankeyfork{IN}
{1/IN-from-ZA,1/IN-from-AO,1/IN-from-MA,1/IN-from-SN,1/IN-from-ML}
\sankeyfork{JP}
{3/JP-from-ZA,3/JP-from-AO,3/JP-from-MA,3/JP-from-SN,3/JP-from-ML}
\sankeyfork{CN}
{5/CN-from-ZA,5/CN-from-AO,5/CN-from-MA,5/CN-from-SN,5/CN-from-ML}

\foreach \country in {IN,JP,CN}{
  \sankeyadvance[color=\country]{\country}{\hwidth}
  \sankeyend[color=\country]{\country}
}

\foreach \startcountry/\countries in {
  CA/{PT,GB,FR},    US/{PT,SP,GB,FR},    MX/{PT,SP,GB,FR},
  BR/{PT,SP,GB,FR}, FR/{ML,SN,MA,AO,ZA}, GB/{SN,MA,AO,ZA},
  SP/{SN,MA,ZA},   PT/{SN,MA,AO,ZA},    ML/{IN,JP,CN},
  SN/{IN,JP,CN},  MA/{IN,JP,CN},    AO/{IN,JP,CN},
  ZA/{IN,JP,CN}}
{
  \foreach \endcountry in \countries {
    \sankeyoutin[shade={\startcountry}{\endcountry}]
    {\startcountry-to-\endcountry}{\endcountry-from-\startcountry}
  }
}

\foreach \country/\countryname in {CA/Canada, US/USA, MX/Mexico,
  BR/Brazil, FR/France, GB/England, SP/Spain, PT/Portugal}
{
  \node[anchor=south,inner sep=.1em,font=\small]
  at (\country) {\countryname\vphantom{Ag}};
}

\foreach \country/\countryname in {
  ML/Mali, SN/Senegal, MA/Morocco, AO/Angola,
  ZA/South Africa, IN/India, JP/Japan, CN/China}
{
  \node[anchor=south,inner sep=.1em,font=\small]
  at (\country) {\countryname\vphantom{Ag}};
}
\end{sankeydiagram}
\end{tikzpicture}

```

12 Very nice example – Nadieh Bremer creation

Graphic designer Nadieh Bremer created this very nice Sankey diagram⁵ for Adyen's second half 2018 report to shareholders. It is coded here with her kind permission.

You can change the data values between lines 28 and 53.

See figure 6 on the following page. The `sankey-example4.tex` file contains the following code and is an attachment of the current PDF document.

```
1 \begin{tikzpicture}
2   \renewcommand*\sfdefault{txss}
3   \sffamily
4   \sisetup{
5     detect-all=true,
6     group-separator={,},
7     group-minimum-digits=4,
8   }
9   % storage of labels
10  \newcommand\LabSet[2]{% node name, label
11    \expandafter\edef\csname#1@Lab\endcsname{#2}}
12  \newcommand\Lab[1]{% node name
13    \csname#1@Lab\endcsname}
14  % storage of quantities
15  \newcommand\QtySet[2]{% node name, quantity
16    \expandafter\edef\csname#1@Qty\endcsname{\fpeval{#2}}}
17  \newcommand\Qty[1]{% node name
18    \csname#1@Qty\endcsname}
19  % all nodes with their name, label and quantity
20  \sankeyset{
21    def data/.code args={#1/#2/#3}{% node name/label/values
22      \LabSet{#1}{#2}
23      \QtySet{#1}{#3}
24      \typeout{#1: \Qty{#1}€ (\Lab{#1})}
25    },
26    def data/.list={
27      {Pf/Processing\fees/71713},
28      {Sog/Sales of\good/4547},
29      {Sf/Settlement\fees/842075},
30      {Os/Other\services/37532},
31      {R/Revenues/\Qty{Pf}+\Qty{Sog}+\Qty{Sf}+\Qty{Os}},
32      {Coi/Cost of Inventory/5151},
33      {Ciffi/Cost insecure from financial institutions/758234},
34      {Nr/Net revenue/\Qty{R}-\Qty{Coi}-\Qty{Ciffi}},
35      {Aadotaifa/Amortization and\depreciation of tangible and\
36        intangible fixed assets/4688},
37      {Ssapc/Social securities and\pension costs/7860},
38      {Was/Wages and salaries/35627},
39      {Ooe/Other operating expenses/37346},
40      {Nr2/-/\Qty{Nr}-\Qty{Aadotaifa}-\Qty{Ssapc}-\Qty{Was}-\Qty{Ooe}},
41      {Oi/Other income/47},
42      {Ibiieait/Income before interest income,\interest expense and
43        income taxes/\Qty{Nr2}+\Qty{Oi}},
44      {Fe/Finance expense/561},
45      {Ofr/Other financial results/2533},
46      {Ibiieait2/-/\Qty{Ibiieait}-\Qty{Fe}-\Qty{Ofr}},
47      {Fi/Finance income/204},
48      {Ibit/Income before income taxes/\Qty{Ibiieait2}+\Qty{Fi}},
49      {It/Income taxes/21134},
50      {Niftp/Net income for the period/\Qty{Ibit}-\Qty{It}},
51      {Octa/Other currency\translation adjustments/785},
52      {Tci/Total comprehensive income/\Qty{Niftp}+\Qty{Octa}}
53    },
54  }
55
56  \definecolor{mygreen}{RGB}{9,192,82}
57  \tikzset{
58    cost node/.style={
```

⁵<https://www.visualcinnamon.com/portfolio/adyen-report-2019/>

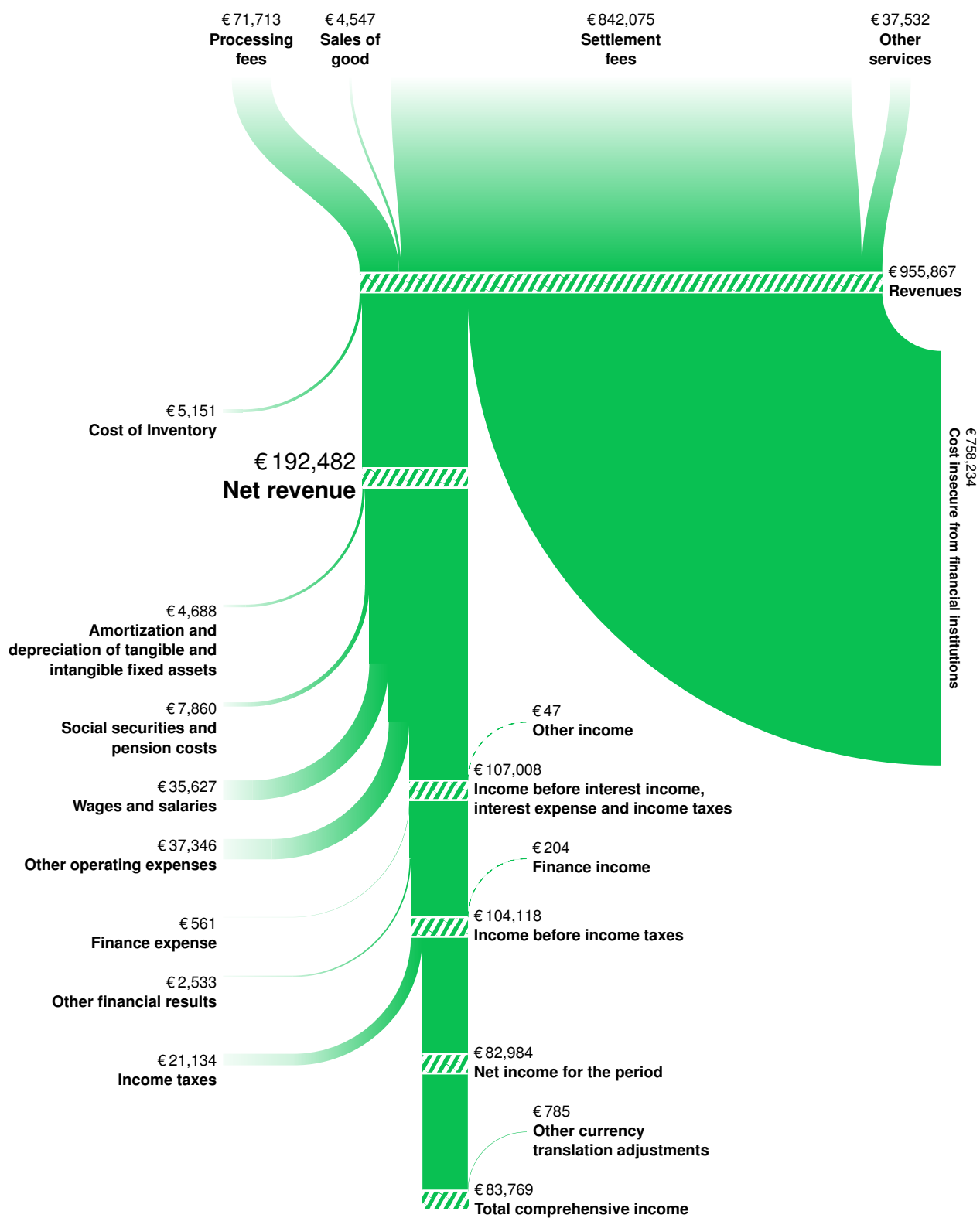


Figure 6: Very nice example – Nadieh Bremer’s creation (from [Adyen’s Shareholder Report](#))

```

59     overlay,
60     align=flush center,
61     node font=\footnotesize\sffamily\bfseries,
62     inner sep=0,
63     node contents={%
64         {\mdseries€\,\num{\Qty{#1}}}\
65         \Lab{#1}\vphantom{g}%
66     },
67 },
68 white hash/.style={
69     draw=none,fill=none,
70     pattern={Lines[angle=60,line width=2pt,distance=4pt]},
71     pattern color=white,
72 },
73 line sep/.style={draw=white,line width=1pt},
74 left label/.style={left=#1,align=flush right,anchor=north east},
75 right label/.style={right=#1,align=flush left},
76 right label hashed/.style={
77     right=1mm of $(#1.left)!.5!(#1-old.left)$,align=flush left,
78 },
79 left label hashed/.style={
80     left=1mm of $(#1.right)!.5!(#1-old.right)$,align=flush right,
81 },
82 }
83
84 \newcommand\turnandstop[1]{
85     \sankeyturn[green to greenwhite]{#1}{-90}
86     \sankeynode{as=#1,name=#1-e,at={#1 -| Coi}}
87     \sankeyoutin[greenwhite to white]{#1}{#1-e}
88     \node[cost node=#1,left label={1mm of #1-e.right}];
89 }
90
91 \begin{sankeydiagram}%[debug]
92     \sankeyset{
93         ratio=28em/1000000,
94         minimum radius=2cm,
95         start style=none,
96         every node/.style={angle=-90},
97         % default fill and draw styles
98         fill/.style={
99             line width=0pt,
100            fill=mygreen,
101        },
102        draw/.style={draw=none},
103        % specific fill and draw styles
104        green to greenwhite/.style={
105            fill/.style={
106                line width=0pt,
107                right color=mygreen,
108                left color=mygreen!20!white,
109            }
110        },
111        greenwhite to white/.style={
112            fill/.style={
113                line width=0pt,
114                right color=mygreen!20!white,
115                left color=mygreen!5!white,
116            }
117        },
118        dashed/.style={draw/.style={draw=mygreen,dashed}},
119    }
120
121     \coordinate (top) at (0,2em);
122
123     \sankeynodestart{name=Pf,quantity=\Qty{Pf}}
124     \node[cost node=Pf,above=.5em of Pf.center];
125
126     \sankeynodestart{name=Sog,quantity=\Qty{Sog},
127         at={[xshift=4em]Pf.left},anchor=right}

```



```

128 \node[cost node=Sog,above=.5em of Sog.center];
129
130 \sankeynodestart{name=Sf,quantity=\Qty{Sf},
131 at={[xshift=2em]Sog.left},anchor=right}
132 \node[cost node=Sf,above=.5em of Sf.center];
133
134 \sankeynodestart{name=Os,quantity=\Qty{Os},
135 at={[xshift=2em]Sf.left},anchor=right}
136 \node[cost node=Os,above=.5em of Os.center];
137
138 \sankeynode{
139 name=R,quantity=\Qty{R},at={[yshift=-10em]Sf.center},
140 forked={\Qty{Os}/Os-a,\Qty{Sf}/Sf-a,\Qty{Sog}/Sog-a,\Qty{Pf}/Pf-a},
141 }
142
143 \foreach \nodename in {Pf,Sog,Sf,Os}{
144 \sankeyoutin[fill/.style={top color=white,bottom color=mygreen}]
145 {\nodename}{\nodename-a}
146 }
147
148 \sankeyadvance{R}{1em}
149 \node[cost node=R,right label hashed=R];
150
151 \sankeyfork{R}{\Qty{Ciffi}/Ciffi,\Qty{Nr}/Nr,\Qty{Coi}/Coi}
152
153 \sankeyturnleft[minimum radius=1.cm]{Ciffi}{90}
154 \node[cost node=Ciffi,at={([shift={(1mm,0)}]Ciffi.center)},rotate=-90,
155 anchor=south,align=flush left,node font=\scriptsize\sffamily\bfseries];
156
157 \sankeyturnright[green to greenwhite]{Coi}{90}
158 \sankeyadvance[greenwhite to white]{Coi}{1em}
159 \node[cost node=Coi,left={1mm of [yshift=.75ex]Coi.left},
160 align=flush right,anchor=north east,overlay];
161
162 \sankeyadvance{Nr}{9em}
163 \sankeyadvance{Nr}{1em}
164 \node[cost node=Nr,left label hashed=Nr,
165 node font=\large\sffamily\bfseries];
166
167 \sankeyfork{Nr}{\Qty{Nr2}/Nr2,\Qty{Ooe}/Ooe,
168 \Qty{Was}/Was,\Qty{Ssapc}/Ssapc,\Qty{Aadotaifa}/Aadotaifa}
169
170 \turnandstop{Aadotaifa}
171
172 \sankeyadvance{Ssapc}{5em}
173 \turnandstop{Ssapc}
174
175 \sankeyadvance{Was}{9em}
176 \turnandstop{Was}
177
178 \sankeyadvance{Ooe}{12em}
179 \turnandstop{Ooe}
180
181 \sankeyadvance{Nr2}{15em}
182 \sankeynode{name=Ibiieait,quantity=\Qty{Ibiieait},
183 anchor=right,at={Nr2.right},
184 forked={\Qty{Oi}/Oi,\Qty{Nr2}/Nr2-e}}
185
186 \sankeyturnleftbackward[minimum radius=1cm,dashed]{Oi}{90}
187 \node[cost node=Oi,right label=1mm of Oi.left];
188
189 \sankeyadvance{Ibiieait}{1em}
190 \node[cost node=Ibiieait,right label hashed=Ibiieait];
191
192 \sankeyfork{Ibiieait}
193 {\Qty{Ibiieait2}/Ibiieait2,\Qty{Ofr}/Ofr,\Qty{Fe}/Fe}
194
195 \turnandstop{Fe}
196

```

```

197 \sankeyadvance{0fr}{3em}
198 \turnandstop{0fr}
199
200 \sankeyadvance{Ibiiieait2}{6em}
201 \sankeynode{name=Ibit,quantity={\Qty{Ibiiieait2}+\Qty{Fi}},
202   anchor=right,at={Ibiiieait2.right},
203   forked={\Qty{Fi}/Fi,\Qty{Ibiiieait2}/Ibiiieait2-e}}
204
205 \sankeyturnleftbackward[minimum radius=1cm,dashed]{Fi}{90}
206 \node[cost node=Fi,right label=1mm of Fi.left];
207
208 \sankeyadvance{Ibit}{1em}
209 \node[cost node=Ibit,right label hashed=Ibit];
210
211 \sankeyfork{Ibit}{\Qty{Niftp}/Niftp,\Qty{It}/It}
212
213 \turnandstop{It}
214
215 \sankeyadvance{Niftp}{6em}
216
217 \sankeyadvance{Niftp}{1em}
218 \node[cost node=Niftp,right label hashed=Niftp];
219
220 \sankeynode{name=Tci,quantity=\Qty{Niftp}+\Qty{Octa},
221   anchor=right,at={[yshift=-6em]Niftp.right},
222   forked={\Qty{Octa}/Octa,\Qty{Niftp}/Niftp-e}}
223 \sankeyoutin{Niftp}{Niftp-e}
224
225 \sankeyturnleftbackward[minimum radius=1cm]{Octa}{90}
226 \node[cost node=Octa,right label=1mm of Octa.left];
227
228 \sankeyadvance{Tci}{1em}
229 \node[cost node=Tci,right label hashed=Tci];
230
231 \newcommand\hashband[1]{
232   \draw[line sep] (#1-old.right) -- (#1-old.left);
233   \draw[line sep] (#1.right) -- (#1.left);
234   \path[white hash] (#1-old.right) rectangle (#1.left);
235 }
236
237 \foreach \nodename in {R,Nr,Nr,Ibiiieait,Ibit,Niftp,Tci}{
238   \hashband{\nodename}
239 }
240
241 \end{sankeydiagram}
242 \end{tikzpicture}

```

This manual contains three parts: [User manual](#) (p.1), [Examples](#) (p.22) and [Installation & Implementation](#) (p.43).

Part III

Installation & Implementation

Contents

13 Compiling sankey	43
14 The sankey.sty file	44
14.1 Fields	44
14.1.1 Definition of <i>global</i> and <i>expanded</i> fields (using <code>\xdef</code>)	44
14.1.2 Definitions of <i>local</i> fields (using <code>\def</code>)	45
14.1.3 Check if a sankey node is defined	45
14.2 The sankey node shape	45
14.3 Keys	46
14.3.1 Keys to define the scale	46
14.3.2 Rotate offset	46
14.3.3 Minimum radius	46
14.3.4 Outin step	46
14.3.5 Sankey debug	47
14.3.6 Start and end styles	47
14.3.7 Initial parameters	48
14.3.8 Sankey node parameters	48
14.3.9 Internal Tikz style	50
14.4 The sankeydiagram environment	50
14.5 Internal macros	50
14.6 User macros	53
14.7 The sankeydiagram environment (the end)	59
14.8 Predefined start and end styles	60
15 tikzlibrarydubins.code.tex	61
16 Change History	66
17 Index	67

13 Compiling sankey

To produce the `sankey` package:

```
pdflatex sankey.ins # or 'latex sankey.ins'
```

To finish the installation you have to move the `tikzlibrarydubins.code.tex` and `sankey.sty` files into a directory searched by L^AT_EX.

To compile the `sankey` documentation (the `sankey.pdf` file):

```
pdflatex sankey.dtx
makeindex -s gind.ist -o sankey.ind sankey.idx
pdflatex sankey.dtx
makeindex -s gind.ist -o sankey.ind sankey.idx
pdflatex sankey.dtx
pdflatex sankey.dtx
```

14 The `sankey.sty` file

Poorly commented source code...

Version information:

```
1 \NeedsTeXFormat{LaTeX2e}[2015/10/01]
2 \ProvidesPackage{sankey}[2022/02/04 v3.0.1 to draw Sankey diagrams]
```

All required packages and TikZ libraries:

```
3 \RequirePackage{xparse}
4 \RequirePackage{etoolbox}
5 \RequirePackage{xfp}
6 \RequirePackage{tikz}
7 \usetikzlibrary{
8   calc,
9   decorations.markings,
10  dubins
11 }
```

Declarations of PGF layers (to debug Sankey diagrams):

```
12 %% add a new layer to debug sankey diagrams
13 \pgfdeclarelayer{background}
14 \pgfdeclarelayer{foreground}
15 \pgfdeclarelayer{sankeydebug}
16 \pgfsetlayers{background,main,foreground,sankeydebug}
```

14.1 Fields

`\snk@newfield` The `sankeynewfield` macro defines setter and getter macros for *key/value* pairs. It requires five parameters: the *def* macro used to store a new value, the *setter* macro name, the *getter* macro name, the *cs name* used by the new field (including a #1 parameter – the *key*) and the *error message* (used by the getter macro if the key is not defined).

The *setter* macro requires two parameters: the key and the value. The *getter* macro requires one parameter: the key.

```
17 \def\snk@newfield#1#2#3#4#5{
18   % setter
19   \def#2##1##2{\expandafter#1\csname #4\endcsname{##2}}
20   % getter
21   \def#3##1{%
22     \ifcsdef{#4}{%
23       \csname#4\endcsname%
24     }{%
25       \PackageError{sankey}{#5}{unknown key with \string#3}%
26     }%
27   }
28 }
```

14.1.1 Definition of *global* and *expanded* fields (using `\xdef`)

`\snk@setnodeqty` `\sankeygetnodeqty` The setter and getter macros to store and retrieve the *quantity* field associated with each Sankey node (the key is the name of the Sankey node).

```
29 \snk@newfield\xdef\snk@setnodeqty\sankeygetnodeqty%
30 {\snk@node@qty@#1}{Unknown sankey node '#1'}
```

`\snk@setnodeorient` `\sankeygetnodeorient` The setter and getter macros to store and retrieve the *angle* (or orientation) field associated with each Sankey node (the key is the name of the Sankey node).

```
31 \snk@newfield\xdef\snk@setnodeorient\sankeygetnodeorient%
32 {\snk@node@orient@#1}{Unknown sankey node '#1'}
```

14.1.2 Definitions of *local* fields (using `\def`)

`\snk@setstartfill` The setter and getter macros to store and retrieve the starting fill/draw paths (the key is the style name).

```
\snk@getstartfill
\snk@setstartdraw
\snk@getstartdraw 33 \snk@newfield\def\snk@setstartfill\snk@getstartfill%
34 {\snk@start@fill@#1}{Unknown sankey start fill path #1}
35
36 \snk@newfield\def\snk@setstartdraw\snk@getstartdraw%
37 {\snk@start@draw@#1}{Unknown sankey start draw path #1}
```

`\snk@setendfill` The setter and getter macros to store and retrieve the ending fill/draw paths (the key is the style name).

```
\snk@getendfill
\snk@setenddraw
\snk@getenddraw 38 \snk@newfield\def\snk@setendfill\snk@getendfill%
39 {\snk@end@fill@#1}{Unknown sankey end fill path #1}
40
41 \snk@newfield\def\snk@setenddraw\snk@getenddraw%
42 {\snk@end@draw@#1}{Unknown sankey end draw path #1}
```

14.1.3 Check if a sankey node is defined

`\snk@ifnodedefined` The `\snk@ifnodedefined` macro checks if a Sankey node is defined by checking if its name is associated to a *quantity*.

```
43 \newcommand\snk@ifnodedefined[3]{%
44 \ifcsdef{@snk@node@qty@#1}{#2}{#3}%
45 }
```

`\snk@errorifnotdefined` The `\snk@errorifnotdefined` macro generates an error message if the Sankey node is not defined.

```
46 \newcommand\snk@errorifnotdefined[1]{%
47 \snk@ifnodedefined{#1}{}%
48 {\PackageError{sankey}{Unknown sankey node '#1'}{}}%
49 }
```

14.2 The sankey node shape

A **sankey node** is defined as a TikZ node with a particular *shape*: its width is null and its height matches the associated *quantity*. This shape requires only three anchors: **center**, **left** and **right**. These three anchors are sufficient to use the **sankey** package. But the **fit** library needs anchors defined by rectangular node.

```
50 \pgfdeclareshape{sankey node}{
51 \inheritsavedanchors[from=rectangle]
52 \inheritanchor[from=rectangle]{center}
53 \inheritanchorborder[from=rectangle]
54 \anchor{left}{\pgf@process{\northeast}}
55 \anchor{right}{\pgf@process{\southwest}}
56 % compatibility with 'fit' library
57 \inheritanchor[from=rectangle]{west}
58 \inheritanchor[from=rectangle]{east}
59 \inheritanchor[from=rectangle]{north}
60 \inheritanchor[from=rectangle]{south}
61 \inheritanchor[from=rectangle]{north west}
62 \inheritanchor[from=rectangle]{south east}
63 \inheritanchor[from=rectangle]{north east}
64 \inheritanchor[from=rectangle]{south west}
65 }
```

14.3 Keys

`\sankeyset` The **sankey** package uses **pgfkeys** to set options via *key=value* pairs using the `/sankey` path (for Sankey diagram options) and using the `/sankey/node` parameters path (for Sankey node parameters).

The `\sankeyset` macro processes its parameter as a list of comma separated pairs of the form *key=value* with `/sankey` as default path.

```
66 \pgfkeys{/sankey/.is family}
67 \NewDocumentCommand\sankeyset{m}{\pgfkeys{sankey,#1}}
```

14.3.1 Keys to define the scale

`\snk@totalqty` The **ratio quantity**, **ratio length** and **ratio** keys define the ratio between *flow quantity* and *graphic length* (the scale). The `\snk@totalqty` and `\snk@totallen` macros store the values. All *quantities* are processed by `\fpeval` and all *lengths* are processed by `\pgfmath`.

```
68 \sankeyset{
69   ratio quantity/.code={\edef\snk@totalqty{\fpeval{#1}}},
70   ratio quantity/.value required,
71   ratio length/.code={
72     \pgfmathsetmacro\snk@totalen{#1}
73     \edef\snk@totalen{\snk@totalen pt}
74   },
75   ratio length/.value required,
76   ratio/.style args={#1/#2}{
77     ratio length=#1,
78     ratio quantity=#2,
79   },
80   ratio/.value required,
81 }
```

14.3.2 Rotate offset

`\snk@rotate` The **rotate** key stores an offset angle applied to all Sankey nodes. This is useful when using the **rotate** option within a **tikzpicture** or a **scope**. This TikZ option is only applied to coordinates and not to TikZ nodes (remember that Sankey nodes are TikZ nodes). It's up to the author to keep the **rotate** option of the **tikzpicture** and that of the **sankeydiagram** synchronous.

```
82 \sankeyset{
83   rotate/.code={\edef\snk@rotate{\fpeval{#1}}},
84   rotate/.value required,
85 }
```

14.3.3 Minimum radius

`\snk@minradius` The **minimum radius** key processes the minimum radius of curvature by `\pgfmath` then stores it in the `\snk@minradius` macro.

```
86 \sankeyset{
87   minimum radius/.code={
88     \pgfmathsetmacro\snk@minradius{#1}
89     \edef\snk@minradius{\snk@minradius pt}
90   },
91   minimum radius/.value required,
92 }
```

14.3.4 Outin step

`\snk@stepoutin` The **outin** key stores its value in the `\snk@stepoutin` macro.

```
93 \sankeyset{
94   outin steps/.estore in=\snk@stepoutin,
95   outon steps/.value required,
96 }
```

14.3.5 Sankey debug

The `debug` key drives the `sankey debug` toggle.

```
97 \newtoggle{sankey debug}
98 \sankeyset{
99   debug/.is choice,
100  debug/true/.code={\toggletrue{sankey debug}},
101  debug/false/.code={\togglefalse{sankey debug}},
102  debug/.default=true,
103 }
```

14.3.6 Start and end styles

`\snk@startstyle` The `start style` and `end style` keys are choices.
`\snk@endstyle`

The `new start style` and `new end style` keys add new option to these choices. They use the `startfill`, `startdraw` fields or the `endfill` and `enddraw` fields (using the style *name* as key) to store the fill and draw paths then create a new option to install the new start (`\snk@startstyle`) or end (`\snk@endstyle`) style.

```
104 \sankeyset{
105   start style/.is choice,
106   end style/.is choice,
107   % to define new start and end styles
108   new start style/.code n args={3}{% name, fill path, draw path
109     \snk@setstartfill{#1}{#2}
110     \snk@setstartdraw{#1}{#3}
111     \sankeyset{start style/#1/.code={\def\snk@startstyle{#1}}}
112   },
113   new end style/.code n args={3}{% name, fill path, draw path
114     \snk@setendfill{#1}{#2}
115     \snk@setenddraw{#1}{#3}
116     \sankeyset{end style/#1/.code={\def\snk@endstyle{#1}}}
117   },
118 }
```

14.3.7 Initial parameters

The `@initial options` style defines default values for options of Sankey diagram. The `every diagram` style (initially empty) allows the user to choose its own default values.

The `@initial options` and the `every diagram` styles are applied (in this order) at the beginning of each Sankey diagram.

```
119 \sankeyset{
120   debug color/.style={/utils/exec={\colorlet{debug color}{#1}}},
121   @initial options/.style={
122     ratio=1cm/10,
123     minimum radius=5mm,%
124     outin steps=10,
125     debug=false,
126     start style=none,
127     end style=none,
128     rotate=0,
129     % default fill/draw styles,
130     fill/.style={line width=0pt,fill=white},
131     draw/.style={draw=black,line width=.4pt},
132     % debug color used by all debug macros
133     debug color=red!75!black,
134     % debug line between left and right anchors
135     debug line/.style={overlay,draw=debug color,|-|},
136     % debug line between center and label
137     debug normal/.style={overlay,draw=debug color},
138     % debug node label
139     debug label/.style={
140       overlay,
141       draw,
142       font=\ttfamily\tiny,
143       text=debug color,text opacity=1,
144       inner sep=.1em,
145       fill=white,fill opacity=1,
146       rounded corners=.1em,
147       node contents={\name},
148     },
149     every node/.style={},
150   },
151   every diagram/.style={},
152 }
153
```

14.3.8 Sankey node parameters

The `/sankey/node parameters` family defines all parameters during creation of Sankey node.

```
154 \sankeyset{node parameters/.is family}
```

`\name` The `name`, `quantity`, `angle` and `at` keys use the `\name`, `\qty`, `\orient` and `\pos` macros to store the *name*, the *quantity*, the *orientation* (or *angle*) and the *position* of a Sankey node during its creation.

`\pos` The *quantity* is processed via `\fpeval`. The *orientation* is normalized.

```
155 \sankeyset{node parameters,
156   name/.estore in=\name,
157   name/.value required,
158   quantity/.code={\edef\qty{\fpeval{#1}}},
159   quantity/.value required,
160   angle/.code={\edef\orient{\snk@normalize@angle{#1}}},
161   angle/.value required,
162   at/.code={\snk@getpos\pos{#1}},
163   at/.value required,
164 }
```


The `as` key is just a shortcut to define the four current node parameters by copying them from an existing Sankey node.

```

165 \sankeyset{node parameters,
166   as/.style={
167     name=#1,
168     quantity=\sankeygetnodeqty{#1},
169     angle=\sankeygetnodeorient{#1},
170     at={#1.center},
171   },
172   as/.value required,
173 }

```

`\snk@anchor` The `anchor` key stores in the `\snk@anchor` macro the anchor name to use to create the new current Sankey node

```

174 \sankeyset{node parameters,
175   anchor/.is choice,
176   anchor/left/.code={\def\snk@anchor{left}},
177   anchor/right/.code={\def\snk@anchor{right}},
178   anchor/center/.code={\def\snk@anchor{center}},
179   anchor/.value required,
180 }

```

The `start` and `end` keys drive the `sankey node start` and `sankey node end` toggles.

```

181 \newtoggle{sankey node start}
182 \newtoggle{sankey node end}
183 \sankeyset{node parameters,
184   start/.is choice,
185   start/true/.code={\toggletrue{sankey node start}},
186   start/false/.code={\togglefalse{sankey node start}},
187   start/.default=true,
188   %
189   end/.is choice,
190   end/true/.code={\toggletrue{sankey node end}},
191   end/false/.code={\togglefalse{sankey node end}},
192   end/.default=true,
193 }

```

`\snk@listofforks` The `forked` and `fork anchor` keys store their value in the `\snk@listofforks` and `\snk@forkanchor` macros.

```

194 \sankeyset{node parameters,
195   forked/.estore in=\snk@listofforks,
196   forked/.value required,
197   fork anchor/.estore in=\snk@forkanchor,
198   fork anchor/.value required,
199 }

```

The `@initial parameters` style initialises all Sankey node parameters at the start of the creation of a new Sankey node.

```

200 \sankeyset{node parameters,
201   @initial parameters/.style={
202     start=false,
203     end=false,
204     forked=,
205     fork anchor=,
206     anchor=center,
207     at={0,0},
208     angle=0,
209   },
210 }

```

14.3.9 Internal Tikz style

To apply this style with Tikz, use absolute key name (`/sankey/@sankey node`). This style is used to create the Tikz node associated to a Sankey node.

```
211 \sankeyset{
212   % sankey node TikZ style
213   @sankey node/.style n args={3}{% name, pos, anchor
214     shape=sankey node,
215     inner sep=0,
216     minimum height={\sankeyqtytolen{\sankeygetnodeqty{#1}}},
217     minimum width=0,
218     draw=none,
219     line width=0pt,
220     fill=none,
221     node contents={},
222     rotate=\sankeygetnodeorient{#1}+\snk@rotate,
223     at={#2}},
224     name=#1,
225     anchor=#3,
226   },
227 }
```

14.4 The sankeydiagram environment

Env `sankeydiagram` The `sankeydiagram` environment defines locally all the macros used by a Sankey diagram. Then it applies the `@initial options` and `every diagram` styles (in this order) and applies all the keys provided in its optional argument.

```
228 \NewDocumentEnvironment{sankeydiagram}{0}{}
```

14.5 Internal macros

`\snk@getpos` The `\snk@getpos` macro extracts the position of a TikZ node⁶.

```
229 \def\snk@getpos##1##2{%
230   \tikz@scan@one@point\pgfutil@firstofone{##2}\relax%
231   \edef##1{\the\pgf@x,\the\pgf@y}%
232 }
```

`\snk@modulo` The `\snk@modulo` macro evaluates `#1` modulo `#2` using `\fpeval`.

```
233 \def\snk@modulo##1##2{\fpeval{##1-(floor((##1)/(##2),0)*##2)}}
```

`\snk@normalize@angle` The `\snk@normalize@angle` macro normalizes `#1` (an angle) between `-180` and `180` (using `\fpeval`).

```
234 \def\snk@normalize@angle##1{%
235   \fpeval{\snk@modulo{(##1)+180}{360}-180}%
236 }
```

⁶Thanks to Andrew Stacey <https://tex.stackexchange.com/a/33765/14500>

`\snk@show@debug` The `\snk@show@debug` macro draws debug information of the Sankey node named #1 but only if the `sankey debug` toggle is true. Everything is drawn on the `sankeydebug` layer. It uses the `/sankey/debug line`, `/sankey/debug normal` and `/sankey/debug label` Tikz styles.

```

237 \def\snk@show@debug##1{% node name
238   \iftoggle{sankey debug}{
239     \begin{group}
240     \edef\name{##1}
241     \edef\qty{\sankeygetnodeqty{\name}}
242     \edef\orient{\sankeygetnodeorient{\name}}
243     \begin{pgfonlayer}{sankeydebug}
244       \path[/sankey/debug line] (\name.left) -- (\name.right);
245       \pgfmathsetmacro{\snk@len}{\sankeyqtytolen{\qty}/3}
246       \path[/sankey/debug normal] (\name.center)
247       -- ($(\name.center)!\snk@len pt!90:(\name.right)$)
248       node[/sankey/debug label,rotate=\orient+90+\snk@rotate,anchor=north];
249     \end{pgfonlayer}
250   \endgroup
251   }{}
252 }

```

`\snk@makeforkednode` The `\snk@makeforkednode` forks a Sankey node.

```

\snk@tot
\snk@subnodeqty
\snk@subnodename
\snk@added@values
253 \def\snk@makeforkednode{
254   \begin{group}
255   \ifdefempty{\snk@listofforks}{
256     \ifdefempty{\snk@forkanchor}{-}{
257       \PackageWarning{sankey}%
258       {Can't use 'fork anchor' key without 'forked' key}
259     }
260   }{
261     \def\snk@tot{0}
262     \def\snk@added@values{}
263     \sankeyset{
264       @add forked node/.code args={####1/####2}{
265         \coordinate (####2) at ($(\name.left)%
266         !\fpeval{(\snk@tot+.5*(####1))/\qty}%
267         !(\name.right)$);
268         \edef\snk@orient{\orient}
269         \sankeynode[debug=false]
270         {name=####2,quantity=####1,at=####2,angle=\snk@orient}
271         \edef\snk@tot{\fpeval{\snk@tot+####1}}
272         \edef\snk@added@values{\snk@added@values+####1}
273       },
274       @add forked node/.list/.expand once=\snk@listofforks,
275     }
276     \def\snk@diff{\fpeval{abs(\qty-\snk@tot)}}
277     \ifnumequal{\snk@diff}{0}{-}{
278       \PackageWarning{sankey}%
279       {^^J*** Warning: bad sankey fork: %
280       \qty\space!=\space\snk@added@values(=\snk@tot)%
281       ^^J\snk@listofforks}
282     }
283     \ifdefempty{\snk@forkanchor}{
284       \edef\snk@forkanchor{\name.\snk@anchor}
285     }{}
286     \snk@getpos\snk@c{$(\snk@forkanchor) - (\pos)$}
287     \sankeynode{as=\name,at={$(\name) - (\snk@c)$}}
288     \foreach \snk@subnodeqty/\snk@subnodename in \snk@listofforks {
289       \sankeynode{as=\snk@subnodename,at={$(\snk@subnodename) - (\snk@c)$}}
290     }
291   }
292 \endgroup
293 }

```

`\snk@makenode` The `\snk@makenode` macro creates a new Sankey node named `\name` with `\qty` quantity, oriented at `\orient` degrees (but modified by the `\snk@rotate` angle offset), anchored by its `\anchor` (or its *center* by default) at `\pos` position.

```

294 \def\snk@makenode{
295   \begin{group}
296   \snk@setnodeqty{\name}{\qty}
297   \edef\orient{\snk@normalize@angle{\orient}}
298   \snk@setnodeorient{\name}{\orient}
299   \ifundef{\snk@anchor}{\def\snk@anchor{center}}{}
300   \node[/sankey/@sankey node={\name}{\pos}{\snk@anchor}];
301   \end{group}
302 }

```

`\snk@filldrawstart` The `\snk@filldrawstart` macro fills (with the `/sankey/fill` TikZ style) then draws (with the `/sankey/draw` TikZ style) a start of flow using paths from style `\snk@startstyle` on the Sankey node named `\name`.

```

303 \def\snk@filldrawstart{
304   \begin{scope}[shift={(\name)},rotate=\orient]
305     \path[/sankey/fill] \snk@getstartfill{\snk@startstyle};
306     \path[/sankey/draw] \snk@getstartdraw{\snk@startstyle};
307   \end{scope}
308 }

```

`\snk@filldrawend` The `\snk@filldrawend` macro fills (with the `/sankey/fill` TikZ style) then draws (with the `/sankey/draw` TikZ style) an end of flow using paths from style `\snk@endstyle` on the Sankey node named `\name`.

```

309 \def\snk@filldrawend{
310   \begin{scope}[shift={(\name)},rotate=\sankeygetnodeorient{\name}]
311     \path[/sankey/fill] \snk@getendfill{\snk@endstyle};
312     \path[/sankey/draw] \snk@getenddraw{\snk@endstyle};
313   \end{scope}
314 }

```

`\snk@checkquantities` The `\snk@checkquantities` compares quantities from Sankey nodes `#1` and `#2` and emits an error message if they differ (`#3` is the name of the macro which requested the verification).

`\snk@qtyi`
`\snk@qtyii`

```

315 \def\snk@checkquantities##1##2##3{
316   \begin{group}
317   \edef\snk@qtyi{\sankeygetnodeqty{##1}}
318   \edef\snk@qtyii{\sankeygetnodeqty{##2}}
319   \ifdefstrequal{\snk@qtyi}{\snk@qtyii}{}{
320     \PackageError{sankey}%
321     {^^J*** \string##3: quantities differ between %
322      ##1 (\snk@qtyi) and ##2 (\snk@qtyii)%
323      ^^J}%
324     {The quantities of the two Sankey nodes must be equal.}
325   }
326   \end{group}
327 }

```

14.6 User macros

`\sankeydubins` The `\sankeydubins` macro links two Sankey nodes via a Dubins path. First, it computes the Dubins path between centers (left and right radii are the same) and stores the result in `sankey`. Then it uses the stored result to fill and draw the lane (left border and right borders use Dubins paths with asymmetric radii).

```

328 \NewDocumentCommand\sankeydubins{0{mm}}{% options, sn, en
329   \snk@errorifnotdefined{##2}
330   \snk@errorifnotdefined{##3}
331   \snk@checkquantities{##2}{##3}{\sankeydubins}
332   \beginpgfgroup
333   \sankeyset{##1}
334   \pgfmathsetmacro\qty{\sankeygetnodeqty{##2}}
335   \dubinspathset{
336     sankey/.style={
337       start point=##2.center,start angle=\sankeygetnodeorient{##2},
338       end point=##3.center,end angle=\sankeygetnodeorient{##3},
339       minimum radius=\snk@minradius + .5 * \sankeyqtytolen{\qty} pt,
340     },
341   }
342   \dubinspathcalc{sankey,store=sankey}
343   \dubinspathset{
344     left border/.style={
345       sankey, use store=sankey,
346       left and right minimum radii={\snk@minradius}
347       and {\snk@minradius + \sankeyqtytolen{\qty} pt},
348     },
349     right border/.style={
350       sankey, use store=sankey,
351       left and right minimum radii=
352       {\snk@minradius + \sankeyqtytolen{\qty} pt}
353       and {\snk@minradius},
354     },
355   }
356   % fill the region
357   \path[/sankey/fill] (##2.left) \dubinspath{left border}
358   -- (##3.left) -- (##3.right) \dubinspath{right border,reverse}
359   -- (##2.right) -- cycle;
360   % draw left and right borders
361   \path[/sankey/draw] (##2.left) \dubinspath{left border}
362   (##2.right) \dubinspath{right border};
363   \endpgfgroup
364 }

```

`\sankeyoutin` The `\sankeyoutin` macro links two Sankey nodes via a Bézier curve. First, to simulate constant width, it creates `\snk@stepoutin` intermediate Sankey nodes along the Bézier curve. Then, the lane is filled and drawn linking all the intermediate Sankey node via smaller Bézier curves.

```

365 \NewDocumentCommand\sankeyoutin{0{mm}}{% options, sn, en
366   \snk@errorifnotdefined{##2}
367   \snk@errorifnotdefined{##3}
368   \snk@checkquantities{##2}{##3}{\sankeyoutin}
369   \beginpgfgroup
370   \sankeyset{##1}
371   \edef\qty{\sankeygetnodeqty{##2}}
372   \pgfmathsetmacro\snk@len{\sankeyqtytolen{\qty}/2}
373   \edef\snk@step{\fpeval{1/\snk@stepoutin}}
374   \edef\snk@laststep{\inteval{\snk@stepoutin-1}}
375   \path[overlay,decorate,decoration={
376     markings,
377     mark=between positions \snk@step and {\fpeval{1-.5*\snk@step}}
378     step \snk@step with {
379       \edef\snk@outinmidptname{%
380         snk@outinmidpt-%
381         \pgfkeysvalueof{/pgf/decoration/mark info/sequence number}}%
382       }
383       \path
384         (0,0) coordinate(\snk@outinmidptname)
385         (0,-\snk@len pt) coordinate(\snk@outinmidptname-r)
386         (0,\snk@len pt) coordinate(\snk@outinmidptname-l)
387       ;
388     }
389   }]
390   (##2.center)

```

```

391 to[out=\sankeygetnodeorient{##2},in=\sankeygetnodeorient{##3}+180]
392 (##3.center);
393 \foreach \snk@ptnum in {1,...,\snk@laststep}{
394   \edef\snk@outinmidptname{\snk@outinmidpt-\snk@ptnum}
395   \dbp@anglebetween\snk@outinmidptangle%
396   {\snk@outinmidptname-r}{\snk@outinmidptname-l}
397   \sankeynode[debug=false]{%
398     name=\snk@outinmidptname,
399     quantity=\qty,
400     angle=\snk@outinmidptangle-90,%
401     at=\snk@outinmidptname%
402   }
403 }
404 \sankeynode[debug=false]{%
405   name={\snk@outinmidpt-0},
406   quantity=\sankeygetnodeqty{##2},
407   angle=\sankeygetnodeorient{##2},%
408   at={##2}%
409 }
410 \sankeynode[debug=false]{%
411   name={\snk@outinmidpt-\snk@stepoutin},
412   quantity={\sankeygetnodeqty{##3}},
413   angle={\sankeygetnodeorient{##3}},%
414   at={##3}%
415 }
416 \path[/sankey/fill,looseness=1]
417 (snk@outinmidpt-0.left)
418 \foreach \snk@curpt
419 [remember=\snk@curpt as \snk@prevpt (initially 0)]
420 in {1,...,\snk@stepoutin}{
421   to[out=\sankeygetnodeorient{\snk@outinmidpt-\snk@prevpt},
422     in=\sankeygetnodeorient{\snk@outinmidpt-\snk@curpt}+180]
423     (snk@outinmidpt-\snk@curpt.left)
424 }
425 --
426 (snk@outinmidpt-\snk@stepoutin.right)
427 \foreach \snk@curpt
428 [remember=\snk@curpt as \snk@prevpt (initially \snk@stepoutin)]
429 in {\snk@laststep,...,0}{
430   to[out=\sankeygetnodeorient{\snk@outinmidpt-\snk@prevpt}+180,
431     in=\sankeygetnodeorient{\snk@outinmidpt-\snk@curpt}]
432     (snk@outinmidpt-\snk@curpt.right)
433 }
434 -- cycle;
435 \path[/sankey/draw,looseness=1]
436 (snk@outinmidpt-0.left)
437 \foreach \snk@curpt
438 [remember=\snk@curpt as \snk@prevpt (initially 0)]
439 in {1,...,\snk@stepoutin}{
440   to[out=\sankeygetnodeorient{\snk@outinmidpt-\snk@prevpt},
441     in=\sankeygetnodeorient{\snk@outinmidpt-\snk@curpt}+180]
442     (snk@outinmidpt-\snk@curpt.left)
443 }
444 (snk@outinmidpt-\snk@stepoutin.right)
445 \foreach \snk@curpt
446 [remember=\snk@curpt as \snk@prevpt (initially \snk@stepoutin)]
447 in {\snk@laststep,...,0}{
448   to[out=\sankeygetnodeorient{\snk@outinmidpt-\snk@prevpt}+180,
449     in=\sankeygetnodeorient{\snk@outinmidpt-\snk@curpt}]
450     (snk@outinmidpt-\snk@curpt.right)
451 };
452 \endgroup
453 }

```

`\sankeynodealias` The `\sankeynodealias` macro clones the Sankey node named `#1` into a Sankey node named `#2`.

```

454 \NewDocumentCommand\sankeynodealias{mm}{%name, alias
455   \snk@errorifnotdefined{##1}
456   \path[late options={name=##1,alias=##2}];
457   \snk@setnodeqty{##2}{\sankeygetnodeqty{##1}}
458   \snk@setnodeorient{##2}{\sankeygetnodeorient{##1}}
459 }

```

`\sankeynode` The `\sankeynode` macro creates the new Sankey node named #2.

```
460 \NewDocumentCommand\sankeynode{0}{m}{% options, node parameters
461   \beginngroup
462   \sankeyset{##1}
463   \sankeyset{node parameters,@initial parameters,/sankey/every node,##2}
464   \snk@makenode{ }
465   \snk@makeforkednode{ }
466   \iftoggle{sankey node start}{\snk@filldrawstart}{ }
467   \iftoggle{sankey node end}{\snk@filldrawend}{ }
468   \snk@show@debug{name}
469   \endgroup
470 }
```

`\sankeystart` The `\sankeystart` macro fills and draws a starting lane attached to the Sankey node named #2.

```
471 \NewDocumentCommand\sankeystart{0}{m}{% options, name
472   \snk@errorifnotdefined{##2}
473   \beginngroup
474   \sankeyset{##1}
475   \edef\name{##2}
476   \edef\orient{\sankeygetnodeorient{##2}}
477   \edef\qty{\sankeygetnodeqty{##2}}
478   \snk@filldrawstart
479   \endgroup
480 }
```

`\sankeynodestart` The `\sankeynodestart` macro creates the new Sankey node named #2 then fills and draws a starting lane attached to this new Sankey node.

```
481 \NewDocumentCommand\sankeynodestart{0}{m}{% option, node parameters
482   \sankeynode[##1]{start,##2}
483 }
```

`\sankeyend` The `\sankeyend` macro fills and draws an ending lane attached to the Sankey node named #2.

```
484 \NewDocumentCommand\sankeyend{0}{m}{%options, name
485   \snk@errorifnotdefined{##2}
486   \beginngroup
487   \sankeyset{##1}
488   \edef\name{##2}
489   \edef\orient{\sankeygetnodeorient{##2}}
490   \edef\qty{\sankeygetnodeqty{##2}}
491   \snk@filldrawend
492   \endgroup
493 }
```

`\sankeynodeend` The `\sankeynodeend` macro creates the new Sankey node named #2 then fills and draws an ending lane attached to this new Sankey node.

```
494 \NewDocumentCommand\sankeynodeend{0}{m}{% options, node parameters
495   \sankeynode[##1]{end,##2}
496 }
```

`\sankeyadvance` The `\sankeyadvance` macro moves toward (or backward if *starred* calls `-#1`) the Sankey node named `#3`. `#4` is a distance. The previous position is kept by a Sankey node named `#3-old`.

```

497 \NewDocumentCommand\sankeyadvance{s0{mm}}{%
498   %params: *(reverse), options, name, distance
499   \snk@errorifnotdefined{##3}
500   \beginngroup
501   \sankeyset{##2}
502   \edef\name{##3}
503   \edef\snk@oldname{##3-old}
504   \sankeynodealias{\name}{\snk@oldname}
505   \IfBooleanTF{##1}{
506     % move backward
507     \sankeynode{
508       at={$(\snk@oldname.center)!##4!90:(\snk@oldname.left)$},
509       angle=\sankeygetnodeorient{\snk@oldname},
510       quantity=\sankeygetnodeqty{\snk@oldname},
511       name=\name,
512     }
513     \path[/sankey/fill]
514     (\name.left) -- (\snk@oldname.left)
515     -- (\snk@oldname.right) -- (\name.right) -- cycle;
516     \path[/sankey/draw]
517     (\name.left) -- (\snk@oldname.left)
518     (\snk@oldname.right) -- (\name.right);
519   }{
520     % move forward
521     \sankeynode{
522       at={$(\snk@oldname.center)!##4!-90:(\snk@oldname.left)$},
523       angle=\sankeygetnodeorient{\snk@oldname},
524       quantity=\sankeygetnodeqty{\snk@oldname},
525       name=\name,
526     }
527     \path[/sankey/fill]
528     (\snk@oldname.left) -- (\name.left)
529     -- (\name.right) -- (\snk@oldname.right) -- cycle;
530     \path[/sankey/draw]
531     (\snk@oldname.left) -- (\name.left)
532     (\name.right) -- (\snk@oldname.right);
533   }
534   \snk@show@debug{\name}
535   \endgroup
536 }

```

`\sankeyturnright` The `\sankeyturnright` macro moves forward the Sankey node named `#3` by turning right. The angle is `#4` (the starred version uses the opposite of `#4`). If the angle is *negative*, the macro calls the `\sankeyturnrightbackward` macro to move backward else the macro fills/draws the lane between the previous position and the new position. The previous position is kept by a Sankey node named `#3-old`.

```

537 \NewDocumentCommand\sankeyturnright{s0{mm}}{
538   % *(reverse), options, name, angle
539   \snk@errorifnotdefined{##3}
540   \beginngroup
541   \IfBooleanTF{##1}
542   {\edef\snk@angle{\fpeval{-1*##4}}}
543   {\edef\snk@angle{\fpeval{1*##4}}}
544   \edef\snk@anglesign{\fpeval{sign(\snk@angle)}}
545   \ifnumgreater{\snk@anglesign}{-1}{
546     \sankeyset{##2}
547     \edef\name{##3}
548     \edef\snk@oldname{##3-old}
549     \sankeynodealias{\name}{\snk@oldname}
550     \edef\qty{\sankeygetnodeqty{\name}}
551     \edef\orient{\snk@normalize@angle{\sankeygetnodeorient{\name}-\snk@angle}}
552     \snk@getpos\snk@c{$(\name.right)!-\snk@minradius!(\name.left)$}
553     \snk@getpos\pos{$(\snk@c)!1!-\snk@angle:(\name.center)$}
554     \snk@makenode{}
555     % fill the region
556     \path[/sankey/fill] let
557     \p1=(\snk@oldname.left),\p2=(\snk@oldname.right),
558     \p3=(\name.left),\p4=(\name.right),
559     \n1={\sankeyqytytolen{\qty}},
560     \n{maxr}={\snk@minradius+\n1},
561     \n{minr}={\snk@minradius}
562     in

```



```

563 (\p1) arc(\orient+\snk@angle+90:\orient+90:\n{maxr}) -- (\p3) --
564 (\p4) arc(\orient+90:\orient+\snk@angle+90:\n{minr}) -- (\p2) -- cycle;
565 % draw left and right borders
566 \path[/sankey/draw] let
567 \p1=(\snk@oldname.left),\p2=(\snk@oldname.right),
568 \p3=(\name.left),\p4=(\name.right),
569 \n1={\sankeyqtytolen{\qty}},
570 \n{maxr}={\snk@minradius+\n1},
571 \n{minr}={\snk@minradius}
572 in
573 (\p1) arc(\orient+\snk@angle+90:\orient+90:\n{maxr})
574 (\p4) arc(\orient+90:\orient+\snk@angle+90:\n{minr});
575 \snk@show@debug{\name}
576 }{
577 \sankeyturnrightbackward[##2]{##3}{-1*\snk@angle}
578 }
579 \endgroup
580 }

```

`\sankeyturnrightbackward` The `sankeyturnrightbackward` macro moves backward the Sankey node named `#3`
`\sankeyturnrightbackward*` by turning right. The angle is `#4` (the starred version uses the opposite of `#4`). If the angle is *negative*, the macro calls the `\sankeyturnright` macro to move forward else the macro fills/draws the lane between the previous position and the new position. The previous position is kepted by a Sankey node named `#3-old`.

```

581 \NewDocumentCommand\sankeyturnrightbackward{s0{mm}}{
582 % *(reverse), options, name, angle
583 \snk@errorifnotdefined{##3}
584 \begingroup
585 \IfBooleanTF{##1}
586 {\edef\snk@angle{\fpeval{-1*##4}}}
587 {\edef\snk@angle{\fpeval{1*##4}}}
588 \edef\snk@anglesign{\fpeval{sign(\snk@angle)}}
589 \ifnumgreater{\snk@anglesign}{-1}{
590 \sankeyset{##2}
591 \edef\name{##3}
592 \edef\snk@oldname{##3-old}
593 \sankeynodealias{\name}{\snk@oldname}
594 \edef\qty{\sankeygetnodeqty{\name}}
595 \edef\orient{\snk@normalize@angle{\sankeygetnodeorient{\name}+\snk@angle}}
596 \snk@getpos\snk@c{$(\name.right)!-\snk@minradius!(\name.left)$}
597 \snk@getpos\pos{$(\snk@c)!!\snk@angle:(\name.center)$}
598 \snk@makenode{}
599 % fill the region
600 \path[/sankey/fill] let
601 \p1=(\name.left),\p2=(\name.right),
602 \p3=(\snk@oldname.left),\p4=(\snk@oldname.right),
603 \n1={\sankeyqtytolen{\qty}},
604 \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
605 in
606 (\p1) arc(\orient+90:\orient-\snk@angle+90:\n{maxr}) -- (\p3) --
607 (\p4) arc(\orient-\snk@angle+90:\orient+90:\n{minr}) -- (\p2) -- cycle;
608 % draw left and right borders
609 \path[/sankey/draw] let
610 \p1=(\name.left),\p2=(\name.right),
611 \p3=(\snk@oldname.left),\p4=(\snk@oldname.right),
612 \n1={\sankeyqtytolen{\qty}},
613 \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
614 in
615 (\p1) arc(\orient+90:\orient-\snk@angle+90:\n{maxr})
616 (\p4) arc(\orient-\snk@angle+90:\orient+90:\n{minr});
617 \snk@show@debug{\name}
618 }{
619 \sankeyturnright[##2]{##3}{-1*\snk@angle}
620 }
621 \endgroup
622 }

```

`\sankeyturnleft` The `sankeyturnleft` macro moves forward the Sankey node named `#3` by turning left. The angle is `#4` (the starred version uses the opposite of `#4`). If the angle is *negative*, the macro calls the `\sankeyturnleftbackward` macro to move backward else the macro fills/draws the lane between the previous position and the new position. The previous position is kept by a Sankey node named `#3-old`.

```

623 \NewDocumentCommand\sankeyturnleft{s0{}mm}{
624   % *(reverse), options, name, angle
625   \snk@errorifnotdefined{##3}
626   \beginngroup
627   \IfBooleanTF{##1}
628   {\edef\snk@angle{\fpeval{-1*##4}}}
629   {\edef\snk@angle{\fpeval{1*##4}}}
630   \edef\snk@anglesign{\fpeval{sign(\snk@angle)}}
631   \ifnumgreater{\snk@anglesign}{-1}{
632     \sankeyset{##2}
633     \edef\name{##3}
634     \edef\snk@oldname{##3-old}
635     \sankeynodealias{\name}{\snk@oldname}
636     \edef\qty{\sankeygetnodeqty{\name}}
637     \edef\orient{\snk@normalize@angle{\sankeygetnodeorient{\name}+\snk@angle}}
638     \snk@getpos\snk@c{$(\name.left)!-\snk@minradius!(\name.right)$}
639     \snk@getpos\pos{$(\snk@c)!!\snk@angle:(\name.center)$}
640     \snk@makenode{}
641     % fill the region
642     \path[/sankey/fill] let
643     \p1=(\snk@oldname.left),\p2=(\snk@oldname.right),
644     \p3=(\name.left),\p4=(\name.right),
645     \n1={\sankeyqtytolen{\qty}},
646     \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
647     in
648     (\p1) arc(\orient-\snk@angle-90:\orient-90:\n{minr}) -- (\p3) --
649     (\p4) arc(\orient-90:\orient-\snk@angle-90:\n{maxr}) -- (\p2) -- cycle;
650     % draw left and right borders
651     \path[/sankey/draw] let
652     \p1=(\snk@oldname.left),\p2=(\snk@oldname.right),
653     \p3=(\name.left),\p4=(\name.right),
654     \n1={\sankeyqtytolen{\qty}},
655     \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
656     in
657     (\p1) arc(\orient-\snk@angle-90:\orient-90:\n{minr})
658     (\p4) arc(\orient-90:\orient-\snk@angle-90:\n{maxr});
659     \snk@show@debug{\name}
660   }{
661     \sankeyturnleftbackward[##2]{##3}{-1*\snk@angle}
662   }
663   \endgroup
664 }

```

`\sankeyturnleftbackward` The `sankeyturnleftbackward` macro moves backward the Sankey node named `#3` by turning left. The angle is `#4` (the starred version uses the opposite of `#4`). If the angle is *negative*, the macro calls the `\sankeyturnleft` macro to move forward else the macro fills/draws the lane between the previous position and the new position. The previous position is kept by a Sankey node named `#3-old`.

```

665 \NewDocumentCommand\sankeyturnleftbackward{s0{}mm}{
666   % *(reverse), options, name, angle
667   \snk@errorifnotdefined{##3}
668   \beginngroup
669   \IfBooleanTF{##1}
670   {\edef\snk@angle{\fpeval{-1*##4}}}
671   {\edef\snk@angle{\fpeval{1*##4}}}
672   \edef\snk@anglesign{\fpeval{sign(\snk@angle)}}
673   \ifnumgreater{\snk@anglesign}{-1}{
674     \sankeyset{##2}
675     \edef\name{##3}
676     \edef\snk@oldname{##3-old}
677     \sankeynodealias{\name}{\snk@oldname}
678     \edef\qty{\sankeygetnodeqty{\name}}
679     \edef\orient{\snk@normalize@angle{\sankeygetnodeorient{\name}-\snk@angle}}
680     \snk@getpos\snk@c{$(\name.left)!-\snk@minradius!(\name.right)$}
681     \snk@getpos\pos{$(\snk@c)!!\snk@angle:(\name.center)$}
682     \snk@makenode{}
683     % fill the region
684     \path[/sankey/fill] let
685     \p1=(\name.left),\p2=(\name.right),

```

```

686     \p3=(\snk@oldname.left),\p4=(\snk@oldname.right),
687     \n1={\sankeyqtytolen{\qty}},
688     \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
689     in
690     (\p1) arc(\orient-90:\orient+\snk@angle-90:\n{minr}) -- (\p3) --
691     (\p4) arc(\orient+\snk@angle-90:\orient-90:\n{maxr}) -- (\p2) -- cycle;
692     % draw left and right borders
693     \path[/sankey/draw] let
694     \p1=(\name.left),\p2=(\name.right),
695     \p3=(\snk@oldname.left),\p4=(\snk@oldname.right),
696     \n1={\sankeyqtytolen{\qty}},
697     \n{maxr}={\snk@minradius+\n1}, \n{minr}={\snk@minradius}
698     in
699     (\p1) arc(\orient-90:\orient+\snk@angle-90:\n{minr})
700     (\p4) arc(\orient+\snk@angle-90:\orient-90:\n{maxr});
701     \snk@show@debug{\name}
702   }{
703     \sankeyturnleft[##2]{##3}{-1*\snk@angle}
704   }
705 \endgroup
706 }

```

`\sankeyturn` The `\sankeyturn` macro moves toward (or backward if *starred* calls `-#1`) the Sankey node named `#3` by turning left (angle `#4` is positive) or right (angle `#4` is negative). The previous position is kept by a Sankey node named `#3-old`.

```

707 \NewDocumentCommand\sankeyturn{s0{mm}}{%
708   % *(reverse), options, name, angle
709   \snk@errorifnotdefined{##3}
710   \begingroup
711   \edef\snk@anglesign{\fpeval{sign{##4}}}
712   \IfBooleanTF{##1}{
713     \ifnumgreater{\snk@anglesign}{-1}
714     {\sankeyturnleftbackward[##2]{##3}{##4}}
715     {\sankeyturnrightbackward[##2]{##3}{-1*##4}}
716   }{
717     \ifnumgreater{\snk@anglesign}{-1}
718     {\sankeyturnleft[##2]{##3}{##4}}
719     {\sankeyturnright[##2]{##3}{-1*##4}}
720   }
721   \endgroup
722 }

```

`\sankeyfork` The `\sankeyfork` macro forks the Sankey node named `#2` to the list of subnodes given by `#3`. The subnodes are cloned to take into account the `debug` option.

```

723 \NewDocumentCommand\sankeyfork{0{mm}}{%options, name, list of forks
724   \snk@errorifnotdefined{##2}
725   \begingroup
726   \sankeyset{##1}
727   \sankeynode[debug=false]{as={##2},forked={##3}}
728   \foreach \qty/\snk@subnodename in {##3}{\sankeynode{as={\snk@subnodename}}}
729   \endgroup
730 }

```

`\sankeyqtytolen` The `\sankeyqtytolen` macro converts quantity to length using `\fpeval` and the ratio determined by `\snk@totalqty` and `\snk@totallen`.

```

731 \def\sankeyqtytolen##1{\fpeval{##1}/\snk@totalqty*\snk@totallen}

```

14.7 The `sankeydiagram` environment (the end)

Here is the end of the definition of the `sankeydiagram` environment. The `@initial options` style and the `every diagram` style are applied before options provided by user.

```

732 \sankeyset{
733   @initial options,
734   every diagram,
735   % user values
736   #1}
737 }
738 {} % empty but mandatory ! :-)

```

14.8 Predefined start and end styles

The `none` style.

```
739 \sankeyset{
740   new start style={none}{}{ },
741   new end style={none}{}{ },
742 }
```

The `simple` style.

```
743 \sankeyset{
744   new start style={simple}{
745     (\name.left) -- ([xshift=-.5\pgflinewidth]\name.left)
746     -- ([xshift=-.5\pgflinewidth]\name.right) -- (\name.right) -- cycle
747   }{
748     (\name.left) -- ([xshift=-.5\pgflinewidth]\name.left)
749     -- ([xshift=-.5\pgflinewidth]\name.right) -- (\name.right)
750   },
751   new end style={simple}{
752     (\name.left) -- ([xshift=2mm]\name.center)
753     -- (\name.right) -- cycle
754   }{
755     (\name.left) -- ([xshift=2mm]\name.center) -- (\name.right)
756   },
757 }
```

The `arrow` style.

```
758 \sankeyset{
759   new start style={arrow}{
760     (\name.left) -- ++(-10pt,0) -- ([xshift=-10pt/6]\name.center)
761     -- ([xshift=-10pt]\name.right) -- (\name.right) -- cycle
762   }{
763     (\name.left) -- ++(-10pt,0) -- ([xshift=-10pt/6]\name.center)
764     -- ([xshift=-10pt]\name.right) -- (\name.right)
765   },
766   new end style={arrow}{
767     (\name.left) -- ([yshift=1mm]\name.left)
768     -- ([xshift=10pt]\name.center) -- ([yshift=-1mm]\name.right)
769     -- (\name.right) -- cycle
770   }{
771     (\name.left) -- ([yshift=1mm]\name.left)
772     -- ([xshift=10pt]\name.center) -- ([yshift=-1mm]\name.right)
773     -- (\name.right)
774   },
775 }
```

15 tikzlibrarydubins.code.tex

Not yet documented nor commented...

```
\tikzlibrarydubins@version
\tikzlibrarydubins@date

776 \def\tikzlibrarydubins@version{v3.0.1}
777 \def\tikzlibrarydubins@date{2022/02/04}

778 \usetikzlibrary{calc}
779 \RequirePackage{etoolbox}
780 \RequirePackage{xfp}
781
782 \newbool{dubinspathreverse}

\ifpgfmathcond

783 \def\ifpgfmathcond#1{%
784   \pgfmathparse{(#1)?1:0}%
785   \ifnumequal{\pgfmathresult}{1}%
786 }

\dbp@getxy

787 \def\dbp@getxy#1#2#3{%
788   \tikz@scan@one@point\pgfutil@firstofone(#3)\relax%
789   \edef#1{\the\pgf@x}%
790   \edef#2{\the\pgf@y}%
791 }

\dbp@anglebetween

792 \def\dbp@anglebetween#1#2#3{%macro, s, t
793   \dbp@getxy\dbp@ax\dbp@ay{#2}
794   \dbp@getxy\dbp@bx\dbp@by{#3}
795   \pgfmathsetmacro#1{atan2(\dbp@by-\dbp@ay,\dbp@bx-\dbp@ax)}
796 }

\dbp@distancebetween

797 \def\dbp@distancebetween#1#2#3{%macro, s, t
798   \dbp@getxy\dbp@ax\dbp@ay{#2}
799   \dbp@getxy\dbp@bx\dbp@by{#3}
800   \edef#1{\fpeval{sqrt(
801     (\dbp@bx-\dbp@ax)*(\dbp@bx-\dbp@ax)%
802     +(\dbp@by-\dbp@ay)*(\dbp@by-\dbp@ay)%
803     )}}%
804 }

\dbp@rsr

805 \newcommand\dbp@rsr{% s, sa, t, ta, as, len, at, r
806   let
807   \p{tr}=(\shift={(\dbp@angb-90:\dbp@radius pt)}]\dbp@b),
808   \n1={\dbp@anga+90},
809   \n2={\dbp@angb+90},
810   \n3={\n2+\dbp@lastangle}
811   in
812   arc(\n1:\n1-\dbp@firstangle:\dbp@rradius pt)
813   -- (\shift={(\p{tr})}]\n3:\dbp@rradius pt)
814   arc(\n3:\n2:\dbp@rradius pt)
815 }
```

`\dbp@lsl`

```
816 \newcommand\dbp@lsl{% s, sa, t, ta, as, len, at, r
817 let
818 \p{tl}=(\shift={(\dbp@angb+90:\dbp@radius pt)}]\dbp@b),
819 \n1={\dbp@anga-90},\n2={\n1+\dbp@firstangle},
820 \n3={\dbp@angb-90},\n4={\n3-\dbp@lastangle}
821 in
822 arc(\n1:\n2:\dbp@lradius pt)
823 -- (\shift={(\p{tl})})\n4:\dbp@lradius pt)
824 arc(\n4:\n3:\dbp@lradius pt)
825 }
```

`\dbp@rs1`

```
826 \newcommand\dbp@rs1{% s, sa, t, ta, as, len, at, r
827 let
828 \p{tl}=(\shift={(\dbp@angb+90:\dbp@radius pt)}]\dbp@b),
829 \n1={\dbp@anga+90},\n2={\n1-\dbp@firstangle},
830 \n3={\dbp@angb-90},\n4={\n3-\dbp@lastangle}
831 in
832 arc(\n1:\n2:\dbp@rradius pt)
833 -- (\shift={(\p{tl})})\n4:\dbp@lradius pt)
834 arc(\n4:\n3:\dbp@lradius pt)
835 }
```

`\dbp@lsr`

```
836 \newcommand\dbp@lsr{% s, sa, t, ta, as, len, at, r
837 let
838 \p{tr}=(\shift={(\dbp@angb-90:\dbp@radius pt)}]\dbp@b),
839 \n1={\dbp@anga-90},\n2={\n1+\dbp@firstangle},
840 \n3={\dbp@angb+90},\n4={\n3+\dbp@lastangle}
841 in
842 arc(\n1:\n2:\dbp@lradius pt)
843 -- (\shift={(\p{tr})})\n4:\dbp@rradius pt)
844 arc(\n4:\n3:\dbp@rradius pt)
845 }
```

`\dbp@lrl`

```
846 \newcommand\dbp@lrl{% s, sa, t, ta, as, ai, at, r
847 let
848 \n1={\dbp@anga-90},\n2={\n1+\dbp@firstangle},
849 \n3={\dbp@angb-90},\n4={\n3-\dbp@lastangle}
850 in
851 arc(\n1:\n2:\dbp@lradius pt)
852 arc(\n2+180:\n2+180-\dbp@midparam:\dbp@rradius pt)
853 arc(\n4:\n3:\dbp@lradius pt)
854 }
```

`\dbp@rlr`

```
855 \newcommand\dbp@rlr{% s, sa, t, ta, as, ai, at, r
856 let
857 \n1={\dbp@anga+90},\n2={\n1-\dbp@firstangle},
858 \n3={\dbp@angb+90},\n4={\n3+\dbp@lastangle}
859 in
860 arc(\n1:\n2:\dbp@rradius pt)
861 arc(\n2+180:\n2+180+\dbp@midparam:\dbp@lradius pt)
862 arc(\n4:\n3:\dbp@rradius pt)
863 }
```

`\dbp@rev@lsl`

```
864 \newcommand\dbp@rev@lsl{\dbp@rsr}
```

`\dbp@rev@rsr`

```
865 \newcommand\dbp@rev@rsr{\dbp@lsl}
```

```

\dbp@rev@lsr
866 \newcommand\dbp@rev@lsr{\dbp@lsr}

\dbp@rev@rs1
867 \newcommand\dbp@rev@rs1{\dbp@rs1}

\dbp@rev@lrl
868 \newcommand\dbp@rev@lrl{\dbp@lrl}

\dbp@rev@rlr
869 \newcommand\dbp@rev@rlr{\dbp@lrl}

\dubinspath
870 \newcommand\dubinspath[1]{%
871   \pgfextra{
872     \dubinspathset{#1}
873     \ifbool{dubinspathreverse}{
874       \edef\dbp@newa{\dbp@b}
875       \edef\dbp@newb{\dbp@a}
876       \pgfmathsetmacro\dbp@newanga{180+\dbp@angb}
877       \pgfmathsetmacro\dbp@newangb{180+\dbp@anga}
878       \edef\dbp@newfirstangle{\dbp@lastangle}
879       \edef\dbp@newlastangle{\dbp@firstangle}
880       \edef\dbp@newmethod{rev@\dbp@method}
881       \edef\dbp@newlradius{\dbp@rradius}
882       \edef\dbp@newrradius{\dbp@lradius}
883       \dubinspathset{
884         start point=\dbp@newa,
885         end point=\dbp@newb,
886         start angle=\dbp@newanga,
887         end angle=\dbp@newangb,
888         first angle=\dbp@newfirstangle,
889         last angle=\dbp@newlastangle,
890         left and right minimum radii=\dbp@newlradius pt and \dbp@newrradius pt,
891         method=\dbp@newmethod,
892       }
893     }{}
894   }
895   \csname dbp@\dbp@method\endcsname%
896 }

\dbp@store
\dbp@get
897 \def\dbp@store#1#2{%
898   \expandafter\xdef\csname dbp@store@#1@#2\endcsname%
899   {\csname dbp@#2\endcsname}%
900 }
901 \def\dbp@get#1#2{%
902   \csname dbp@store@#1@#2\endcsname%
903 }

\dbp@setparams
904 \def\dbp@setparams#1#2#3#4#5{%
905   % method, length, first angle, middle param, last angle
906   \edef\dbp@method{#1}
907   \edef\dbp@length{#2}
908   \edef\dbp@firstangle{#3}
909   \edef\dbp@middleparam{#4}
910   \edef\dbp@lastangle{#5}
911   \ifdef{\dbp@storename}{
912     \foreach \p in {method,length,firstangle,middleparam,lastangle}{
913       \dbp@store{\dbp@storename}{\p}
914     }
915   }{}
916 }

```

\dbp@updateparams

```
917 \def\dbp@updateparams#1#2#3#4#5{
918   \ifpgfmathcond{#2<\dbp@length}{
919     \dbp@setparams{#1}{#2}{#3}{#4}{#5}
920   }{}
921 }

922 \tikzset{
923   dubins path/.is family,
924   dubins path,
925   start point/.store in=\dbp@a,
926   start angle/.store in=\dbp@anga,
927   end point/.store in=\dbp@b,
928   end angle/.store in=\dbp@angb,
929   store/.store in=\dbp@storename,
930   use store/.style={
931     method=\dbp@get{#1}{method},
932     first angle=\dbp@get{#1}{firstangle},
933     last angle=\dbp@get{#1}{lastangle},
934     middle param=\dbp@get{#1}{middleparam},
935   },
936   minimum radius/.code={
937     \pgfmathsetmacro\dbp@radius{#1}
938     \pgfmathsetmacro\dbp@rradius{#1}
939     \pgfmathsetmacro\dbp@lradius{#1}
940   },
941   left and right minimum radii/.code args={#1 and #2}{
942     \pgfmathsetmacro\dbp@lradius{#1}
943     \pgfmathsetmacro\dbp@rradius{#2}
944     \pgfmathsetmacro\dbp@radius{(\dbp@lradius + \dbp@rradius)/2}
945   },
946   method/.store in=\dbp@method,
947   first angle/.store in=\dbp@firstangle,
948   last angle/.store in=\dbp@lastangle,
949   middle param/.store in=\dbp@midparam,
950   reverse/.is if=dubinspathreverse,
951 }
```

\dubinspathset

```
952 \newcommand\dubinspathset[1]{\tikzset{dubins path,#1}}
```

\dubinspathcalc

```
953 \newcommand\dubinspathcalc[1]{%
954   \begingroup
955   \dubinspathset{#1}
956   \tikzset{
957     declare function={
958       angtodist(\dbp@a,\dbp@r)={abs(\dbp@a)*.01745329*\dbp@r};
959       modangr(\dbp@a,\dbp@b)={
960         (
961           Mod(\dbp@a,360)<Mod(\dbp@b,360)
962           ?
963           Mod(\dbp@a,360)
964           :
965           Mod(\dbp@a,360)-360+\dbp@b-Mod(\dbp@b,360)
966         )
967       };
968       modangl(\dbp@a,\dbp@b)={
969         (
970           Mod(\dbp@a,360)<Mod(\dbp@b,360)
971           ?
972           Mod(\dbp@a,360)+360
973           :
974           Mod(\dbp@a,360)+(\dbp@b)-Mod(\dbp@b,360)
975         )
976       };
977     }
978
979     \pgfmathsetmacro\dbp@radius{\dbp@rradius}
980     \pgfmathsetmacro\dbp@anga{mod((\dbp@anga)+180,360)-180}
981     \pgfmathsetmacro\dbp@angb{mod((\dbp@angb)+180,360)-180}
982     \path
983     let
984     \p{a}=(\dbp@a),
```



```

985 \p{b}=(\dbp@b),
986 \p{ar}=(\p{a}) + (\dbp@anga-90:\dbp@radius pt)$),
987 \p{al}=(\p{a}) + (\dbp@anga+90:\dbp@radius pt)$),
988 \p{br}=(\p{b}) + (\dbp@angb-90:\dbp@radius pt)$),
989 \p{bl}=(\p{b}) + (\dbp@angb+90:\dbp@radius pt)$)
990 in \pgfextra{
991   \pgfinterruptpath
992
993   % RSR (ar and br)
994   \dbp@anglebetween\dbp@rsrarbr{\p{ar}}{\p{br}}
995   \dbp@distancebetween\dbp@rsrdarbr{\p{ar}}{\p{br}}
996   \pgfmathsetmacro\dbp@rsrangone{Mod(\dbp@anga-\dbp@rsrarbr,360)}
997   \pgfmathsetmacro\dbp@rsrangtwo{Mod(\dbp@rsrarbr-\dbp@angb,360)}
998   \pgfmathsetmacro\dbp@rsrlen{\dbp@rsrdarbr}
999   \pgfmathsetmacro\dbp@rsrdist{
1000     angtodist(\dbp@rsrangone,\dbp@radius)
1001     +\dbp@rsrlen
1002     +angtodist(\dbp@rsrangtwo,\dbp@radius)
1003   }
1004   \dbp@setparams{rsr}{\dbp@rsrdist}{\dbp@rsrangone}{\dbp@rsrlen}{\dbp@rsrangtwo}
1005
1006   % LSL (al and bl)
1007   \dbp@anglebetween\dbp@lslalbl{\p{al}}{\p{bl}}
1008   \dbp@distancebetween\dbp@lslalbl{\p{al}}{\p{bl}}
1009   \pgfmathsetmacro{\dbp@lslangone}{mod(\dbp@lslalbl-\dbp@anga+720,360)}
1010   \pgfmathsetmacro{\dbp@lslangtwo}{mod(\dbp@angb-\dbp@lslalbl+720,360)}
1011   \pgfmathsetmacro\dbp@lslllen{\dbp@lslalbl}
1012   \pgfmathsetmacro\dbp@lslldist{
1013     angtodist(\dbp@lslangone,\dbp@radius)
1014     +\dbp@lslllen
1015     +angtodist(\dbp@lslangtwo,\dbp@radius)
1016   }
1017   \dbp@updateparams%
1018   {lsl}{\dbp@lslldist}{\dbp@lslangone}{\dbp@lslllen}{\dbp@lslangtwo}
1019
1020   % RSL (ar and bl)
1021   \dbp@distancebetween\dbp@rslarbl{\p{ar}}{\p{bl}}
1022   \pgfmathtruncatemacro\dbp@rslrok{(\dbp@rslarbl>=2*\dbp@radius)?1:0}
1023   \ifnumequal{\dbp@rslrok}{1}{
1024     \dbp@anglebetween\dbp@rslarbl{\p{ar}}{\p{bl}}
1025     \pgfmathsetmacro\dbp@rslanglesup{
1026       asin(\dbp@radius/\dbp@rslarbl*2)}
1027     \pgfmathsetmacro\dbp@rslangone
1028     {Mod(\dbp@anga-\dbp@rslarbl+\dbp@rslanglesup,360)}
1029     \pgfmathsetmacro\dbp@rslangtwo
1030     {Mod(\dbp@angb-\dbp@rslarbl+\dbp@rslanglesup,360)}
1031     \pgfmathsetmacro\dbp@rslllen{veclen(\dbp@rslarbl,\dbp@radius)}
1032     \pgfmathsetmacro\dbp@rslldist{
1033       angtodist(\dbp@rslangone,\dbp@radius)
1034       +\dbp@rslllen
1035       +angtodist(\dbp@rslangtwo,\dbp@radius)
1036     }
1037
1038     \dbp@updateparams%
1039     {rsl}{\dbp@rslldist}{\dbp@rslangone}{\dbp@rslllen}{\dbp@rslangtwo}
1040   }{}
1041
1042   % LSR (al and br)
1043   \dbp@distancebetween\dbp@lsrdalbr{\p{al}}{\p{br}}
1044   \pgfmathtruncatemacro\dbp@lsrok{(\dbp@lsrdalbr>=2*\dbp@radius)?1:0}
1045   \ifnumequal{\dbp@lsrok}{1}{
1046     \dbp@anglebetween\dbp@lsralbr{\p{al}}{\p{br}}
1047     \pgfmathsetmacro\dbp@lsranglesup{
1048       asin(\dbp@radius/\dbp@lsrdalbr*2)}
1049     \pgfmathsetmacro\dbp@lsrangone
1050     {Mod(\dbp@lsralbr+\dbp@lsranglesup-\dbp@anga,360)}
1051     \pgfmathsetmacro\dbp@lsrangtwo
1052     {Mod(\dbp@lsralbr+\dbp@lsranglesup-\dbp@angb,360)}
1053     \pgfmathsetmacro\dbp@lsrlen{veclen(\dbp@lsrdalbr,\dbp@radius)}
1054     \pgfmathsetmacro\dbp@lsrdist{
1055       angtodist(\dbp@lsrangone,\dbp@radius)
1056       +\dbp@lsrlen
1057       +angtodist(\dbp@lsrangtwo,\dbp@radius)
1058     }
1059     \dbp@updateparams%
1060     {lsr}{\dbp@lsrdist}{\dbp@lsrangone}{\dbp@lsrlen}{\dbp@lsrangtwo}
1061   }{}
1062
1063   % LRL (al and bl)

```

```

1064 \dbp@distancebetween\dbp@lrlalbl{\p{a}}{\p{b}}
1065 \pgfmathtruncatemacro\dbp@lrlrok{(\dbp@lrlalbl<=4*\dbp@radius)?1:0}
1066 \ifnumequal{\dbp@lrlrok}{1}{
1067   \dbp@anglebetween\dbp@lrlalbl{\p{a}}{\p{b}}
1068   \pgfmathsetmacro\dbp@lrlangsup{acos(\dbp@lrlalbl/\dbp@radius/4)}
1069   \pgfmathsetmacro\dbp@lrlangone{
1070     modangl(\dbp@lrlalbl+\dbp@lrlangsup,\dbp@anga-90)-(\dbp@anga-90)}
1071   \pgfmathsetmacro\dbp@lrlangtwo{%
1072     (\dbp@angb-90)-modangr(\dbp@lrlalbl+180-\dbp@lrlangsup,\dbp@angb-90)}
1073   \pgfmathsetmacro\dbp@lrlangthree{360-2*(90-\dbp@lrlangsup)}
1074   \pgfmathsetmacro\dbp@lrlldist{
1075     angtodist(\dbp@lrlangone,\dbp@radius)
1076     +angtodist(\dbp@lrlangthree,\dbp@radius)
1077     +angtodist(\dbp@lrlangtwo,\dbp@radius)
1078   }
1079   \dbp@updateparams%
1080   {lrl}{\dbp@lrlldist}{\dbp@lrlangone}{\dbp@lrlangthree}{\dbp@lrlangtwo}
1081 }{}
1082
1083 % RLR (ar and br)
1084 \dbp@distancebetween\dbp@lrlrdarbr{\p{ar}}{\p{br}}
1085 \pgfmathtruncatemacro\dbp@lrlrok{(\dbp@lrlrdarbr<=4*\dbp@radius)?1:0}
1086 \ifnumequal{\dbp@lrlrok}{1}{
1087   \dbp@anglebetween\dbp@lrlrarbr{\p{ar}}{\p{br}}
1088   \pgfmathsetmacro\dbp@lrlrangsup{acos(\dbp@lrlrdarbr/\dbp@radius/4)}
1089   \pgfmathsetmacro\dbp@lrlrangone{
1090     (\dbp@anga+90)-modangr(\dbp@lrlrarbr-\dbp@lrlrangsup,\dbp@anga+90)}
1091   \pgfmathsetmacro\dbp@lrlrangtwo{%
1092     modangl(\dbp@lrlrarbr+180+\dbp@lrlrangsup,\dbp@angb+90)-(\dbp@angb+90)}
1093   \pgfmathsetmacro\dbp@lrlrangthree{360-2*(90-\dbp@lrlrangsup)}
1094   \pgfmathsetmacro\dbp@lrlldist{
1095     angtodist(\dbp@lrlrangone,\dbp@radius)
1096     +angtodist(\dbp@lrlrangthree,\dbp@radius)
1097     +angtodist(\dbp@lrlrangtwo,\dbp@radius)
1098   }
1099   \dbp@updateparams%
1100   {lrl}{\dbp@lrlldist}{\dbp@lrlrangone}{\dbp@lrlrangthree}{\dbp@lrlrangtwo}
1101 }{}
1102
1103 \endpgfinterruptpath
1104 };
1105 \endgroup
1106 }

```

16 Change History

v1.0	General: first version	44	General: add keys to fork a Sankey node during its creation	19
v2.0	General: first public version (on CTAN)	44	add the reproduction of an example from Google Charts documentation	32
v3.0	\sankeyturn*: simplification by using new <i>turn</i> macros	59	better naming rule	44
	\sankeyturnleft*: new macro	58	fix bad names in second example	28
	\sankeyturnleftbackward*: new macro	58	use .ins and .dtx files	44
	\sankeyturnright*: new macro	56	v3.0.1	
	\sankeyturnrightbackward*: new macro	57	General: fix options used by the new version of siunitx	43
			instructions for compiling and installing the package	43

17 Index

Numbers written in *italic* refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in *roman* refer to the code lines where the entry is used.

A	
anchor (key)	<i>5</i>
angle (key)	<i>5</i>
as (key)	<i>5</i>
at (key)	<i>5</i>
D	
\dbp@a	875, 925, 958, 959, 961, 963, 965, 968, 970, 972, 974, 984
\dbp@anga	808, 819, 829, 839, 848, 857, 877, 926, 980, 986, 987, 996, 1009, 1028, 1050, 1070, 1090
\dbp@angb	807, 809, 818, 820, 828, 830, 838, 840, 849, 858, 876, 928, 981, 988, 989, 997, 1010, 1030, 1052, 1072, 1092
\dbp@anglebetween	395, <u>792</u> , 994, 1007, 1024, 1046, 1067, 1087
\dbp@ax	793, 795, 798, 801
\dbp@ay	793, 795, 798, 802
\dbp@b	807, 818, 828, 838, 874, 927, 959, 961, 965, 968, 970, 974, 985
\dbp@bx	794, 795, 799, 801
\dbp@by	794, 795, 799, 802
\dbp@distancebetween	<u>797</u> , 995, 1008, 1021, 1043, 1064, 1084
\dbp@firstangle	812, 819, 829, 839, 848, 857, 879, 908, 947
\dbp@get	<u>897</u> , 931, 932, 933, 934
\dbp@getxy	<u>787</u> , 793, 794, 798, 799
\dbp@lastangle	810, 820, 830, 840, 849, 858, 878, 910, 948
\dbp@length	907, 918
\dbp@lradius	822, 823, 824, 833, 834, 842, 851, 853, 861, 882, 939, 942, 944
\dbp@lrl	<u>846</u> , 869
\dbp@lrlalbl	1067, 1070, 1072
\dbp@lrlangone	1069, 1075, 1080
\dbp@lrlangsup	<u>1068</u> , 1070, 1072, 1073
\dbp@lrlangthre	1073, 1076, 1080
\dbp@lrlangtwo	1071, 1077, 1080
\dbp@lrladalbl	1064, 1065, 1068
\dbp@lrlldist	1074, 1080
\dbp@lrllok	1065, 1066
\dbp@lsl	<u>816</u> , 865
\dbp@lslalbl	1007, 1009, 1010
\dbp@lslangone	1009, 1013, 1018
\dbp@lslangtwo	1010, 1015, 1018
\dbp@lsladalbl	1008, 1011
\dbp@lslldist	1012, 1018
\dbp@lslllen	1011, 1014, 1018
\dbp@lsr	<u>836</u> , 866
\dbp@lsralbr	1046, 1050, 1052
\dbp@lsranglesup	1047, 1050, 1052
\dbp@lsrangone	1049, 1055, 1060
\dbp@lsrangtwo	1051, 1057, 1060
\dbp@lsrdalbr	<u>1043</u> , 1044, 1048, 1053
\dbp@lsrdist	1054, 1060
\dbp@lsrlen	1053, 1056, 1060
\dbp@lsrok	1044, 1045
\dbp@method	880, 895, 906, 946
\dbp@middleparam	909
\dbp@midparam	852, 861, 949
\dbp@newa	874, 884
\dbp@newanga	876, 886
\dbp@newangb	877, 887
\dbp@newb	875, 885
\dbp@newfirstangle	878, 888
\dbp@newlastangle	879, 889
\dbp@newlradius	881, 890
\dbp@newmethod	880, 891
\dbp@newrradius	882, 890
\dbp@r	958
\dbp@radius	807, 818, 828, 838, 937, 944, 979, 986, 987, 988, 989, 1000, 1002, 1013, 1015, 1022, 1026, 1031, 1033, 1035, 1044, 1048, 1053, 1055, 1057, 1065, 1068, 1075, 1076, 1077, 1085, 1088, 1095, 1096, 1097
\dbp@rev@lrl	<u>868</u>
\dbp@rev@lsl	<u>864</u>
\dbp@rev@lsr	<u>866</u>
\dbp@rev@lrlr	<u>869</u>
\dbp@rev@rsl	<u>867</u>
\dbp@rev@rsr	<u>865</u>
\dbp@rlr	<u>855</u> , 868
\dbp@rlrangone	1089, 1095, 1100
\dbp@rlrangsup	1088, 1090, 1092, 1093
\dbp@rlrangthre	1093, 1096, 1100
\dbp@rlrangtwo	1091, 1097, 1100
\dbp@rlrarbr	1087, 1090, 1092
\dbp@rlrdarbr	1084, 1085, 1088
\dbp@rlrdist	1094, 1100
\dbp@rlrok	1085, 1086
\dbp@rradius
.....	812, 813, 814, 832, 843, 844, 852, 860, 862, 881, 938, 943, 944, 979
\dbp@rsl	826, 867
\dbp@rslanglesup	1025, 1028, 1030
\dbp@rslangone	1027, 1033, 1039
\dbp@rslangtwo	1029, 1035, 1039
\dbp@rslarbl	1024, 1028, 1030
\dbp@rslarbl	<u>1021</u> , 1022, 1026, 1031
\dbp@rslldist	1032, 1039
\dbp@rslllen	1031, 1034, 1039
\dbp@rsllok	1022, 1023
\dbp@rsr	<u>805</u> , 864
\dbp@rsrangone	996, 1000, 1004
\dbp@rsrangtwo	997, 1002, 1004
\dbp@rsrarbr	994, 996, 997
\dbp@rsrdarbr	995, 998
\dbp@rsrdist	999, 1004
\dbp@rsrlen	998, 1001, 1004
\dbp@setparams	<u>904</u> , 919, 1004
\dbp@store	<u>897</u> , 913
\dbp@storename	911, 913, 929
\dbp@updateparams
.....	<u>917</u> , 1017, 1038, 1059, 1079, 1099
debug (key)	<i>4</i>
draw/.style (key)	<i>4</i>
\dubinspath	357, 358, 361, 362, <u>870</u>
\dubinspathcalc	342, <u>953</u>
\dubinspathset	335, 343, 872, 883, <u>952</u> , 955

	E	595, 606, 607, 615, 616, 637, 648,
end (key)	7	649, 657, 658, 679, 690, 691, 699, 700
end style (key)	4	outin steps (key) 3
environment:		
sankeydiagram	2	
environments:		
sankeydiagram	228	
every diagram (key)	3	
every node/.style (key)	6	
	F	
fill/.style (key)	4	
fork anchor (key)	19	
forked (key)	19	
	I	
\ifpgfmathcond	783, 918	
	K	
key:		
anchor	5	
angle	5	
as	5	
at	5	
debug	4	
draw/.style	4	
end	7	
end style	4	
every diagram	3	
every node/.style	6	
fill/.style	4	
fork anchor	19	
forked	19	
minimum radius	3	
name	5	
new end style	4	
new start style	4	
outin steps	3	
quantity	5	
ratio	3	
ratio length	3	
ratio quantity	3	
rotate	3	
start	7	
start style	4	
	M	
minimum radius (key)	3	
	N	
\name	147,	
	155, 240, 241, 242, 244, 246, 247,	
	265, 267, 284, 287, 296, 298, 300,	
	304, 310, 468, 475, 488, 502, 504,	
	511, 514, 515, 517, 518, 525, 528,	
	529, 531, 532, 534, 547, 549, 550,	
	551, 552, 553, 558, 568, 575, 591,	
	593, 594, 595, 596, 597, 601, 610,	
	617, 633, 635, 636, 637, 638, 639,	
	644, 653, 659, 675, 677, 678, 679,	
	680, 681, 685, 694, 701, 745, 746,	
	748, 749, 752, 753, 755, 760, 761,	
	763, 764, 767, 768, 769, 771, 772, 773	
name (key)	5	
new end style (key)	4	
new start style (key)	4	
	O	
\orient 155, 242, 248, 268, 297, 298, 304,		
476, 489, 551, 563, 564, 573, 574,		
	595, 606, 607, 615, 616, 637, 648,	
	649, 657, 658, 679, 690, 691, 699, 700	
	P	
\pos	155, 286, 300, 553, 597, 639, 681	
	Q	
\qty . 155, 241, 245, 266, 276, 280, 296,		
334, 339, 347, 352, 371, 372, 399,		
477, 490, 550, 559, 569, 594, 603,		
612, 636, 645, 654, 678, 687, 696, 728		
quantity (key)	5	
	R	
ratio (key)	3	
ratio length (key)	3	
ratio quantity (key)	3	
rotate (key)	3	
	S	
\sankeyadvance	9, 497	
\sankeyadvance*	9, 497	
sankeydiagram (environment)	2, 228	
\sankeydubins	15, 328	
\sankeyend	18, 484	
\sankeyfork	20, 723	
\sankeygetnodeorient		
.	8, 31, 169, 222, 242, 310,	
	337, 338, 391, 407, 413, 421, 422,	
	430, 431, 440, 441, 448, 449, 458,	
	476, 489, 509, 523, 551, 595, 637, 679	
\sankeygetnodeqty 8, 29, 168, 216, 241,		
317, 318, 334, 371, 406, 412, 457,		
477, 490, 510, 524, 550, 594, 636, 678		
\sankeynode 5, 269, 287, 289, 397, 404,		
410, 460, 482, 495, 507, 521, 727, 728		
\sankeynodealias		
.	21, 454, 504, 549, 593, 635, 677	
\sankeynodeend	6, 494	
\sankeynodestart	6, 481	
\sankeyoutin	15, 365	
\sankeyqtytolen	8,	
	216, 245, 339, 347, 352, 372, 559,	
	569, 603, 612, 645, 654, 687, 696, 731	
\sankeyset	2, 66, 68, 82, 86, 93, 98,	
	104, 111, 116, 119, 154, 155, 165,	
	174, 183, 194, 200, 211, 263, 333,	
	370, 462, 463, 474, 487, 501, 546,	
	590, 632, 674, 726, 732, 739, 743, 758	
\sankeystart	18, 471	
\sankeyturn	10, 707	
\sankeyturn*	10, 707	
\sankeyturnleft	11, 623, 703, 718	
\sankeyturnleft*	11, 623	
\sankeyturnleftbackward 12, 661, 665, 714		
\sankeyturnleftbackward*	12, 665	
\sankeyturnright	13, 537, 619, 719	
\sankeyturnright*	13, 537	
\sankeyturnrightbackward		
.	14, 577, 581, 715	
\sankeyturnrightbackward*	14, 581	
\snk@added@values	253	
\snk@anchor	174, 284, 299, 300	
\snk@angle	542, 543, 544, 551,	
	553, 563, 564, 573, 574, 577, 586,	
	587, 588, 595, 597, 606, 607, 615,	
	616, 619, 628, 629, 630, 637, 639,	
	648, 649, 657, 658, 661, 670, 671,	
	672, 679, 681, 690, 691, 699, 700, 703	

<code>\snk@anglesign</code>	544, 545, 588,	523, 524, 528, 529, 531, 532, 548,
	589, 630, 631, 672, 673, 711, 713, 717	549, 557, 567, 592, 593, 602, 611,
<code>\snk@c</code>	286, 287, 289,	634, 635, 643, 652, 676, 677, 686, 695
	552, 553, 596, 597, 638, 639, 680, 681	<code>\snk@orient</code>
<code>\snk@checkquantities</code>	315, 331, 368	268, 270
<code>\snk@curpt</code>	418,	<code>\snk@outinmidptangle</code>
	419, 422, 423, 427, 428, 431, 432,	395, 400
	437, 438, 441, 442, 445, 446, 449, 450	<code>\snk@outinmidptname</code>
<code>\snk@diff</code>	276, 277	379,
		384, 385, 386, 394, 396, 398, 401
<code>\snk@endstyle</code>	104, 311, 312	<code>\snk@prevpt</code>
<code>\snk@errorifnotdefined</code>	46,	419,
	329, 330, 366, 367, 455, 472, 485,	421, 428, 430, 438, 440, 446, 448
	499, 539, 583, 625, 667, 709, 724	<code>\snk@ptnum</code>
<code>\snk@filldrawend</code>	309, 467, 491	393, 394
<code>\snk@filldrawstart</code>	303, 466, 478	<code>\snk@qtyi</code>
<code>\snk@forkanchor</code>	194, 256, 283, 284, 286	315
<code>\snk@getenddraw</code>	38, 312	<code>\snk@qtyii</code>
<code>\snk@getendfill</code>	38, 311	315
<code>\snk@getpos</code>	162, 229, 286,	<code>\snk@rotate</code>
	552, 553, 596, 597, 638, 639, 680, 681	82, 222, 248
<code>\snk@getstartdraw</code>	33, 306	<code>\snk@setenddraw</code>
<code>\snk@getstartfill</code>	33, 305	38, 115
<code>\snk@ifnodedefined</code>	43, 47	<code>\snk@setendfill</code>
<code>\snk@laststep</code>	374, 393, 429, 447	38, 114
<code>\snk@len</code>	245, 247, 372, 385, 386	<code>\snk@setnodeorient</code>
<code>\snk@listofforks</code>	194, 255, 274, 281, 288	31, 298, 458
<code>\snk@makeforkednode</code>	253, 465	<code>\snk@setnodeqty</code>
<code>\snk@makenode</code>	294, 464, 554, 598, 640, 682	29, 296, 457
<code>\snk@minradius</code>	86, 339, 346, 347, 352,	<code>\snk@setstartdraw</code>
	353, 552, 560, 561, 570, 571, 596,	33, 110
	604, 613, 638, 646, 655, 680, 688, 697	<code>\snk@setstartfill</code>
<code>\snk@modulo</code>	233, 235	33, 109
<code>\snk@newfield</code>	17, 29, 31, 33, 36, 38, 41	<code>\snk@show@debug</code>
<code>\snk@normalize@angle</code> 237, 468, 534, 575, 617, 659, 701
	160, 234, 297, 551, 595, 637, 679	<code>\snk@startstyle</code>
<code>\snk@oldname</code>	503, 504, 508,	104, 305, 306
	509, 510, 514, 515, 517, 518, 522,	<code>\snk@step</code>
		373, 377, 378
		<code>\snk@stepoutin</code>
		93, 373,
		374, 411, 420, 426, 428, 439, 444, 446
		<code>\snk@subnodename</code>
		253, 728
		<code>\snk@subnodeqty</code>
		253
		<code>\snk@tot</code>
		253
		<code>\snk@totallen</code>
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		<code>\snk@totalqty</code>
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		start (key)
		7
		start style (key)
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T		
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