VarTable

VarTable is a package to make variation table, in a simple way
This package is build on top of fletcher
(version : 0.1.0)

Contents

1 - Introduction

This package is designed to simplify the creation of variation tables for functions. To do this, it gives you a typst function, whose parameters are described in detail in this documentation.

A word of warning: it's quite normal that during the array creation process, The elements, such as the lines between the various elements, aren't created as they should be. For example, the line between the labels and the rest, which doesn't go all the way to the end.

If you encounter any bugs, please report them on my GitHub.

2 - tabvar function

2.1 - general description

tabvar

Render a variation table and sign table of your functions

Parameters

```
tabvar(
  init: dictionary,
  domain: array,
  tab-style: lenght color gradient,
  arrow-mark,
  arrow-style: style,
  line-0: bool,
  line-style: string,
  contents: array
)
```

init `dictionary`

initialitation of the table

- `variable` is a content block which contains the table's variable name (like x or t)
- `label` is an array of 2 arguments that contains in first position the line's label and in second position, if the line is a variation table or a sign table with this following keys : "Variation" and "Sign"

Example : for a variation table of a function f, you should write :

```
init: (
  variable: $x$,
  label: (
    ([sign of $f$], "Sign"), // the first line is a sign table
    ([variation of $f$], "Variation") // the second line is a variation table
  )
)
```

Default: `(`

```
    "variable": [],
    "label": [],
  )
```

domain `array`

values taken by the variable
for example if your funtions changes sign or reaches a max/min for $x \in \{0, 1, 2, 3\}$
you should write this :

```
domain: ($0$, $1$, $2$, $3$)
```

Default: `()`

tab-style `lenght` or `color` or `gradient`

Optional
The table's color and thickness
Caution : this stroke can take only lenght, color or gradient types but none of the others

Default: `(stroke: 1pt + black, mark: (symbol: none))`

arrow-style `style`

Optional
the arrow's color and thickness
Caution : this stroke can take only lenght, color or gradient types but none of the others

Default: `(stroke: black + 1pt)`

line-0 `bool`

Optional
if you want to change the default bar sign to a bar with a 0

Default: `false`

line-style `string`

Optional
if you want to change the style of all separator lines between signs

Warning: this will only change the default lines, the ||, | or 0 lines will not be changed.

Default: `(stroke: black + 1pt)`

contents `array`

the content of the table
see below for more details

Default: `((),)`

2.2 - The contents parameter

The contents parameter must be an array with one element per line (per label)

Each element is itself an array with one element per column, with a different format for either sign or variation rows

2.2.1 - Sign rows format

Should contain as much element as the domain less one (one per interval) + one optional end bar style element

Each element is in etheir of these form (can be mixed on a same line):

`()` – Empty : extend previous cell
`body` – Simple body such as `$+$` or `$-$`
`(body, bar_style)` – to specify an optional style for the **previous** bar, with one of `"|"` (simple bar), `"||"` (double bar) or `"0"` (bar with a zero)
NB: the `line-0` parameter change the default bar style to `"|"`

The optional last element is `"||"`

2.2.1.1 - A classical sign array

A sign array must contain contents like `$+$` or `$-$`, but you can put anything else.

Example :
A normal sign table :

```
#tabvar(
  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (($+$, $-$, $+$),),
)
```

t	2	4	6	8
sign	+	−	+	

More complex usage :

```
#tabvar(
  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
    (
      "Hello world !",
      $-$,
      $3/2$
    ),
  ),
)
```

t	2	4	6	8
sign	Hello world !	−	$\frac{3}{2}$	

Note : on the second example the table is squeezed with the scale function)

2.2.1.2 - Custom separation bar

2.2.1.2.1 style of bar

you can modify the style of the bars (note that this modifies all the default ones, not the others, see 2.2.1.2.2).

the bar style is passed as a string, like "-" for a plain bar or ".." for dotted lines, I invite you to read fletcher's documentation on marks to find out what can be done.

Example

```
#tabvar(
  marks-line: "--",
  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$,),
  contents: (
    ($+$, $-$),
  ),
)
```

t	2	4	6
sign	+	−	

PS: yes, technically these bars are arrows for fletcher but shhh, keep it to yourself to make tables that don't make sense.

2.2.1.2.2 type of bar

For all signs except the first one, instead of putting the sign directly, you can put a couple, whose first element defines the previous bar's type.
There are 3 differents types of bar :

- `"|"` : a simple bar
- `"0"` : a bar with a 0 on the center
- `"||"` : a double bar, like for the undefined values

NB : the marks-line parameter has no effect on these bars

Example :

```
#tabvar(
  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$, $8$, $10$),
  contents: (
    (
      $+$,
      ("|", $-$),
      ("0", $-$),
      ("||", $+$)
    ),
  ),
)
```

t	2	4	6	8	1
sign	+	−	0	−	+

Note : The `line-0` parameter is to default lines to `"0"` type or `"|"` type

If you want a double line at the start of the table, you can use a double bar `"||"` on the very first sign. If you want it at the end, you can add this element `"||"` at the end of sign array

Example :

```
#tabvar(

  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
    (
      ("||", $+$),
      $-$,
      "||"
    ),
  ),
)
```

t	2	4	6
sign	+	−	

2.2.1.3 - Same sign for more than one value of the variable

For this, it is pretty easy, instead of putting the sign directly, you can put an empty couple

Example :

```
#tabvar(

  init: (
    variable: $t$,
    label: (([sign], "Sign"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
    (
      $+$,
      (),
      $-$
    ),
  ),
)
```

t	2	4	6	8
sign	+		−	

2.2.2 - Variation table

Should contains as much elements as the domain
Each element is in etheir of these forms :

- `()` to extend the previous arrow
- `(position,body)` with position being one of top, center or bottom
- `(pos1, pos2, "||", body1, body2)` to put in 2 value separated by an undefined value (double bar)
- `(pos, "||", body)` shorthand for `(pos, pos, "||", body, body)` (see previous format)

2.2.2.1 - A classical variation array

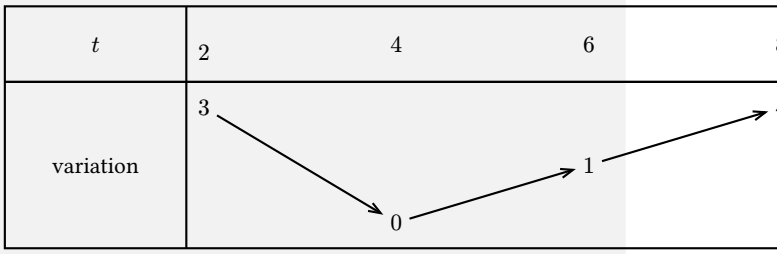
A variation array must contain couple with in first position, the element position, and in second position, whatever you want as long as it's of the contents type.

The position can be `top`, `center` or `bottom`, but no other type of alignment

Example :

```
#tabvar(

  init: (
    variable: $t$,
    label: (([variation], "Variation"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
    (
      (top, $3$),
      (bottom, $0$),
      (center, $1$),
      (top, $4$),
    ),
  ),
)
```



2.2.2.2 - Undefined values

If your function is not defined on some values like $f(x) = \frac{1}{x}$ for $x = 0$, you certainly want to put a double line meaning that the function is undefined on this value, and you can !

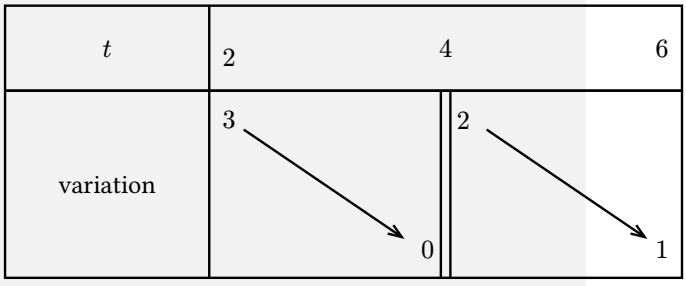
⋆ For each values of domain except the start and the end.

The array of one value should look like `(pos1, pos2, "||", contents1, contents2)`
where :

- pos1 and 2 is `top, center, bottom` and pos1 is for the placement of contents1 similary for pos2
- `"||"` is to precise the value is undefine
- contents1 and 2 is type of contents and contents1 one is for before the double bar and contents2 for after

Example :

```
#tabvar(
  init: (
    variable: $t$,
    label: (([variation], "Variation"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
    (
      (top, $3$),
      (bottom, top, "||", $0$, $2$),
      (bottom, $1$),
    ),
  ),
)
```

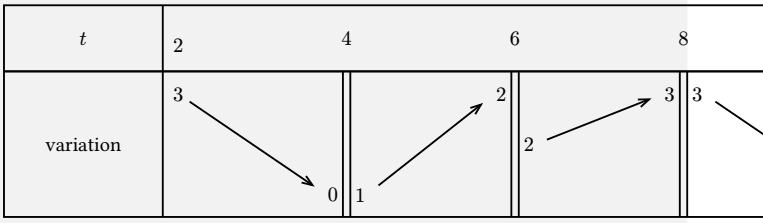


If `pos1` and `pos2` is same, you can just fill in one instead of two,
In the same way if `contents1` and `contents2` is same, you can also enter just one

Example :

Instead of `(top, top, "||" , $0$, $0$)` you can use `(top, "||" ,$0$)`

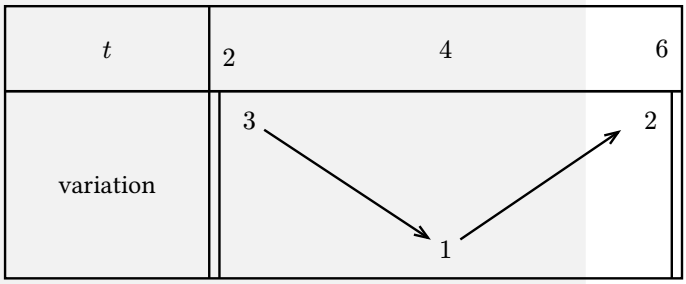
```
#tabvar(
  init: (
    variable: $t$,
    label: (([variation], "Variation"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
      (
        (top, $3$),
        (bottom, "||", $0$, $1$),
        (top, center, "||", $2$),
        (top, "||", $3$),
        (bottom, $1$),
      ),
  ),
)
```



⋆ For the first and the end values

It a basic array but with `"||"` this parameter at the array's center
For example `(top, "||", $3$)`

```
#tabvar(
  init: (
    variable: $t$,
    label: (([variation], "Variation"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
      (
        (top, "||", $3$),
        (bottom, $1$),
        (top, "||", $2$),
      ),
  ),
)
```

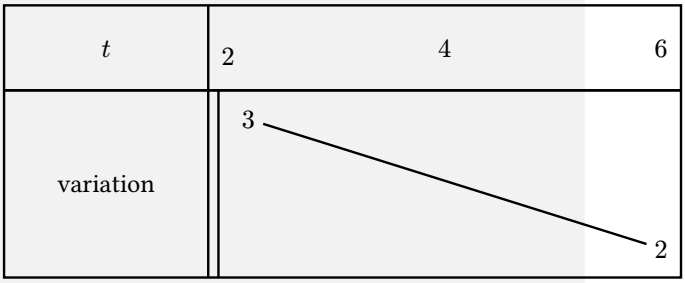


2.2.2.3 - Skip a value

When you want to use several functions in the same table, you will probably want to skip some values, to do this, as with sign arrays, you must create an empty array

Example :

```
#tabvar(
  init: (
    variable: $t$,
    label: (([variation], "Variation"),),
  ),
  domain: ($2$, $4$, $6$, $8$),
  contents: (
      (
        (top, "||", $3$),
        (),
        (bottom, $2$),
      ),
  ),
)
```



3 - More complex examples

Here is a little bundle of what you can do with the package.

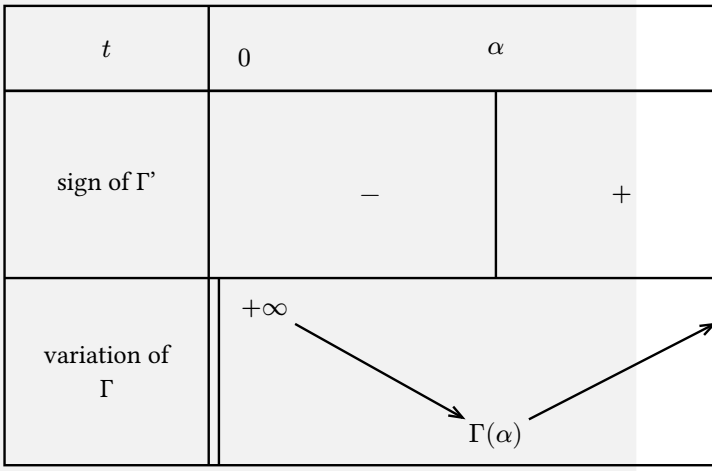
3.1 - Γ function on $[0;+\infty]$

Where it takes a minimum on $[0;+\infty[$ for $x=\alpha$

Code :

```
#tabvar(
    init: (
      variable: $t$,
      label: (
        ([sign of #sym.Gamma], "Sign"),
        ([variation of #sym.Gamma], "Variation"),
      ),
    ),
    domain: ($0$, $ alpha $, $ +oo $),
    contents: (
      ($-$, $+$),
      (
        (top, "||", $+oo$),
        (bottom, $Gamma(alpha)$),
        (top, $+oo$),
      ),
    ),
  )
```

Result :



3.2 - A Rational function

Take $f(x) = \frac{4x^2+12x+29}{4(x^2+3x+2)}$

So we have $f'(x) = \frac{-2x-3}{16(x^2+3x+2)^2}$

And finaly, we get:

Code:

```
#tabvar(
    init: (
      variable: $t$,
      label: (
        ([sign of $f'$], "Sign"),
        ([variation of $f$], "Variation"),
      ),
    ),
    domain: ($ -oo $, $ -2 $, $ -3 / 2 $, $ -1 $, $ +oo $),
    contents: (
      ($+$, ("||", $+$), $-$, ("||", $-$)),
      (
        (bottom, $1$),
        (top, bottom, "||", $+oo$, $-oo$),
        (top, $-20$),
        (bottom, top, "||", $-oo$, $+oo$),
        (bottom, $1$),
      ),
    ),
  )
```

Result:

t	$-\infty$		-2		$-\frac{3}{2}$		-1		$+\infty$
sign of f'	$+$		$+$		0	$-$	$\|\|$	$-$	
variation of f	1	↗	4	↗	-20	↘	$-\infty$	↘	$+\infty$ 1

3.3 Hyperbolic function

Code:

```
  #tabvar(
    arrow: "|-harpoon",
    stroke-arrow:
gradient.linear(..color.map.rainbow),
    marks-line: "..",
    init: (
      variable: $t$,
      label: (
        ([sign of $cosh$], "Sign"),
        ([variation of $cosh$], "Variation"),
        ([sign of $sinh$ and $tanh$], "Sign"),
        ([variation of $sinh$], "Variation"),
        ([variation of $tanh$], "Variation"),
      ),
    ),
    domain: ($ -oo $, $ 0 $, $ +oo $),
    contents: (
      ($-$, $+$),
      (
        (top, $+oo$),
        (bottom, $1$),
        (top, $+oo$),
      ),
      ($+$, ()),
      (
        (bottom, $-oo$),
        (),
        (top, $+oo$),
      ),
      (
        (bottom, $1$),
        (),
        (top, $-1$),
      ),
    ),
  )
```

Result:

t	$-\infty$		0		$+\infty$
sign of cosh	$-$		$+$		
variation of cosh	$+\infty$	$\searrow$	1	$\nearrow$	$+\infty$
sign of sinh and tanh	$+$				
variation of sinh	$-\infty$	$\nearrow$			$+\infty$
variation of tanh	1	$\nearrow$			-1

3.3 A weird table for a simple polynomial function

Take $g(t) = t^2 - t^3$
So, we have $g'(t) = 2t - 3t^2$
And has local extrema for $x = 0$ and $x = \frac{2}{3}$

Code:

```
#tabvar(

  stroke: 5pt + red,
  arrow: "X-*-<>",
  arrow-style: (stroke :purple + 1.4pt),
  marks-line: "<-->",
  init: (
    variable: $t$,
    label: (
      ([sign of $g'$], "Sign"),
      ([variation of $g$], "Variation"),
    ),
  ),
  domain: ($ -oo $, $ 0 $, $ 2 / 3 $, $ +oo $),
  contents: (
    ($-$, ("|", $+$), $-$),
    (
      (top, $+oo$),
      (bottom, $0$),
      (center, $ 4 / 27 $),
      (bottom, $-oo$),
    ),
  ),
)
```

Result: