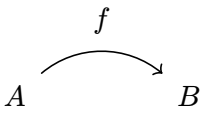


arrow-diagrams

A Typst package for drawing diagrams with arrows, built on top of CeTZ.

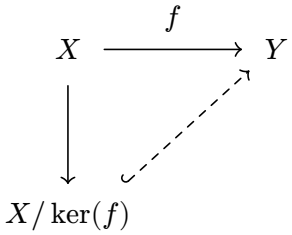
https://github.com/jollywatt/arrow-diagrams

Version 0.1.0

Contents

Examples

```
#arrow-diagram(
  cell-size: 10mm,
  node((0,1), $X$),
  node((1,1), $Y$),
  node((0,0), $X slash ker(f)$),
  conn((0,1), (1,1), $f$, "->"),
  conn((0,0), (1,1), "hook-->"),
  conn((0,1), (0,0), "->"),
)
```

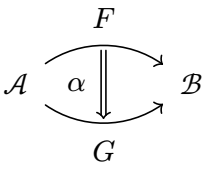


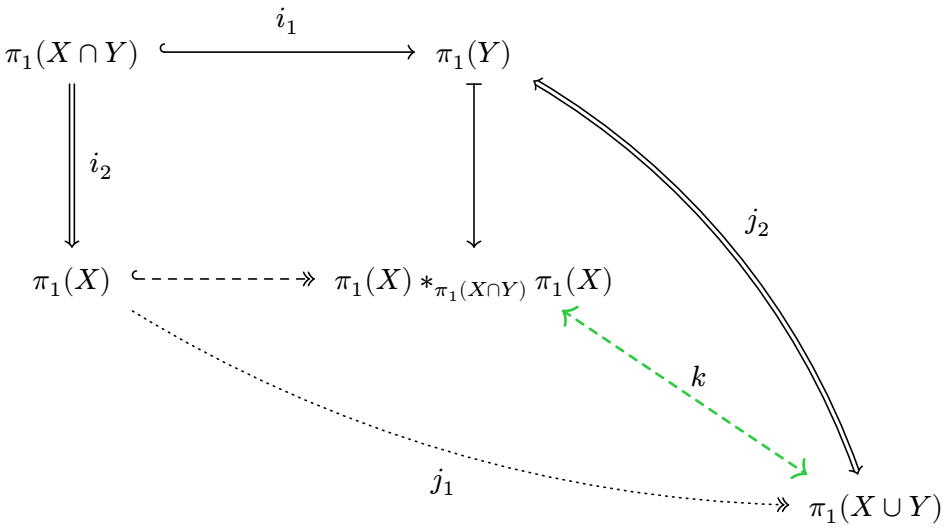

```
Inline $f: A -> B$ equation, \
Inline #arrow-diagram(node-pad: 4pt, {
  node((0,0), $A$)
  conn((0,0), (1,0), text(0.8em, $f$), "->", label-sep: 1pt)
  node((1,0), $B$)
}) diagram.
```

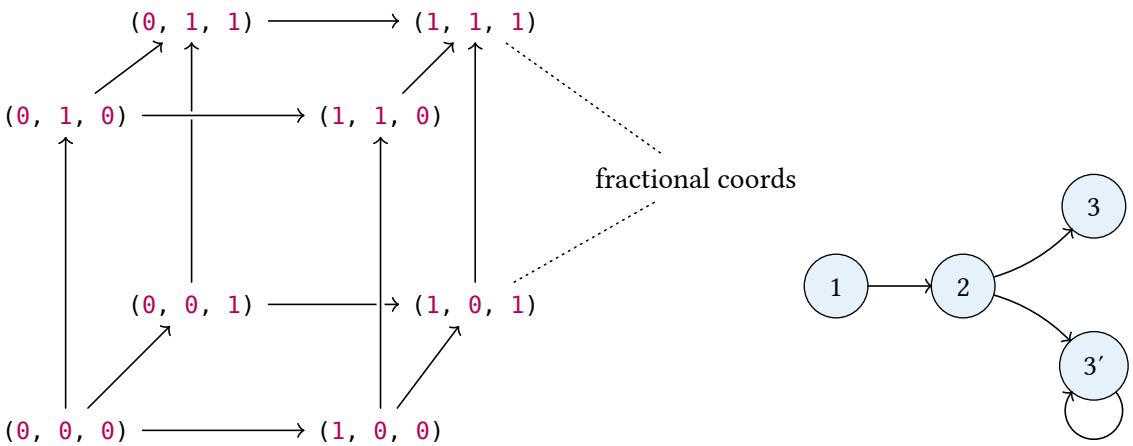
Inline $f : A \to B$ equation,

Inline $A \xrightarrow{f} B$ diagram.

```
#arrow-diagram(
  spacing: 2cm,
  node((0,0), $cal(A)$),
  node((1,0), $cal(B)$),
  conn((0,0), (1,0), $F$, "->", bend: +35deg),
  conn((0,0), (1,0), $G$, "->", bend: -35deg),
  conn((.5,+.21), (.5,-.21), $alpha$, "=>"),
)
```







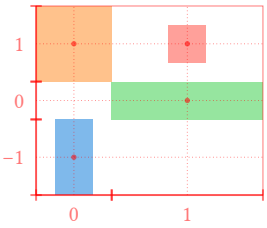
Details

Elastic coordinates

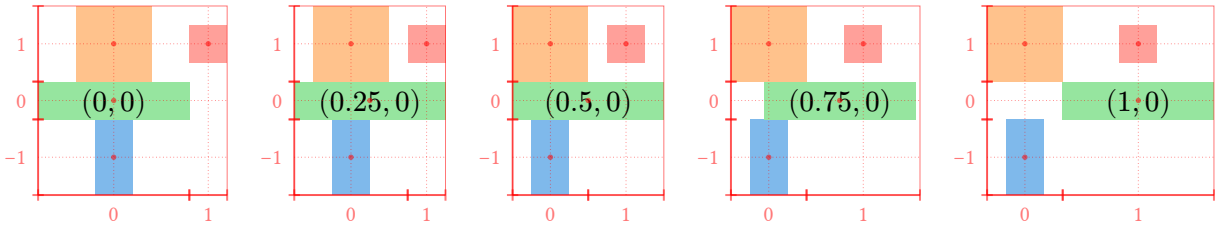
Diagrams are laid out on a flexible coordinate grid, which stretches to fit content like a table. When a node is placed, the rows and columns grow to accommodate the node's size.

This can be seen more clearly with a coordinate grid (`debug: 1`) and no padding between cells:

```
#let b(c, w, h) = box(fill: c.lighten(50%), width: w, height: h)
#arrow-diagram(
  debug: 1,
  spacing: 0pt,
  node-pad: 0pt,
  node((0,-1), b(blue,    5mm, 10mm)),
  node((1, 0), b(green,  20mm,  5mm)),
  node((1, 1), b(red,     5mm,  5mm)),
  node((0, 1), b(orange, 10mm, 10mm)),
)
```



While grid points are always at integer coordinates, nodes may have **fractional coordinates**. A node placed between grid points still causes the neighbouring rows and columns to grow to accommodate its size, but only partially, depending on proximity. For example, see how the column sizes change as the green box moves from $(0, 0)$ to $(1, 0)$:



Specifically, fractional coordinates are dealt with by linearly interpolating the layout, in the sense that if a node is at $(0.25, 0)$, then the width of column $\lfloor 0.25 \rfloor = 0$ is at least 75% of the node's width, and column $\lceil 0.25 \rceil = 1$ at least 25% its width.

As a result, diagrams will automatically adjust when nodes grow or shrink, while still allowing you to place nodes at precise coordinates.

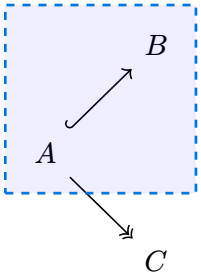
Physical coordinates

Elastic coordinates are determined by the sizes and positions of the nodes in the diagram, and are resolved into physical coordinates which are then passed to CeTZ for drawing.

You can convert elastic coordinates to physical coordinates with a callback:

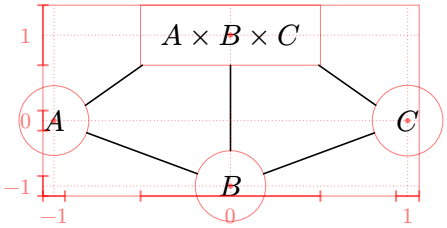
```
#import "@preview/cetz:0.1.2"
#arrow-diagram({
  let (A, B, C) = ((0,0), (1,1), (1,-1))
  node(A, $A$)
  node(B, $B$)
  node(C, $C$)
  conn(A, B, "hook->")
  conn(A, C, "->>")
  resolve-coords(A, B, callback: (p1, p2) => {
    cetz.draw.rect(
      (to: p1, rel: (-15pt, -15pt)),
      (to: p2, rel: (15pt, 15pt)),
      fill: rgb("00f1"),
      stroke: (paint: blue, dash: "dashed"),
    )
```

```
  })
})
```



Connectors

Lines between nodes connect to the node's bounding circle or bounding rectangle. The bounding shape is chosen automatically depending on the node's aspect ratio.



The `defocus` adjustment

For aesthetic reasons, a line connecting to a node should not necessarily be focused to the node's exact center, especially if the node is short and wide or tall and narrow. Notice how in the figure above the lines connecting to the node $A \times B \times C$ would intersect slightly above its center, making the diagram look more comfortable. The effect of this is shown below:

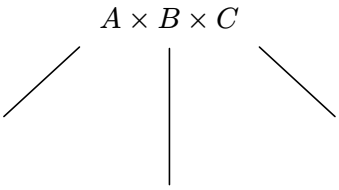


Figure 1: With defocus

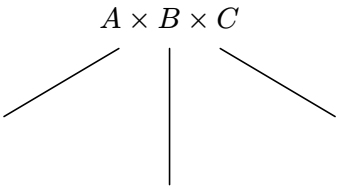
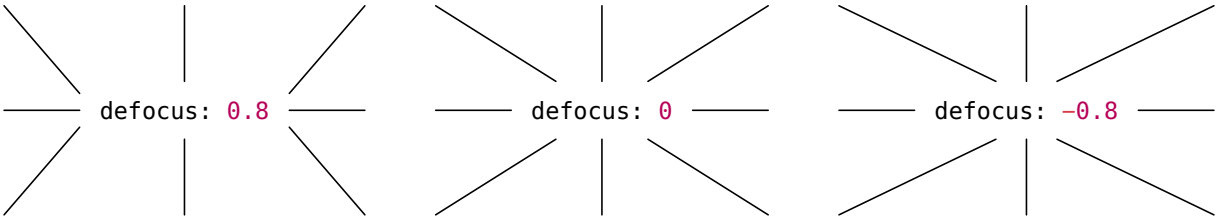


Figure 2: Without defocus

The amount is controlled by the `defocus` attribute of the diagram. It is best explained by example:



For `defocus: 0`, the connecting lines are directed exactly at the grid point at the node's center.

Function reference

`arrow-diagram()`

Draw an arrow diagram.

Parameters

```
arrow-diagram(
  ..objects: array,
  debug: bool 1 2 3,
  spacing: length pair of lengths,
  cell-size: length pair of lengths,
  node-pad: length pair of lengths,
  node-stroke: stroke,
  node-fill: paint,
  defocus: number
)
```

..objects `array`

An array of dictionaries specifying the diagram's nodes and connections.

debug `bool` or `1` or `2` or `3`

Level of detail for drawing debug information. Level 1 shows a coordinate grid; higher levels show bounding boxes and anchors, etc.

Default: `false`

spacing `length` or `pair of lengths`

Gaps between rows and columns. Ensures that nodes at adjacent grid points are at least this far apart (measured as the space between their bounding boxes).

Separate horizontal/vertical gutters can be specified with `(x, y)`. A single length `d` is short for `(d, d)`.

Default: `3em`

cell-size `length` or `pair of lengths`

Minimum size of all rows and columns.

Default: `0pt`

node-pad `length` or `pair of lengths`

Padding between a node's content and its bounding box.

Default: `15pt`

node-stroke `stroke`

Default stroke for all nodes in diagram. Overridden by individual node options.

Default: `none`

node-fill `paint`

Default fill for all nodes in diagram. Overridden by individual node options.

Default: `none`

defocus `number`

Strength of the defocus correction. `0` to disable.

Default: `0.2`

---

conn()

Draw a connecting line or arc in an arrow diagram.

Parameters

```
conn(
  from: elastic coord,
  to: elastic coord,
  ..args: any,
  label: content,
  label-side: left right center,
  label-pos: number,
  label-sep: number,
  label-anchor: anchor,
  paint: paint,
  thickness: length,
  dash: dash type,
  bend: angle,
  marks: pair of strings,
  double: bool,
  extrude: array of numbers,
  crossing: bool,
  crossing-thickness: number
)
```

from `elastic coord`

Start coordinate `(x, y)` of connector. If there is a node at that point, the connector is adjusted to begin at the node's bounding rectangle/circle.

to `elastic coord`

End coordinate `(x, y)` of connector. If there is a node at that point, the connector is adjusted to end at the node's bounding rectangle/circle.

..args `any`

The connector's `label` and `marks` named arguments can also be specified as positional arguments. For example, the following are equivalent:

```
conn((0,0), (1,0), $f$, "->")
conn((0,0), (1,0), $f$, marks: "->")
conn((0,0), (1,0), "->", label: $f$)
conn((0,0), (1,0), label: $f$, marks: "->")
```

label `content`

Content for connector label. See `label-side` to control the position (and `label-sep`, `label-pos` and `label-anchor` for finer control).

Default: `none`

label-side `left` or `right` or `center`

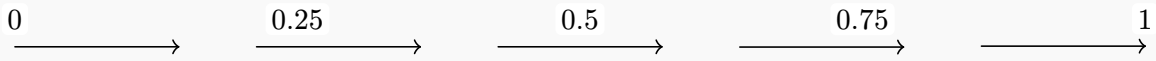
Which side of the connector to place the label on, viewed as you walk along it. If `center`, then the label is place over the connector. When `auto`, a value of `left` or `right` is chosen to automatically so that the label is

- roughly above the connector, in the case of straight lines; or
- on the outside of the curve, in the case of arcs.

Default: `auto`

label-pos `number`

Position of the label along the connector, from the start to end (from `0` to `1`).



Default: `0.5`

label-sep `number`

Separation between the connector and the label anchor.

With the default anchor (`"bottom"`):

With `label-anchor: "center"`:

Default: `0.4em`

label-anchor `anchor`

The anchor point to place the label at, such as `"top-right"`, `"center"`, `"bottom"`, etc. If `auto`, the anchor is automatically chosen based on `label-side` and the angle of the connector.

Default: `auto`

paint `paint`

Paint (color or gradient) of the connector stroke.

Default: `black`

thickness `length`

Thickness the connector stroke. Marks (arrow heads) scale with this thickness.

Default: `0.6pt`

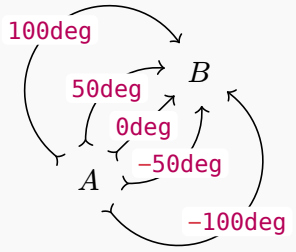
dash `dash type`

Dash style for the connector stroke.

Default: `none`

bend `angle`

Curvature of the connector. If `0deg`, the connector is a straight line; positive angles bend clockwise.



Default: `none`

marks `pair of strings`

The start and end marks or arrow heads of the connector. A shorthand such as `"->"` can used instead. For example, `conn(p1, p2, "->")` is short for `conn(p1, p2, marks: (none, "head"))`.

Arrow	Shorthand	Arguments
———	`-`	`(marks: (none, none))`
- - - - - -	`--`	`(marks: (none, none), dash: "dashed")`
·····	`..`	`(marks: (none, none), dash: "dotted")`
——→	`->`	`(marks: (none, "head"))`
⟸⟹	`<=>`	`(marks: ("head", "head"), double: true)`
↠- - - -→	`>>-->`	`(marks: ("twotail", "head"), dash: "dashed")`
⊦·····⊦	`|..|`	`(marks: ("bar", "bar"), dash: "dotted")`
↪——↠	`hook->>`	`(marks: ("hook", "twohead"))`
↪——↠	`hook'->>`	`(marks: ("hook'", "twohead"))`
↣——⥱	`>-harpoon`	`(marks: ("tail", "harpoon"))`
↣——⥲	`>-harpoon'`	`(marks: ("tail", "harpoon'"))`

Default: `(none, none)`

double `bool`

Shortcut for `extrude: (-1.5, 1.5)`, showing a double stroke.

Default: `false`

extrude `array of numbers`

Draw copies of the stroke extruded by the given multiple of the stroke thickness. Used to obtain doubling effect. Best explained by example:

`(0,)` `(-1.5, 1.5)` `(-2, 0, 2)` `(-4.5,)` `(4.5,)`

Notice how the ends of the line need to shift a little depending on the mark. For basic arrow heads, this offset is computed with `round-arrow-cap-offset()`.

Default: `auto`

crossing `bool`

If `true`, draws a white backdrop to give the illusion of lines crossing each other.

Default: `false`

crossing-thickness `number`

Thickness of the white "crossing" background stroke, if `crossing: true`, in multiples of the normal stroke's thickness.

Default: `5`

---

node()

Draw a labelled node in an arrow diagram.

Parameters

```
node(
  pos: point,
  label: content,
  pad: length none,
  shape: string auto,
  stroke: stroke,
  fill: paint
)
```

pos `point`

Dimensionless “elastic coordinates” `(x, y)` of the node, where `x` is the column and `y` is the row (increasing upwards). The coordinates are usually integers, but can be fractional.

See the `arrow-diagram()` options to control the physical scale of elastic coordinates.

label `content`

Node content to display.

pad `length` or `none`

Padding between the node’s content and its bounding box or bounding circle. If `none`, defaults to the `node-pad` option of `arrow-diagram()`.

Default: `none`

shape `string` or `auto`

Shape of the node, one of `"rect"` or `"circle"`. If `auto`, shape is automatically chosen depending on the aspect ratio of the node’s label.

Default: `auto`

stroke `stroke`

Stroke of the node. Defaults to the `node-stroke` option of `arrow-diagram()`.

Default: `auto`

fill `paint`

Fill of the node. Defaults to the `node-fill` option of `arrow-diagram()`.

Default: `auto`

`resolve-coords()`

Resolve coordinates and pass them to a callback function

Parameters

```
resolve-coords(
  ..args: point2f,
  callback: function
)
```

..args `point2f`

One or more dimensionless 2D points of the form `(x, y)`.

callback `function`

Function to be called with the resolved coordinates as arguments.

Default: `(..args) => none`

---

compute-grid()

Determine the number, sizes and positions of rows and columns.

Parameters

```
compute-grid(
  nodes,
  options
)
```

nodes

options

---

expand-fractional-rects()

Convert an array of rects with fractional positions into rects with integral positions.

If a rect is centered at a factional position `floor(x) < x < ceil(x)`, it will be replaced by two new rects centered at `floor(x)` and `ceil(x)`. The total width of the original rect is split across the two new rects according two which one is closer. (E.g., if the original rect is at `x = 0.25`, the new rect at `x = 0` has 75% the original width and the rect at `x = 1` has 25%.) The same splitting procedure is done for `y` positions and heights.

Parameters

`expand-fractional-rects(rects: array of rects) -> array of rects`

rects `array of rects`

An array of rectangles of the form `(pos: (x, y), size: (width, height))`. The coordinates `x` and `y` may be floats.

---

round-arrow-cap-offset()

Calculate cap offset of round-style arrow cap

Parameters

```
round-arrow-cap-offset(
  r: length,
  θ: angle,
  y: length
)
```

r `length`

Radius of curvature of arrow cap.

θ `angle`

Angle made at the the arrow's vertex, from the central stroke line to the arrow's edge.

y `length`

Lateral offset from the central stroke line.

`get-arc-connecting-points()`

Determine arc between two points with a given bend angle

The bend angle is the angle between chord of the arc (line connecting the points) and the tangent to the arc and the first point.

Parameters

```
get-arc-connecting-points(
  from: point,
  to: point,
  angle: angle
)
```

from `point`

2D vector of initial point.

to `point`

2D vector of final point.

angle `angle`

The bend angle between chord of the arc (line connecting the points) and the tangent to the arc and the first point.