# Meander User guide

### **Abstract**

Meander implements a content layout algorithm to provide text threading (when text from one box spills into a different box if it overflows), uneven columns, and image wraparound.

### Feature requests

For as long as the feature doesn't exist natively in Typst (see issue: github:typst/typst #5181), feel free to submit test cases of layouts you would like to see supported by opening a new issue.

### **Versions**

- dev
- 0.2.0 (latest)
- 0.1.0

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Lipsum

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### I Quick start

The main function provided is #meander.reflow, which takes as input a sequence of "containers", "obstacles", and "flowing content", created respectively by the functions #container, #placed, and #content. Obstacles are placed on the page with a fixed layout. After excluding the zones occupied by obstacles, the containers are segmented into boxes then filled by the flowing content.

### I.a A simple example

Below is a single page whose layout is fully determined by Meander. Currently multi-page setups are not supported, but this is definitely a desired feature.

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Meander is expected to respect the majority of styling options, including headings, paragraph justification, font size, etc. Notable exceptions are detailed in Section VI. If you find a discrepancy make sure to file it as a bug report if it is not already part of the known limitations.

Note: paragraph breaks may behave incorrectly. You can insert vertical spaces if needed.

### I.b Multiple obstacles

#meander.reflow can handle as many obstacles as you provide (at the cost of potentially performance issues if there are too many, but experiments have shown that up to ~100 obstacles is no problem).

```
#meander.reflow({
  import meander: *
  // As many obstacles as you want
  placed(top + left, my-img-1)
  placed(top + right, my-img-2)
  placed(horizon + right, my-img-3)
  placed(bottom + left, my-img-4)
  placed(bottom + left, dx: 32%,
         my-img-5)
  // The container wraps around all
  container()
  content[
    #set par(justify: true)
    #lorem(600)
  1
})
```

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### I.c Columns

In order to simulate a multi-column layout, you can provide several container invocations. They will be filled in the order provided.

```
#meander.reflow({
   import meander: *
   placed(bottom + right, my-img-1)
   placed(center + horizon, my-img-2)
   placed(top + right, my-img-3)

// With two containers we can
// emulate two columns.
   container(width: 55%)
   container(align: right, width: 40%)
   content[#lorem(600)]
})
```

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### II Showcase

A selection of nontrivial examples of what is feasible.

seminar.sty
is a LaTeX style
for typesetting slides
or transparencies, and accompanying notes. Here are
some of its special features: It is
compatible with AmS-LaTeX, and you
can use PostScript and AmS fonts. Slides can
be landscape and portrait. There is support for
color and frames. The magnification can be changed
easily. Overlays can be produced from a single slide environment. Accompanying notes, such as the
text of a presentation, can be put outside the
slide environments. The slides, notes or both
together can then be typeset in a variety of formats.

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examples/5181-a/main.typ
Inspired by github:typst/typst #5181 (a)

examples/5181-b/main.typ
Inspired by github:typst/typst #5181 (b)

## III Understanding the algorithm

The same page setup as the previous example will internally be separated into

- obstacles my-img-1, my-img-2, and my-img-3.
- containers #(x: 0%, y: 0%, width: 55%, height: 100%) and #(x: 60%, y: 0%, width: 40%, height: 100%)
- flowing content #lorem(600).

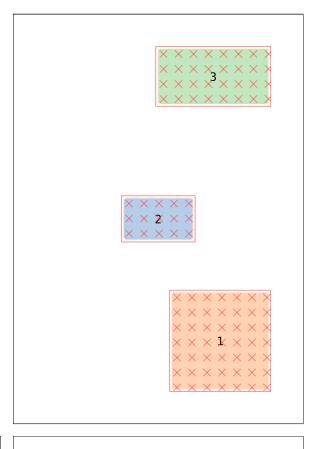
Initially obstacles are placed on the page  $(\rightarrow)$ . If they have a boundary parameter, it recomputes the exclusion zone.

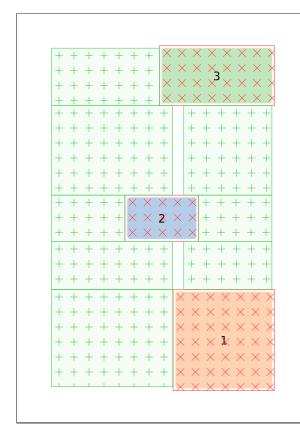
Then the containers are placed on the page and segmented into rectangles to avoid the exclusion zones  $(\downarrow)$ .

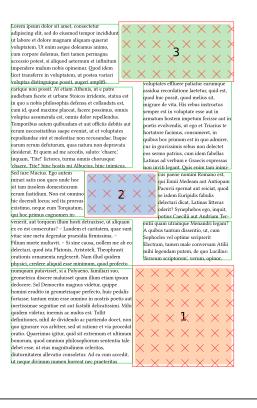
Finally the flowing content is threaded through those boxes (\( \)), which may be resized vertically a bit compared to the initial segmentation.

The debug views on this page are accessible via #meander.regions and

#meander.reflow.with(debug: true)





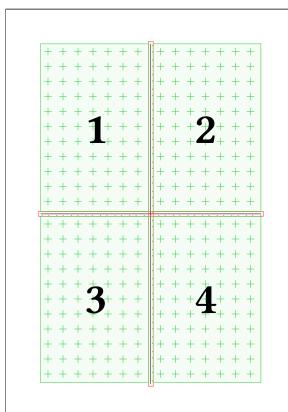


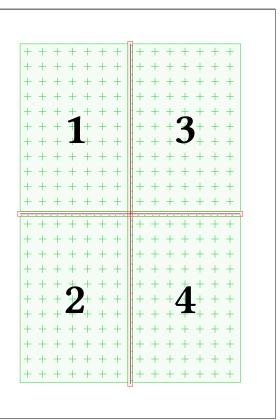
The order in which the boxes are filled is in the priority of

- · container order
- $top \rightarrow bottom$
- left  $\rightarrow$  right

which has implications for how your text will be laid out. Indeed compare the following situations that result in the same boxes but in different orders:

```
#meander.regions({
                                            #meander.regions({
  import meander: *
                                              import meander: *
  placed(center + horizon,
                                              placed(center + horizon,
    line(end: (100%, 0%)))
                                                line(end: (100%, 0%)))
  placed(center + horizon,
                                              placed(center + horizon,
    line(end: (0%, 100%)))
                                                line(end: (0%, 100%)))
  container(width: 100%)
                                              container(width: 50%)
                                              container(align: right, width: 50%)
})
                                            })
```





And even in the example above, the box 1 will be filled before the first line of 2 is used. In short, Meander does not "guess" columns. If you want columns rather than a top-bottom and left-right layout, you need to specify them.

### IV Advanced techniques

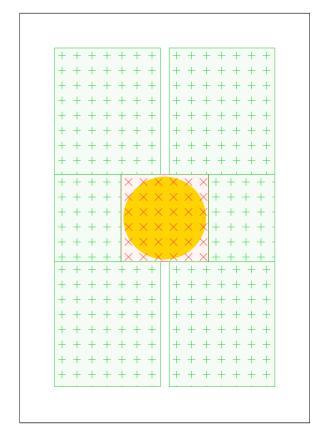
Although Meander started as only a text threading engine, the ability to place text in boxes of unequal width has direct applications in more advanced paragraph shapes. This has been a desired feature since at least issue #5181.

Even though this is somewhat outside of the original feature roadmap, Meander makes an effort for this application to be more user-friendly, by providing functions to redraw the boundaries of an obstacle. Here we walk through these steps.

Here is our starting point: a simple double-column page with a cutout in the middle for an image.

```
#meander.reflow({
   import meander: *
   placed(center + horizon)[#circle(radius: 3cm, fill: yellow)]
   container(width: 48%)
   container(align: right, width: 48%)

content[
    #set par(justify: true)
    #lorem(600)
]
})
```



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Meander sees all obstacles as rectangular, so the circle leaves a big ugly square hole in our page.

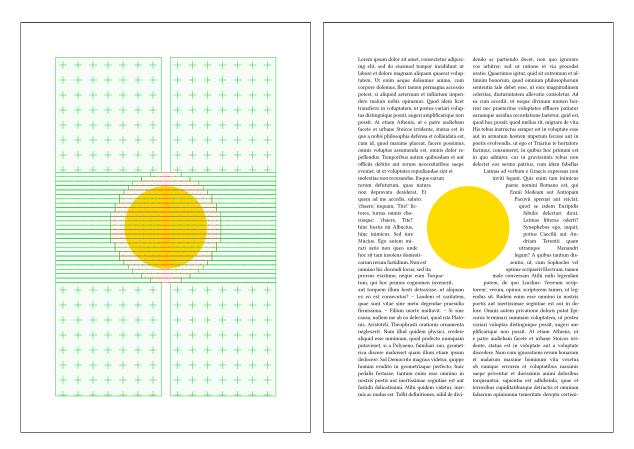
Fear not! We can redraw the boundaries. #meander.placed accepts as parameter boundary a sequence of box transformers to change the way the object affects the layout. These transformations are normalized to the interval [0,1] for convenience. The default boundary value is #contour.margin(5pt).

#meander.contour.grid is one such redrawing function, from  $[0,1] \times [0,1]$  to bool, returning for each normalized coordinate (x, y) whether it belongs to the obstacle.

So instead of placing directly the circle, we write:

```
#meander.reflow({
  import meander: *
  placed(
    center + horizon,
    boundary:
      // Override the default margin
      contour.margin(1cm) +
      // Then redraw the shape as a grid
      contour.grid(
        // 25 vertical and horizontal subdivisions (choose whatever looks good)
        div: 25,
        // Equation for a circle of center (0.5, 0.5) and radius 0.5
        (x, y) \Rightarrow calc.pow(2 * x - 1, 2) + calc.pow(2 * y - 1, 2) \Leftarrow 1
      ),
    // Underlying object
    circle(radius: 3cm, fill: yellow),
  )
  // ...
})
```

This results in the new subdivisions of containers below.



This enables in theory drawing arbitrary paragraph shapes. If your shape is not convenient to express through a grid function, here are the other options available:

•  $vert(div: \_, fun):$  subdivide vertically in div sections, then fun(x) = (top, bottom) produces an obstacle between top and bottom.

- height(div: \_, flush: \_, fun): subdivide vertically in div sections, then fun(x) = (anchor, height) produces an obstacle of height height, with the interpretation of anchor depending on the value of flush:
  - if flush = top then anchor will be the top of the obstacle;
  - if flush = bottom then anchor will be the bottom of the obstacle;
  - if flush = horizon then anchor will be the center of the obstacle.
- horiz: a horizontal version of vert.
- width: a horizontal version of height.

Reminder: all of these functions operate on values normalized to [0, 1]. See some examples below.

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```
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— Filium morte multavit. — Si sine causas, nollem me ab eo delecturi, qud ista Platonis, Aristoteli, Theophratis orianis orianenta negleeerii. Nam illu quiedim physici, credere alquide esse minimum, quod profecto numquam putavisset, si a Polyaeno, familiari suo, geometrica discere maluisset quam illum etiam ipsum dedocere. Sol Demecrito magnus videtur, quiedo stati in delicatissimi, Milti quidem videtur, nermi as e madus est. Tolli definitiones, nihil delicatismi, molitar quiedo prosesti, quori arrivate, quod buc possit, quori servina delicati, alima li dependam putem, de quoti desti auti retentia quod est delicati, alima li depotis auti intrusi tale de
```

```
#meander.reflow({
  import meander: *
  placed(right + bottom,
    boundary:
      // The right aligned edge makes
      // this easy to specify using
      // `horiz`
      contour.horiz(
        div: 20,
        // (left, right)
        y => (1 - y, 1),
      // Add a post-segmentation margin
      contour.margin(5mm)
  )[...]
  // ...
})
```

```
#meander.reflow({
  import meander: *
  placed(center + bottom,
    boundary:
      // This time the vertical symetry
      // makes `width` a good match.
      contour.width(
        div: 20,
        flush: center,
        // Centered in 0.5, of width y
        y => (0.5, y),
      ) +
      contour.margin(5mm)
  )[...]
 // ...
})
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim acque dolorams animo, cum corpore dolerams, ferit tamen permagna accessio potest, si aliquo da etternum et infinitum impendere malum mobis opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguiuse possit, augeri amplificacique non possit. At etiam Athenis, ut e pater audiebam facete et urbane Stocios risidente, statua est in quo a nobis philosophia defensa et collaudata est, cum id, quod maxime placest, facere possimus, omnis voluptas assumenda est, monis dolor repellendas. Temporibus auter quabudam et aut officia debitis aut rerum necessitatibus suspe evente, ut et voluptates repudlandes sint et molettate non recusandae. Lague earum reme defenturum, quae natura non depravata dosidera. El guema di me accedis, saluto: 'chaere; 'inquam, 'Tite!' lictores, turma omnis chorusque: 'chaere, 'Tite!' hinc hostis mi Albucius, hine inimicus. Sed inre Mucius. Ego autem mirari suti non quest unde hos at tum insolera domenticarum rerum factifuium. Non est cominio his choerali locus; sed ita prorsus existimo, neque euri Torquatum, qui hoe primus cogionnes invenerit, aut torquem illum hostie draxisses, ut alquam ex co est consecutiva?—Laudem et cartafistem, quae sum vitue sine metu degendae praesida firmissima. "Filium morte mulavit." – Si sine cusus, nollem me al vo defectari, quoi star Palentia, Aristotich. Theophrasti routionis ornamenta neglexerit. Nami illud quidem physic, credere aliquid esse minimum, quol profecto numquam putavistes, si a Polyane, familiari suo, geometrias diexere mulaiser quam illum etiam ipsum debecere. Sol Democrito nagnus videtur, quippe homini erudito in geometriaque perfecto, huis pedali fortasse; tuntum emi enae cominio in nostris poets aut inertissimae segnitiae est aut fastidi delicutissimi. Mihi quidem videturi, termisa en audus est. Toliit definitiones, nili del dividendo ac partiendo docet, non quo ignorare utranque Menandri legam? A quibus tantum dissentio, ut, cum Sophocles vel optime scripserti Electran, tanem nale conversam Attili milu legendam putent, de quo Lacillus 'Ferreum scriptorem', verum, opinor, scriptorem hamen, ut legendus sit. Budem entim esse omnino in nostris poets aut intertissiame seguitiae est aut in dolore. Omnis autem privatione doloris putat. Epicurus terminari summam voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e patre audebam facete et urbame Solicos irridente, statua et in voluptate aut a voluptate discodere. Nam cum ingoration rerum honarum et malentim maxime hominum vita vecetur, ob eumque errorem et voluptatibus maximis suepe priventur et durissimis aimi doloribus torqueaturs, aspientate est adhienda, quae et terroribus cupilatibusque detractis et omnium falsarum opinionum temeritate derepta certissimam se nobis ducem praebeat ad voluptatem. Sepientia emin est uma, quae meastitam pellate ex aninis, quae nos exforrescere metu non sinat. Qua praeceptrice in tranquillitate vivi potest omnium cupiditatum ardore restincto. Cupiditates enim sunt

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere malum nobis opinemus. Quoi diem lett transferre in voluptatem, ut postes variari voluptas distinguique posts, augeri amplificarique non possit. At etiam Athenis, ut e patre audiebam facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et colladata est, cum id, quod maxime placeat, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officials debitas aut rerum mecastitablus saepe evenie, ut et voluptates repudiandas ent em dolestale non recusandae. Itaque earum rerum defuturum, quas natura non depravata desiderat. Et quem ad mecacedis, saluto-chaere; inquam. Tite! lictores, tumos monis chorsuse; chaere, Tite! historis mi Albucius, hine inimicus. Sed iure Mueixa. Ego autem mirari satis non queo unde hoe sit tam insolens domesticarum rerum fastidium. Non est omnino hi decordi locus sed fila prorass estitinos, neque eum Torquatum, qui hoe primus cognomen invaerit, aut torquem llum hosti inderacis quae silquam es eve et concectura! — Laudem et caristitem, quae sunt vitae sine metu degendae praesidia firmissima. — Filium morte multavit. — 5 si sine causa, nollem me ab eo delectari, quod stas Platoria, Artistochi. Theophrastic cardionis ormanetan neglecerit. Nam iliad quideem physici, creclere aliquid esse minimum, quod profecto munquam putvisses, i a Polyseno, familiari son, geometrica discreen muliasset quam ilium etiam ipsum dedocere. Sol Democrito magnus videtur, quipe homini erudito in geometriaque perfecto, huic pedalis fortasse; tantum emi mes eminomo rare voa arbitres, sed ut ratione et via proceda toratio. Quaerimus igitur, qui sit extremum et ultimum homorum, quod omnium philosophorum senentiala tied elet-esse, ut eius angritudinem ecleritas, duturunitate

```
#meander.reflow({
  import meander: *
  placed(left + horizon,
    boundary:
      contour.height(
        div: 20,
        flush: horizon,
        x => (0.5, 1 - x),
      contour.margin(5mm)
  )[...]
  // ...
})
```

```
#meander.reflow({
  import meander: *
  placed(left + horizon,
    boundary:
      contour.horiz(
        div: 25,
        y => if y <= 0.5 {
          (0, 2 * (0.5 - y))
        } else {
          (0, 2 * (y - 0.5))
        },
      ) +
      contour.margin(5mm)
 )[...]
  // ...
```

The contouring functions available should already cover a reasonable range of use-cases, but if you have other ideas you could always try to submit one as a new issue.

There are of course limits to this technique, and in particular increasing the number of obstacles will in turn increase the number of boxes that the layout is segmented into. This means

- performance issues if you get too wild (though notice that having 20+ obstacles in the previous examples went completely fine, and I have test cases with up to ~100)
- text may not fit in the boxes, and the vertical stretching of boxes still needs improvements.

In the meantime it is highly discouraged to use a subdivision that results in obstacles much smaller than the font height.

# V Modularity (WIP)

Because meander is cleanly split into three algorithms (content segmentation, page segmentation, text threading), there are plans to provide

- configuration options for each of those steps
- the ability to replace entirely an algorithm by either a variant, or a user-provided alternative that follows the same signature.

### VI Style-sensitive layout

Meander respects most styling options through a dedicated content segmentation algorithm. Bold, italic, underlined, stroked, highlighted, colored, etc. text is preserved through threading, and easily so because those styling options do not affect layout much.

There are however styling parameters that have a consequence on layout, and some of them require special handling. Some of these restrictions may be relaxed or entirely lifted by future updates.

### VI.a Paragraph justification

In order to properly justify text across boxes, Meander needs to have contextual access to #par.justify, which is only updated via a #set rule.

```
As such do not use #par(justify: true)[...].
```

Instead prefer #[#set par(justify: true); ...], or put the #set rule outside of the invocation of #meander.reflow altogether.

# Wrong

### Correct

```
#meander.reflow({
    // ...
    content[
        #set par(justify: true)
        #lorem(600)
    ]
})
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fiert lamen permagna accessio potest, si aliquod aetrum et infinitum impendere malum nobils opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e patre audichem facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et collaudata est, cum id, quod maxime placeat, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autre equal valuation and autoribus defensa et collaudata est, cum id, quod maxime placeat, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autra en qualvadam et aut officiis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandase intet molestiae non recusandae. Itaque earum rerum defutrum, quas natura non depravata desiderat. Et quem ad me accedis, saluto: 'chaerec', inquam. Tite' lictores, turma omnis chorusque: 'chaere. Tite' hin hostis ind Albucius, hin ciminus. Sed iur Muchus. Ego autem mirari astis non que oune hoe sit tam insolens domesticarum rerum fastidium. Non est omnino hio docendi locus; sed ita prorsus estatum in collection de locus; sed ita prorsus estatum in entre abe o delectari, undo ista elaridate desiderat. I aliquam ex o est consecutus? - Laudem et caritatem, quae sunt vitae sine metu degendae learesidati firmissium. - Filium motem multavit. - Si isac cuasa, nollem me abe o delectari, undo ista Platonis, Aristoteli, Theophrasti orationis ornamenta neglescrit. Nami illud quidem physici, credere adiquid esse minimum, quod profecto numquam putatiseste, si a Polyaeno, familiari suo, geometrica discere maluisset quami illum etiam ipsum dedocere. Sol Democrito magnus videtur, quippe homini erudito in geometriaque perfecto, hui pedials fortases: tantum enime seo enominio ni nostiri

### VI.b Font size

The font size indirectly affects layout because it determines the spacing between lines. When a linebreak occurs between containers, Meander needs to manually insert the appropriate spacing there. Since the spacing is affected by font size, make sure to update the font size outside of the #meander.reflow invocation if you want the correct line spacing.

As such, it is currently discouraged to do large changes of font size in highly segmented regions from within the invocation. A future update will provide a way to do this in a more well-behaved manner.

# Wrong

```
#meander.reflow({
    // ...
    content[
        #set text(size: 30pt)
        #lorem(600)
    ]
})
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere malum nobis opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e patre audiebam facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et collaudata est, cum id, quod maxime placeat, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum defuturum, quas natura non depravata desiderat. Et

# Correct

```
#set text(size: 30pt)
#meander.reflow({
    // ...
    content[
        #lorem(600)
    ]
})
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere malum nobis opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e patre audiebam facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et collaudata est, cum id, quod maxime placeat, facere possimus,

### VI.c Hyphenation and language

The language is not yet configurable. This feature will come soon.

Hyphenation can only be fetched contextually, and highly influences how text is split between boxes. Thus hyphenation can currently only be enabled or disabled outside of the #meander.reflow invocation. A future update will provide a means to change it more locally.

# Wrong

```
#meander.reflow({
    // ...
    content[
        #set text(hyphenate: true)
        #lorem(600)
    ]
})
```

# Correct

```
#set text(hyphenate: true)
#meander.reflow({
    // ...
    content[
        #lorem(600)
    ]
})
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus antino, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinituim impendere malum nobis opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e parte audiebam facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et collusadata est, cum id, quod maxime placest, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum defutruum, quas natura non depravata desiderat. Et quem ad me accedis, saluto: 'chaerer, inquam. Tite! lictores, turma omnis chorusque: 'chaerer. Tite!' hinc hostis mi Albucius, hinc iminisue. Sed urb Mucius. Ego autem miriar salts non quee unde hoe sit tam insolens domesticarum rerum fastidium. Non est omnino hic docendi locus; sed ita prorsus existimo, neque eum Torquatum, qui hoc primus cognomen invenerit, aut torquem illum hosti detraxisse, ut aliquam ex o est consecutus?'—Laudem et caritatem, quue sunt vitae sine metu degendae praesidis firmissima.—Filium motter multavit.—5 si asine causa, nollem me abe o debectari, quod ista Platonis, Aristoteli, Theophrasti orationis orasamenta neglexerit. Nam Illud quidem physici, credere aliquid esse minimum, quod profetor numquam putavises, et al Polyacon, familiari suo geometrica discree maluiset quam illum etiam ipsum dedocere. Sol Democrito magnus videtur, quippe homini erudito in geometriaque perfecto, buic pedalis fortasse; tantum enim esse onmino in nostris poetis aut inertissimae segnitiae est auf fastidii delicatissimi. Mihi quidem videtur, inermis ae mulus est. Tolli definitiones, mili dei dividendo ae partiendo docet, non quo ignorare

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eisumod tempor incididunt ut labore et dolore magnam aliquum quaerati voluptatem. Ul enim aeque doloemus animo, cum corpore dolemus, ferit tumen permagna accessio poteste, si aliquod aeterum et infinitum impendere nulum nobis opinemus. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificacique non possit. Actient ant Athenis, ut e potestea variari voluptas distinguique possit, augeri amplificacique non possit al ceitam Athenis, ut esperalendus. Temportubus attem quibusdam et aut officis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandae et aut officis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandae vint et molestiae non recusandae. Ilaque carum rerum defutturum, quae natura non depravata desident. El gene and me accedis, saluto: 'chaere, 'inquam, Titel' lictores, turma omnis chorusque: 'chaere, Titel' hinc hostis mi Albucis, hia intimicus. Sed nute micusia. Sego autem mirari satis non que unde hoe sit tan insolem do-mesticarum rerum fastidium. Non est omnino hic docendi locus; sed ita prorsus existimo, neque eum Torquatum, qui hoe primus cognome invenerit, aut troquem illum hosti detraxisse, ut aliquam ex co est consecutus?' – Laudem et caritatem, quae sunt vitae sine metu degendae praesidis firmissima. – Flictium motre multivit. — Si sine causa, nollem me a be o delectari, qued ista Palonis, Aristoteli, Theophrasti orationis ornamenta neglexerit. Nam Illud quidem physici, credere aliquid esse minimum, quod profecto numquum patavisce, is a Polyaeno. familiari suo geometrica discere multivatie est aut fastidi delicatissimi. Mili quidem videtur, inermis a ruudus est. Tollit definitiones, nihil de dividendo appartiendo doce, non quo ignorer vos orabiters, est uri tasio est videritiine est aut fastidi delicatissimi. Mili quidem videtur, inermis a ruudus est. Tollit definitiones, nihil de dividendo appartiendo doce, non quo ignorer vos orabiters,

### VII Module details

### VII.a Geometry (geometry.typ)

Generalist functions for 1D and 2D geometry.

- clamp()
- between()
- intersects()
- resolve()
- align()

### clamp

Bound a value between min and max. No constraints on types as long as they support inequality testing.

### **Parameters**

```
clamp(
  val: any,
 min: any none,
 max: any none
) -> any
val
       any
Base value.
min
        any or none
Lower bound.
Default: none
max
        any or none
Upper bound.
```

### between

Testing a <= b <= c, helps only computing b once.

### **Parameters**

```
between(
  a: length,
  b: length,
  C: length
) -> bool
```

Default: none

```
a length
Lower bound.
```

```
b length
Tested value.
```

```
c length
Upper bound. Asserted to be >= c.
```

### intersects

Tests if two intervals intersect.

### **Parameters**

```
intersects(
  i1: (length, length),
  i2: (length, length),
  tolerance: length
)
```

```
i1 (length, length)
```

First interval as a tuple of (low, high) in absolute lengths.

```
i2 (length, length)
Second interval.
```

```
tolerance length

Set to nonzero to ignore small intersections.

Default: Opt
```

### resolve

Converts relative and contextual lengths to absolute. The return value will contain each of the arguments once converted, with arguments that contain 'x' or start with 'w' being interpreted as horizontal, and arguments that contain 'y' or start with 'h' being interpreted as vertical.

```
#context resolve(
   (width: 100pt, height: 200pt),
   x: 10%, y: 50% + 1pt,
   width: 50%, height: 5pt,
)
(x: 10pt, y: 101pt, width: 50pt, height: 5pt)
```

### **Parameters**

```
resolve(
    size: (width: length, height: length),
    ..args: dictionary
) -> dictionary

size (width: length, height: length)
Size of the container as given by the layout function.
```

### align

Compute the position of the upper left corner, taking into account the alignment and displacement.

### **Parameters**

```
align(
  alignment: alignment,
  dx: relative,
  dy: relative,
  width: relative,
  height: relative
) -> (x: relative, y: relative)

alignment alignment
Absolute alignment.

dx relative

Horizontal displacement.
```

```
dx relative

Horizontal displacement.

Default: Opt
```

```
dy relative
Vertical displacement.
Default: 0pt
```

```
width relative
Object width.
Default: 0pt
```

```
height relative

Object height.

Default: Opt
```

### VII.b Tiling (tiling.typ)

Page splitting algorithm.

- placed()
- container()
- content()
- separate()
- pat-forbidden()
- pat-allowed()
- forbidden-rectangles()
- tolerable-rectangles()
- regions()

### placed

Core function to create an obstacle.

### **Parameters**

```
placed(
   align: alignment,
   dx: relative,
   dy: relative,
   boundary: (..function,),
   content: content
) -> obstacle
```

```
align alignment
```

Reference position on the page (or in the parent container).

```
dx relative
```

Horizontal displacement.

Default: 0% + 0pt

```
dy relative
```

Vertical displacement.

Default: 0% + 0pt

```
boundary (..function,)

An array of functions to transform the bounding box of the content. By default, a 5pt margin. See contour.typ.

Default: (auto,)

content content
```

# container

Inner content.

Core function to create a container.

### **Parameters**

```
container(
  align: alignment,
  dx: relative,
  dy: relative,
  width: relative,
  height: relative
) -> container

align alignment
Location on the page.
Default: top + left
```

```
dx relative
Horizontal displacement.
Default: 0% + 0pt
```

```
dy relative
Vertical displacement.
Default: 0% + 0pt
```

```
width relative

Width of the container.

Default: 100%
```

```
height relative

Height of the container.

Default: 100%
```

### content

Core function to add flowing content.

### **Parameters**

```
content(data: content) -> flowing

data    content

Inner content.
```

### separate

Splits the input sequence into obstacles, containers, and flowing content.

An "obstacle" is data produced by the placed function. It can contain arbitrary content, and defines a zone where flowing content cannot be placed.

A "container" is produced by the function container. It defines a region where (once the obstacles are subtracted) is allowed to contain flowing content.

Lastly flowing content is produced by the function content. It will be threaded through every available container in order.

```
#separate({
    // This is an obstacle
    placed(top + left, box(width: 50pt, height: 50pt))
    // This is a container
    container(height: 50%)
    // This is flowing content
    content[#lorem(50)]
})

Parameters
    separate(seq: content) -> (containers: (..box,), obstacles: (..box,), flow: (..content,))
```

### pat-forbidden

Pattern with red crosses to display forbidden zones.

### **Parameters**

```
pat-forbidden(sz: length) -> pattern
```

```
sz length
Size of the tiling.
```

### pat-allowed

Pattern with green pluses to display allowed zones.

### **Parameters**

```
pat-allowed(sz: length) -> pattern

sz length
Size of the tiling.
```

### forbidden-rectangles

From a set of obstacles (see separate: an obstacle is any placed content) construct the blocks (x: length, y: length, width: length, height: length) that surround the obstacles.

The return value is as follows:

- rects, a list of blocks (x: length, y: length, width: length, height: length)
- display, show this to include the placed content in the final output
- debug, show this to include helper boxes to visualize the layout

### **Parameters**

```
forbidden-rectangles(
  obstacles: (..box,),
  size: (width: length, height: length)
) -> (rects: (..box,), display: content, debug: content)

obstacles (..box,)
Array of all the obstacles that are placed on this document.
```

```
size (width: length, height: length)
Dimensions of the parent container, as provided by layout.
Default: none
```

### tolerable-rectangles

Partition the complement of avoid into containers as a series of rectangles.

The algorithm is roughly as follows:

```
for container in containers {
  horizontal-cuts = sorted(top and bottom of zone for zone in avoid)
  for (top, bottom) in horizontal-cuts.windows(2) {
    vertical-cuts = sorted(
      left and right of zone for zone in avoid
      if zone intersects (top, bottom)
    )
    new zone (top, bottom, left, right)
  }
}
```

The main difficulty is in bookkeeping and handling edge cases (weird intersections, margins of error, containers that overflow the page, etc.) There are no heuristics to exclude zones that are too small, and no worries about zones that intersect vertically. That would be the threading algorithm's job.

Blocks are given an additional field bounds that dictate the upper limit of how much this block is allowed to stretch vertically, set to the dimensions of the container that produced this block.

### **Parameters**

```
tolerable-rectangles(
  containers: (..box,),
  avoid: (..box,),
  size: (width: length, height: length)
) -> (rects: (..box,), debug: content)

containers (..box,)
Array of the containers in which content can be placed.
```

```
avoid (..box,)
Array of all the obstacles that are placed on this document. Will be subtracted from containers.
Default: ()
```

```
size (width: length, height: length)
Dimensions of the parent container, as provided by layout.
Default: none
```

### regions

Debug version of the toplevel reflow, that only displays the partitioned layout.

### **Parameters**

```
regions(
  ct: content,
  display: bool
) -> content
```

```
ct content
```

Content to be segmented and have its layout displayed.

### display bool

Whether to show the placed objects.

Default: true

### VII.c Contouring (contour.typ)

Image boundary transformers.

- margin()
- frac-rect()
- horiz()
- vert()
- width()
- height()
- grid()
- ascii-art()

### **Variables**

• phantom

### margin

Contouring function that pads the inner image.

### **Parameters**

```
margin(size: length) -> function

size length
Padding.
```

### frac-rect

Helper function to turn a fractional box into an absolute one.

### **Parameters**

```
frac-rect(
  frac: (x: fraction, y: fraction, width: fraction, height: fraction),
  abs: (x: length, y: length, width: length, height: length),
    ..style
) -> (x: length, y: length, width: length, height: length)

frac (x: fraction, y: fraction, width: fraction, height: fraction)
Child dimensions as fractions.
```

```
abs (x: length, y: length, width: length, height: length)
Parent dimensions as absolute lengths.
```

```
..style
Currently ignored.
```

### horiz

Horizontal segmentation as (left, right)

### **Parameters**

```
horiz(
  div: int,
  fun: function(fraction) => (fraction, fraction)
) -> function
```

```
div int
```

Number of subdivisions.

Default: 5

```
fun function(fraction) => (fraction, fraction)
```

For each location, returns the left and right bounds.

### vert

Vertical segmentation as (top, bottom)

### **Parameters**

```
vert(
  div: int,
  fun: function(fraction) => (fraction, fraction)
) -> function
```

```
div int
```

Number of subdivisions.

Default: 5

```
fun
function(fraction) => (fraction, fraction)
```

For each location, returns the top and bottom bounds.

### width

Horizontal segmentation as (anchor, width).

```
Parameters
```

```
width(
    div: int,
    flush: alignment,
    fun: function(fraction) => (fraction, fraction)
) -> function

div int
Number of subdivisions.
Default: 5
```

```
flush alignment
```

Relative horizontal alignment of the anchor.

Default: center

```
fun function(fraction) => (fraction, fraction)
```

For each location, returns the position of the anchor and the width.

### height

Vertical segmentation as (anchor, height).

### **Parameters**

```
height(
  div: int,
  flush: alignment.,
  fun: function(fraction) => (fraction, fraction)
) -> function
```

```
div int
```

Number of subdivisions.

Default: 5

```
flush alignment.
```

Relative vertical alignment of the anchor.

Default: horizon

```
fun
function(fraction) => (fraction, fraction)
```

For each location, returns the position of the anchor and the height.

### grid

Cuts the image into a rectangular grid then checks for each cell if it should be included. The resulting cells are automatically grouped horizontally.

### **Parameters**

```
grid(
    div: int (x: int, y: int),
    fun: function(fraction, fraction) => bool
) -> function

div    int or (x: int, y: int)

Number of subdivisions.

Default: 5
```

```
fun function(fraction, fraction) => bool
```

Returns for each cell whether it satisfies the 2D equations of the image's boundary.

### ascii-art

Allows drawing the shape of the image as ascii art.

### **Blocks**

- #: full
- : empty

### Half blocks

- [: left
- ]: right
- ^: top
- \_: bottom

### Quarter blocks

- `: top left
- ': top right
- ,: bottom left
- .: bottom right

### Anti-quarter blocks

- J: top left
- L: top right
- 7: bottom left

• F: bottom right

Diagonals

- /: positive
- \: negative

### **Parameters**

```
ascii-art(ascii: code)
```

```
ascii code
```

Draw the shape of the image in ascii art.

### phantom function

Drops all boundaries. Using boundary: phantom will let other content flow over this object.

### VII.d Bisection (bisect.typ)

Content splitting algorithm.

- fits-inside()
- default-rebuild()
- take-it-or-leave-it()
- has-text()
- has-child()
- has-children()
- is-list-item()
- is-enum-item()
- has-body()
- dispatch()
- fill-box()

### fits-inside

Tests if content fits inside a box.

WARNING: horizontal fit is not very strictly checked A single word may be said to fit in a box that is less wide than the word. This is an inherent limitation of measure(box(...)) and I will try to develop workarounds for future versions.

The closure of this function constitutes the basis of the entire content splitting algorithm: iteratively add content until it no longer fits-inside, with what "iteratively add content" means being defined by the content structure. Essentially all remaining functions in this file are about defining content that can be split and the correct way to invoke fits-inside on them.

```
#let dims = (width: 100%, height: 50%)
#box(width: 7cm, height: 3cm)[#layout(size
=> context {
  let words = [#lorem(12)]
  [#fits-inside(dims, words, size: size)]
  linebreak()
  box(..dims, stroke: 0.1pt, words)
```

<del>})]</del>

### true

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor.

```
#let dims = (width: 100%, height: 50%)
#box(width: 7cm, height: 3cm)[#layout(size
=> context {
  let words = [#lorem(15)]
  [#fits-inside(dims, words, size: size)]
  linebreak()
  box(..dims, stroke: 0.1pt, words)
})]
```

### false

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore.

### **Parameters**

```
fits-inside(
  dims: (width: relative, height: relative),
  ct: content,
  size: (width: length, height: length)
) -> bool
```

```
dims (width: relative, height: relative)
```

Maximum container dimensions. Relative lengths are allowed.

```
ct content
```

Content to fit in.

```
size (width: length, height: length)
```

Dimensions of the parent container to resolve relative sizes. These must be absolute sizes.

Default: none

### default-rebuild

Destructure and rebuild content, separating the outer content builder from the rest to allow substituting the inner contents. In practice what we will usually do is recursively split the inner contents and rebuild the left and right halves separately.

Inspired by wrap-it's implementation (see: \_rewrap in github:ntjess/wrap-it)

```
#let content = box(stroke: red)[Initial]
#let (inner, rebuild) = default-rebuild(
    content, "body",
```

```
Content: #content \
Inner: #inner \
Rebuild: #rebuild("foo")
```

```
Content: Initial
Inner: Initial
Rebuild: foo
```

```
#let content = [*_Initial_*]
#let (inner, rebuild) = default-rebuild(
   content, "body",
)

Content: #content \
Inner: #inner \
Rebuild: #rebuild("foo")
```

```
Content: Initial
Inner: Initial
Rebuild: foo
```

```
#let content = [a:b]
#let (inner, rebuild) = default-rebuild(
   content, "children",
)

Content: #content \
Inner: #inner \
Rebuild: #rebuild(([x], [y]))
```

```
Content: a:b
Inner: ([a], [:], [b])
Rebuild: xy
```

### **Parameters**

```
default-rebuild(
  ct: content,
  inner-field: string
) -> (dictionnary, function)
```

```
inner-field string
What "inner" field to fetch (e.g. "body", "text", "children", etc.)
```

### take-it-or-leave-it

"Split" opaque content.

### **Parameters**

```
take-it-or-leave-it(
  ct: content,
  fits-inside: function
) -> (content?, content?)
```

```
ct content
```

This content cannot be split. If it fits take it, otherwise keep it for later.

### fits-inside function

Closure to determine if the content fits (see fits-inside above).

### has-text

Split content with a "text" main field. Strategy: split by " " and take all words that fit. Then if hyphenation is enabled, split by syllables and take all syllables that fit. End the block with a linebreak that has the justification of the paragraph.

### **Parameters**

```
has-text(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

### ct content

Content to split.

### split-dispatch function

Recursively passed around (see split-dispatch below).

### fits-inside function

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### has-child

Split content with a "child" main field. Strategy: recursively split the child.

### **Parameters**

```
has-child(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

```
ct content
```

Content to split.

```
split-dispatch function
```

Recursively passed around (see split-dispatch below).

```
fits-inside function
```

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### has-children

Split content with a "children" main field. Strategy: take all children that fit.

### **Parameters**

```
has-children(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

### **ct** content

Content to split.

```
split-dispatch function
```

Recursively passed around (see split-dispatch below).

```
fits-inside function
```

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### is-list-item

Split a list.item. Strategy: recursively split the body, and do some magic to simulate a bullet point indent.

### **Parameters**

```
is-list-item(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

```
ct content
```

Content to split.

```
split-dispatch function
```

Recursively passed around (see split-dispatch below).

```
fits-inside function
```

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### is-enum-item

Split an enum.item. Strategy: recursively split the body, and do some magic to simulate a numbering indent.

### **Parameters**

```
is-enum-item(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

```
ct content
```

Content to split.

```
split-dispatch function
```

Recursively passed around (see split-dispatch below).

### fits-inside function

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### has-body

Split content with a "body" main field. There is a special strategy for list.item and enum.item which are handled separately. Elements strong, emph, underline, stroke, overline, highlight are splittable, the rest are treated as non-splittable.

### **Parameters**

```
has-body(
  ct: content,
  split-dispatch: function,
  fits-inside: function,
  cfg: dictionary
)
```

### ct content

Content to split.

### split-dispatch function

Recursively passed around (see split-dispatch below).

### fits-inside function

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### dispatch

Based on the fields on the content, call the appropriate splitting function. This function is involved in a mutual recursion loop, which is why all other splitting functions take this one as a parameter.

### **Parameters**

```
dispatch(
  ct: content,
  fits-inside: function,
  cfg: dictionary
)
```

### ct content

Content to split.

### fits-inside function

Closure to determine if the content fits (see fits-inside above).

```
cfg dictionary
```

Extra configuration options.

### fill-box

Initialize default configuration options and take as much content as fits in a box of given size. Returns a tuple of the content that fits and the content that overflows separated.

### **Parameters**

```
fill-box(
  dims: (width: length, height: length),
  ct: content,
  size: (width: length, height: length),
  cfg: dictionary
) -> (content, content)

dims (width: length, height: length)
Container size.
```

```
ct content
Content to split.
```

```
size (width: length, height: length)
Parent container size.
Default: none
```

```
cfg dictionary
Configuration options.

• list-markers: (..content,), default value ([•], [•], [-], [•], [-]). If you change the markers of list, put the new value in the parameters so that lists are correctly split.

• enum-numbering: (..str,), default value ("1.", "1.", "1.", "1.", "1.", "1."). If you change the numbering style of enum, put the new style in the parameters so that enums are
```

Default: (:)

correctly split.

### VII.e Threading (threading.typ)

Filling and stretches boxes iteratively.

- smart-fill-boxes()
- reflow()

### smart-fill-boxes

Thread text through a list of boxes in order, allowing the boxes to stretch vertically to accommodate for uneven tiling.

### **Parameters**

```
smart-fill-boxes(
  body: content,
  avoid: (..block,),
  boxes: (..block,),
  extend: length,
  size: (width: length, height: length)
) -> (..content,)
```

```
body content
```

Flowing text.

```
avoid (..block,)
Obstacles to avoid. A list of (x: length, y: length, width: length, height: length).
Default: ()
```

```
boxes (..block,)
Boxes to fill. A list of (x: length, y: length, width: length, height: length, bound: block).
bound is the upper limit of how much to stretch the container, i.e. also (x: length, y: length, width: length, height: length).
Default: ()
```

### extend length

How much the baseline can extend downwards (within the limits of bounds).

Default: 1em

```
size (width: length, height: length)
Dimensions of the container as given by layout.
Default: none
```

### reflow

Segment the input content according to the tiling algorithm, then thread the flowing text through it.

### **Parameters**

```
reflow(
   ct: content,
   debug: bool
) -> content
```

### ct content

See module tiling for how to format this content.

### debug bool

Whether to show the boundaries of boxes.

Default: false