Wide–range METAPOST tutorial

Luís Nobre Gonçalves
(L. Nobre G.)

14. april 2012

Sammendrag

Sort of workshop about TEX–things, focusing on the METAPOST language.

The Church of Free Software

Pope: Richard Stallman.

Evil

WYSIWYG

WYSIWYG

What you get is what you don't see

Freedom

You choose what you get

Freedom

You choose what you get
but
you only get it at the end of a long path.

1. Introduction
   - A bit of history
   - What is METAPOST?
   - Main reason to use METAPOST
2. For Almost Absolute Beginners
   - Availability
   - Mathematically oriented
   - Programmability/Scriptability
   - Forced Simplicity
   - Consistency
3. Workflow
   - Workflow example

A bit of history

Donald Knuth – *The Art of Computer Programming*

- Volume1, 1969, hot metal
- Volume2, $2^{\underline{\text{nd}}}$ ed., 1977, photographic
- TEX, v1, 1978, $\text{v} \longrightarrow \pi$
- METAFONT, v1, 1979, $\text{v} \longrightarrow e$ — affine
- AMS, 1983
- APS, AIP, OSA, AAS, Springer-Verlag
- METAPOST, 1994, John Hobby

A bit of history

Donald Knuth – *The Art of Computer Programming*

- Volume1, 1969, hot metal
- Volume2, $2^{\underline{\text{nd}}}$ ed., 1977, photographic
- TEX, v1, 1978, $\mathrm{v} \longrightarrow \pi$
- METAFONT, v1, 1979, $\mathrm{v} \longrightarrow e$ — affine
- AMS, 1983
- APS, AIP, OSA, AAS, Springer-Verlag
- METAPOST, 1994, John Hobby

METAPOST is the realm og graphic parameterization.

Main features of METAPOST

- It is easy to express geometry as METAPOST code
- METAPOST outputs `postscript` or SVG

```
outputformat := "svg";
```

- Very good control of 2D Bézier splines
- Special 2D operators
- Many operators work the same way in 1, 2, 3 or 4D
- Linear equations
- May include LaTeX
- May be included in LaTeX

Use METAPOST because

METAPOST helps the user to experiment different diagram layouts without changing specified geometric relationships among diagram elements.

For Almost Absolute Beginners

- Availability
- Mathematically oriented
- Programmability/Scriptability
- Forced simplicity
- Consistency

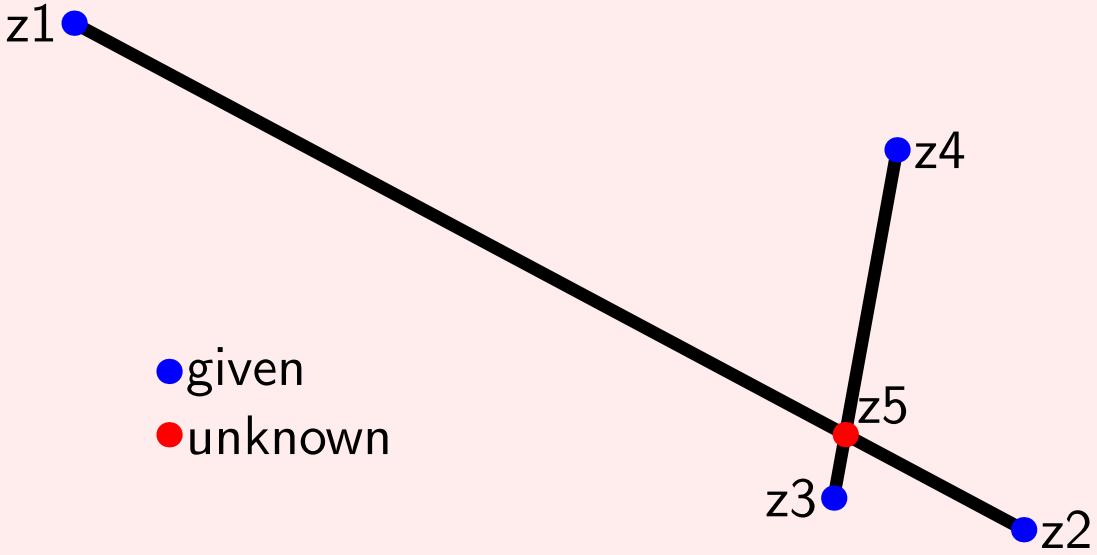
Availability

- Development site
- CTAN
  - /graphics/metapost/contrib/macros

Availability

- Development site
- CTAN
  - /graphics/metapost/contrib/macros
- TeX Users Group
  - `texlive`
- Debian
  - `texlive-metapost`
  - `texlive-publishers` includes RevTeX
  - `latex-beamer`
  - `tex4ht`
- "The LaTeX Companions"

Linear equations



- Constraints may be expressed as linear equations

```
z5 = whatever[z1,z2];
z5 = whatever[z3,z4];
```

- No need to explicitly assign calculations to unknowns

pair doublets

- pair $(x,y) \longrightarrow$ (X,Y)
  origin (0,0)
- Coordinates

```
z[i] = (x[i],y[i]);
```

color triplets

- color $(red, green, blue) \longrightarrow (X, Y, Z)$

black	(0,0,0)
red	(1,0,0)
green	(0,1,0)
blue	(0,0,1)
white	(1,1,1)

cmykcolor tetraplets

- cmykcolor
  $(cyan, magenta, yellow, black) \longrightarrow (X, Y, Z, W)$
  (quaternions, homogeneous coordinates, 4D splines, animation frames, straight line segments, etc.)

Special operators

- Pythagorean addition and subtraction

$$h = a \texttt{ ++ } b \texttt{ +-+ } c; \ (h = \sqrt{a^2 + b^2 - c^2})$$

Special operators

- Pythagorean addition and subtraction

$$h = a \;{+}{+}\; b \;{+}{-}{+}\; c; \; (h = \sqrt{a^2 + b^2 - c^2})$$

- Interval 0—1 ND operator s[,]

```
0.5[(1,1),(3,5)]              ⟶  (2,3)
-0.5[(1,1,1),(3,5,7)]         ⟶  (0,-1,-2)
1.5[(1,1,1,1),(3,5,7,9)]      ⟶  (4,7,10,13)
```

Special operators

- Pythagorean addition and subtraction

```
h = a ++ b +-+ c;
```
($h = \sqrt{a^2 + b^2 - c^2}$)

- Interval 0—1 ND operator s[,]

```
0.5[(1,1),(3,5)]              ⟶  (2,3)
-0.5[(1,1,1),(3,5,7)]         ⟶  (0,-1,-2)
1.5[(1,1,1,1),(3,5,7,9)]      ⟶  (4,7,10,13)
```

- N-dimensional scalar arithmetic

```
b = 2a;
z1 = 2*(1,2);
c2 = 2*(1,2,3); grey = 0.5white;
cc3 = 2*(1,2,3,4);
```

Other features

- Throw–in–the–garbage unknowns

  whatever

Other features

- Throw–in–the–garbage unknowns

  `whatever`

- Special functions

  `dir()` `abs()` `angle()` `unitvector()`
  `sind()` `cosd()`

Other features

- Throw–in–the–garbage unknowns

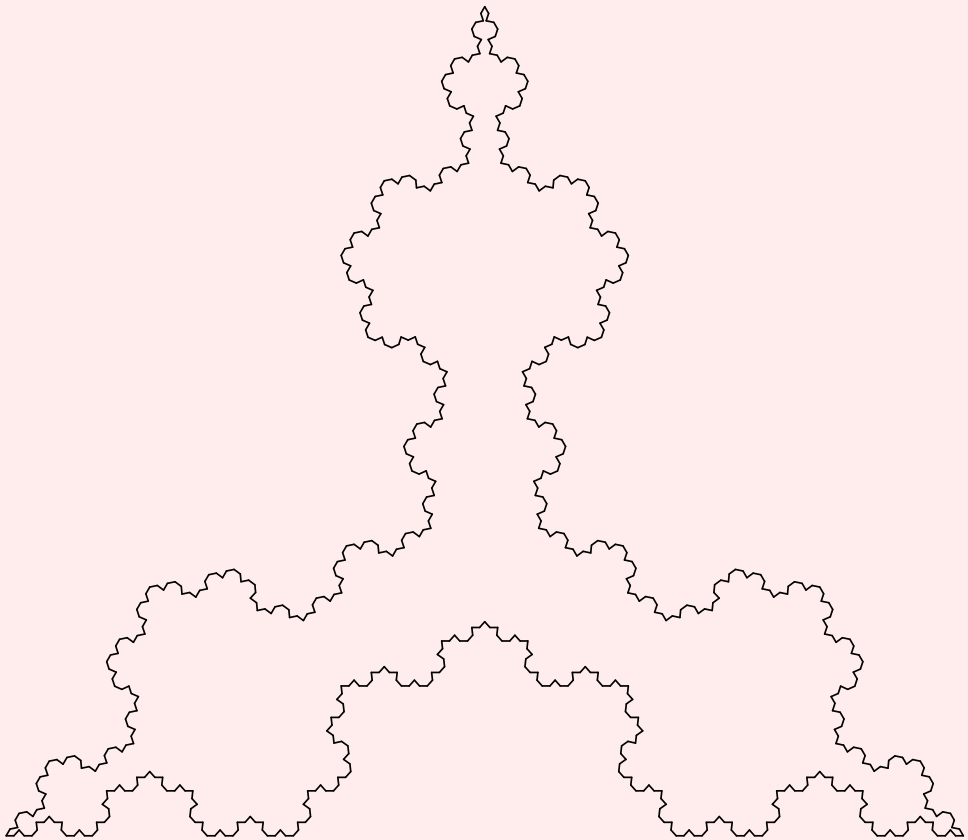
  whatever

- Special functions

  dir() abs() angle() unitvector()
  sind() cosd()

- Affine transforms (linear)
- Totally parameterized 2D cubic Bézier splines

Programmability



ø æ å ì § ü ç @ £ œ ß ≪ ≫ “ ” . . . 3.14159e-2 = 3,1416 · 10^{-2}

Scriptability

- *scantokens "string of commands";*
- MPlib

Forced Simplicity

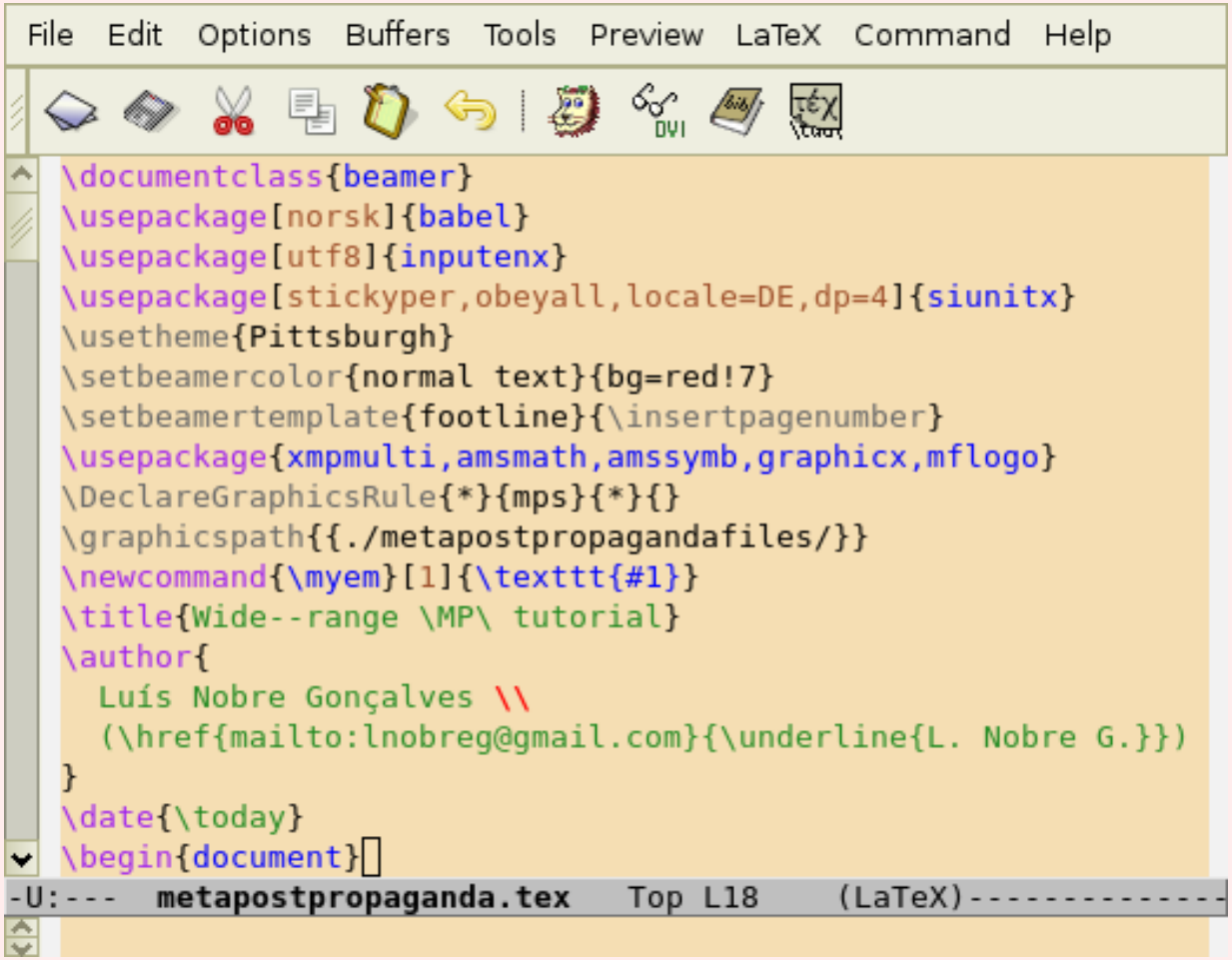
- (8×)4096
- 1/65536
- 2000 points in a path
- Memory
- Number of variables

Not for long...

Consistency

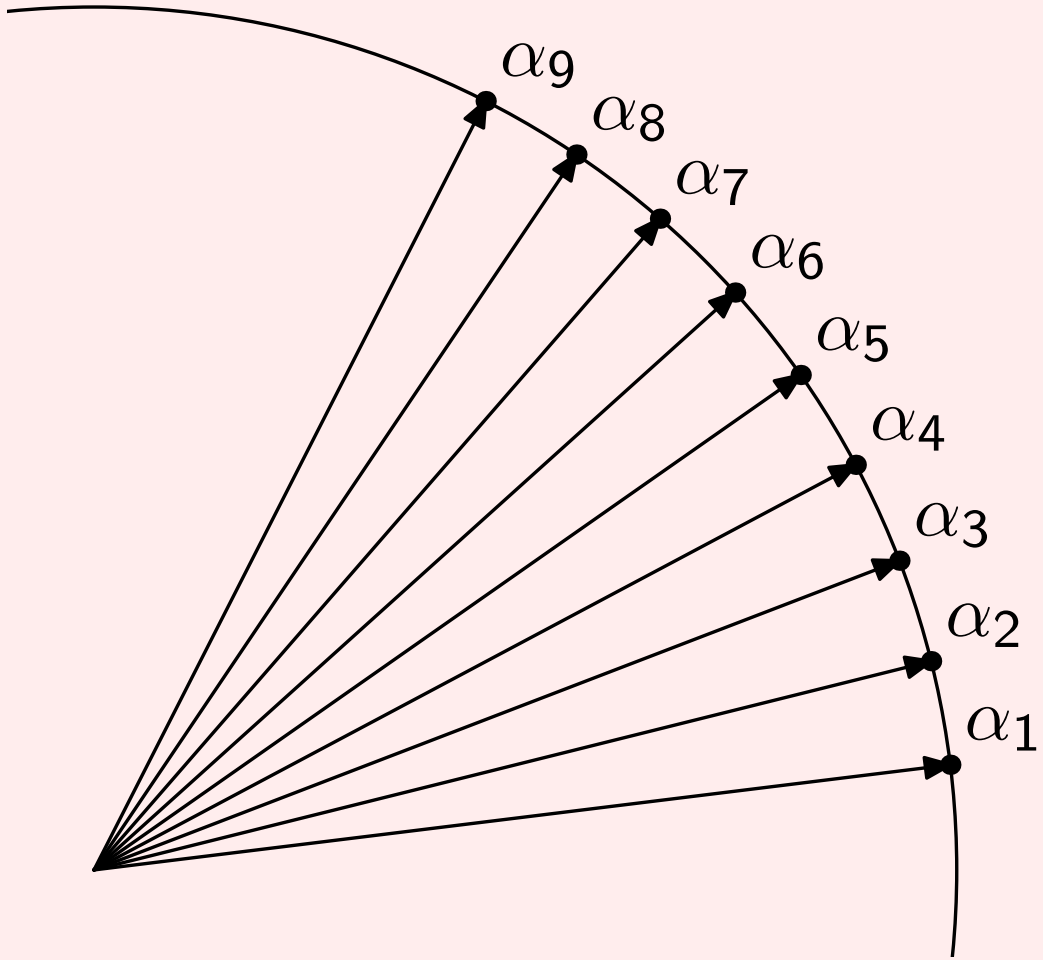
- emacs+auctex/texmacs
- latexmp
- emp/LuaTEX
- graphicx
- beamer+xmpmulti
- GNUPLOT
- xfig
- dia/expressg
- gs+potrace+pstoedit+PstoeditMpostPreeditor
- siunitx

emacs+auctex



See code

latexmp



See code.

graphicx

```
\usepackage{graphicx}
\DeclareGraphicsRule{*}{mps}{*}{}
—
\includegraphics[height=61mm]{fekslatexmp.1}
```

beamer+xmpmulti

```
\usepackage{xmpmulti}
—
\multiinclude[<+>][graphics={width=8cm},end=10]
{feksmulti}
```

GNUPLOT

set term mp color solid latex
set output "feksgnuplot.mp"

xfig

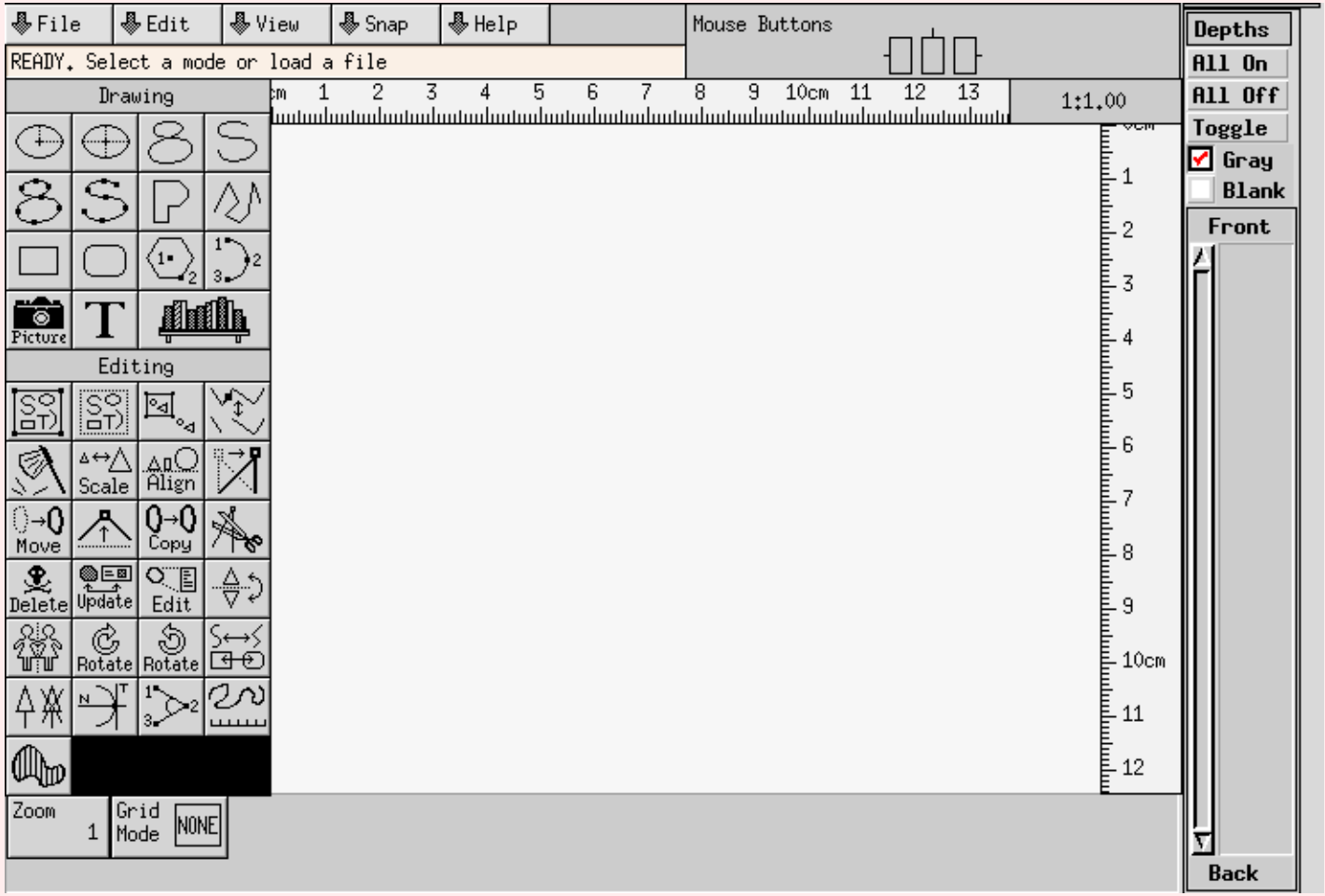

File
Edit
View
Snap
Help
Mouse Buttons
READY. Select a mode or load a file
Drawing
1:1.00
Depths
All On
All Off
Toggle
Gray
Blank
Front
Back
Picture
Editing
Scale
Align
Move
Copy
Delete
Update
Edit
Rotate
Rotate
Zoom
1
Grid
Mode
NONE

fig2ps

dia

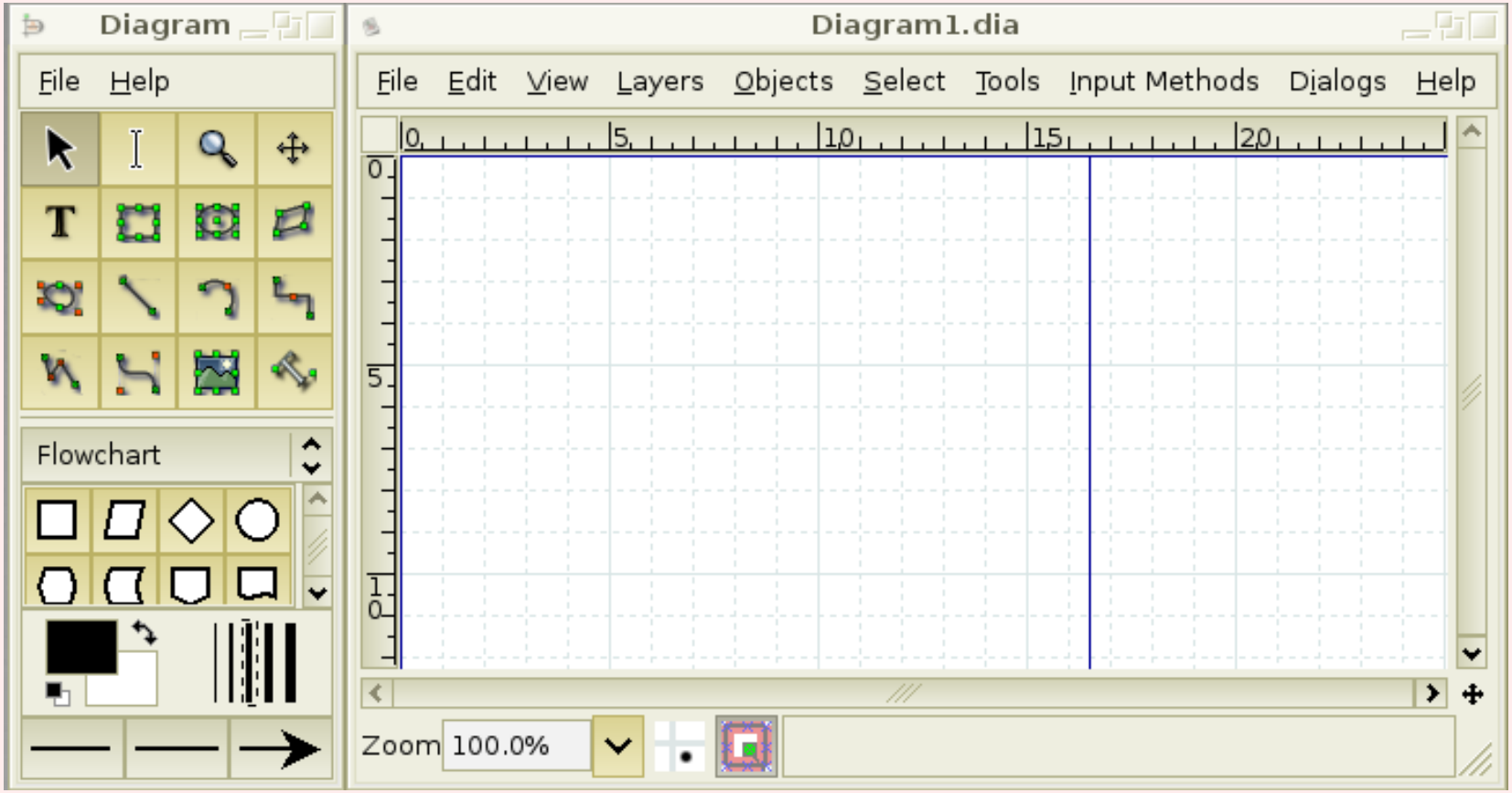


Diagram
File Help
Flowchart
Diagram1.dia
File Edit View Layers Objects Select Tools Input Methods Dialogs Help
0 5 10 15 20
Zoom 100.0%

epspdf+gs

epspdf minimal-1.mps

—

gs -q -sDEVICE=jpeggray -r100 -dNOPAUSE
-sOutputFile=minimal.jpg minimal-1.pdf < /dev/null

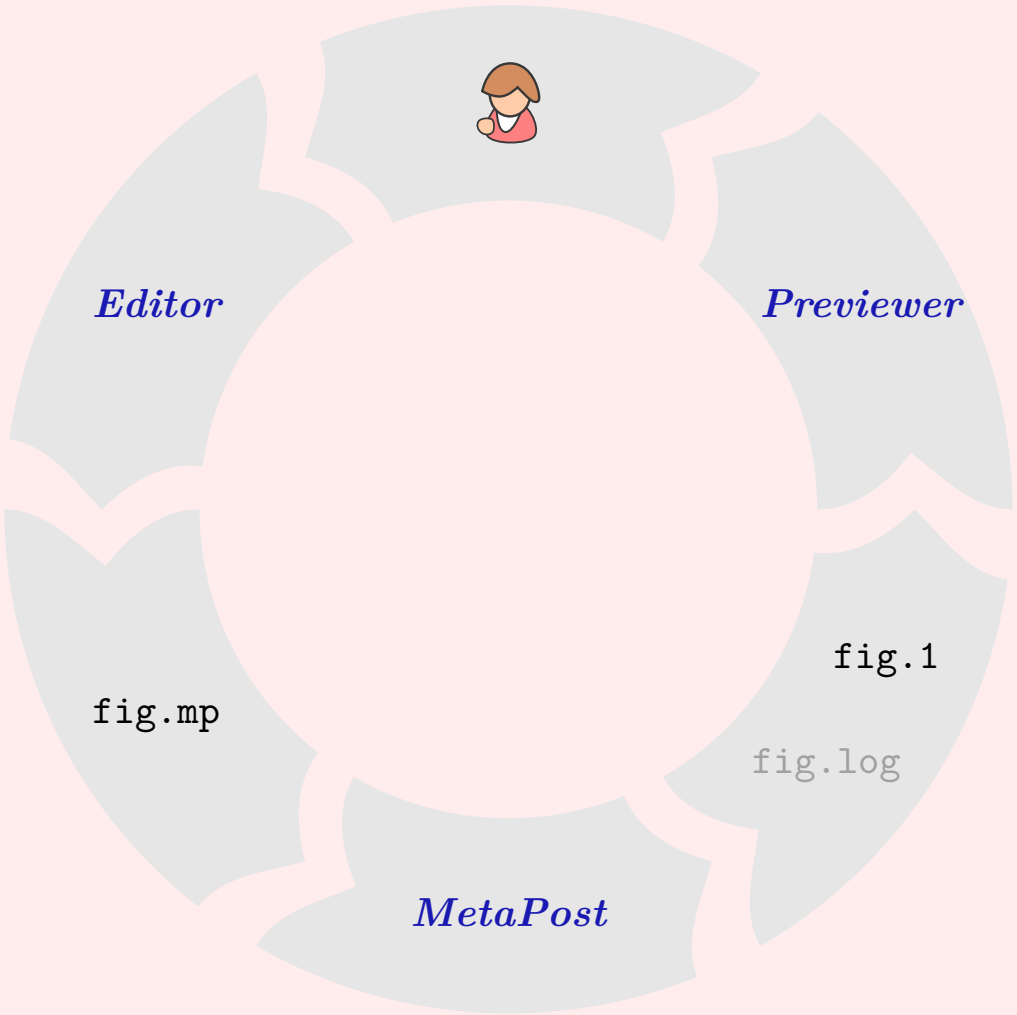
potrace+pstoedit+PstoeditMpostPreeditor

Example

PstoeditMpostPreeditor

Example

Basic workflow



Workflow

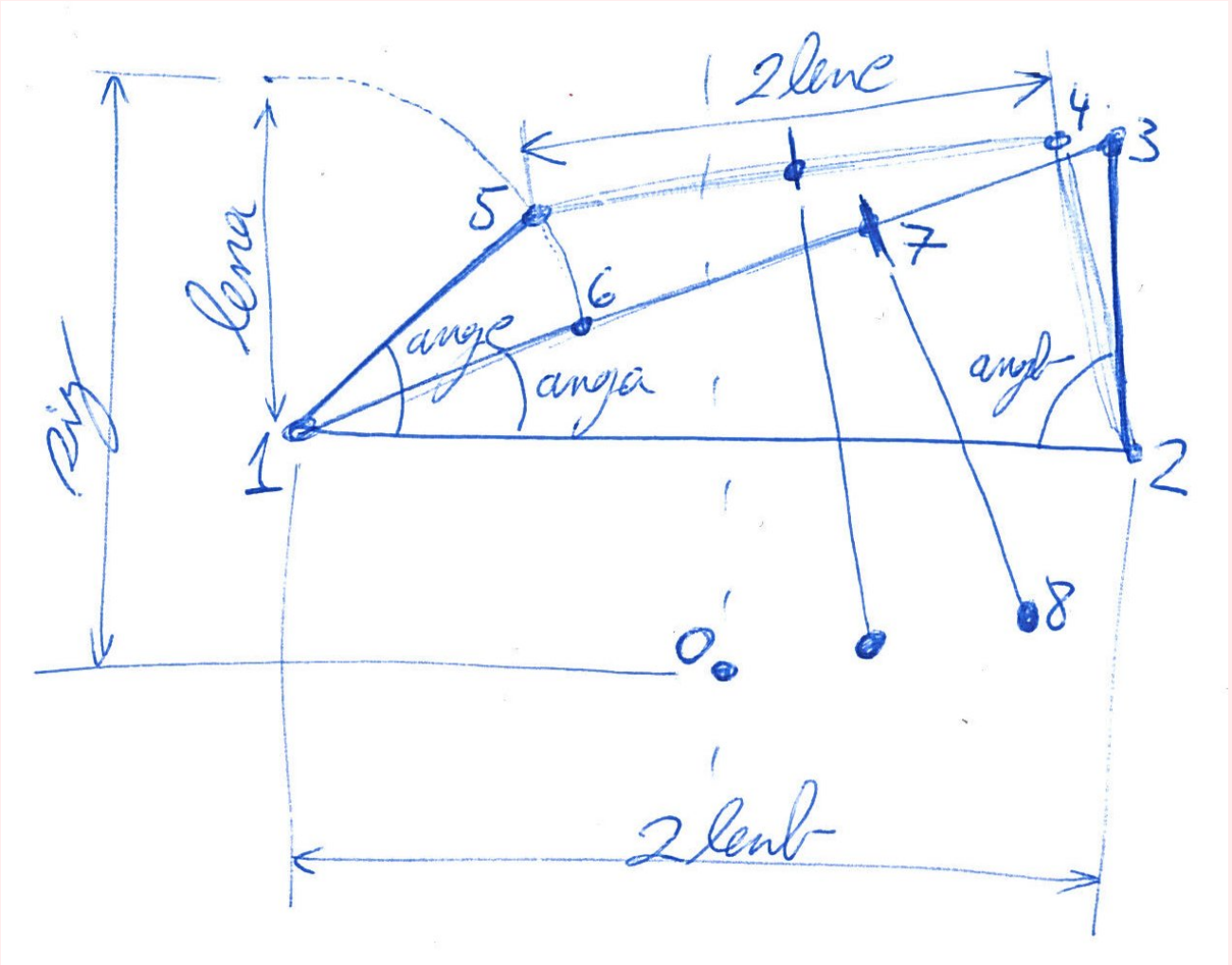
1. Draw scheme by hand
2. Identify parameters

Workflow

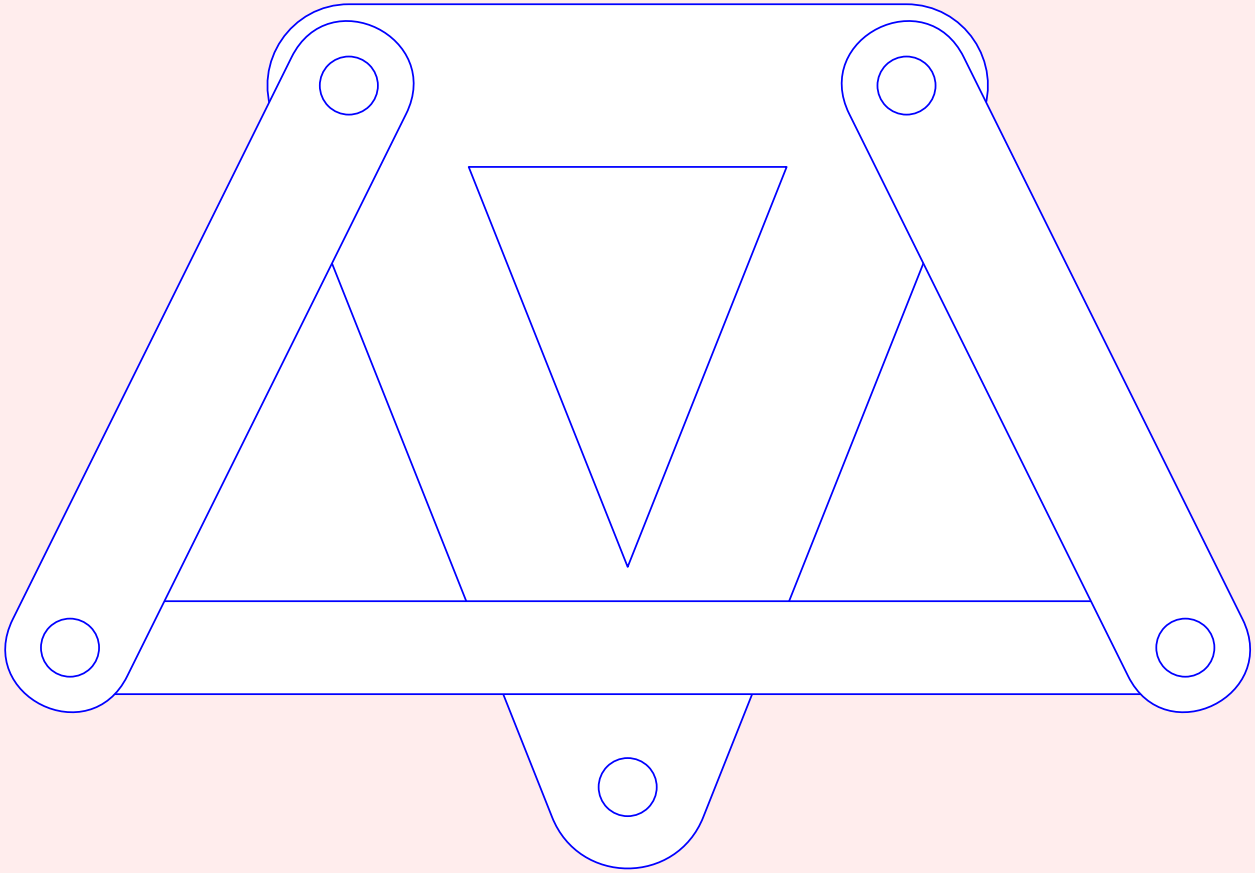
1. Draw scheme by hand
2. Identify parameters
3. Express constraints
4. Determine valid ranges
5. Program
6. Test

Workflow example (0)

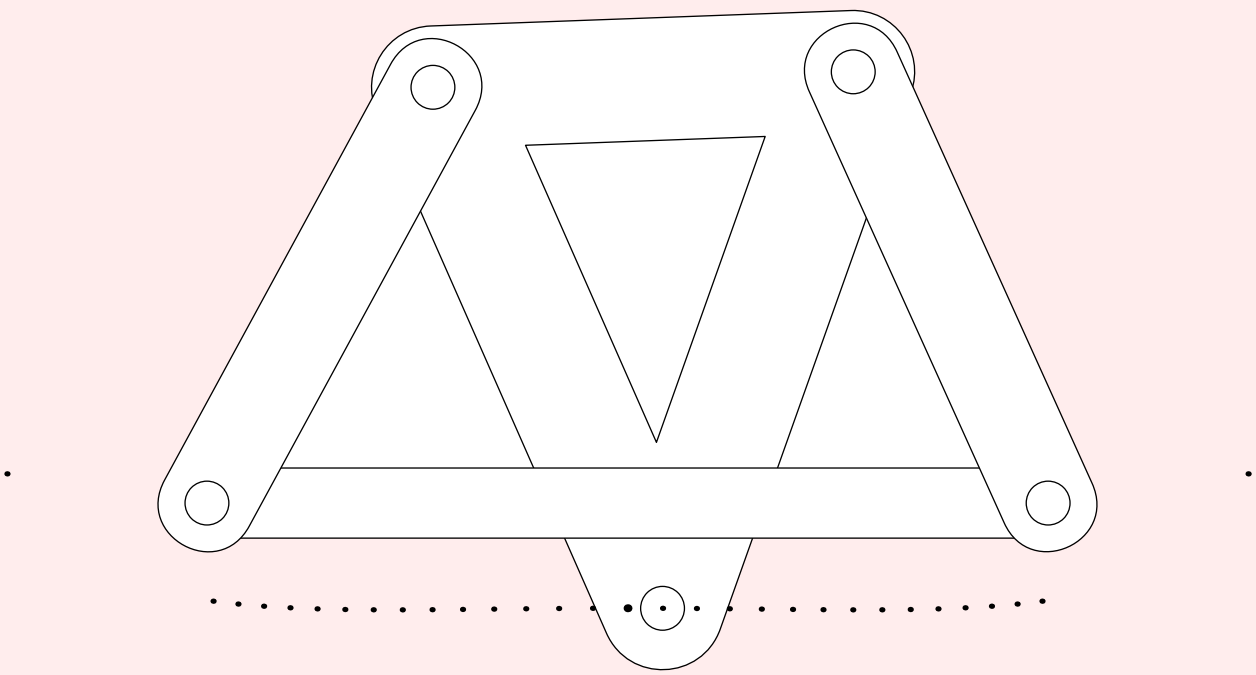
Workflow example (1)



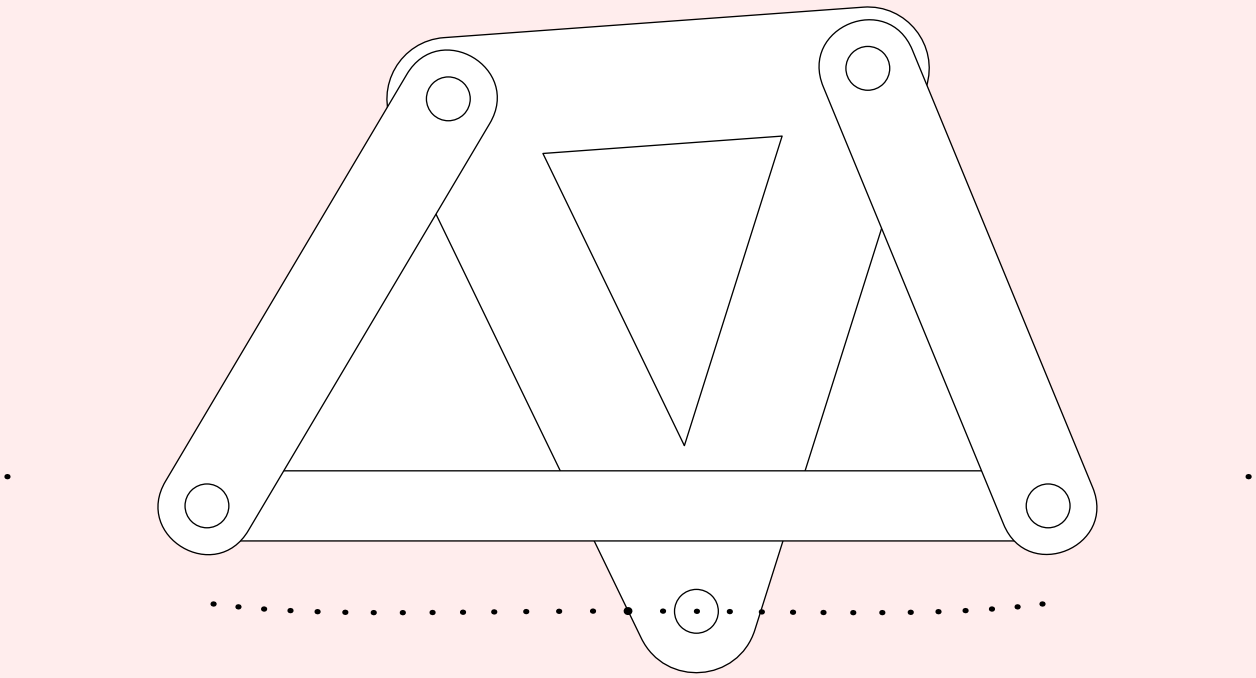
Workflow example (2)



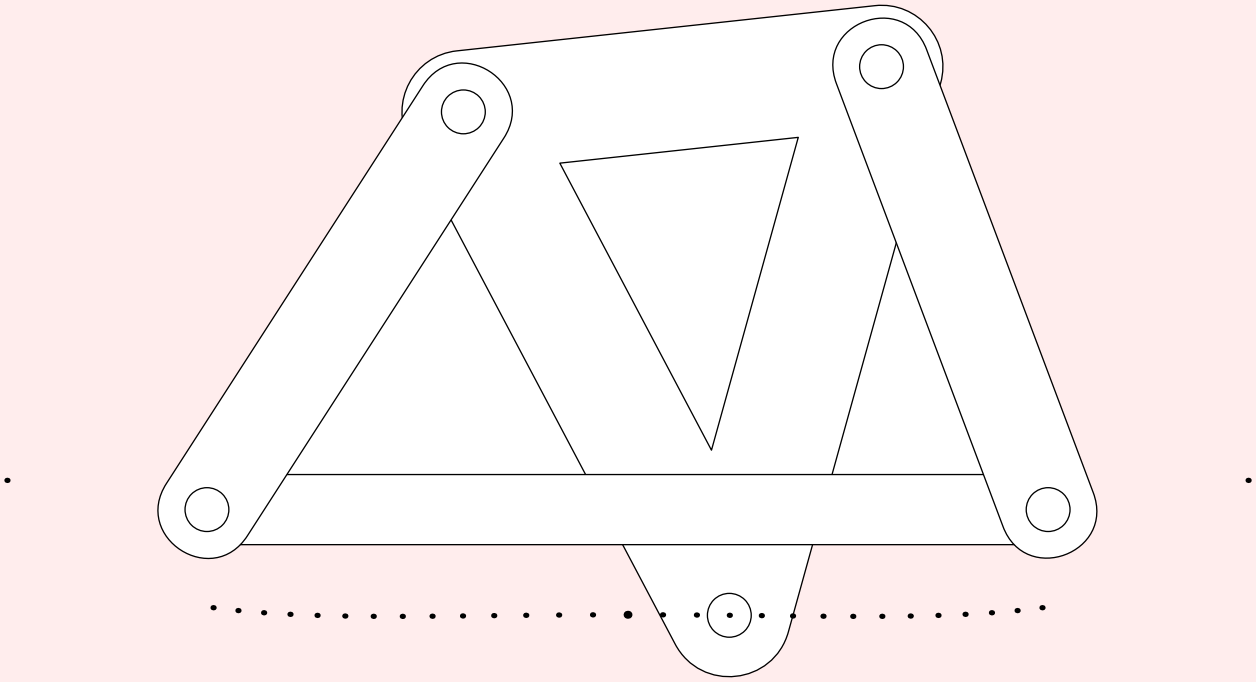
Workflow example (2)



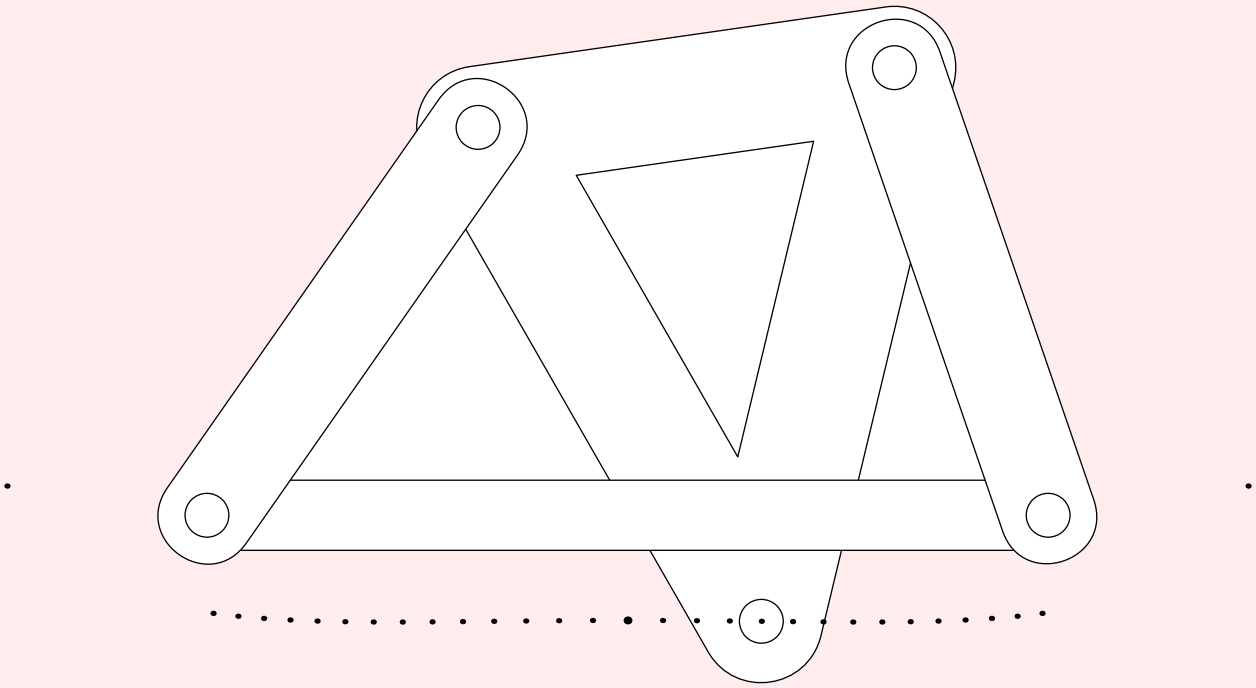
Workflow example (2)



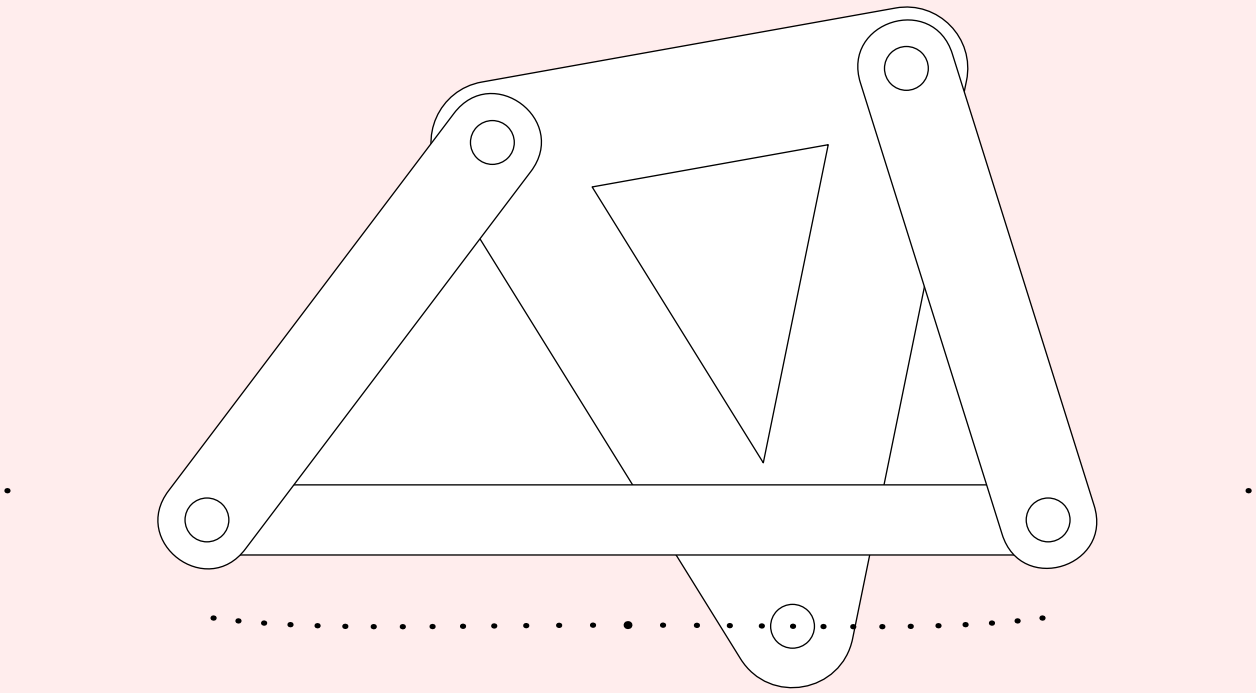
Workflow example (2)



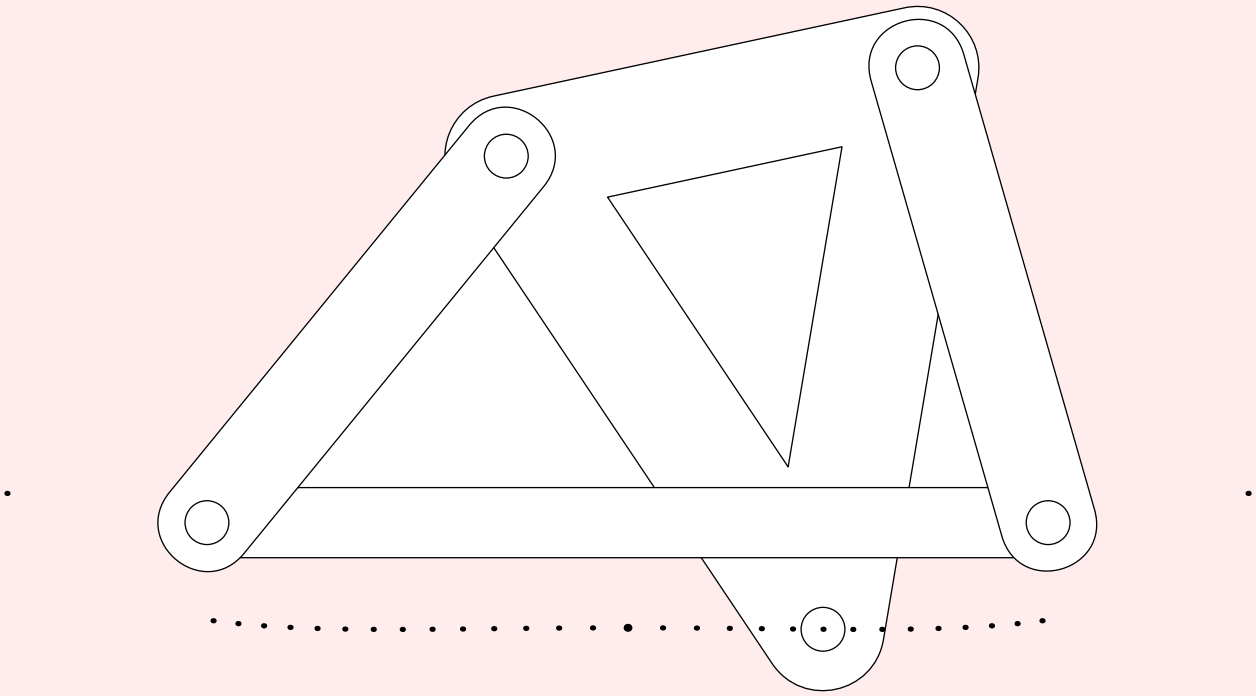
Workflow example (2)



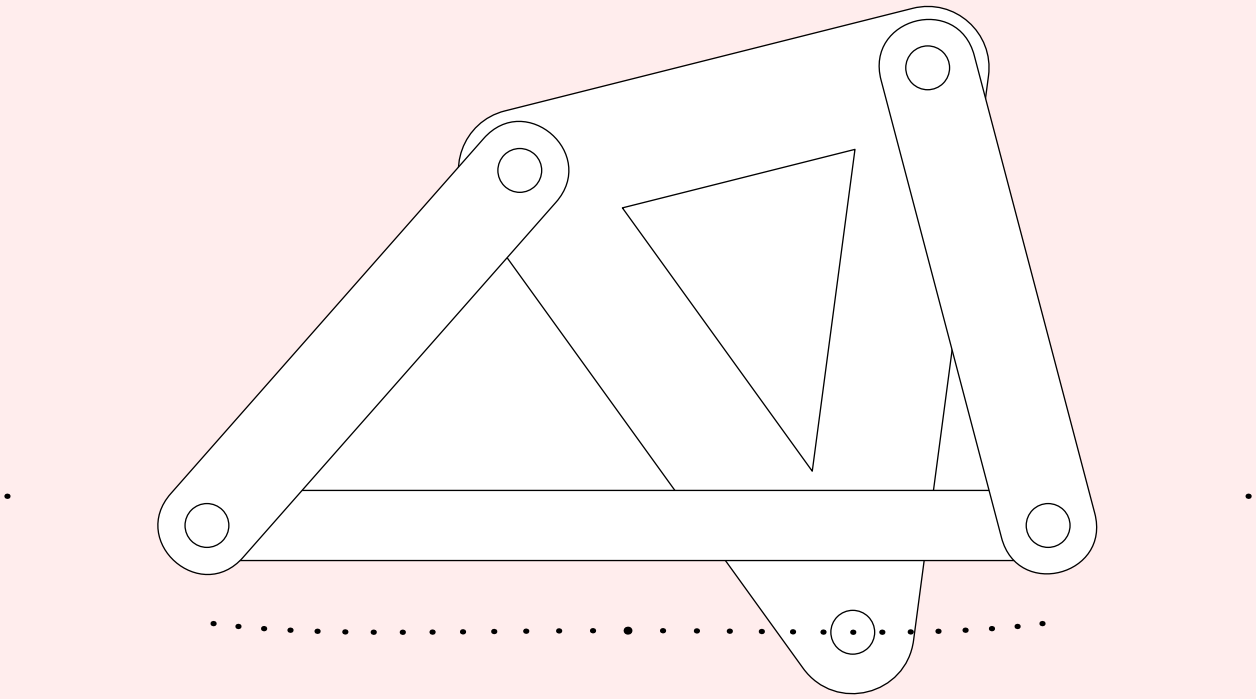
Workflow example (2)



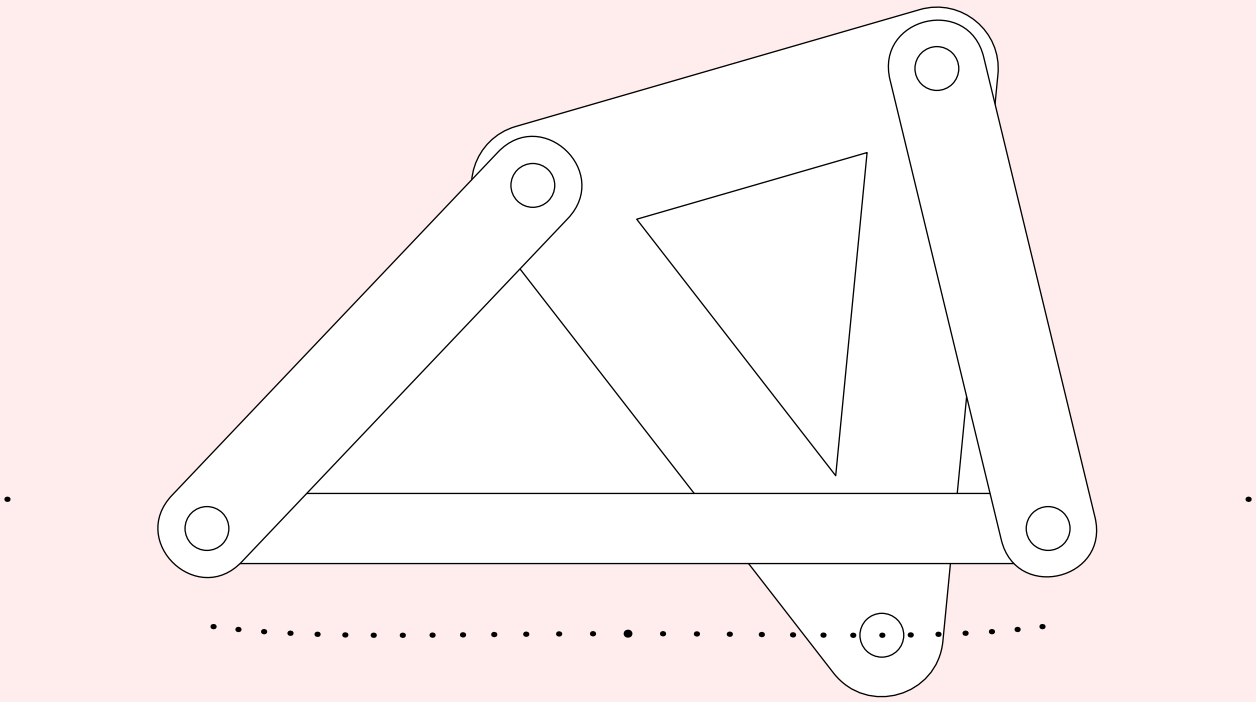
Workflow example (2)



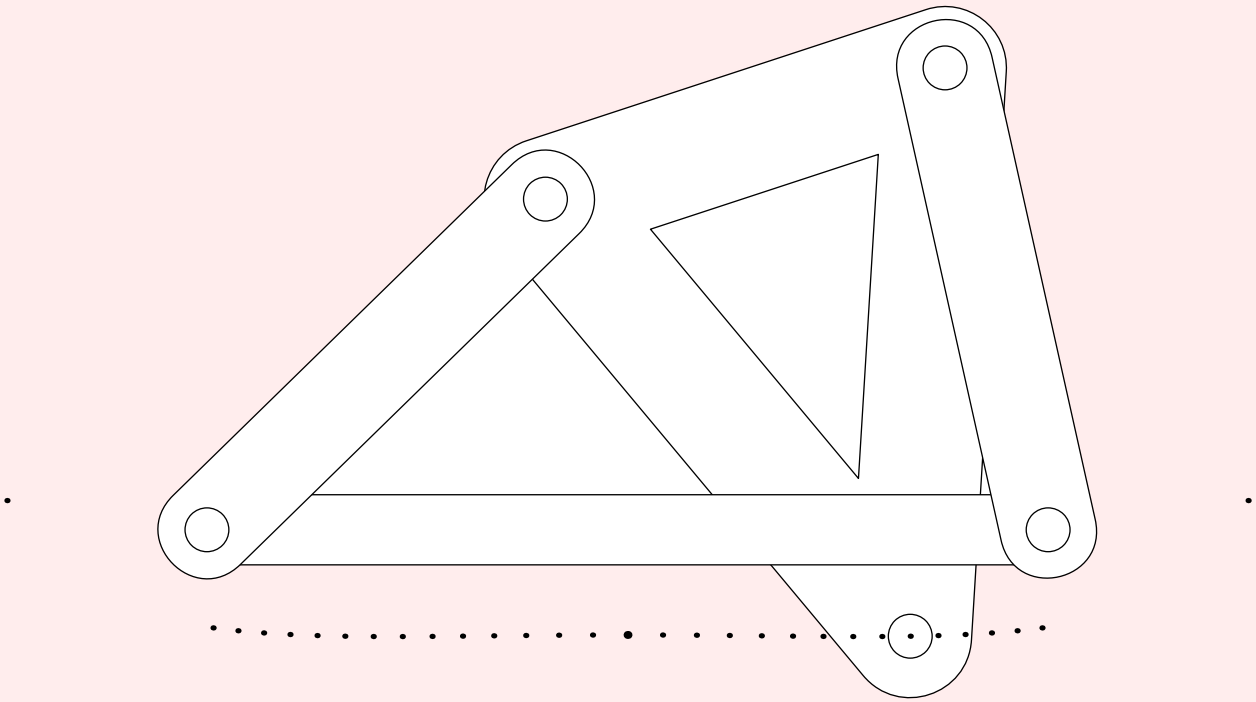
Workflow example (2)



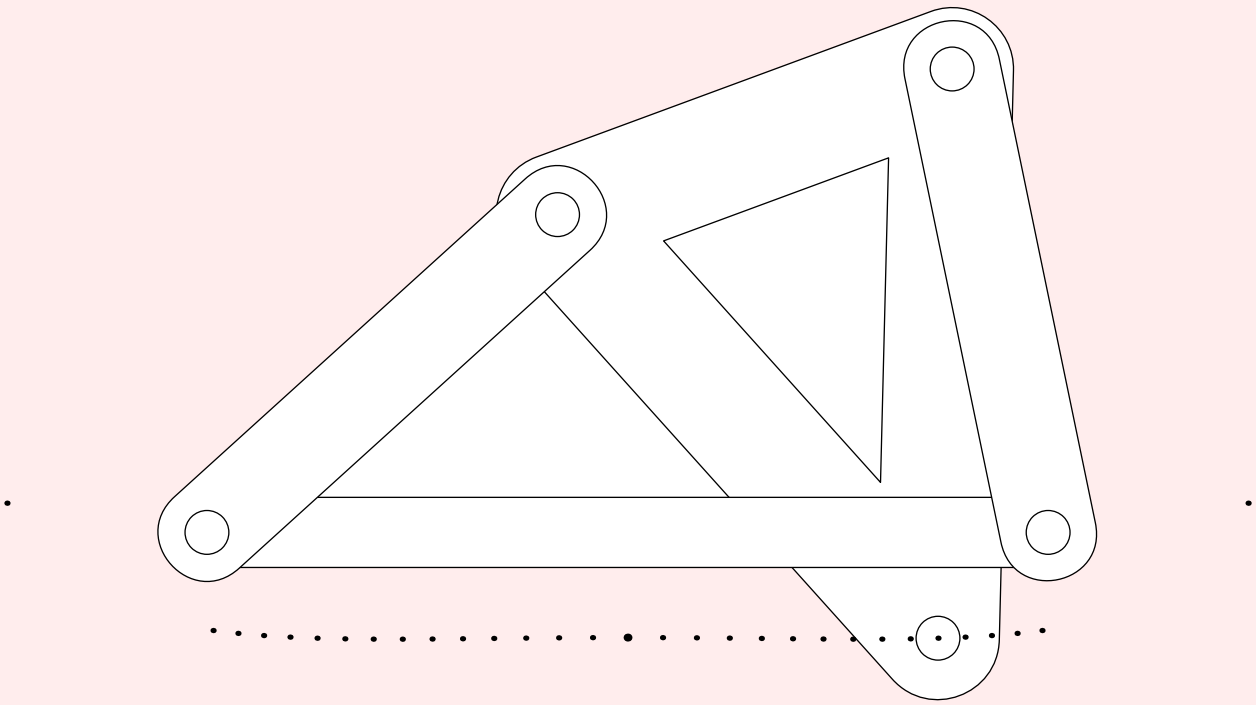
Workflow example (2)



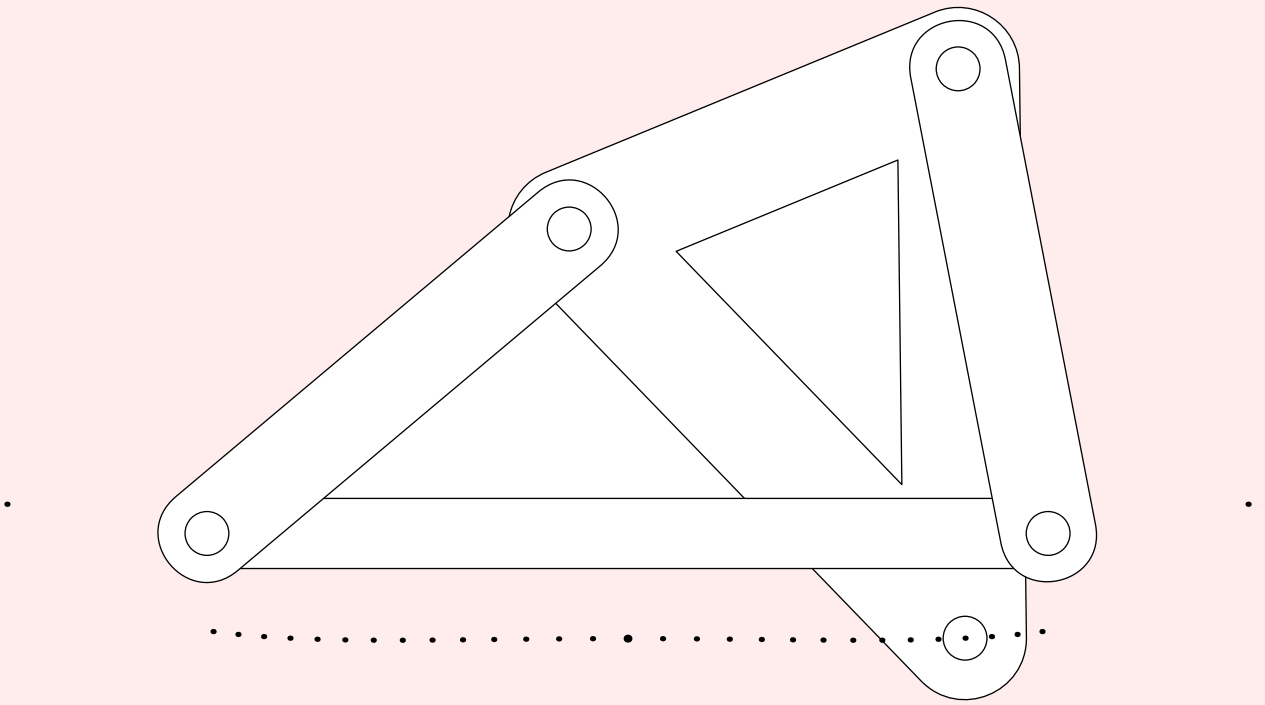
Workflow example (2)



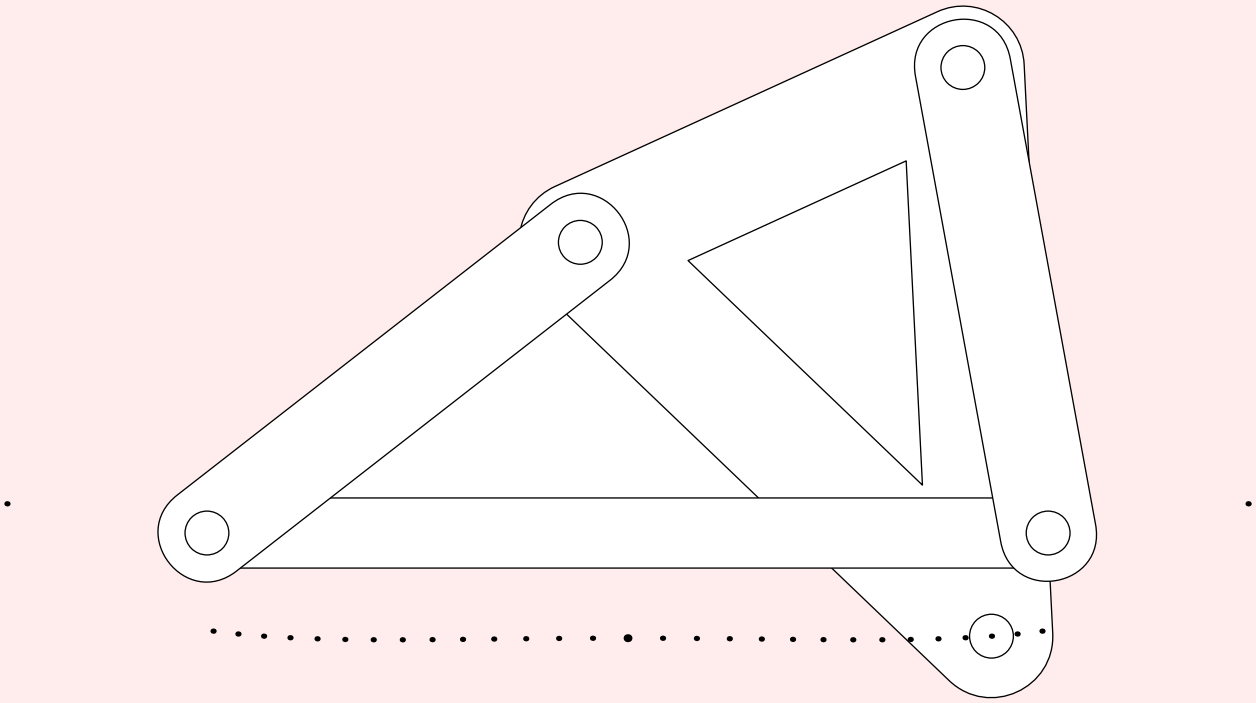
Workflow example (2)



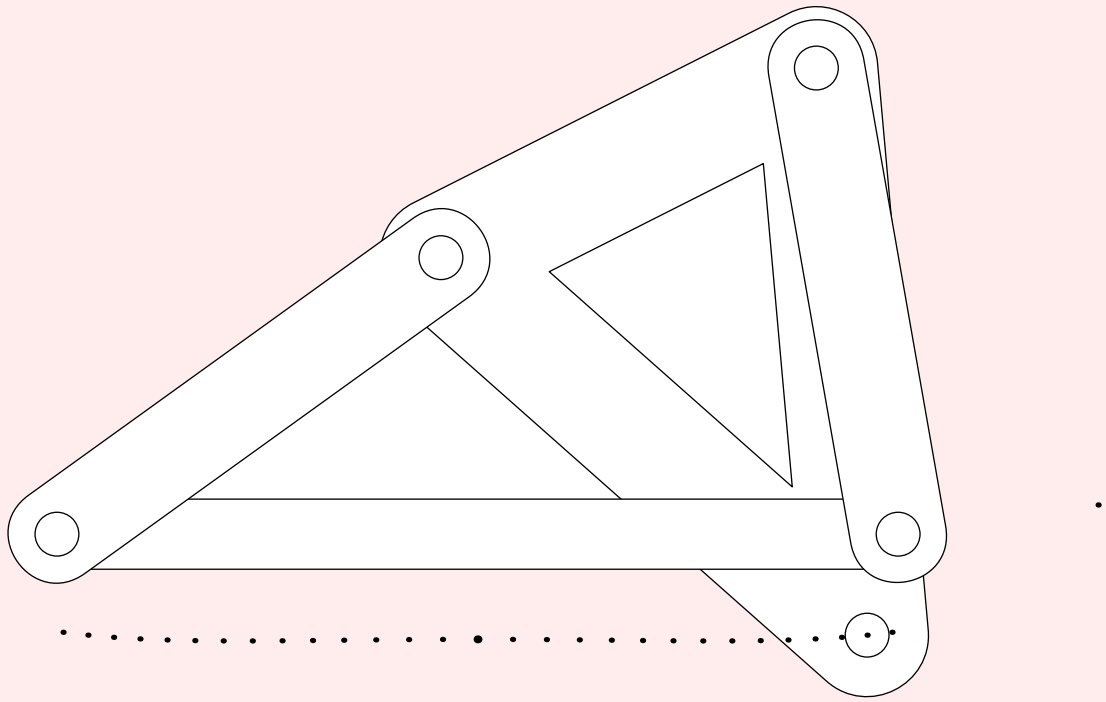
Workflow example (2)



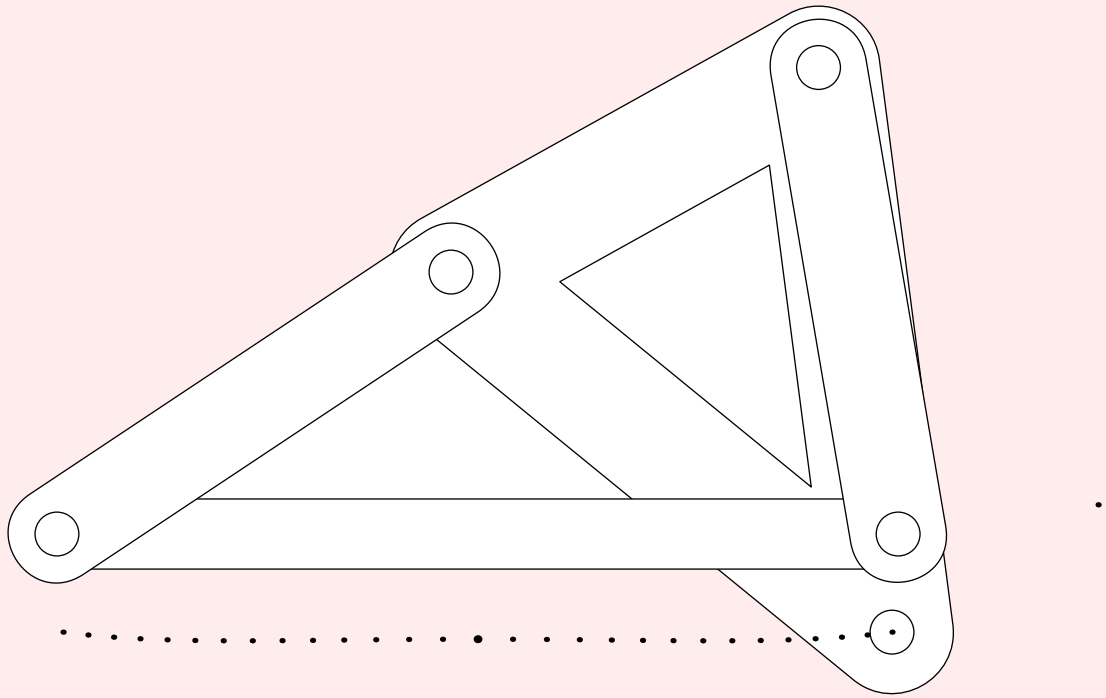
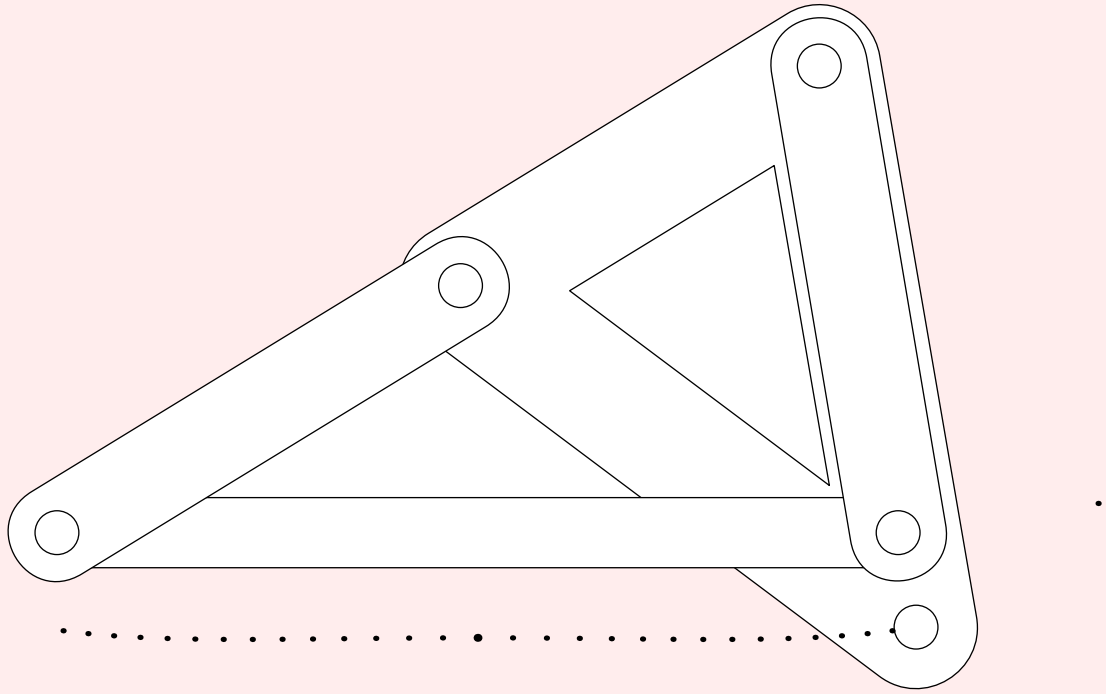
Workflow example (2)



Workflow example (2)



Workflow example (2)



Workflow example (2)