

# Wide-range METAPOST tutorial

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## Sammendrag

Sort of workshop about T<sub>E</sub>X–things, focusing on the METAPOST language.

# The Church of Free Software

Pope: Richard Stallman.

Evil

WYSIWYG

Evil

# 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<sup>nd</sup> ed., 1977, photographic
- T<sub>E</sub>X, v1, 1978,  $v \longrightarrow \pi$
- METAFONT, v1, 1979,  $v \longrightarrow e - \text{affine}$
- AMS, 1983
- APS, AIP, OSA, AAS, Springer-Verlag
- METAPOST, 1994, John Hobby



## A bit of history

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- METAPOST, 1994, John Hobby

METAPOST is the realm of 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  $\text{\LaTeX}$
- May be included in  $\text{\LaTeX}$

## 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

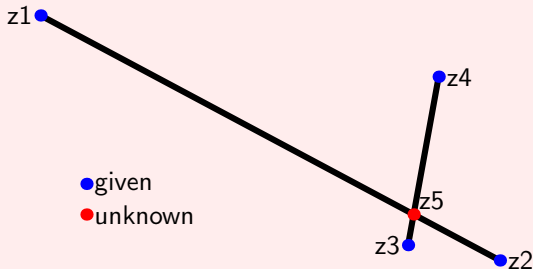
# Availability

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

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- CTAN
  - /graphics/metapost/contrib/macros
- T<sub>E</sub>X Users Group
  - texlive
- Debian
  - texlive-metapost
  - texlive-publishers includes RevTeX
  - latex-beamer
  - tex4ht
- “The L<sup>A</sup>T<sub>E</sub>X Companions”

## Linear equations



- Constraints may be expressed as linear equations

$$z5 = \text{whatever}[z1, z2];$$

$$z5 = \text{whatever}[z3, z4];$$

- 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

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

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- Interval 0—1 ND operator s[,]

$$\begin{array}{ll} 0.5[(1, 1), (3, 5)] & \longrightarrow (2, 3) \\ -0.5[(1, 1, 1), (3, 5, 7)] & \longrightarrow (0, -1, -2) \\ 1.5[(1, 1, 1, 1), (3, 5, 7, 9)] & \longrightarrow (4, 7, 10, 13) \end{array}$$

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- N-dimensional scalar arithmetic

$$\begin{array}{l} b = 2a; \\ z1 = 2*(1,2); \\ cc2 = 2*(1,2,3); \text{ grey} = 0.5\text{white}; \\ cc3 = 2*(1,2,3,4); \end{array}$$

## Other features

- Throw-in-the-garbage unknowns  
*whatever*

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- Special functions

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

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*whatever*

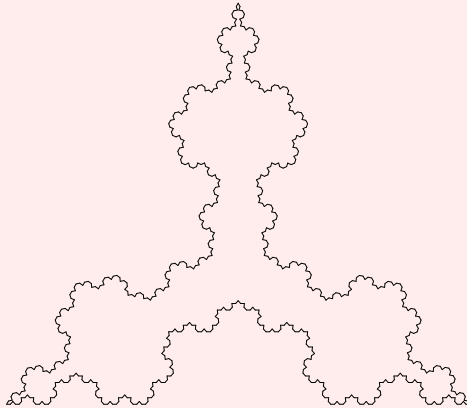
- Special functions

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

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



# Programmability



ø æ å ì § ü ç @ £ œ ß « » “ ” ...  $3.14159e-2 = 3,1416 \cdot 10^{-2}$

# Scriptability

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

# Forced Simplicity

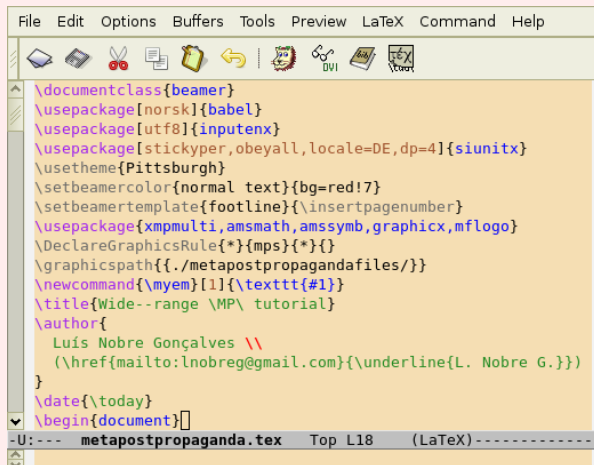
- $(8 \times) 4096$
- $1/65536$
- 2000 points in a path
- Memory
- Number of variables

Not for long. . .

# Consistency

- emacs+auctex/texmacs
- latexmp
- emp/LuaT<sub>E</sub>X
- graphicx
- beamer+xmpmulti
- GNUPLOT
- xfig
- dia/expressg
- gs+potrace+pstoedit+PstoeditMpostPreeditor
- siunitx

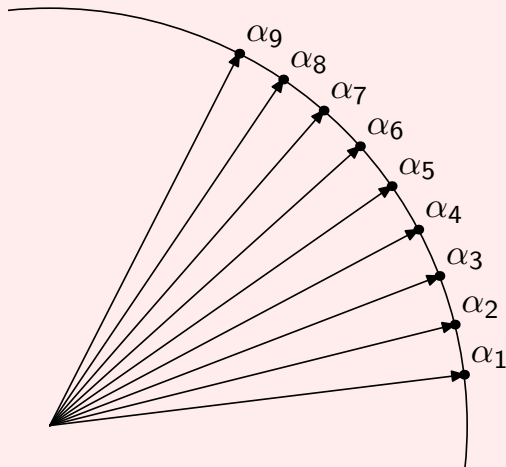
## emacs+auctex



```
\documentclass{beamer}
\usepackage[norsk]{babel}
\usepackage[utf8]{inputenx}
\usepackage[stickyper,obeyall,locale=DE,dp=4]{siunitx}
\usetheme{Pittsburgh}
\setbeamercolor{normal text}{bg=red!7}
\setbeamertemplate{footline}{\insertpagenumber}
\usepackage{xmpmulti,amsmath,amssymb,graphicx,mflogo}
\DeclareGraphicsRule{*}{mps}{*}{}
\graphicspath{./metapostpropagandafiles/}
\newcommand{\myem}[1]{\texttt{#1}}
\title{Wide--range \MP\ tutorial}
\author{
  Luís Nobre Gonçalves \\\
  (\href{mailto:lnobreg@gmail.com}{\underline{L. Nobre G.}})
}
\date{\today}
\begin{document}
```

-U:--- metapostpropaganda.tex Top L18 (LaTeX)-----

See code



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"
```

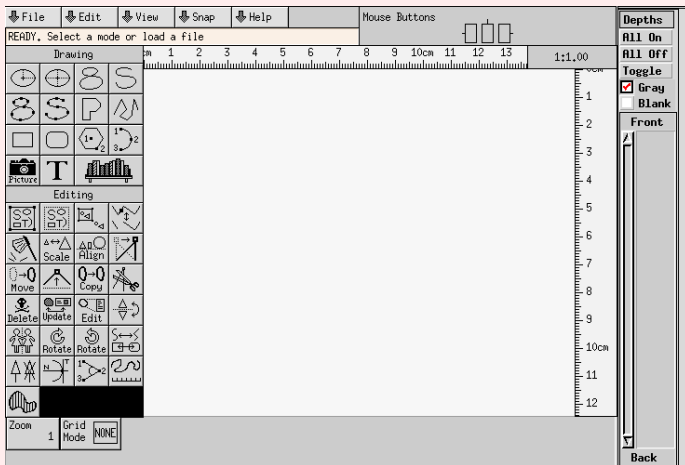
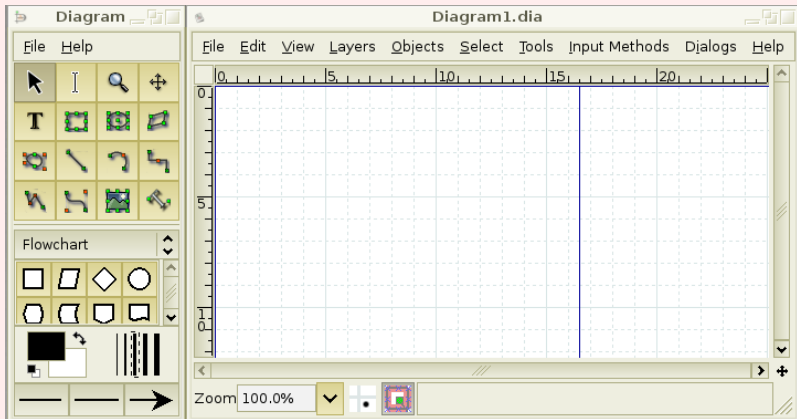


fig2ps

dia



## epspdf+gs

epspdf minimal-1.mps

---

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

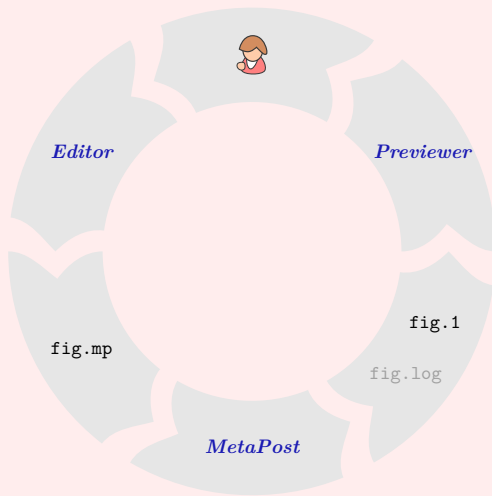
potrace+pstoedit+PstoeditMpostPreeditor

## Example

# PstoeditMpostPreeditor

## Example

## Basic workflow



# Workflow

- ① Draw scheme by hand
- ② Identify parameters



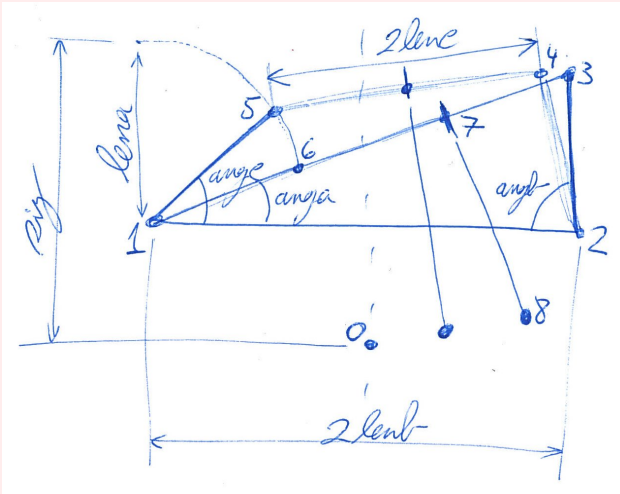
# Workflow

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

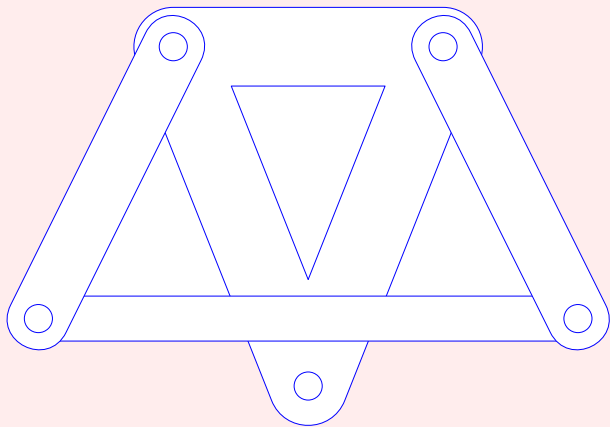
## Workflow example (0)



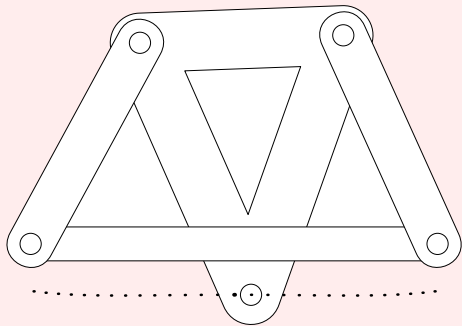
## Workflow example (1)



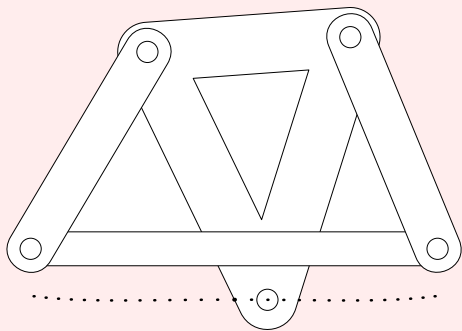
## Workflow example (2)



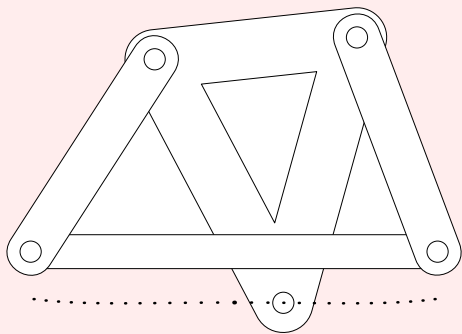
## Workflow example (2)



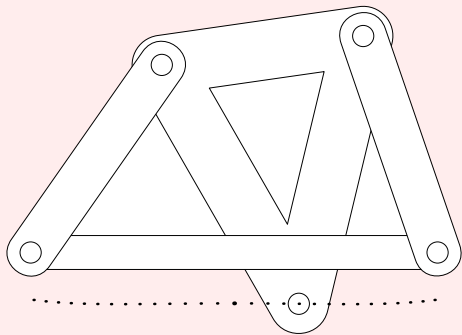
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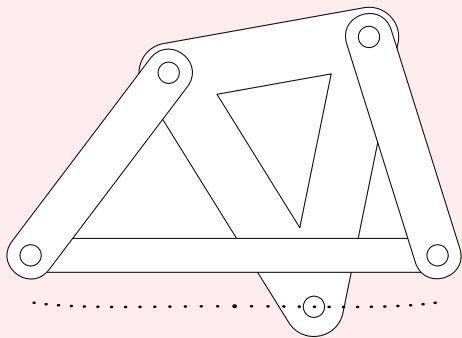


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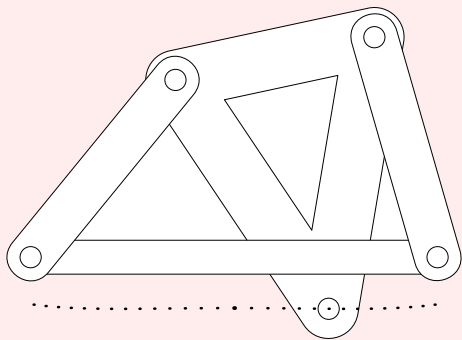




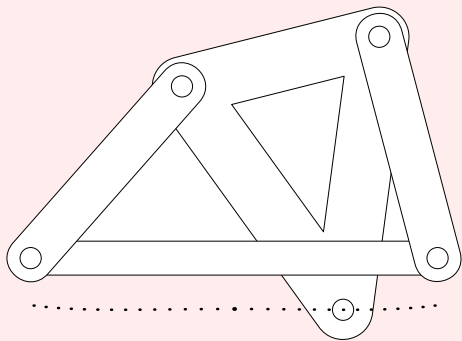
## Workflow example (2)



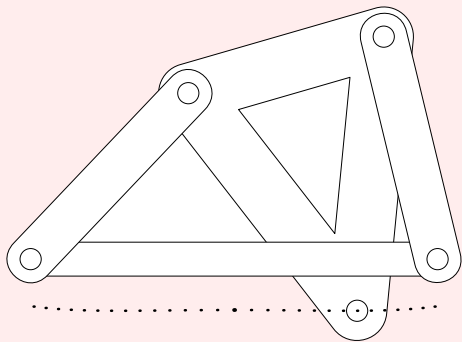
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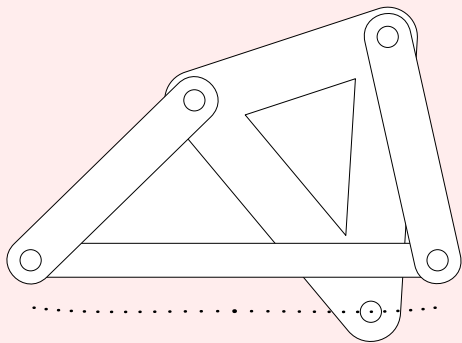
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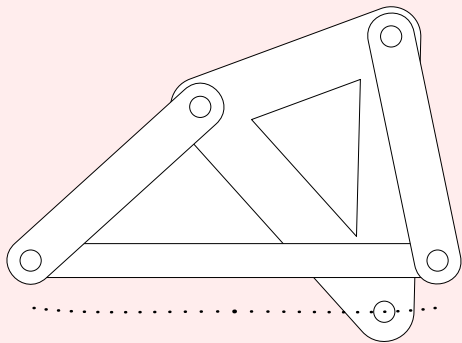
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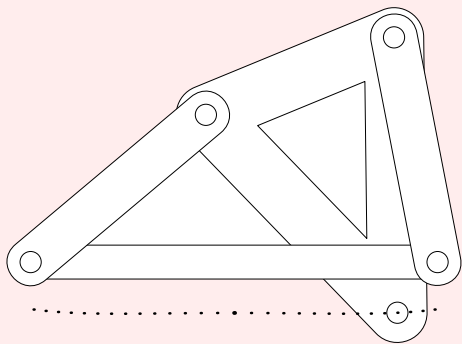
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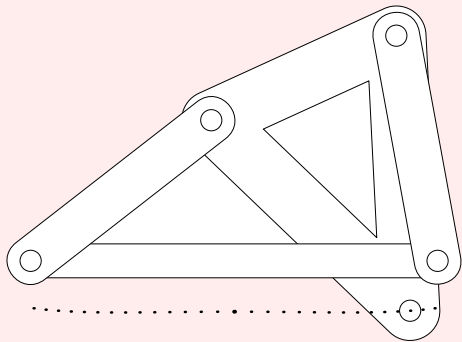
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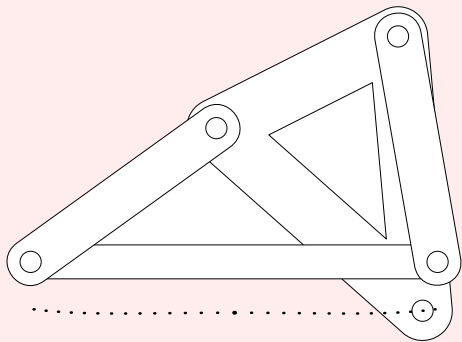


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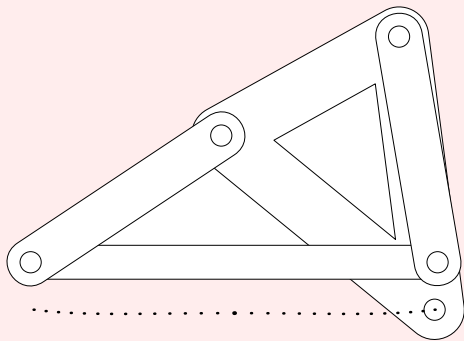




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