

# TikZ & PGF(Plots)

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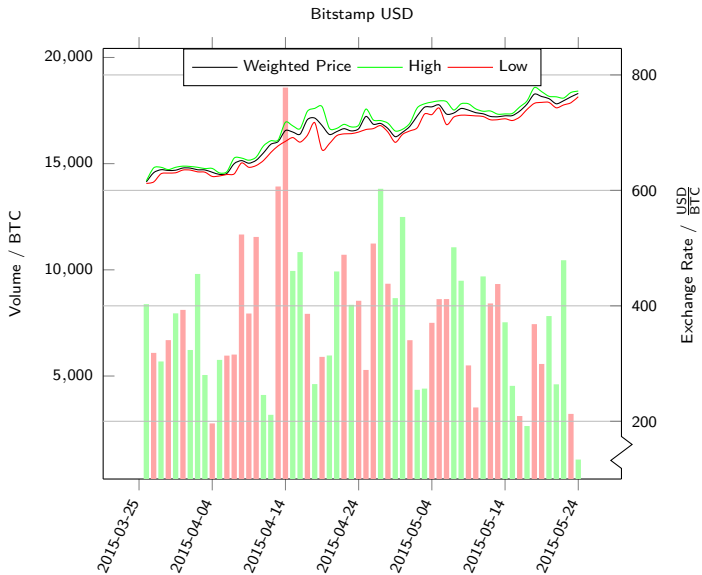
fhLUG



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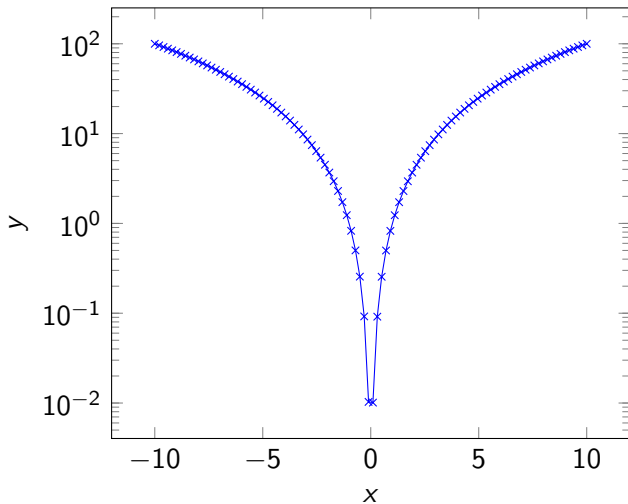
(CC-BY-SA)

# 2D value plot

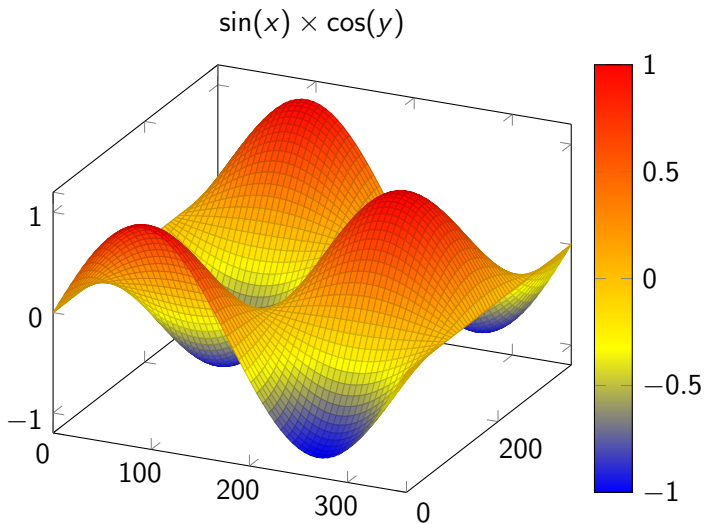


## 2D function plot

$$x^2 - y = 0$$



## 3D function plot



# TikZ & PGF(plots)

- ▶ TikZ ist kein Zeichenprogramm
- ▶ Portable Graphics Format / pretty, good, functional
- ▶ Usable with  $\text{\LaTeX}$ ,  $\text{\TeX}$ ,  $\text{\ConTeXt}$

- ▶ “Program” your graphics
- ▶ Advantages: quick creation of simple graphics, precise positioning, macros, superior typography
- ▶ Disadvantages: steep learning curve, no WYSIWYG, compilation times

# PGFPLOTS

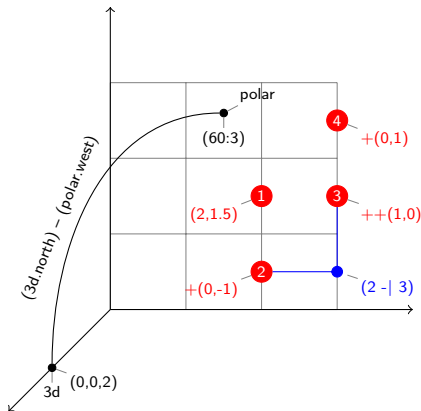
- ▶ Draw plots and labeled axes easily
- ▶ Linear plots, logplots, semi-logplots
- ▶ 2D and 3D

Part I

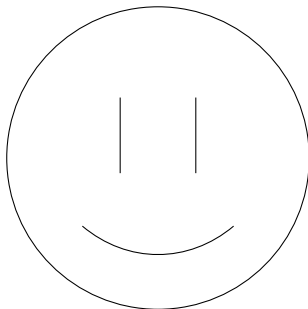
TikZ



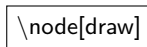
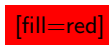
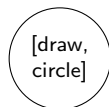
- ▶ Many different *coordinate systems*
- ▶ Always in round brackets
- ▶ Absolute or relative
- ▶ Cartesian, Polar, Barycentric, Perpendicular, user-defined, ...



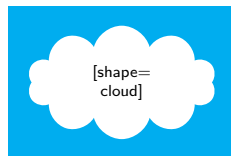
- ▶ Basic entity of drawing
- ▶ Consist of parts
- ▶ Closed or open curves



- ▶ Text placed at coordinate
- ▶ Simple and complex shapes
- ▶ Anchors for precise positioning
- ▶ `\node` is shorthand for `\path node`



There is NO CLOUD, just



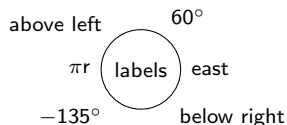
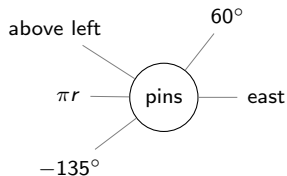
other people's computers

[draw=red, fill=blue,  
text=white, font=, thick,  
rounded corners=4mm]

# TikZ

## Nodes: Labels and Pins

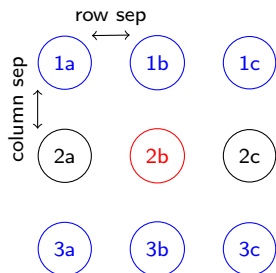
- ▶ Add nodes to existing nodes
- ▶ Can be called multiple times per node



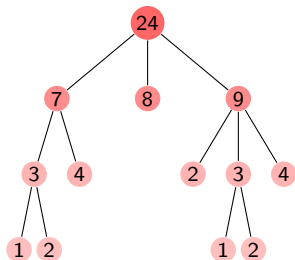
# TikZ

## Nodes: Matrices

- ▶ Mostly treated like nodes
- ▶ Similar to tabular environment
- ▶ Consist of rows of *cells*
- ▶ Each cell contains a *cell picture*
- ▶ `cell 1; & cell 2; \\`



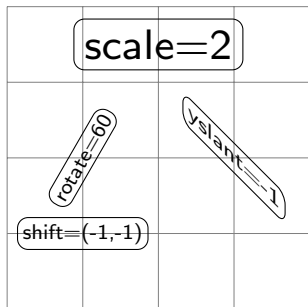
- ▶ Visualize hierarchical structures
- ▶ Customizable growth functions



# TikZ

## Coordinate transformations

- ▶ Rotate, translate, scale, slant



# Libraries

- ▶ Arrow tip
- ▶ Automata drawing
- ▶ Background
- ▶ Calc
- ▶ Calendar
- ▶ Chains
- ▶ Circuits (logical)
- ▶ Circuits (electrical engineering)
- ▶ Decoration
- ▶ ER diagram drawing
- ▶ Externalization
- ▶ Fading
- ▶ Fitting
- ▶ Fixed point arithmetic
- ▶ Lindenmayer system drawing
- ▶ Matrix
- ▶ Mindmap drawing
- ▶ Paper folding diagrams
- ▶ Pattern
- ▶ Petri-net drawing
- ▶ Plot handler
- ▶ Plot mark
- ▶ Profiler
- ▶ Shadings
- ▶ Shadow
- ▶ Shape
- ▶ Spy
- ▶ SVG-path
- ▶ To path
- ▶ Through
- ▶ Tree
- ▶ Turtle graphics



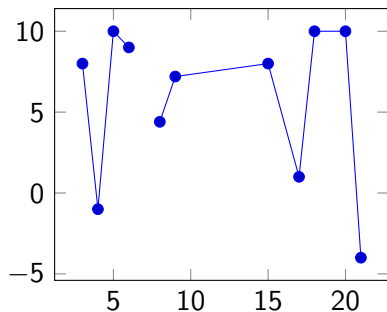
# Part II

## PGFPLOTS

# PGFPLOTS

## Plots

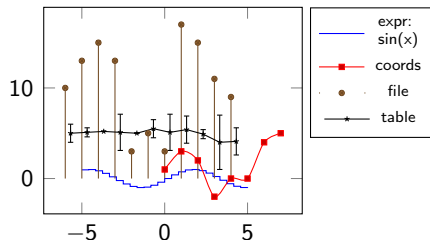
- ▶ Plots contained in axis environment
- ▶ `\addplot`
- ▶ Data inline or from file



# PGFPLOTS

Plots: `\addplot`

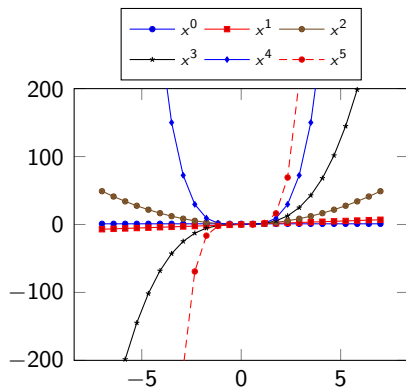
- ▶ coordinates, file, table, expression
- ▶ `\addplot`, `\addplot+`
  - ▶ `const plot`, `sharp plot`, `smooth`, `x/ybar (interval)`, `x/ycomb`, `only marks`, `scatter`, `mesh`
- ▶ `\addplot3`, `\addplot3+`
  - ▶ `sharp plot`, `smooth`, `scatter`, `only marks`, `mesh`, `surf`



# PGFPLOTS

Plots: Automatic style cycling

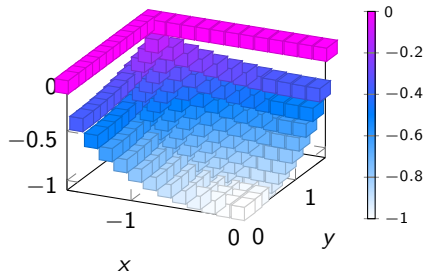
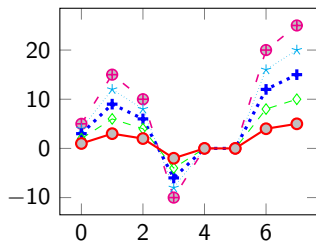
- ▶ Plot styles from a predefined list
- ▶ Used for plot lines and legend entries



# PGFPLOTS

## Plots: styles

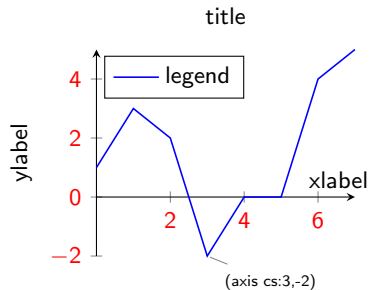
- ▶ solid, (densely/loosely) dotted, (densely/loosely) dashed
- ▶ thin, ultra thin, very thin, semithick, thick, very thick, ultra thick
- ▶ red, green, blue, cyan, magenta, yellow, black, gray, white, darkgray, lightgray, brown, lime, olive, orange, pink, purple, teal, violet
- ▶ mark=\*, x, +, -, |, o, asterisk, star, oplus(\*), otimes(\*), square(\*), triangle(\*), diamond(\*), pentagon(\*), cube(\*), text, *user defined*



# PGFPLOTS

## Plots: descriptions

- ▶ title
- ▶ x/ylabel
- ▶ legend
- ▶ ticklabel style
- ▶ axis x/y line



# PGFPLOTS

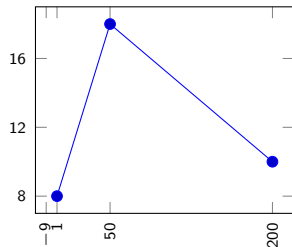
## Number formatting

- ▶ Pretty-print numbers
- ▶ `\pgfmathprintnumber [...]{...}`
- ▶ fixed, sci, std, frac, ...
- ▶ std:  $1.23 \cdot 10^7$
- ▶ fixed: 12,304,567.89
- ▶ fixed, zerofill: 12,304,567.890
- ▶ sci:  $1.23 \cdot 10^7$
- ▶ sci, sci e:  $1.23e+7$
- ▶ sci, zerofill:  $1.230 \cdot 10^7$
- ▶ frac:  $12304567 \frac{89}{100}$
- ▶ frac, frac whole=false:  
 $\frac{1230456789}{100}$

# PGFPLOTS

## Plots: Tick options

- ▶ `xtick/ytick/ztick = \emptyset,`  
`data, coordinate list`
- ▶  $\{0,1,3.5,2\text{e}1\}$ ,  $\{0,\dots,5\}$  ,  
 $\{0,2,\dots,5\}$  ,  $\{9,\dots,3.5\}$

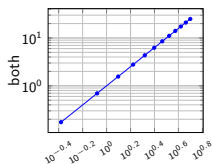
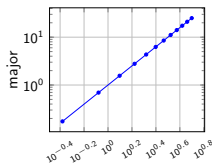
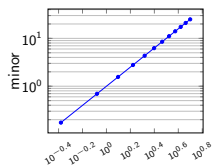




# PGFPLOTS

## Plots: Grid options

- ▶ Minor grids
  - ▶ xminorgrids
  - ▶ yminorgrids
  - ▶ zminorgrids
- ▶ Major grids
  - ▶ xmajorgrids
  - ▶ ymajorgrids
  - ▶ zmajorgrids
- ▶ grid=major/minor/both



# References

- ▶ <http://pgf.sourceforge.net>
- ▶ <http://pgfplots.sourceforge.net>
- ▶ <http://en.wikibooks.org/wiki/LaTeX/PGF/TikZ>
- ▶ <http://tex.stackexchange.com>
- ▶ <http://texample.net/tikz>