LaTeX Experiments
Part III: PGF/TikZ

AeAeA

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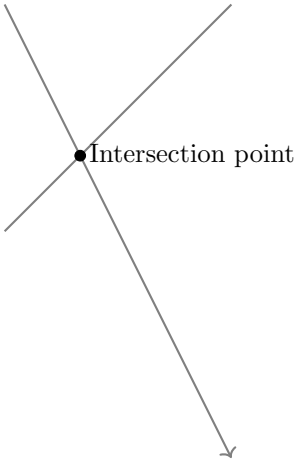
1 TikZ ist *kein* Zeichenprogramm

Für meinen Vater, damit er noch viele schöne TEX-Graphiken erschaffen kann.

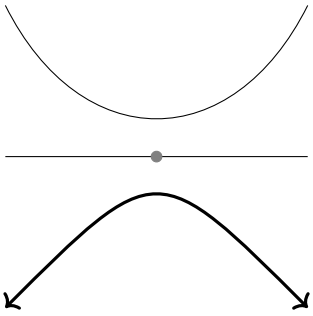
— Till Tantau, *PGF Manual*



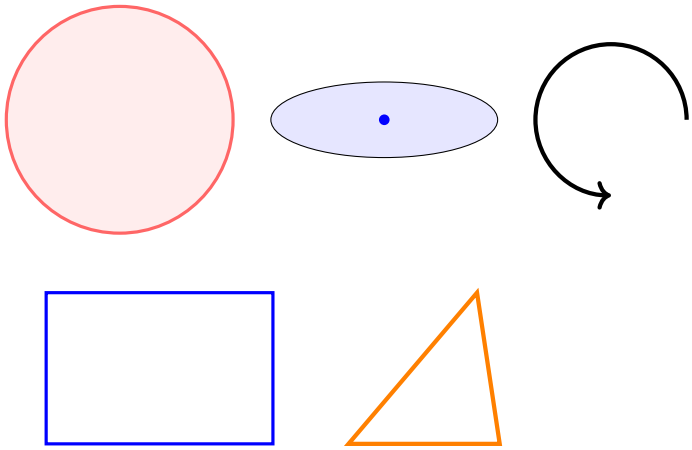
- `https://en.wikipedia.org/wiki/PGF/TikZ`
- `https://www.ctan.org/pkg/pgf`
- `https://github.com/pgf-tikz/pgf`
- Minimal introduction to TikZ (unofficial)
- It comes with very good documentation; the version 3.1.5b of the PGF Manual has over 1,300 pages (!) ...
- ... and an extensive collection of examples: `http://www.texample.net/tikz/`

- https://en.wikibooks.org/wiki/LaTeX/PGF/TikZ
- https://www.overleaf.com/learn/latex/TikZ_package

1.1 Basic elements: points, lines and paths



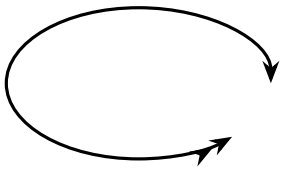
1.2 Basic geometric shapes: Circles, ellipses and polygons



The code for the little "turned" ellipse  is

```
\tikz \draw[rotate=30] (0,0) ellipse [x radius=6pt,y radius=3pt];
```

1.3 Elliptical arc



1.4 Arrow tips

Stealth

Karl wonders whether such a military name for the arrow type is really necessary. He is not really mollified when his son tells him that Microsoft's PowerPoint uses the same name. He decides to have his students discuss this at some point.

— Till Tantau, *PGF Manual*

This is an example of `Stealth` arrow tip  which is a "stealth-fighter-like".

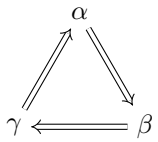
All arrow tips:

(Almost) zero-length arrow:

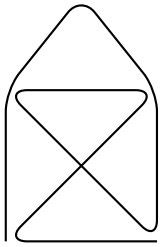
1.4.1 Arrow Tip Kind `Implies`

$\therefore$
$e_l * e_r \implies e_r$

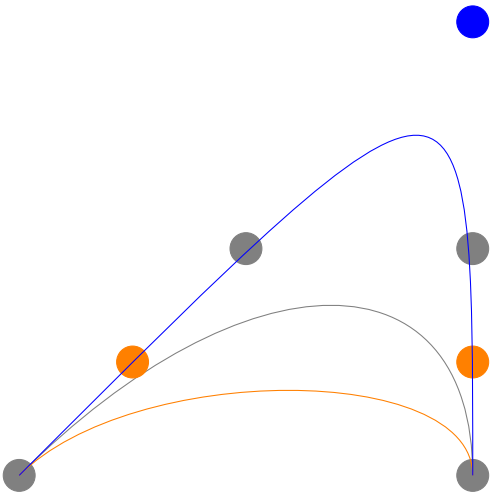
This arrow tip makes only sense in conjunction with the double option: attach it to a double line to get something ($\implies$) that looks like `amsmath` TEX's `\implies` arrow ($\implies$). A typical use of this arrow tip is:



1.5 Path



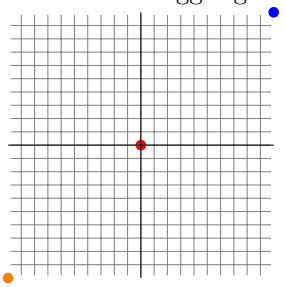
1.6 Curved path



1.7 Grid

The code `\tikz \draw[step=2pt] (0,0) grid (10pt,10pt);` produces .

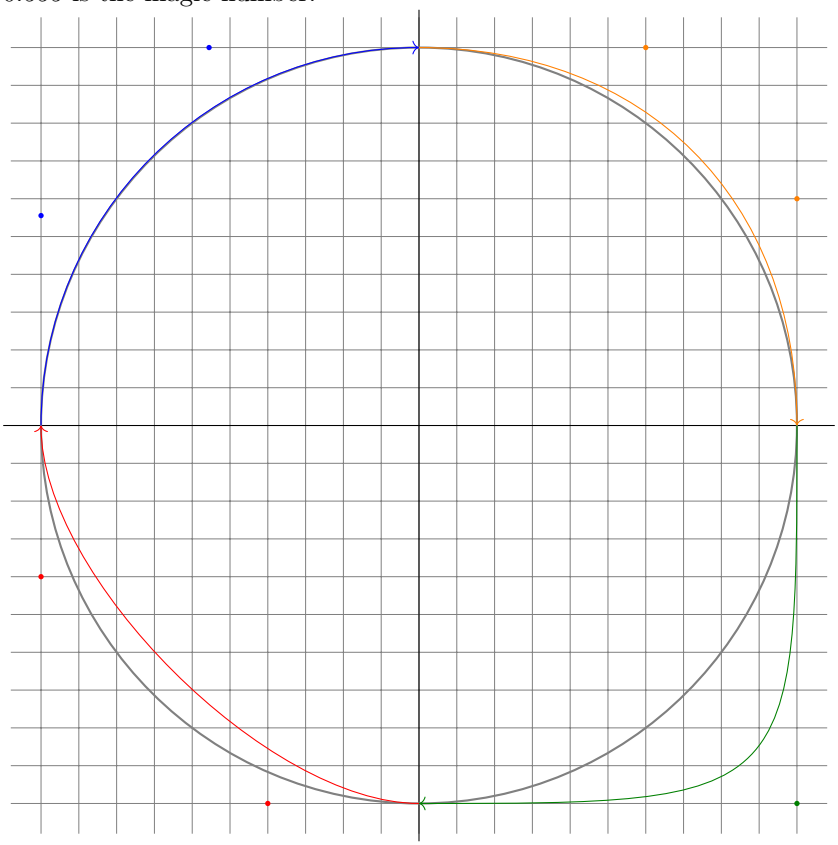
Here is a bigger grid:



1.8 Circle and curved path

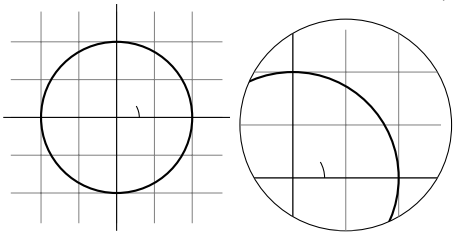
0.555

0.555 is the magic number.



1.9 Clipping a path

Original drawing on the left, clipped (and 1.4 scaled) drawing on the right:



1.10 Parabola and Sine

Two parabolas  and a parabola with placed bend 

A parabola with the bend: 

A sine curve, and a longer span of sine and cosine: 

1.11 Closing the path

The `--cycle` causes the current path to be closed (actually the current part of the current path) by smoothly joining the first and last point. To appreciate the difference, consider the following example:

1.12 Shading

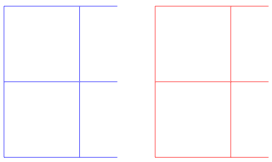
The default shading is a smooth transition from gray at the top to white at the bottom:

To specify different colors, you can use options:

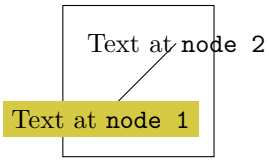
1.13 Scoping

2 A picture for Karl

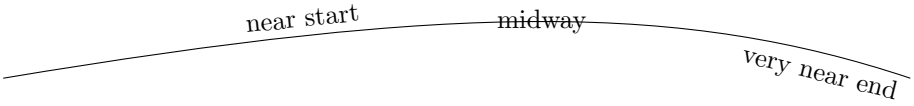
2.1 Style



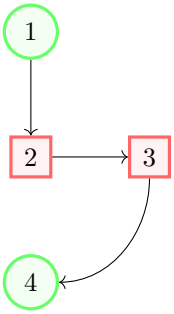
2.2 Adding Text



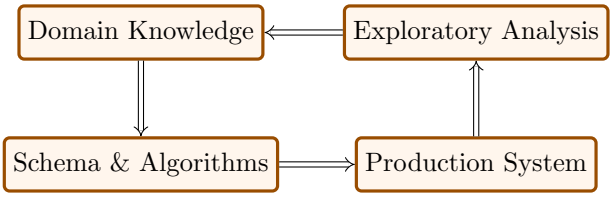
If the label directly after the `--` and before the coordinate, this places the label in the middle of the line, but the `pos=` options can be used to modify this. Also, options like `near start` and `near end` can be used to modify this position. You can also position labels on curves and, by adding the `sloped` option, have them rotated such that they match the line's slope. Here is an example:



2.3 Diagrams with nodes



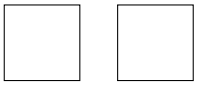
2.3.1 Extracting Insights From Data diagram



2.4 Specifying Coordinates

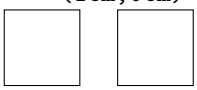
To appreciate the difference between + and ++ consider the following example:

```
-- ++(1cm,0cm)  -- ++(0cm,1cm)  -- ++(-1cm,0cm) -- cycle
```

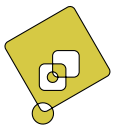


By comparison, when using a single +, the coordinates are different:

```
-- +(1cm,0cm)  -- +(1cm,1cm)  -- +(0cm,1cm) -- cycle
```



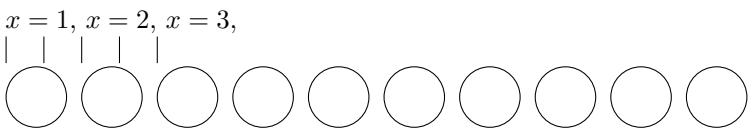
2.5 Transformations



Another way to display all options for arrow tips:

2.6 Repeating Things: For-Loops

1. Arc Barb
2. Bar
3. Bracket
4. Butt Cap
5. Circle
6. Diamond
7. Ellipse
8. Fast Round
9. Fast Triangle
10. Hooks
11. Implies
12. Kite
13. LaTeX
14. Latex
15. Parenthesis
16. Rays
17. Rectangle
18. Round Cap
19. Square
20. Stealth
21. Straight Barb
22. Tee Barb
23. To
24. Triangle
25. Triangle Cap
26. Turned Square

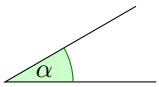


2.6.1 2D tables

1,5	2,5	3,5	4,5	5,5
1,4	2,4	3,4	4,4	5,4
1,3	2,3	3,3	4,3	5,3
1,2	2,2	3,2	4,2	5,2
1,1	2,1	3,1	4,1	5,1

7,5	8,5	9,5	10,5	11,5	12,5
7,4	8,4	9,4	10,4	11,4	12,4
7,3	8,3	9,3	10,3	11,3	12,3
7,2	8,2	9,2	10,2	11,2	12,2
7,1	8,1	9,1	10,1	11,1	12,1

2.7 Karl's picture



The angle α is $30°$ in the example ($\pi/6$ in radians). The sine of α, which is the height of the red line, is

$$\sin\alpha = 1/2.$$

By the Theorem of Pythagoras ...