How to TikZ?

An overview

Jan-Philipp Kappmeier

Technische Universität Berlin

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TikZ

TikZ ist *kein* Zeichenprogramm

- A language to create images within LaTex
- Two components:
  1. TikZ
     easy to use high-level commands
  2. PGF (Portable Graphics Format)
     low-level commands (at aleast: lower level)

Usage

First: include the package tikz. Then:

- directly code images. See details in this talk
- create images in Inkscape and export
- lots of other tools provide TikZ-Output

For starters

How to add a TikZ picture to your document?

- TikZ-code is written in an `tikzpicture` environment.
- Put into a picture environment to add caption, reference etc.
- Inline-TikZ: use the `\tikz` command to create inline graphics like this nice 5-wheel here.

Example

It is easy to draw a thistle .

```
\tikz{ \filldraw[color=Thistle] circle (0.5ex); }
```

Drawing on paths

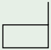
Generel principle

- Everything is drawn on a so-called path
- A sequence of coordinates and drawing commands
- General syntax:

  `\draw[options] (coordinate) command (coordinate) ...;`

  like moving a pencil to some place and start drawing something.
- Special commands like `\fill` also exists.

Example



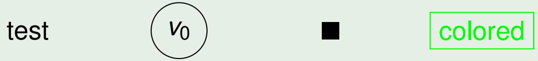
```
\draw (1,0) rectangle +(2,1) -- (3,2);
\draw (0,0) -- (0,2) -- (1,3.25){[rounded corners] -- (2,2)
  -- (2,0)} -- (0,2) -- (2,2) -- (0,0) -- (2,0);
```

Drawing Graphs

Nodes

- Nodes can be put on any path using the command `node`
- `\draw[parameter] node at coordinate {content};`
- Special draw command for nodes: `\node`
- by default, a node is just a position and no shape is drawn

Example




```
\node at (0,0) {test};
\node[draw,circle] at (2,0) {$v_0$};
\node[fill] at (4,0) {};
\node[draw,color=red] at (6,0) [green] {colored};
```

Drawing the 5 wheel

We are ready to pimp our slides with the COGA-5-Wheel!

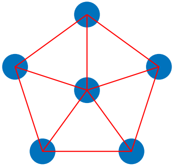
Drawing the 5 wheel

We are ready to pimp our slides with the COGA-5-Wheel!

```
\node[fill,circle,draw,RoyalBlue] at (0,1) {};
\node[fill,circle,draw,RoyalBlue] at (-0.9511,0.3091) {};
\node[fill,circle,draw,RoyalBlue] at (-0.5878,-0.8091) {};
\node[fill,circle,draw,RoyalBlue] at (0.5878,-0.8091) {};
\node[fill,circle,draw,RoyalBlue] at (0.9511,0.3091) {};
\node[fill,circle,draw,RoyalBlue] at (0,0) {};
\draw[red] (0,1) to (-0.9511,0.3091) to (-0.5878,-0.8091)
    to (0.5878,-0.8091) to (0.9511,0.3091) to (0,1);
\draw[red] (0,0) to (0,1) (0,0) to (-0.9511,0.3091) (0,0)
    to (-0.5878,-0.8091) (0,0) to (0.5878,-0.8091) (0,0)
    to (0.9511,0.3091);
```

Drawing the 5 wheel

We are ready to pimp our slides with the COGA-5-Wheel!



Unfortunately we have do to a lot of computation.
➡ Can be done by PGF!

Also, lines are drawn over the nodes.
➡ Solve this using named nodes.

Drawing the 5 wheel

Computations using PGF

- `\pgfmathsetmacro{\x}{computation}`
  Creates a variable `\x` with the result of the computation
- `\pgfmathparse{computation}`
  Stores the result in the variable `\pgfmathresult`

Drawing the 5 wheel

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```
\pgfmathsetmacro{\xa}{cos(90)}
\pgfmathsetmacro{\ya}{sin(90)}
\pgfmathsetmacro{\xb}{cos(90+72)}
\pgfmathsetmacro{\yb}{sin(90+72)}
...
\node[fill,circle,draw,RoyalBlue] (1) at (\xa,\ya) {};
\node[fill,circle,draw,RoyalBlue] (2) at (\xb,\yb) {};
...
\draw[red] (1) to (2) to (3) to (4) to (5) to (1);
\draw[red] (0) to (1) (0) to (2) (0) to (3) (0) to (4) (0) to
```

Drawing the 5 wheel

Computations using PGF

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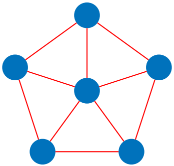

Still we need to know a lot about how to compute coordinates on a circle

Polar coordinates

Polar coordinates

- All coordinates can be defined via polar coordinates
- Needed only an angle and the radius (distnace from the origin)
- expressed as `(angle:radius)`

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```
\node[fill,circle,draw,RoyalBlue] (1) at (90+0*72:1) {};
\node[fill,circle,draw,RoyalBlue] (2) at (90+1*72:1) {};
\node[fill,circle,draw,RoyalBlue] (3) at (90+2*72:1) {};
\node[fill,circle,draw,RoyalBlue] (4) at (90+3*72:1) {};
\node[fill,circle,draw,RoyalBlue] (5) at (90+4*72:1) {};
\node[fill,circle,draw,RoyalBlue] (0) at (0,0) {};
\draw[red] (1) to (2) to (3) to (4) to (5) to (1);
\draw[red] (0) to (1) (0) to (2) (0) to (3) (0) to (4) (0) to
```

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- All coordinates can be defined via polar coordinates
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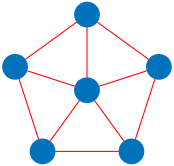
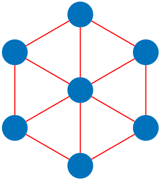


Loops

What happens when the logo surprisingly changes to a 6 wheel?



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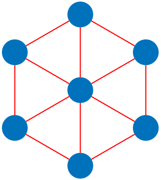
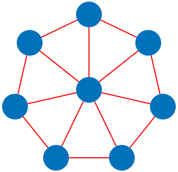


Or even to a 7 wheel?



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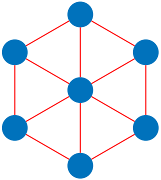

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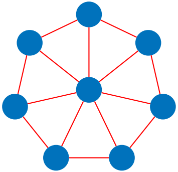


The foreach command

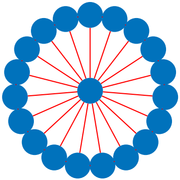
- executes the same commands for all items of a given set
- assigns the value to a variable
- `\foreach \var in \{ item1, item2, ..., itemN\} { }`

Putting things together

```
\pgfmathsetmacro{\n}{5}
\pgfmathtruncatemacro{\nodes}{\n-1}
\node[fill,circle,draw,RoyalBlue] (c) at (0,0) {};
\foreach \i in {0,...,\nodes}
  \node[fill,circle,draw,RoyalBlue] (\i) at (90+\i*360/\n:1)
\foreach \i in {0,...,\nodes} {
  \draw[red] (c) to (\i);
  \pgfmathtruncatemacro{\j}{mod(round(1+\i),\n)}
  \draw[red] (\i) -- (\j);
}
```

Putting things together

```
\pgfmathsetmacro{\n}{5}
\pgfmathtruncatemacro{\nodes}{\n-1}
\node[fill,circle,draw,RoyalBlue] (c) at (0,0) {};
\foreach \i in {0,...,\nodes}
  \node[fill,circle,draw,RoyalBlue] (\i) at (90+\i*360/\n:1)
\foreach \i in {0,...,\nodes} {
  \draw[red] (c) to (\i);
  \pgfmathtruncatemacro{\j}{mod(round(1+\i),\n)}
  \draw[red] (\i) -- (\j);
}
```



Loops cont.

\foreach with more variables

- The `\foreach` command can iterate over tuples
- values are assigned to several variables

Example

Want to highlight specific numbers on the real line.

Loops cont.

\foreach with more variables

- The `\foreach` command can iterate over tuples
- values are assigned to several variables

Example

Want to highlight specific numbers on the real line.
Give it a first try:

```
\draw[->] (0,0) to (8,0);
\foreach \x in {0, 1, 1.57, 3.14, 2.71} {
  \draw (\x,0.1) to (\x,-0.1);
  \node at (\x, -0.3) {\footnotesize{\x}};
```

Loops cont.

\foreach with more variables

- The `\foreach` command can iterate over tuples
- values are assigned to several variables

Example

Want to highlight specific numbers on the real line.
Give it a first try:

Loops cont.

\foreach with more variables

- The `\foreach` command can iterate over tuples
- values are assigned to several variables

Example

Want to highlight specific numbers on the real line.
Better:

Loops cont.

\foreach with more variables

- The `\foreach` command can iterate over tuples
- values are assigned to several variables

Example

Want to highlight specific numbers on the real line.

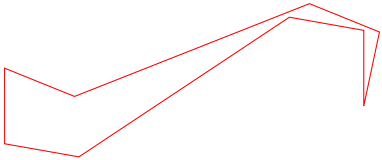
```
\draw[->] (0,0) to (4,0);
\foreach \x / \txt in
{0, 1, 1.57 / $\frac{\pi}{2}$, 3.14 / $\pi$, 2.71 / $e$} {
  \draw (\x,0.1) to (\x,-0.1);
  \node at (\x, -0.3) {\footnotesize{\txt}};
```

Calculate coordinates

Coordinates

- Can be defined using `coordinate`
- Like nodes with empty text
- Coordinates can be computed (like vector math)
- need to add the package calc (`\includetikzpackage{calc}`)

An example using coordinate calculation - Background



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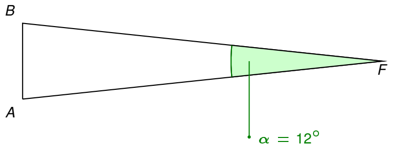

Construction

1. Start with an isosceles triangle with base of length a

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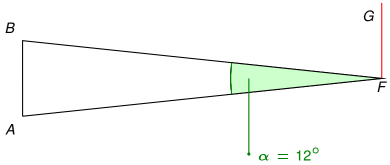

Construction

1. Start with an isosceles triangle with base of length *a*
2. Draw a copy of $\overline{AB}$ at *F*

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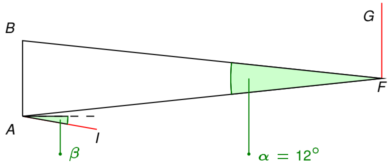

Construction

1. Start with an isosceles triangle with base of length a
2. Draw a copy of $\overline{AB}$ at F
3. Draw segment $\overline{AI}$ of length b with some angle β

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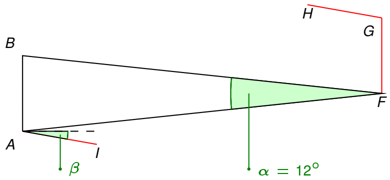
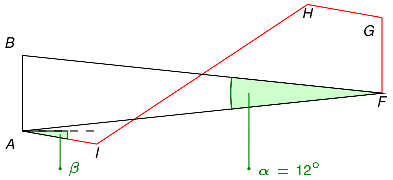


Construction

1. Start with an isosceles triangle with base of length a
2. Draw a copy of $\overline{AB}$ at F
3. Draw segment $\overline{AI}$ of length b with some angle β
4. and copy it to G

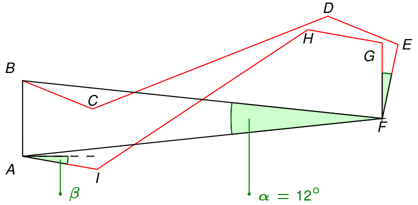
An example using coordinate calculation - Background



Construction

1. Start with an isosceles triangle with base of length a
2. Draw a copy of $\overline{AB}$ at F
3. Draw segment $\overline{AI}$ of length b with some angle β
4. and copy it to G
5. Connect H and I

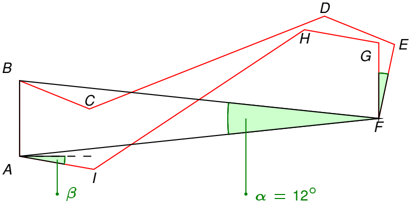
An example using coordinate calculation - Background



Construction

1. Start with an isosceles triangle with base of length a
2. Draw a copy of $\overline{AB}$ at F
3. Draw segment $\overline{AI}$ of length b with some angle β
4. and copy it to G
5. Connect H and I
6. Rotate the polygonal path $\overline{FGHIA}$ around A by $12°$

An example using coordinate calculation - Ti*k*Z realization



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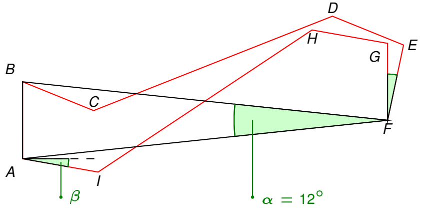

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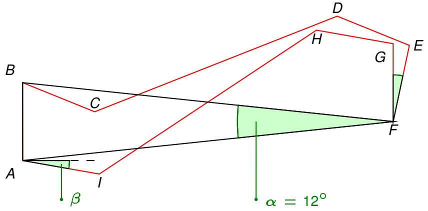

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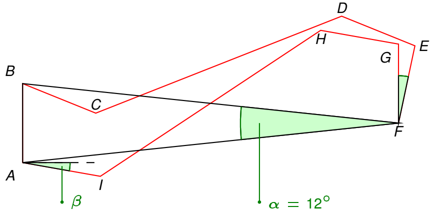

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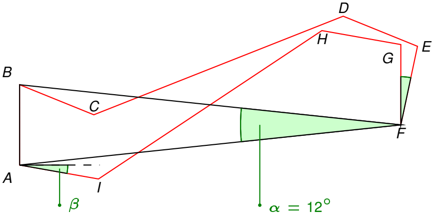

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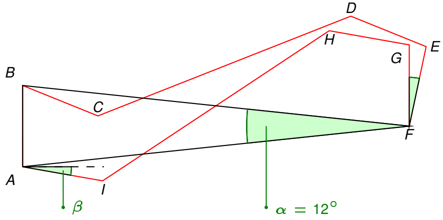

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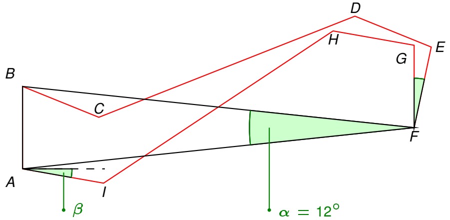

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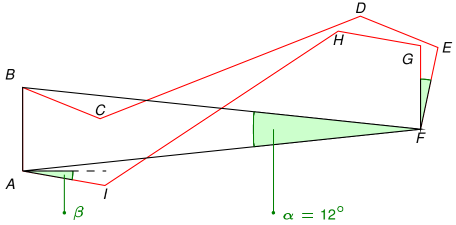

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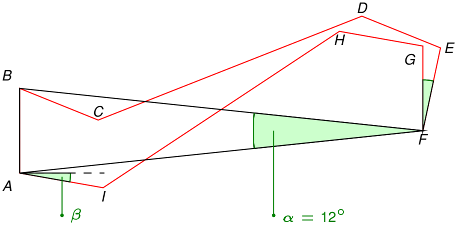

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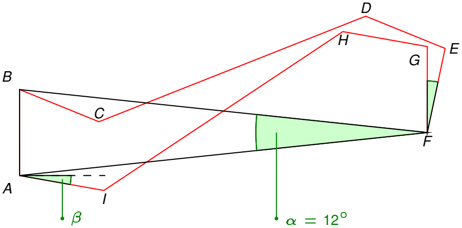

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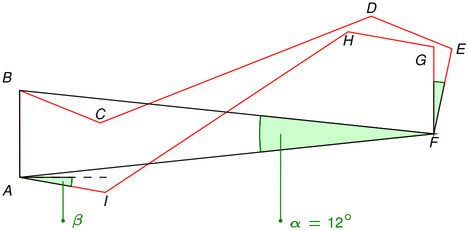

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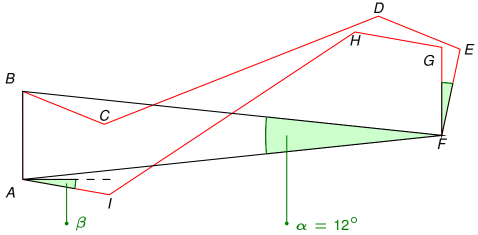

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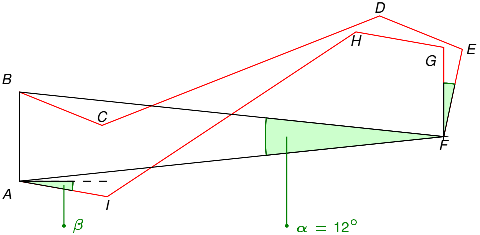

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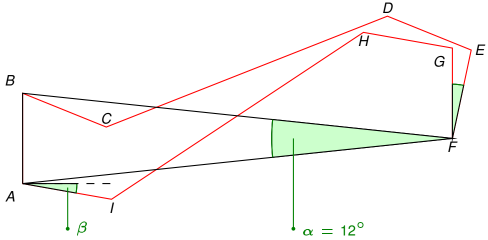

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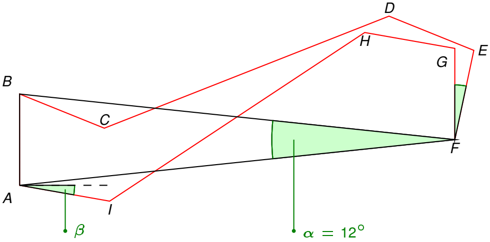

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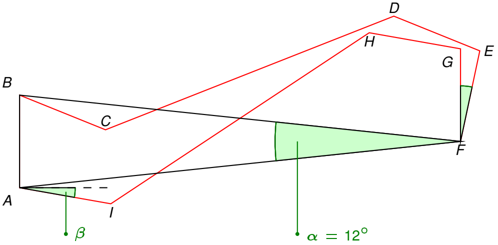

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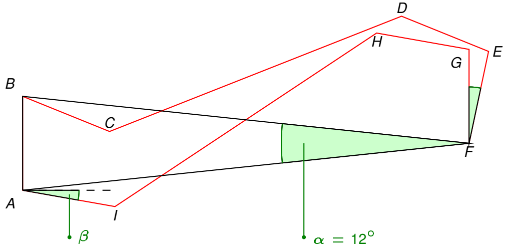

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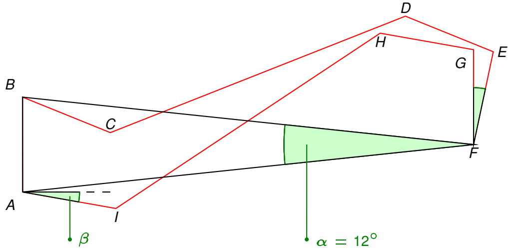

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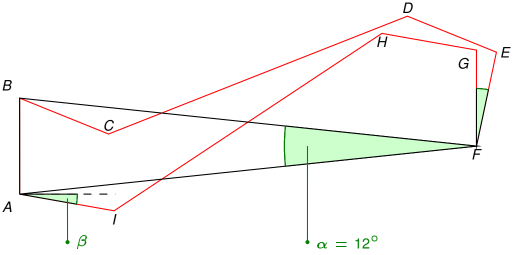

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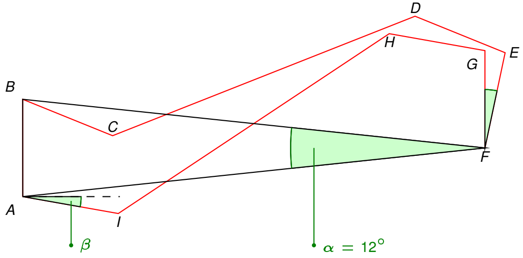

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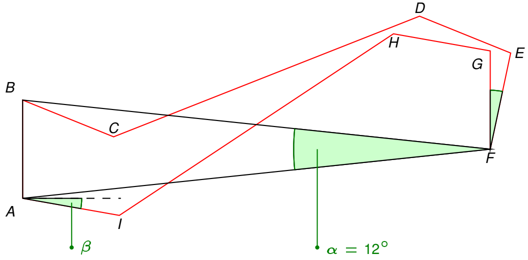

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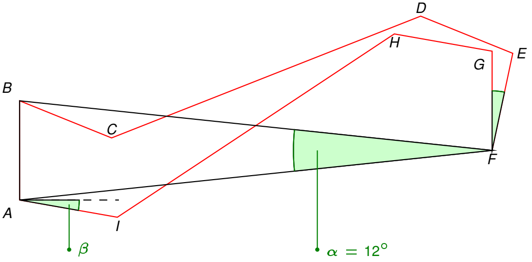

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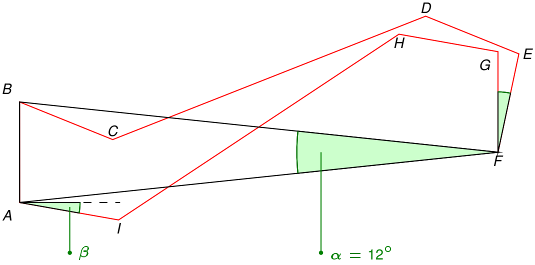

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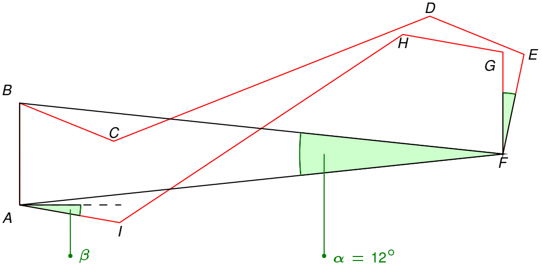

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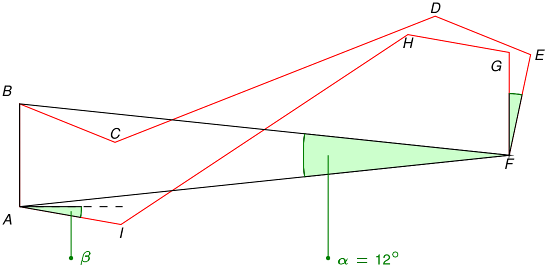
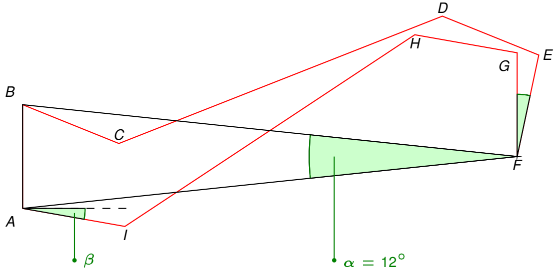
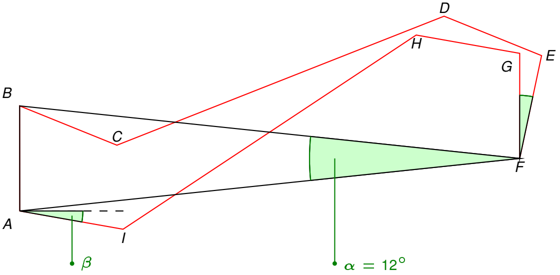


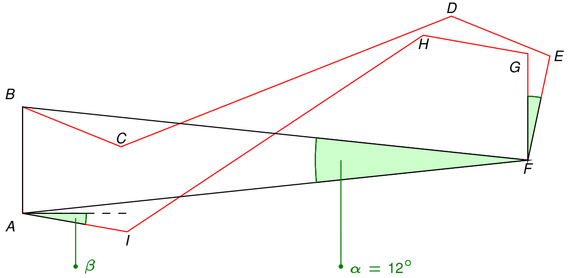
An example using coordinate calculation - Ti*k*Z realization



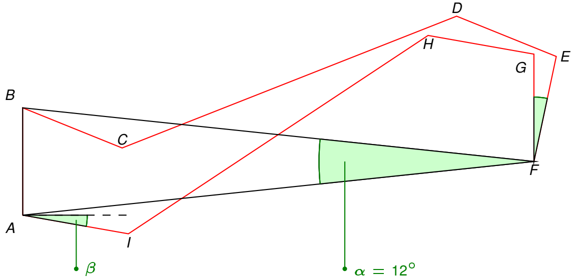
An example using coordinate calculation - Ti*k*Z realization



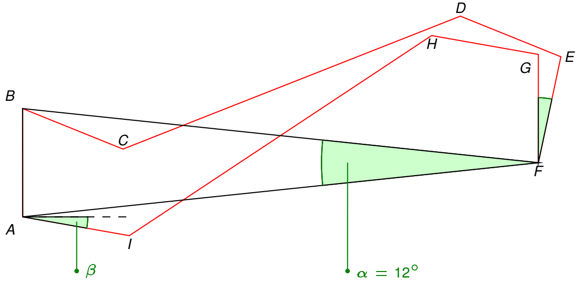
An example using coordinate calculation - Ti*k*Z realization



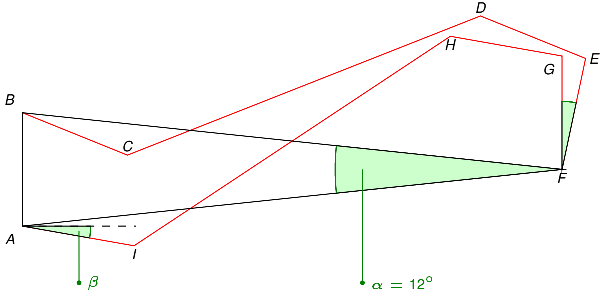
An example using coordinate calculation - Ti*k*Z realization



An example using coordinate calculation - TikZ realization

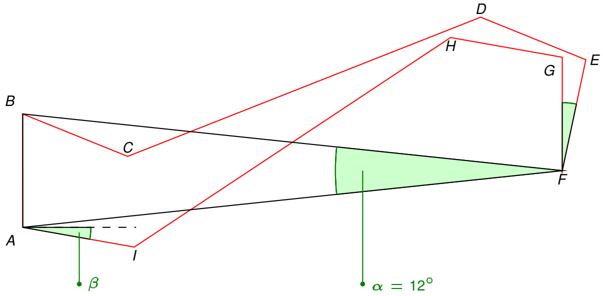


An example using coordinate calculation - Ti*k*Z realization



$$a = \overline{AB} = \overline{FG}$$
$$b = \overline{AI} = \overline{HG}$$

An example using coordinate calculation - TikZ realization



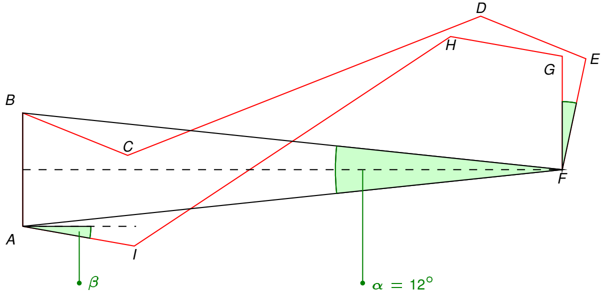
$$a = \overline{AB} = \overline{FG}$$
$$b = \overline{AI} = \overline{HG}$$

Example

Define Variables to use:

```
\def\a{0.5}
\def\b{0.5}
\def\bAngle{-10}
```

An example using coordinate calculation - Ti*k*Z realization



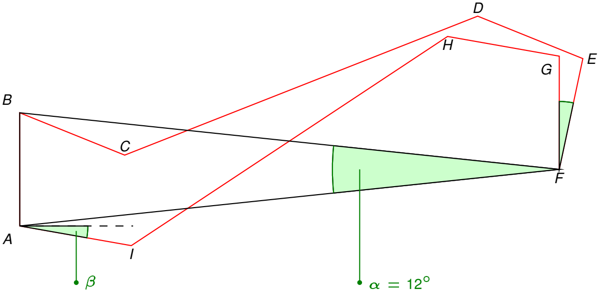
$$a = \overline{AB} = \overline{FG}$$
$$b = \overline{AI} = \overline{HG}$$

Example

Compute Distance of Point F from $\overline{AB}$:

```
\pgfmathsetmacro{\hyp}{\a*0.5 / cos(84)}
\pgfmathsetmacro{\len}{sqrt(\hyp*\hyp-0.25*\a*\a)}
```

An example using coordinate calculation - TikZ realization



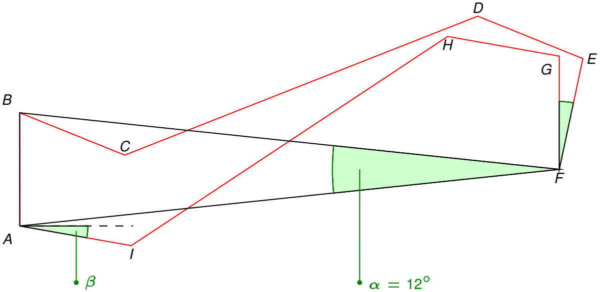
$$\boxed{\begin{aligned} a &= \overline{AB} = \overline{FG} \\ b &= \overline{AI} = \overline{HG} \end{aligned}}$$

Example

Compute the locations of the points:

```
\coordinate (A) at (0,0);        % start coordinate
\coordinate (B) at ($ (A) + (0,\a) $);
\coordinate (F) at ($ (B) + (\len,0.5*\a) $);
\coordinate (G) at ($ (F) + (0,\a) $);
```

An example using coordinate calculation - Ti*k*Z realization



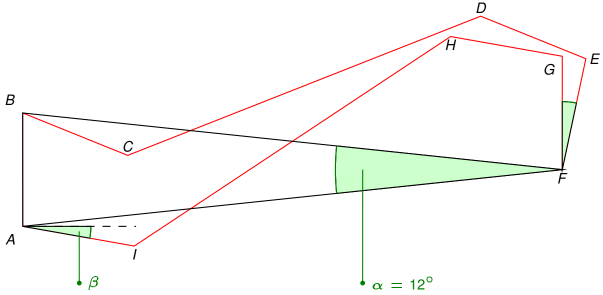
$$a = \overline{AB} = \overline{FG}$$
$$b = \overline{AI} = \overline{HG}$$

Example

Compute the locations of the points:

```
\coordinate (Htemp) at ($ (G) - (\b,0) $);
\coordinate (H) at ($ (G)!1!\bAngle:(Htemp) $);
\coordinate (Itemp) at ( $ (A) + (\b,0)$ );
\coordinate (I) at ($ (A)!1!\bAngle:(Itemp) $);
```

An example using coordinate calculation - Ti*k*Z realization



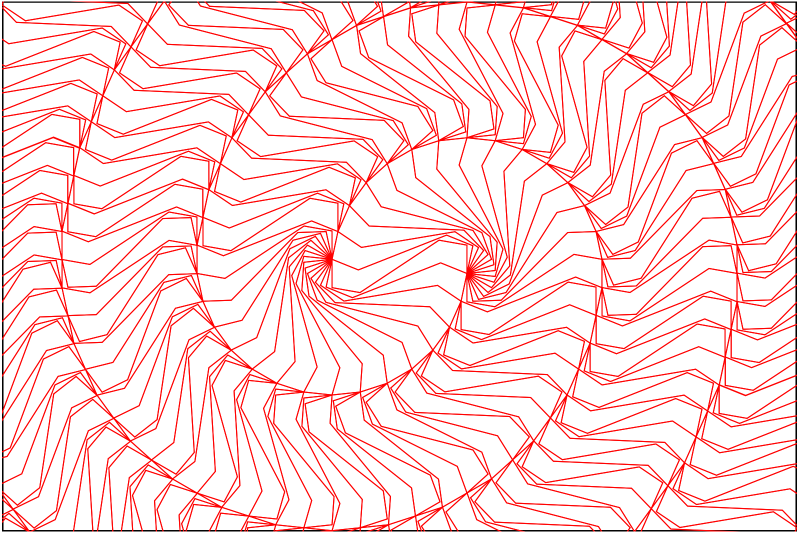
$$a = \overline{AB} = \overline{FG}$$
$$b = \overline{AI} = \overline{HG}$$

Example

Compute the locations of the points:

```
\coordinate (E) at ($ (F)!1!-12:(G) $);
\coordinate (D) at ($ (F)!1!-12:(H) $);
\coordinate (C) at ($ (F)!1!-12:(I) $);
```

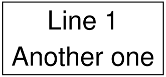
The complete example



Node features

- Multiline nodes: Allows to have several lines of text within one node

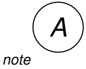
```
\node[align=center] {Line 1 \\ Another line};
```



Only works with TikZ 2.10

- Node labels: can add a label to all corners of the node

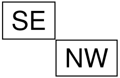
```
\node at (0,0) [label=below left:\tiny{$note$}] {A};
```



Node features (cont.)

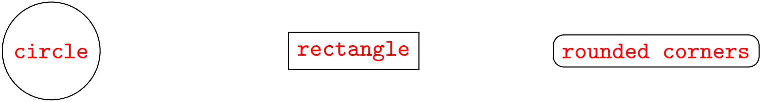
- Anchors: defines the corner of the node that lies at the specifies position. Default is `center`.

```
\node[draw,anchor=north west] at (0,0) {NW};
\node[draw,anchor=south east] at (0,0) {SE};
```



- Shapes: The outer appearance of a drawn node.

```
\node[circle] at (0,0) {ellipse};
```



Creating own shapes is possible, but not easy. Needs low level coding of so-called basic layer.

If you still miss a powerpoint feature

Do you really miss anything?

If you still miss a powerpoint feature

Do you really miss anything?

If you really, really need, just do, it's easy!

If you still miss a powerpoint feature

Do you really miss anything?

If you really, really need, just do, it's easy!

```
\node[starburst,fill=yellow,draw=red,line width=2pt] at
```

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`cloud callout` – the shape name

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`cloud puffs` – the number of puffs of the cloud

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`cloud puff arc` – the angle of two meeting puffs

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`callout pointer segments` – the number of round bubbles

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`callout relative pointer` – the angle and distance of the pointer

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`aspect` – ratio between width and height

The cloud code

Example

```
\node[align=center,draw,shading=ball,text=white,
    cloud callout,cloud puffs=17,cloud puff arc=140,
    callout pointer segments=3,anchor=pointer,
    callout relative pointer={(200:2cm)},aspect=2.5]
    at (current page.center)
    { I wouldn't mind having\\these fancy clouds };
```

`current page.center` – *absolute* coordinate on the page

Scopes in Ti*k*Z

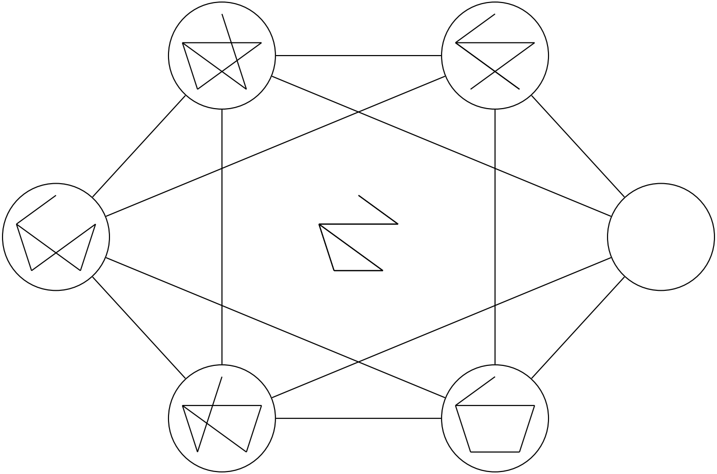
- Ti*k*Z allows scopes, just like e. g. JAVA
- Scopes can alter the drawing projection
- That means rotating, moving or scaling etc.

Possible commands are:

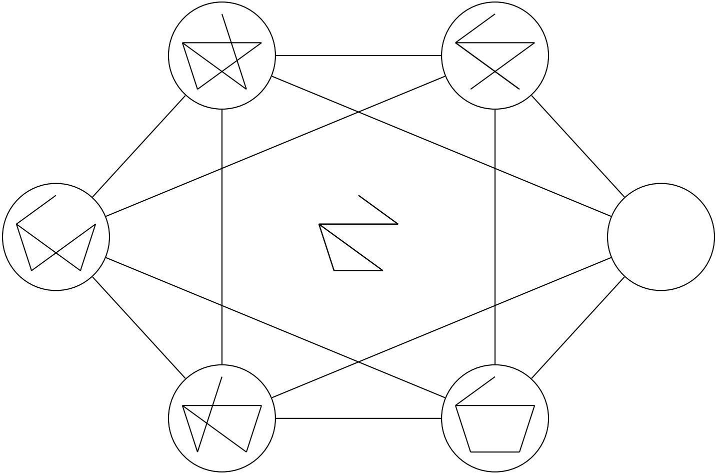
- `xscale`, `yscale` and `scale` for scaling
- `rotate` for rotation around an angle
- `xshift`, `yshift` and `shift` for movements of the origin

```
\begin{scope}[rotate=30,xscale=0.5,shift={(0:\s)}]
...
\end{scope}
```

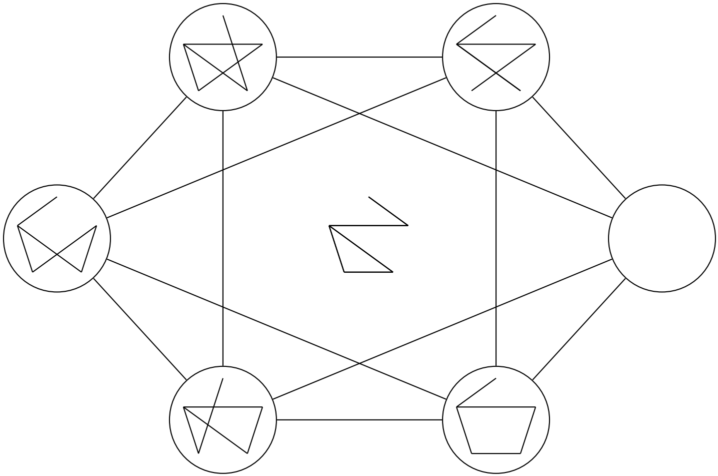
Example for scopes



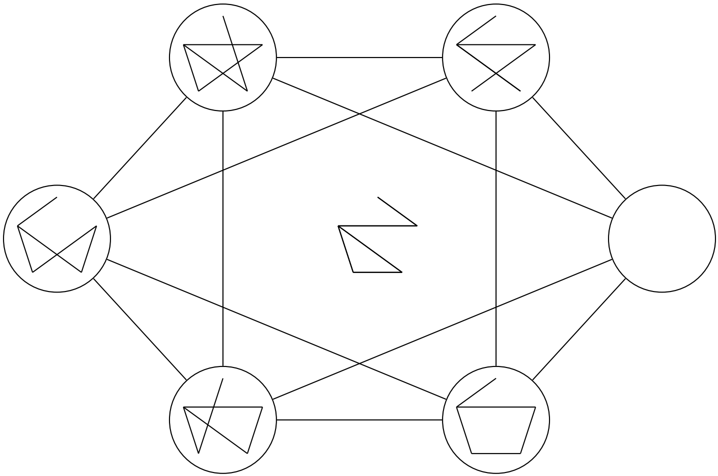
Example for scopes



Example for scopes



Example for scopes



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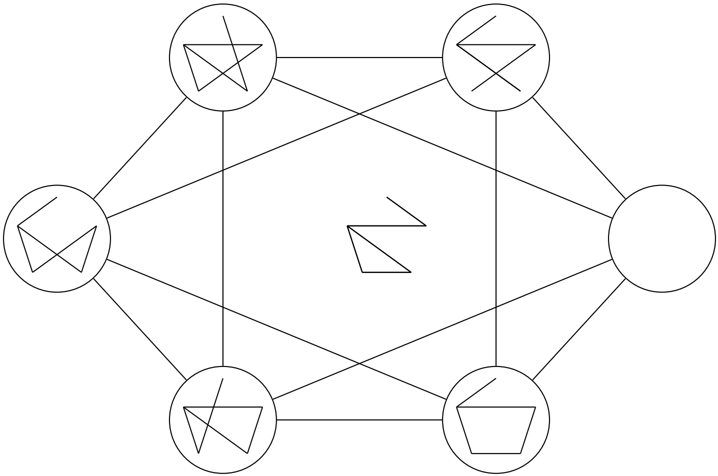
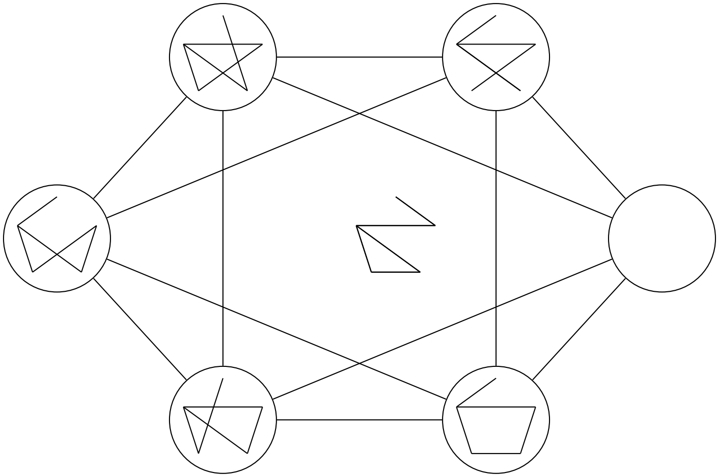
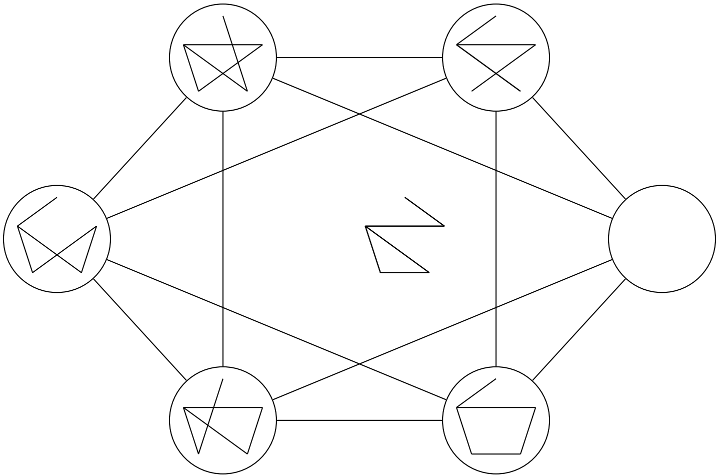


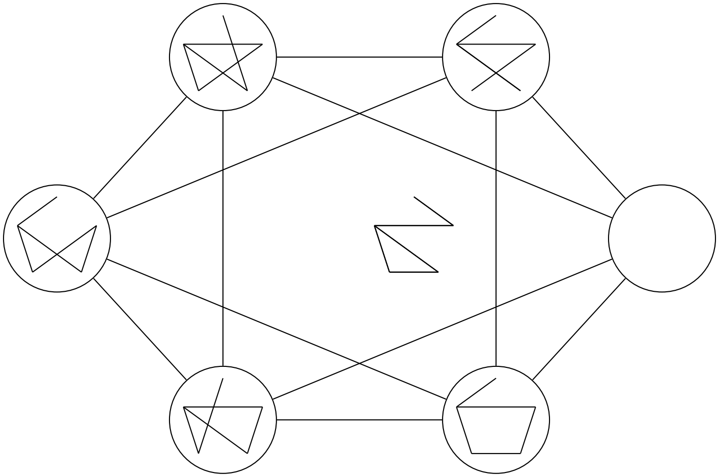
Example for scopes



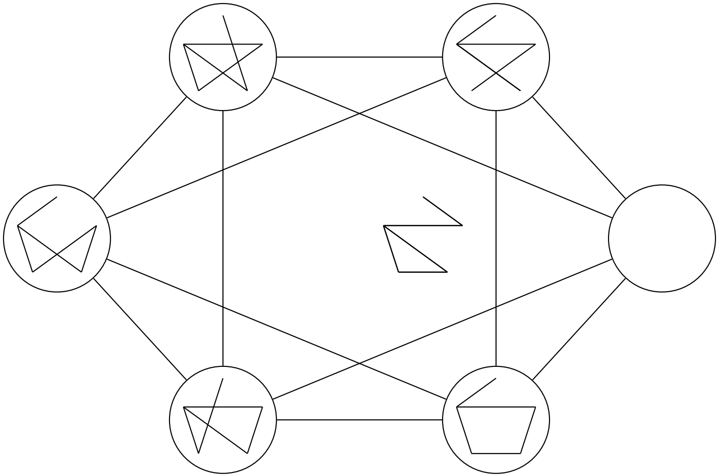
Example for scopes



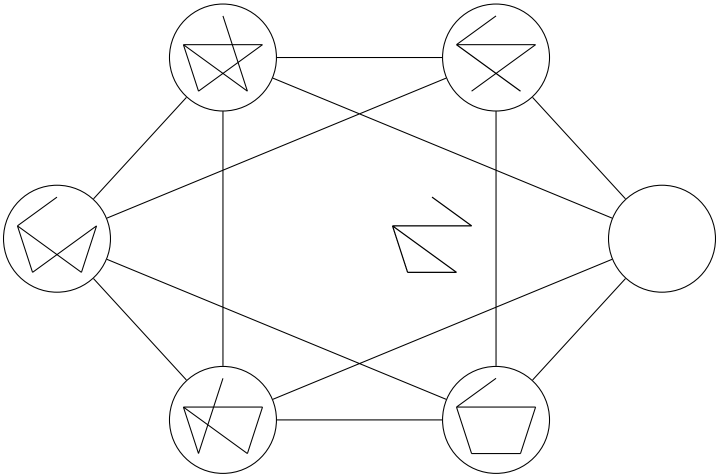
Example for scopes



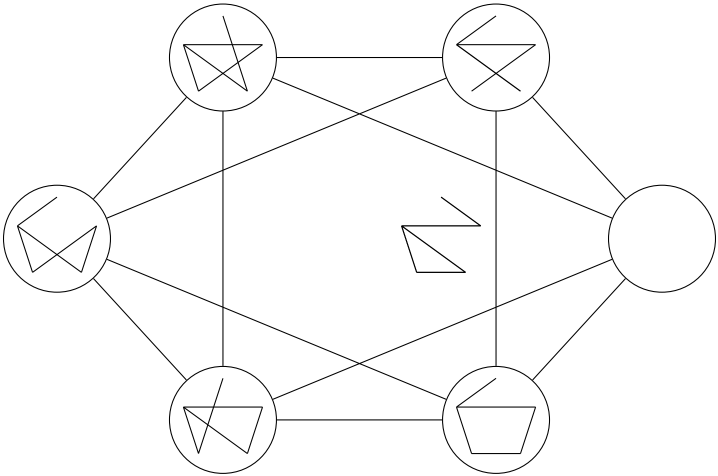
Example for scopes



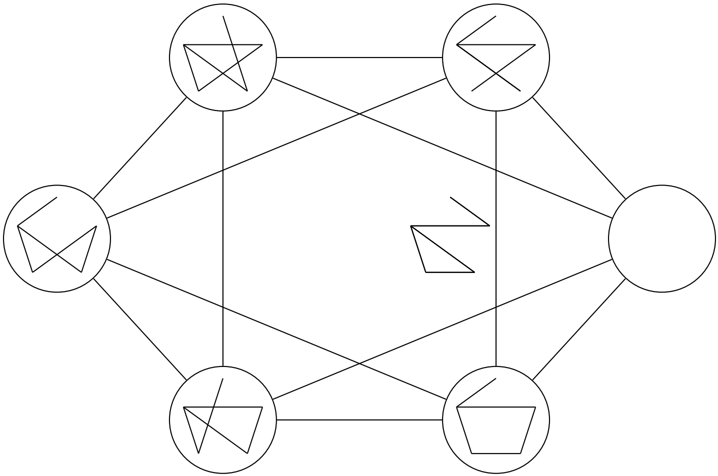
Example for scopes



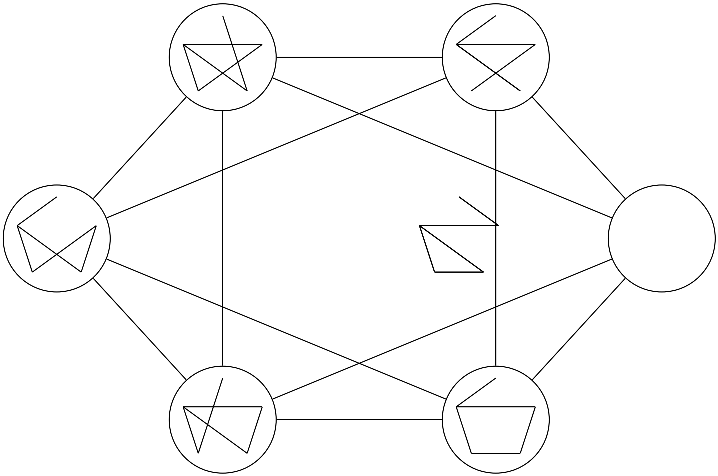
Example for scopes



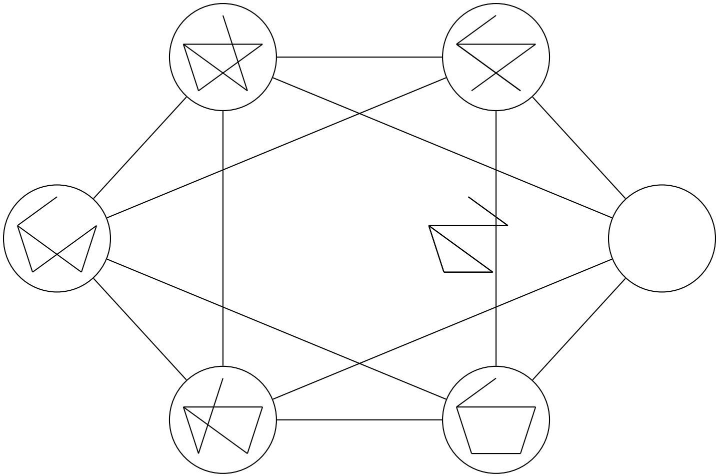
Example for scopes



Example for scopes



Example for scopes



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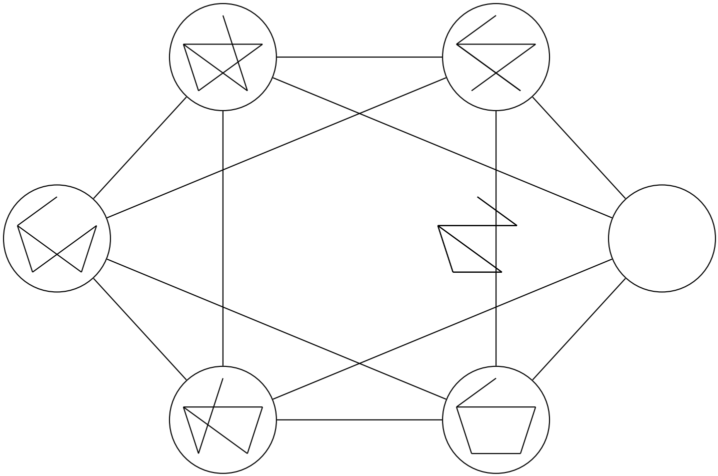
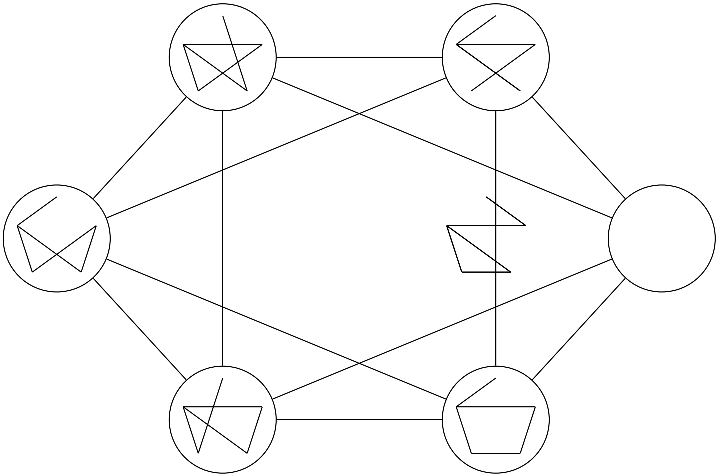


Example for scopes



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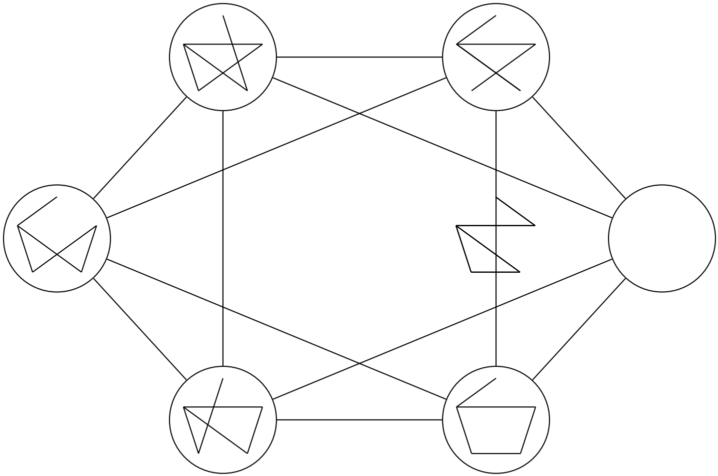

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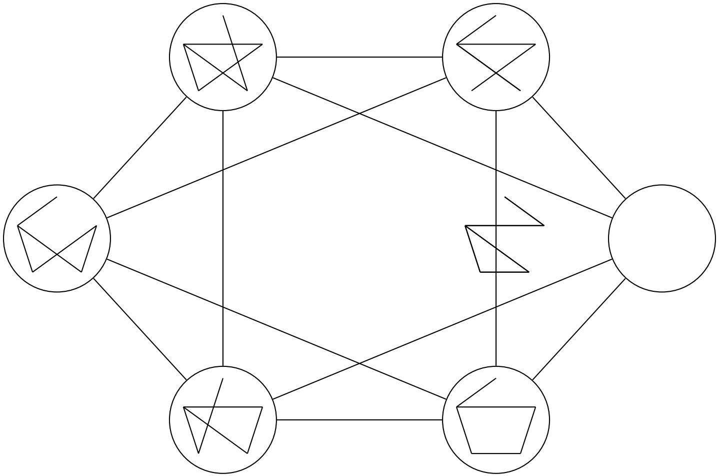
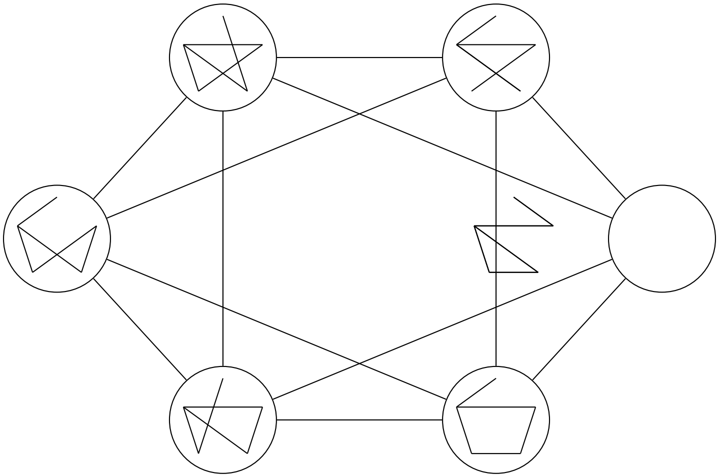
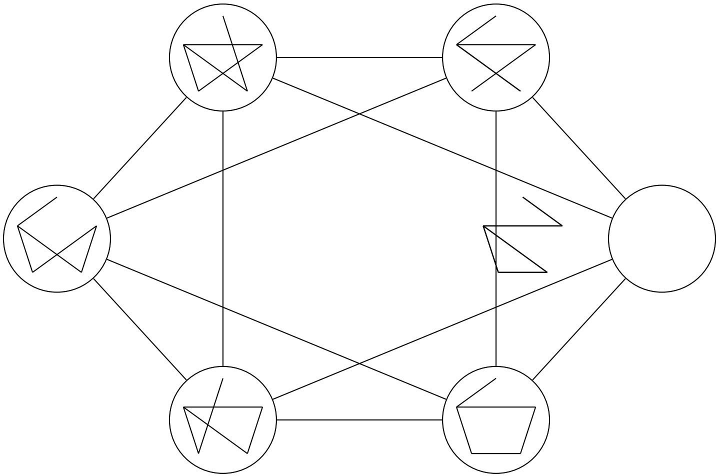


Example for scopes



Example for scopes



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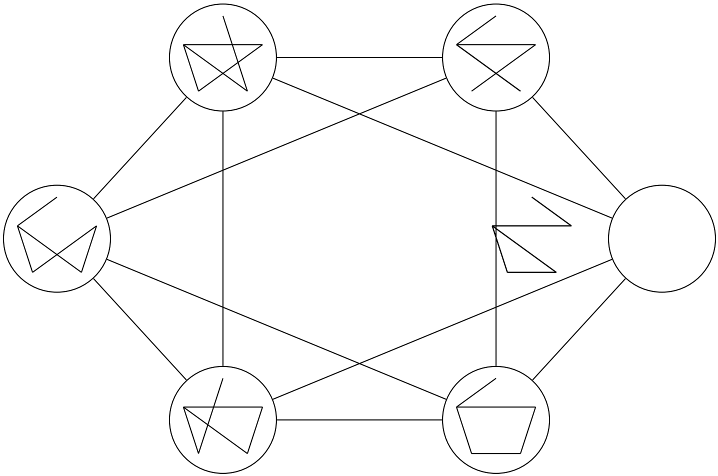
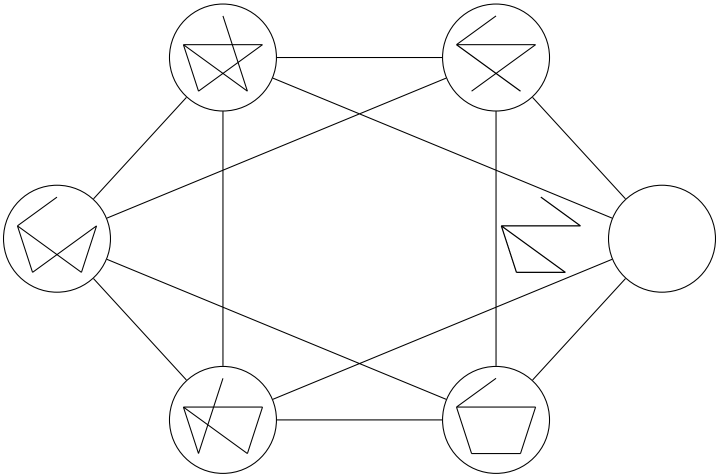


Example for scopes



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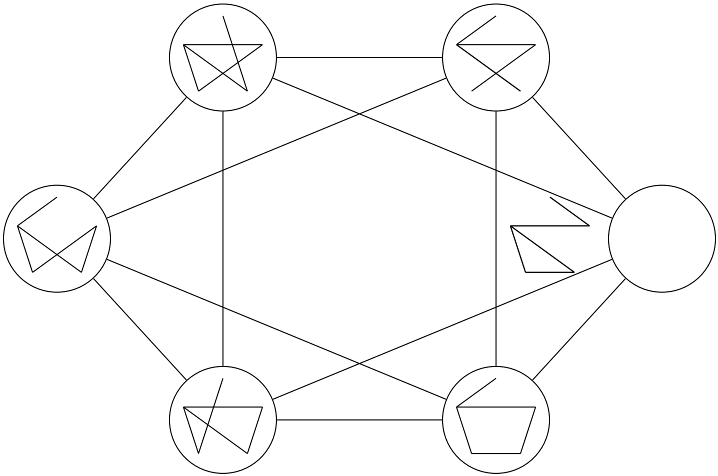
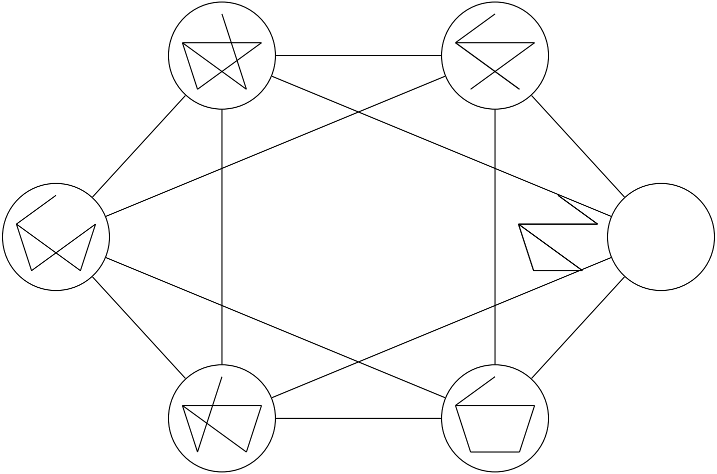
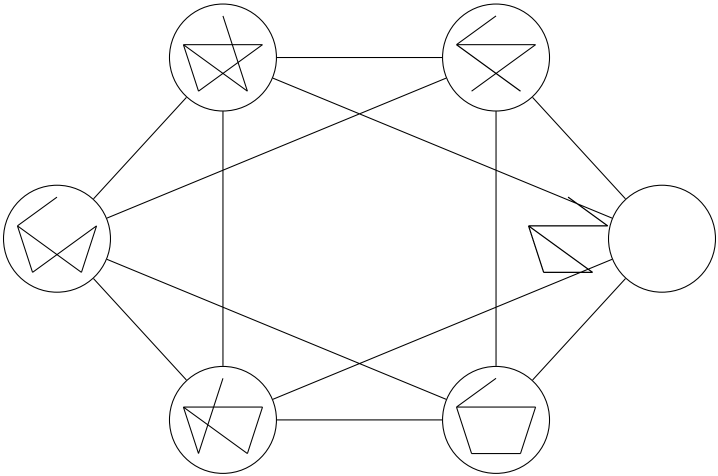


Example for scopes



Example for scopes



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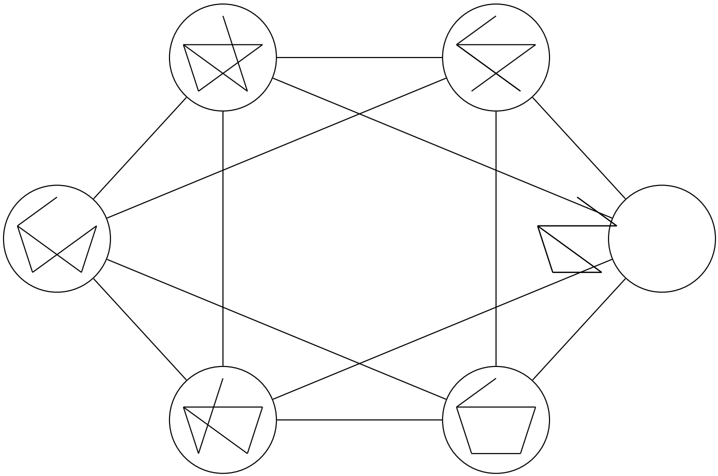

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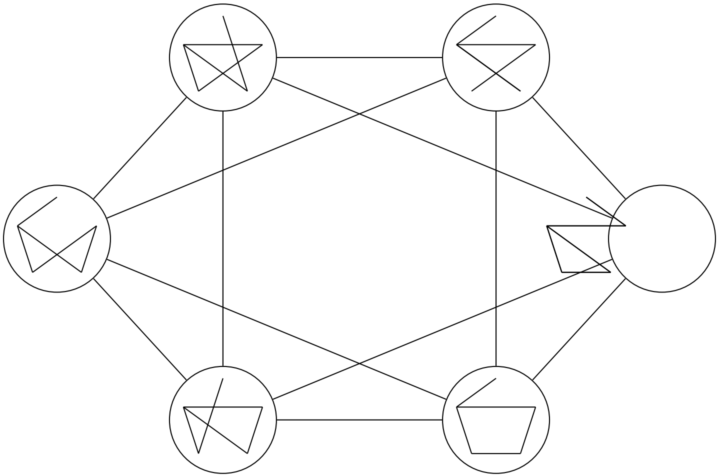

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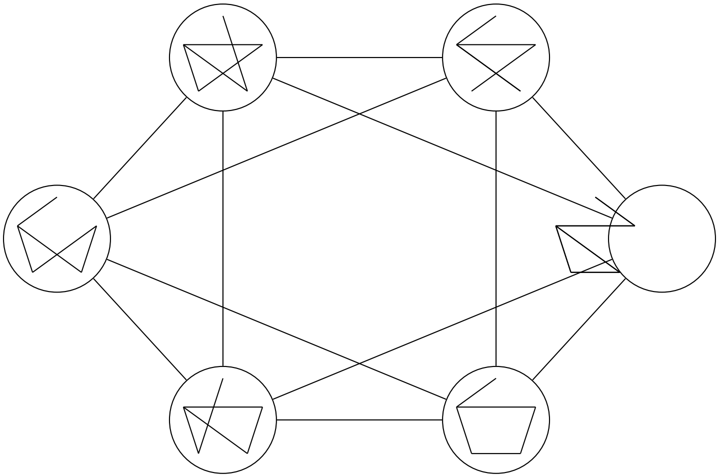

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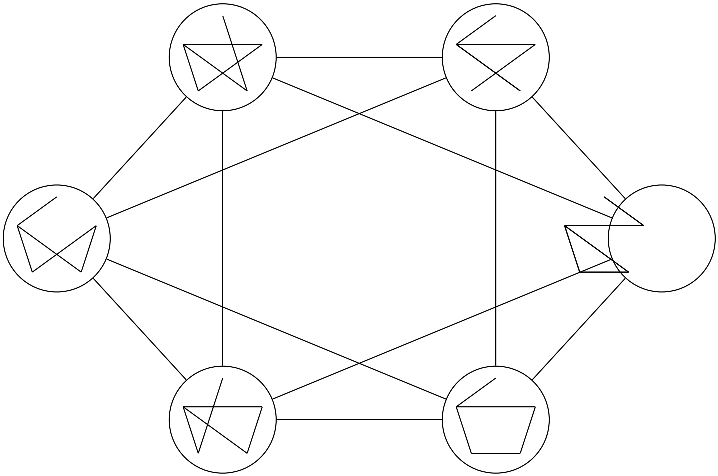

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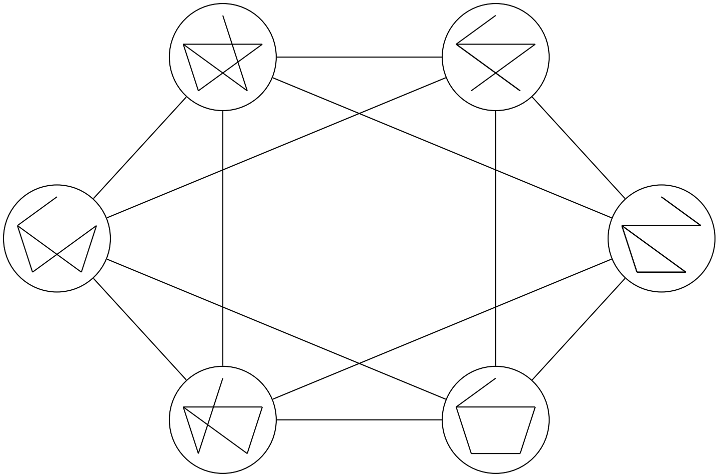
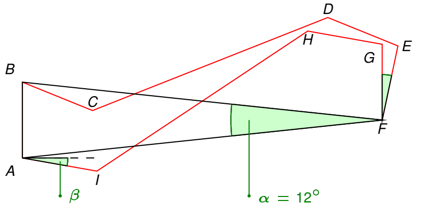
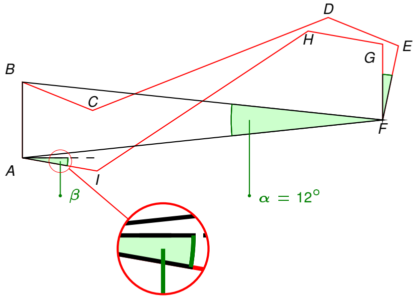


Intersections

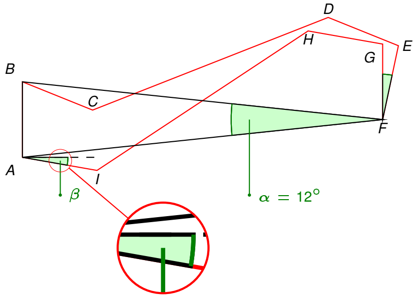


Intersections



Nice detail:
End point of helping line is in the middle of the angle.

Intersections



Nice detail:
End point of helping line is in the middle of the angle.

The good thing:
Ti*k*Z can automatically compute these intersection points.
Paths can be arbitrary, not only line segments!

Intersections (cont.)

How to compute intersections

1. Include the package `intersections`
2. Name paths using the option `[name path=pname]`
   Hint: invisible paths can be drawn using `\path`
3. Compute intersections as new path:
   `\path [name intersections={of=pname1 and pname2}];`

➡ new intersection points are now available at `(intersection-1)`, `(intersection-2)` etc.

Intersections (cont.)

How to compute intersections

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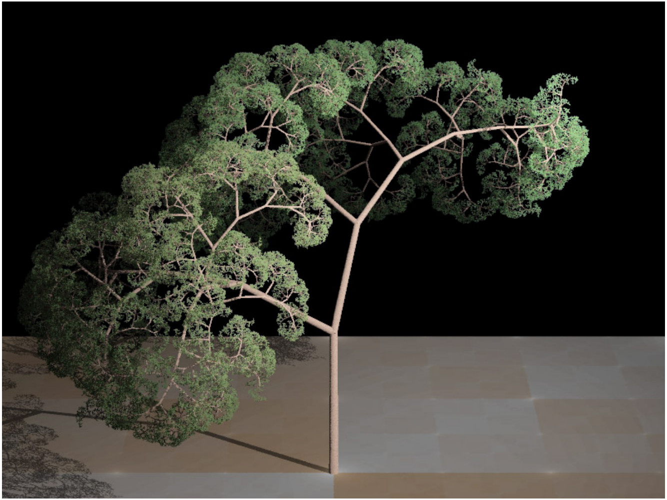
➡ new intersection points are now available at `(intersection-1)`, `(intersection-2)` etc.

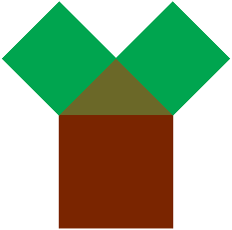
```
\path[name path=helpPath] (helpPoint) -- (labelPoint);
\path[name path=ai] (B) -- (F);
\path [name intersections={of=helpPath and ai}];
\coordinate (inters) at ($ (intersection-1)!0.5!(helpPoint) $
```

Trees

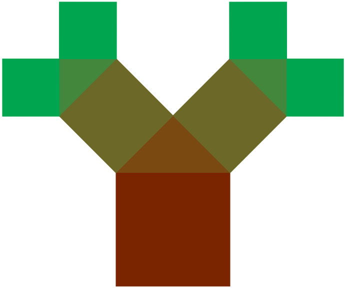


Trees

Trees



Trees



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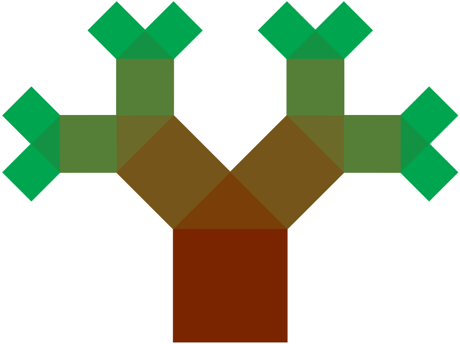

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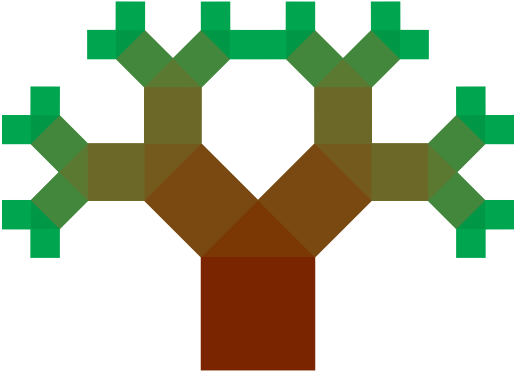

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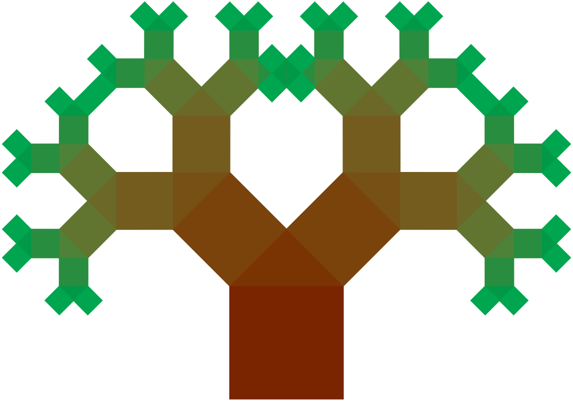

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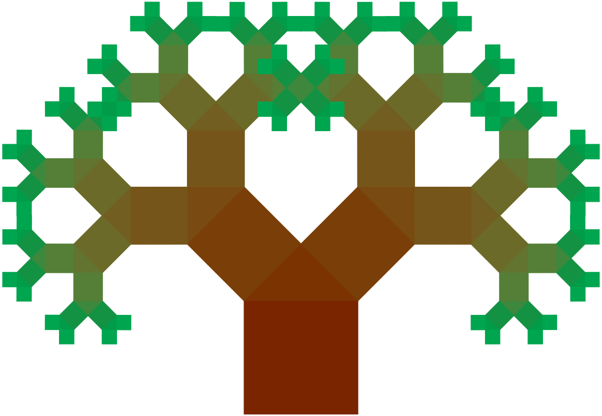
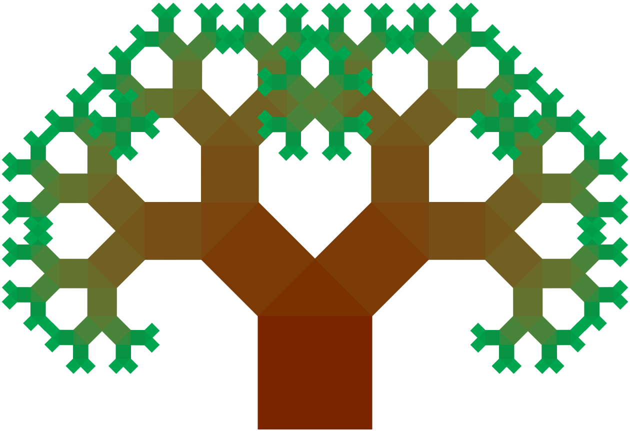


Trees

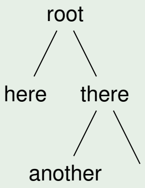


Trees – More like this

Defining Trees

- Use `child{}` in a node definition to create a child
- Use node and childs iterativeley to create a tree

Example




```
\node {\footnotesize root}
  child {
    node {\footnotesize here}}
  child {node {\footnotesize there}
    child {
      node {\footnotesize another}}
    child {
      node {}
};
```

Split nodes

The Rectangle Split Shape

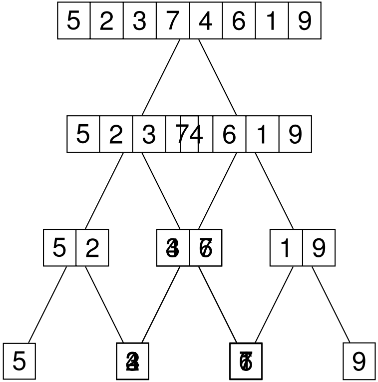
- Allows to put more than one text into nodes
- Need to include tikzlibrary `shapes.multipart`
- The style is `rectangle split`
- This gives a vertically split. For horizontally split add `rectangle split horizontal`

Example

```
\node[rectangle split,rectangle split parts=3,draw]
{1\nodepart{two}2\nodepart{three}3};
```

1
2
3

Recursive Sorting



Recursive Sorting

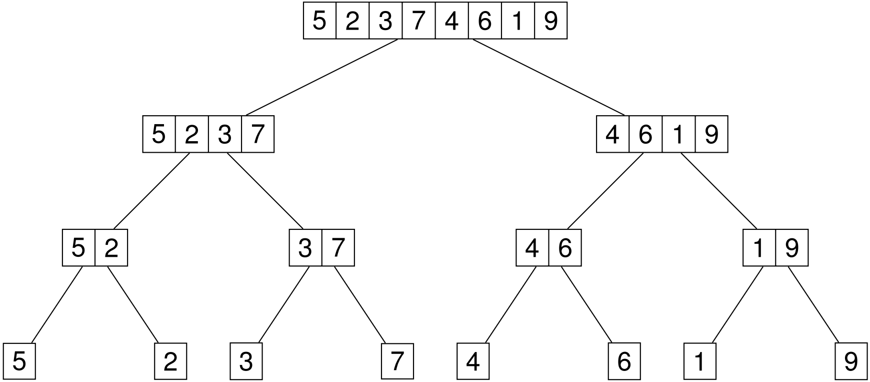
- Unfortunately children overlap
- Can be solved via `sibling distance`
- A style for each level of the tree

Example

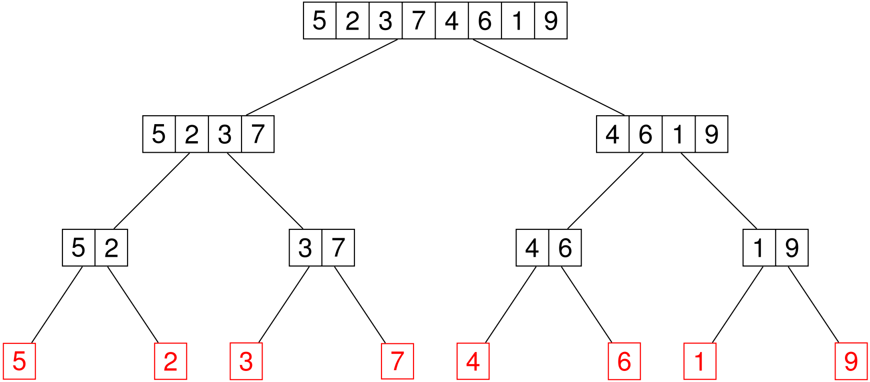
```
\begin{tikzpicture}[
level 1/.style={sibling distance=60mm},
level 2/.style={sibling distance=30mm},
level 3/.style={sibling distance=20mm}]
\end{tikzpicture}
```

➡ All siblings on level 1 will have a distance of $60mm$

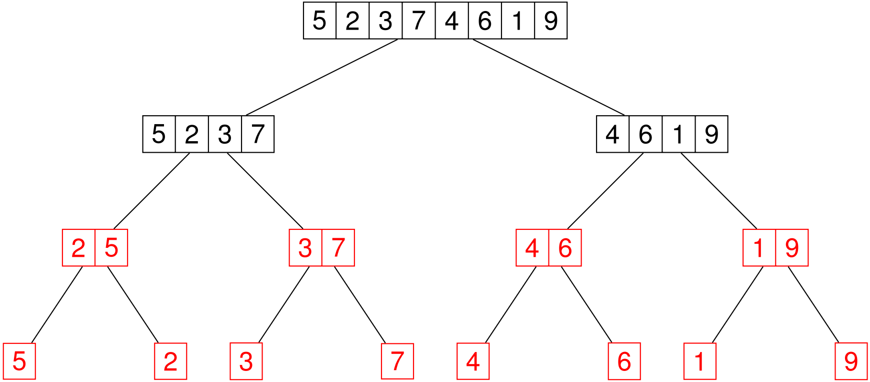
Recursive Sorting



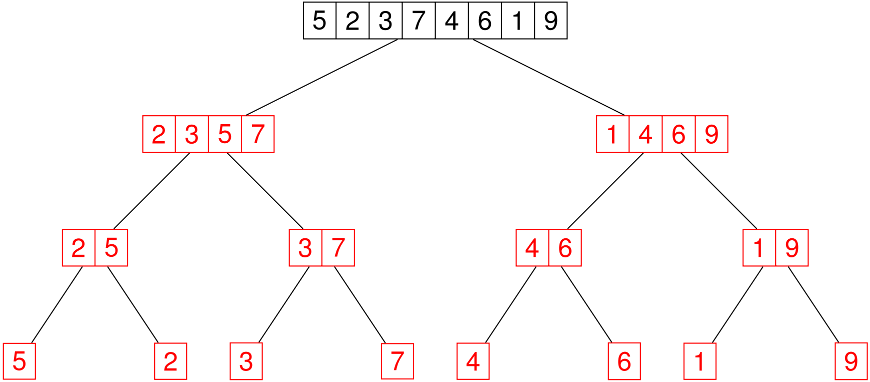
Recursive Sorting



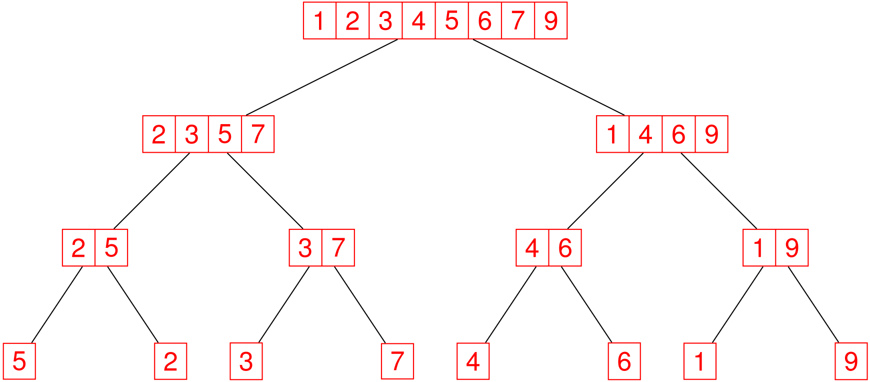
Recursive Sorting



Recursive Sorting



Recursive Sorting



Using styles to clean up code

Styles

- Using a lot of parameters creates ugly code
- User defined styles help keeping code clean
- Style needs to be changed once only

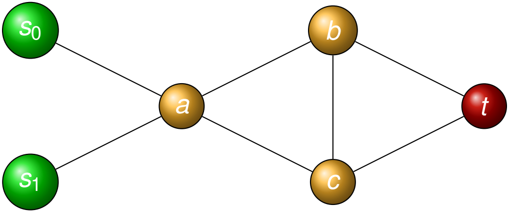
Usage:

```
\begin{tikzpicture}
[stylename/.style={some commands},
 otherstyle/.style={some commands}]
\end{tikzpicture}
```

Styles example

Example

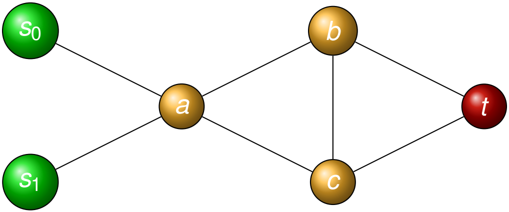
```
[default/.style={draw,fill,circle,shading=ball,
  ball color=Dandelion,text=white},
source/.style={draw,fill,circle,shading=ball,
  ball color=ForestGreen,text=white},
sink/.style={draw,fill,circle,shading=ball,
  ball color=BrickRed,text=white}]
```



Styles example

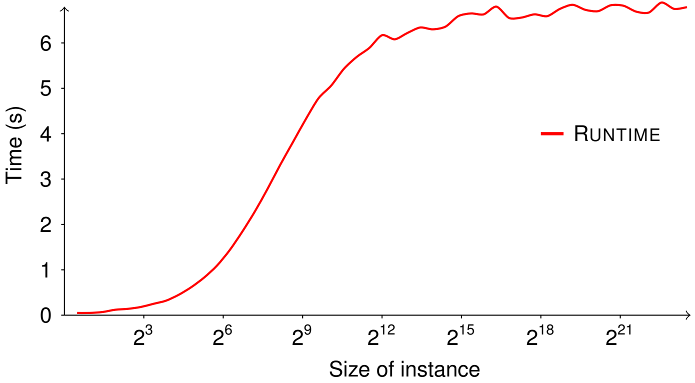
Example

```
\node[source] (1) at (0,1) {$s_0$};
\node[source] (2) at (0,-1) {$s_1$};
\node[default] (3) at (2,0) {$a$};
\node[default] (4) at (4,1) {$b$};
\node[default] (5) at (4,-1) {$c$};
\node[sink] (6) at (6,0) {$t$};
```



Plotting in Ti*k*Z

Something like this is possible in Ti*k*Z:



But: quite lengthy code, as axes and legend have to be drawn manually

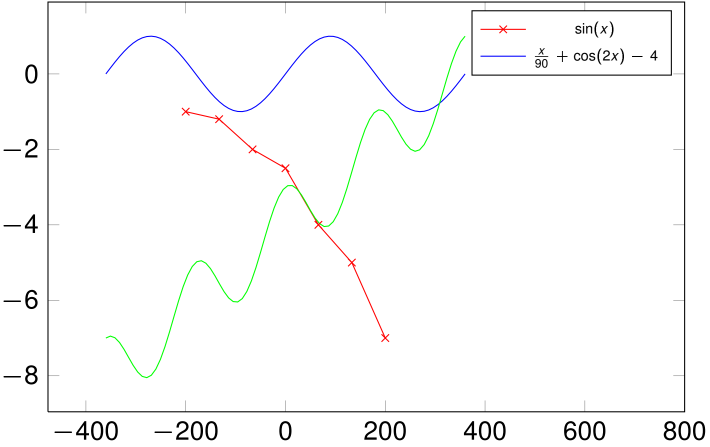
Plotting using PGFPLOTS

The PGFPLOTS package

- Package specialized for drawing plots
- Based upon PGF/Ti*k*Z
- Available at http://sourceforge.net/projects/pgfplots
- The manual is as good as the one of Ti*k*Z

On the following slides, there will be just three examples. For more, have a look in the manual.

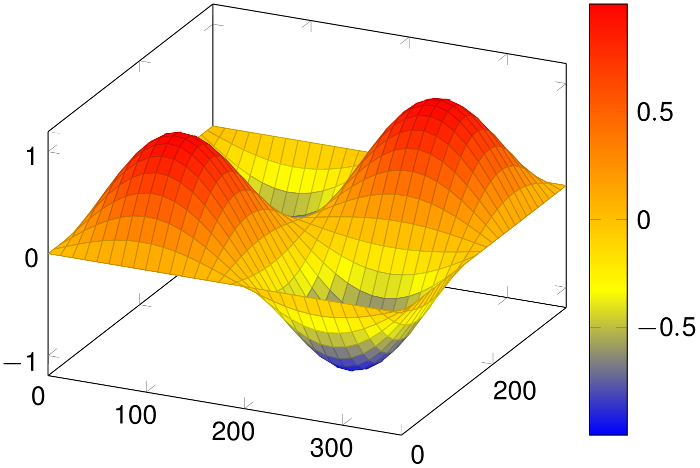
A starting example



A starting example

```
\begin{tikzpicture}
  \begin{axis}[domain=-360:360,samples=80,
                 width=10cm,height=7cm,xmax=800]
    \addplot[color=red,mark=x] coordinates {
      (-200,-1)
      (-133,-1.2)
      (-66,-2)
      (0,-2.5)
      (66,-4)
      (133,-5)
      (200,-7)
    };
    \addplot[color=blue] {sin(x)};
    \addplot[color=green] {-4+x/90+cos(x*2)};
  \end{axis}
\end{tikzpicture}
```

Plots in 3D

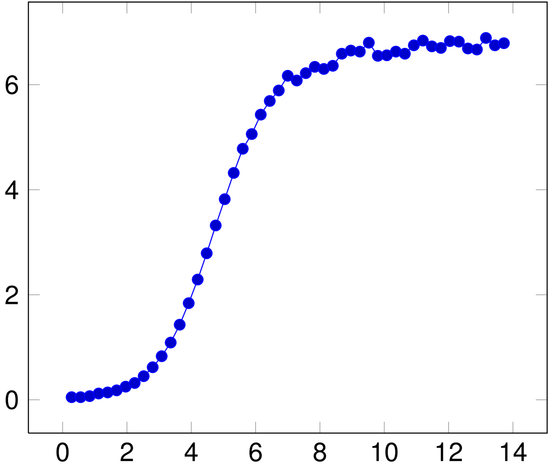


Plots in 3D

```
\begin{tikzpicture}
  \begin{axis}
    \addplot3[surf,domain=0:360,samples=50]
      {sin(x)*sin(y)};
  \end{axis}
\end{tikzpicture}
```

Take care, high sample values are not possible due to memory limitations!

Plotting from files



Plotting from files

```
\begin{tikzpicture}
  \begin{axis}
    \addplot file {charts/data.table};
  \end{axis}
\end{tikzpicture}
```

File features

- Reads gnuplot style files with datapoints specified as `x y i` with x and y beeing floating point values
- Also specific rows of a table can be read
- For details, see the manual

Some styles to define a graph and algorithm visualization

Requirements

- Need styles for nodes and edges
- Styles should change with the algorithm state

➡ Good idea to nest styles!

Some styles to define a graph and algorithm visualization

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- Need styles for nodes and edges
- Styles should change with the algorithm state

➡ Good idea to nest styles!

```
\tikzstyle{vertex}=[draw,circle,fill=Gray,minimum size=20pt]
\tikzstyle{selected vertex} = [vertex, fill=Maroon]
\tikzstyle{edge} = [draw,thick,-]
\tikzstyle{weight} = [font=\small]
\tikzstyle{selected edge} = [draw,line width=5pt,-,Green]
\tikzstyle{ignored edge} = [draw,line width=5pt,-,Salmon]
```

➡ Style „selected vertex“ based on „vertex“, but changes the fill color

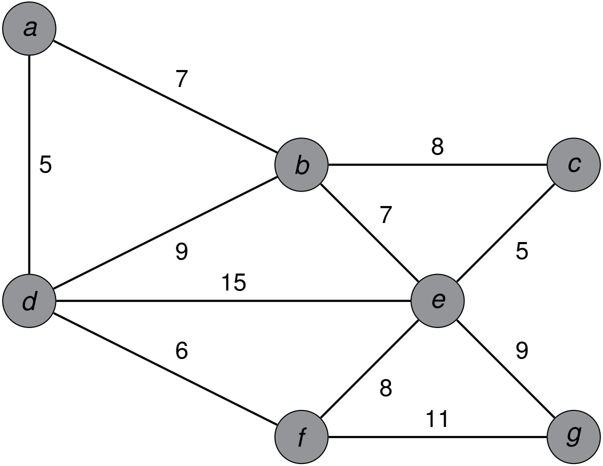
Defining a graph in four lines...

Using all our so far gained knowledge, we can say:

```
\foreach \pos/\name in {{(0,2)/a}, {(2,1)/b}, {(4,1)/c},
          {(0,0)/d}, {(3,0)/e}, {(2,-1)/f}, {(4,-1)/g}}
  \node[vertex] (\name) at \pos {$\name$};
\foreach \source/\dest /\weight in {b/a/7,c/b/8,d/a/5,d/b/9,
                e/b/7,e/c/5,e/d/15,f/d/6,f/e/8,g/e/9,g/f/11}
  \path[edge] (\source) -- node[weight] {$\weight$} (\dest);
```

Using: styles, node names and foreach with tuples

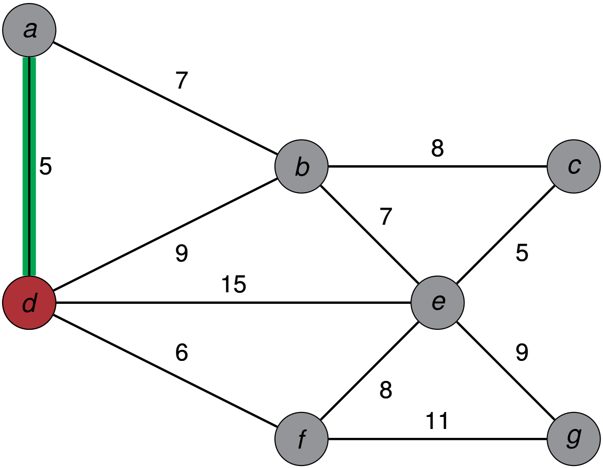
Defining a graph in four lines...



... and an algorithm in another six

```
\foreach \vertex / \slide in {d/1,a/2,f/3,b/4,e/5,c/6,g/7}
  \path<\slide-> node[selected vertex] at (\vertex) {$\vertex
\foreach \source / \dest in {d/a,d/f,a/b,b/e,e/c,e/g}
  \path<+->[selected edge] (\source) -- (\dest);
\foreach \source / \dest / \slide in
        {d/b/4,d/e/5,e/f/5,b/c/6,f/g/7}
  \path<\slide->[ignored edge] (\source) -- (\dest);
```

... and an algorithm in another six



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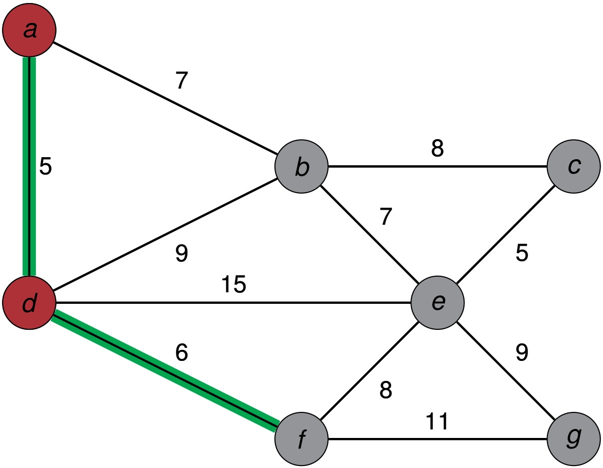
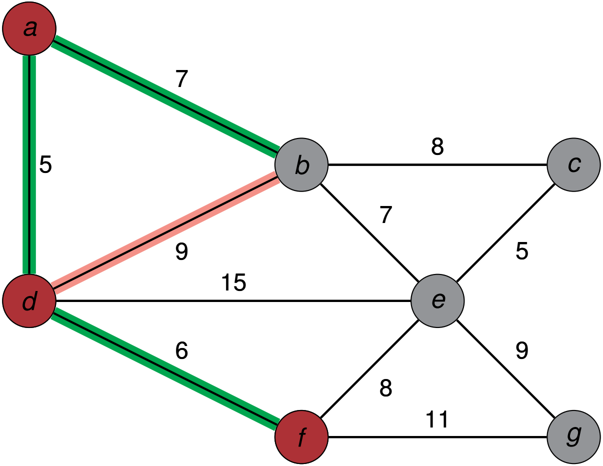


... and an algorithm in another six



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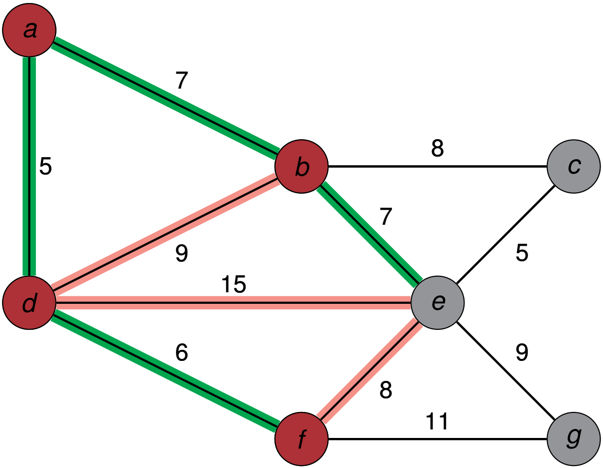

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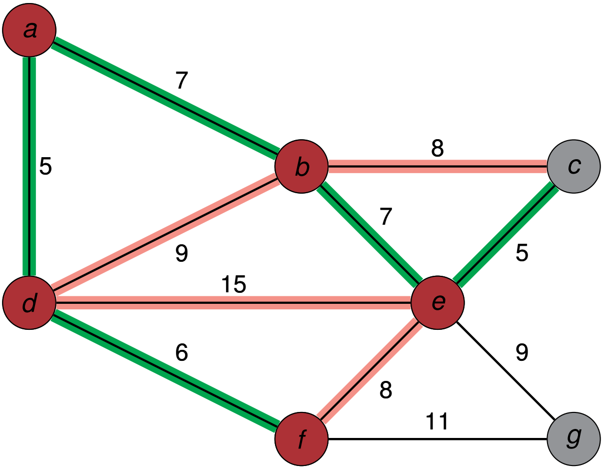

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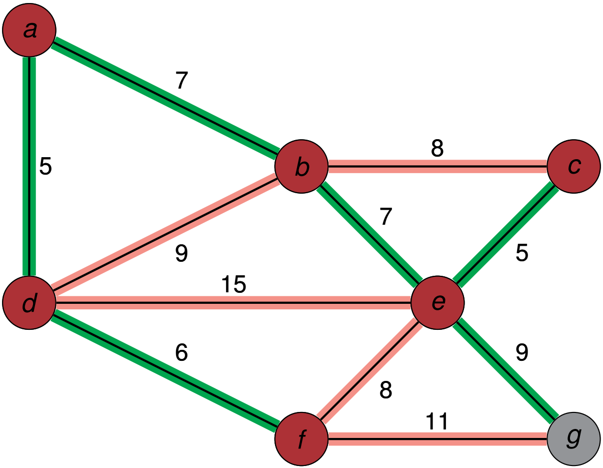

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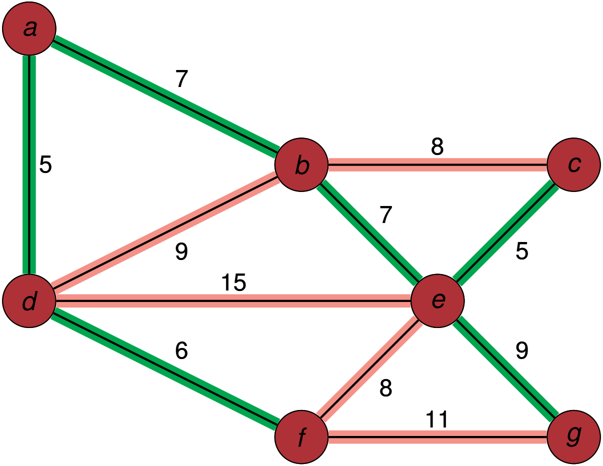
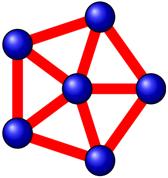


Outlook

- Ti*k*Z really can do a lot of stuff
- Much more can be done using some of the many packages
- For example object oriented programming
- Worth reading a bit in the manual



Thank you!