

Cristóbal Camarero Coterillo

March 29, 2011

Chapter 1

Notes

Lorem ipsum dolor sit amet, consectetur adipiscing elit.] — 1em

(Huge) Lorem ipsum dolor sit amet.] — 1em

(tiny) Lorem ipsum dolor sit amet, consectetur adipiscing elit.] — 1em

Lorex ipsum dolor sit amet, consectetur adipiscing elit.] — 1ex

(Huge) Lorex ipsum dolor sit amet.] — 1ex

(tiny) Lorex ipsum dolor sit amet, consectetur adipiscing elit.] — 1ex

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

1p 16pt 64pt 256pt

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

1b 16bp 64bp 256bp

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

1cm 2cm 3cm 4cm 8cm 16cm

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

1mm 16mm 32mm 64mm 128mm

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

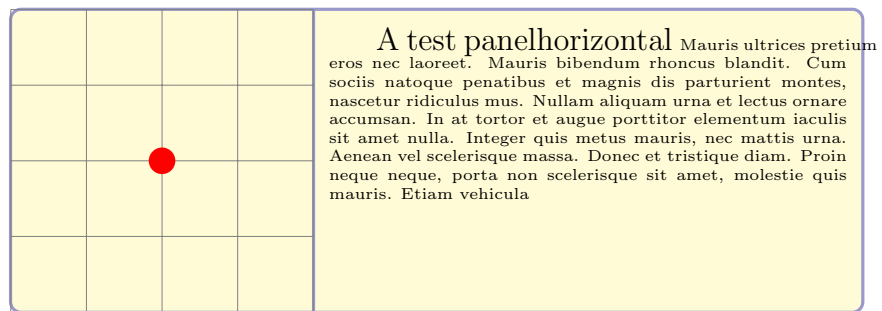
1in 2in 3in 4in 5in 6in

a 95.36984pt uu 42.4pt b

The box has a length of 85.90796pt and a height of 16.5657pt once, I am in a box second, I am in a box third?

+ , 15.93878pt, 10.31662pt.

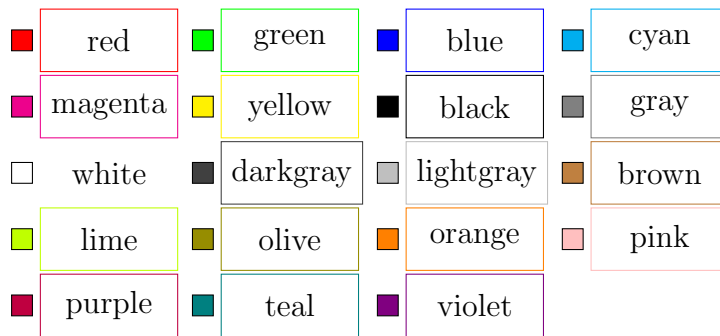
*, 12.8pt, 8.98334pt.



Before the panel

This is after the panel

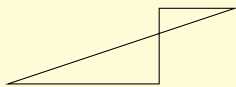
Predefined colors in the xcolor package:




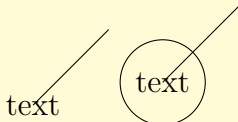
Chapter 2

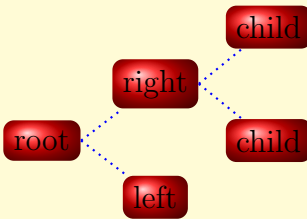
TikZ ist kein Zeichenprogramm


2.1 Design Principles

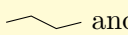

	<p>Hola</p> <pre>\begin{tikzpicture} \draw (0,0) -- (1,0) -- ++(1,0) -- +(0,1) -- +(1,1) -- cycle; \end{tikzpicture}</pre>
---	--

	<p>TikZ in one line</p> <pre>\tikz \path[draw,line width=2pt,color=red] (1,0) -- (0,0) -- (0,1) -- cycle;</pre>
---	---


	<p>Drawing a node in a path</p> <pre>\tikz \draw (1,1) node {text} -- (2,2); \tikz \draw (1,1) node[circle,draw](name) {text} -- (2,2);</pre>
---	---

	<p>You can draw trees</p> <pre>\begin{tikzpicture} [parent anchor=east,grow=east, every node/.style={ball color=red,rounded corners}, edge from parent/.style={draw,thick,dotted,blue},] \node {root} child {node {left}} child {node {right}} child {node {child}} child {node {child}} ; \end{tikzpicture}</pre>
---	---

	<h3 data-bbox="400 255 512 293">Scoping</h3> <pre data-bbox="352 320 738 544">\begin{tikzpicture}[ultra thick] \begin{scope}[color=red] \draw (0mm,10mm) -- +(10mm,0mm); \draw (0mm,8mm) -- +(10mm,0mm); \draw (0mm,6mm) -- +(10mm,0mm); \end{scope} \begin{scope}[color=green] \draw (0mm,4mm) -- +(10mm,0mm); \draw (0mm,2mm) -- +(10mm,0mm); \end{scope} \draw[blue] (0mm,0mm) -- +(10mm,0mm); \end{tikzpicture}</pre>
---	---

The baseline option is useful for in-lined graphics as $A \rightarrow B$ instead of $A \rightsquigarrow B$. Normally the baseline is put at the bottom of the picture, with the baseline option you specify its height. See  and .

Hello ~~world.~~ Hello ~~world.~~

And we can align a rectangle by its top: 


$A \rightarrow B$ $A \rightsquigarrow B$.

```
$A \mathbin{\tikz[baseline]\draw[->](Opt,.5ex)--(3ex,.5ex);} B$
$A \mathbin{\tikz\draw[->](Opt,.5ex)--(3ex,.5ex);} B$.
```


```
See \tikz\draw (0,0) -- (2ex,.5ex) -- (4ex,-.5ex) -- (6ex,0);
and \tikz[baseline]\draw (0,0) -- (2ex,.5ex) -- (4ex,-.5ex) -- (6ex,0);
```

Hello ~~world.~~ Hello ~~world.~~

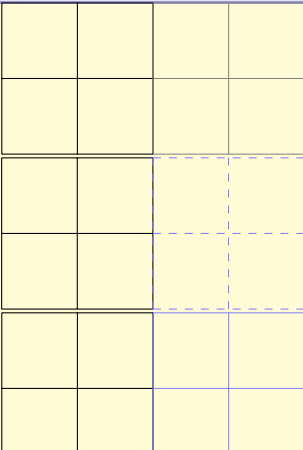
```
Hello \tikz[baseline=(X.base)]\node[cross out,draw] (X) {world.};
Hello \tikz\node[cross out,draw] (X) {world.};
```

Aligned rectangle: 

```
\tikz[baseline=(current bounding box.north)]
\draw (0,0) rectangle (1cm,1ex);
```

 Using scopes inside a path

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

 Using and modifying styles

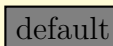
```
\begin{tikzpicture}
\draw (0,0) grid +(2,2);
\draw[help lines] (2,0) grid +(2,2);
\end{tikzpicture}
```


```
\begin{tikzpicture}[help lines/.style={blue!50,dashed}]
\draw (0,0) grid +(2,2);
\draw[help lines] (2,0) grid +(2,2);
\end{tikzpicture}
```


```
\begin{tikzpicture}[help lines/.append style={blue!50}]
\draw (0,0) grid +(2,2);
\draw[help lines] (2,0) grid +(2,2);
\end{tikzpicture}
```

You can define parametrized styles by using #1

```
\begin{tikzpicture}[
outline/.style={draw=#1,thick,fill=#1!50},
outline/.default=black,
]
\node[outline] at (0,2) {default};
\node[outline=red] at (0,1) {red};
\node[outline=blue] at (0,0) {blue};
\end{tikzpicture}
```


 default


 red

 blue

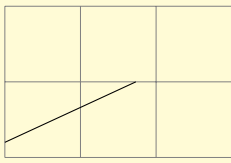
Using a macro as parametrized style

```
\def\mycolor#1{\ifnum#1=0 red\else blue\fi}
\begin{tikzpicture}[
outline/.style={draw=\mycolor#1,very thick,
fill=\mycolor#1!50},
]
\node[outline=0] at (0,1) {red};
\node[outline=1] at (0,0) {blue};
\end{tikzpicture}
```

 red

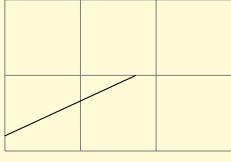
 blue

2.3 Specifying Coordinates



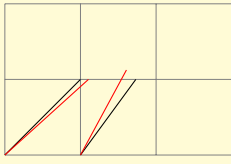
Specifying the coordinate system explicitly

```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (canvas cs:x=0cm,y=2mm)
    -- (canvas polar cs:radius=2cm,angle=30);
\end{tikzpicture}
```



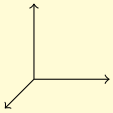
Specifying the coordinate system implicitly

```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (0cm,2mm) -- (30:2cm);
\end{tikzpicture}
```



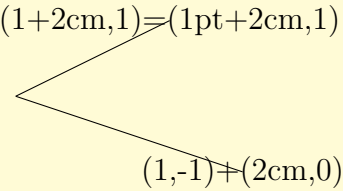
Transformation options can be applied to a single coordinate.

```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (0,0) -- (1,1);
  \draw[red] (0,0) -- ([xshift=3pt] 1,1);
  \draw (1,0) -- (30:2cm);
  \draw[red] (1,0) -- ([shift=(135:5pt)] 30:2cm);
\end{tikzpicture}
```



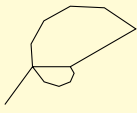
The default `canvas` and the `xyz` coordinate systems

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0);
  \draw (0,0) -- (xyz cs:y=1);
  \draw (0,0) -- (0,0,1);
\end{tikzpicture}
```



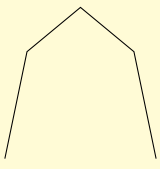
Note: When adding dimensionless magnitudes they are interpreted as pt. So $(1+2\text{cm}, 0)$ evaluates to $(1\text{pt}+2\text{cm})$ instead of $(1, 0) + (2\text{cm}, 0) = (3\text{cm}, 0)$.

```
\begin{tikzpicture}
  \draw (0,0) -- (1+2cm,1) node {(1+2cm,1)=(1pt+2cm,1)};
  \draw (0,0) -- ($(1,-1)+(2cm,0)$) node {(1,-1)+(2cm,0)};
\end{tikzpicture}
```



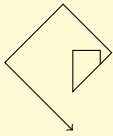
The polar coordinate systems

```
\tikz\draw (0,0) -- (canvas polar cs:angle=30,radius=1cm)
  -- (60:0.9cm) -- (90:0.8cm) -- (120:0.7cm) -- (150:0.6cm)
  -- (180:0.5cm) -- (210:0.4cm) -- (240:0.3cm) -- (270:0.2cm)
  -- (300:0.1cm) -- (330:0cm) -- (360:-0.5cm) -- (390:-1cm);
```



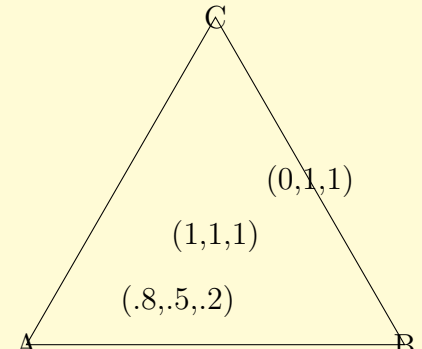
Using ellipses in the polar coordinate systems

```
\tikz\draw (canvas polar cs:angle=0,x radius=1cm,y radius=2cm)
-- (45:1cm and 2cm) -- (90:1cm and 2cm)
-- (135:1cm and 2cm) -- (180:1cm and 2cm);
```



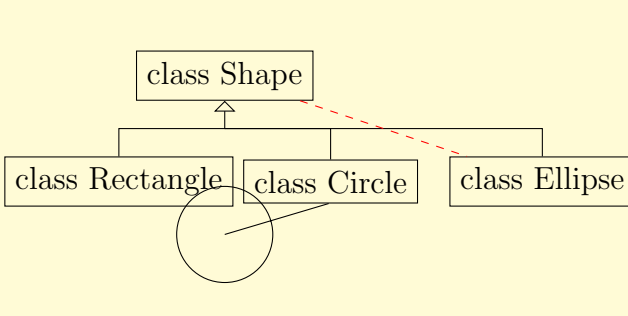
Using names as angles in the polar coordinate systems

```
\tikz\draw[->] (0,0) -- ++(up:1ex) -- ++(left:2ex)
-- ++(down:3ex) -- ++(north east:4ex)
-- ++(north west:5ex) -- ++(south west:6ex)
-- ++(south east:7ex);
```



The barycentric coordinate system.

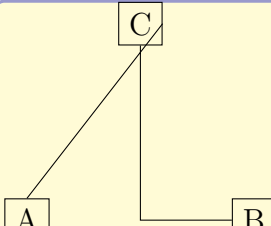
```
\begin{tikzpicture}
\draw (0,0) node(A) {A}
-- +(5,0) node(B) {B} -- +(60:5) node(C) {C} -- cycle;
\node at (barycentric cs:A=1,B=1,C=1) {(1,1,1)};
\node at (barycentric cs:A=0,B=1,C=1) {(0,1,1)};
\node at (barycentric cs:A=.8,B=.5,C=.2) {(.8,.5,.2)};
\end{tikzpicture}
```



The node coordinate systems

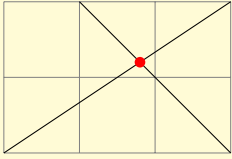
```
\begin{tikzpicture}
\node (shape) at (0,2) [draw] {class Shape};
\node (rect) at (-2,0) [draw] {class Rectangle};
\node (circle) at (2,0) [draw] {class Circle};
\node (ellipse) at (6,0) [draw] {class Ellipse};

\draw (node cs=name=circle,anchor=north) |- (0,1);
\draw (node cs=name=ellipse,anchor=north) |- (0,1);
\draw[-open triangle 90] (node cs=name=rect,anchor=north)
|- (0,1) -| (node cs=name=shape,anchor=south);
\draw (node cs=name=circle,angle=-95)
-- (down:1) circle (5ex);
\draw[red,dashed] (node cs=name=shape) -- (node cs=name=ellipse);
\end{tikzpicture}
```



Using implicitly the node coordinate systems

```
\begin{tikzpicture}
\path (0,0) node[draw] (A) {A}
+(3,0) node[draw] (B) {B}
+(60:3) node[draw] (C) {C};
\draw (A.north) -- (C.east)
(B) -| (C);
\end{tikzpicture}
```

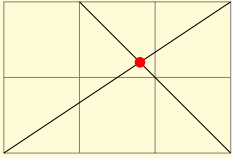


Using intersection coordinate systems

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (0,0) coordinate (A) -- (3,2) coordinate (B)
        (1,2) -- (3,0);
  \fill[red] (intersection cs:
    first line={(A)--(B)},
    second line={(1,2)--(3,0)} ) circle (2pt);
\end{tikzpicture}

```

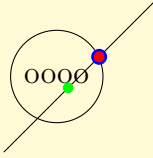


Using implicitly the intersection coordinate systems

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (0,0) coordinate (A) -- (3,2) coordinate (B)
        (1,2) -- (3,0);
  \fill[red] (intersection of
    A--B and 1,2--3,0 ) circle (2pt);
\end{tikzpicture}

```

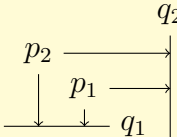


Intersecting a line with a node, several intersection points.

```

\begin{tikzpicture}
  \node[draw,circle] (A) at (0.7,1) {oooo};
  \draw (0,0) -- (2,2);
  \fill[blue] (intersection of 0,0--1,1 and A) circle (3pt);
  \fill[red] (intersection 1 of 0,0--1,1 and A) circle (2pt);
  \fill[green] (intersection 2 of 0,0--1,1 and A) circle (2pt);
\end{tikzpicture}

```

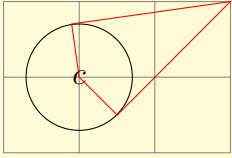


Using implicitly the perpendicular coordinate systems

```

\begin{tikzpicture}
  \path (30:1cm) node(p1) {$p_1$}
        (75:1cm) node(p2) {$p_2$};
  \draw (-0.2,0) -- (1.2,0) node(xline)[right] {$q_1$};
  \draw (2,-0.2) -- (2,1.2) node(yline)[above] {$q_2$};
  \draw[->] (p1) -- (p1-xline);
  \draw[->] (p2) -- (p2-xline);
  \draw[->] (p1) -- (p1-lyline);
  \draw[->] (p2) -- (p2-lyline);
\end{tikzpicture}

```

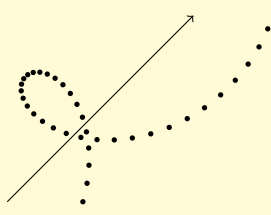


Using the tangent coordinate systems. Has no implicit syntax.

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \coordinate (a) at (3,2);
  \node[circle,draw] (c) at (1,1) [minimum size=40pt] {$c$};
  \draw[red] (a) --
    (tangent cs:node=c,point={(a)},solution=1) --
    (c.center) --
    (tangent cs:node=c,point={(a)},solution=2) -- cycle;
\end{tikzpicture}

```

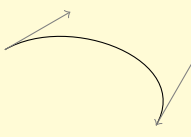



Defining a new coordinate system

```

\makeatletter
\define@key{cylindricalkeys}{angle}{\def\myangle{#1}}
\define@key{cylindricalkeys}{radius}{\def\myradius{#1}}
\define@key{cylindricalkeys}{z}{\def\myz{#1}}
\makeatother
\tikzdeclarecoordinatesystem{cylindrical}%
{
  \setkeys{cylindricalkeys}{#1}%
  \pgfpointadd{\pgfpointxyz{0}{0}{\myz}}{\pgfpointpolarxy{\myangle}{\myradius}}
}
\begin{tikzpicture}[z=0.2pt]
  \draw[->] (0,0,0) -- (0,0,350);
  \foreach \num in {0,10,...,350}
    \fill (cylindrical cs:angle=\num,radius=1,z=\num)
      circle (1pt);
\end{tikzpicture}

```




When you use relative coordinates as the control points of a Bezier curve, they are relative to the curve limits instead of the previously typed coordinate.

```

\begin{tikzpicture}
  \draw (1,0) .. controls +(30:1cm) and +(60:1cm) .. (3,-1);
  \draw[gray,->] (1,0) -- +(30:1cm);
  \draw[gray,<-] (3,-1) -- +(60:1cm);
\end{tikzpicture}

```

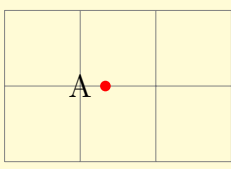


Curly braces has no effect in the relative coordinates unless it is declared local.

```

\begin{tikzpicture}
  \draw (0,0) -- ++(1,0) -- ++(0,1) -- ++(-1,0);
  \draw[red] (0,-1.5) -- ++(1,0) { -- ++(0,1) } -- ++(-1,0);
  \draw[red] (0,-3) -- ++(1,0) { [current point is local] -- ++(0,1) } -- ++(-1,0);
\end{tikzpicture}

```

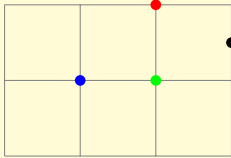


With the `calc` tikz library you can make calculations in the coordinates.

```

\usetikzlibrary{calc}
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \node (a) at (1,1) {A};
  \fill[red] ($(a)+1/3*(1cm,0)$) circle (2pt);
\end{tikzpicture}

```



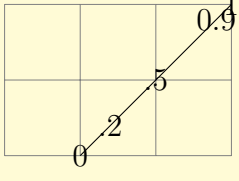
Multiplying a coordinate by a factor.

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \fill[red] ($2*(1,1)$) circle (2pt);
  \fill[green] ($1+1*(1,.5)$) circle (2pt);
  \fill[blue] ($\cos(0)*\sin(90)*(1,1)$) circle (2pt);
  \fill[black] ($3*(4-3)*(1,0.5)$) circle (2pt);
\end{tikzpicture}

```

Using pathway modifiers to put a node in position along a line.

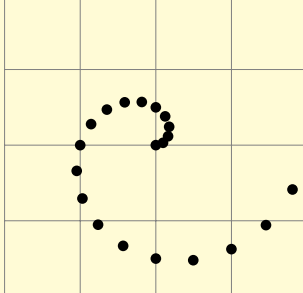


```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (1,0) -- (3,2);
  \foreach \i in {0,.2,.5,0.9,1}
    \node at ($(1,0)!\i!(3,2)$) {\i};
\end{tikzpicture}

```

Using angles in pathway modifiers.

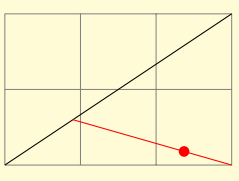


```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (4,4);
  \foreach \i in {0,0.1,...,2}
    \fill ($(2,2)!\i!\i*180:(3,2)$) circle (2pt);
\end{tikzpicture}

```

Combining several pathway modifiers.

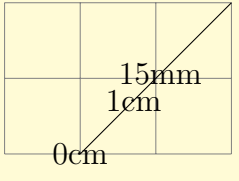


```

\begin{tikzpicture}
  \draw [help lines] (0,0) grid (3,2);
  \draw (0,0) -- (3,2);
  \draw [red] ($(0,0)!.3!(3,2)$) -- (3,0);
  \fill [red] ($(0,0)!.3!(3,2)!.7!(3,0)$) circle (2pt);
\end{tikzpicture}

```

Using distance modifiers. Like pathway modifiers but with a dimension instead a fraction.

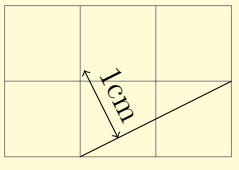


```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (1,0) -- (3,2);
  \foreach \i in {0cm,1cm,15mm}
    \node at ($(1,0)!\i!(3,2)$) {\i};
\end{tikzpicture}

```

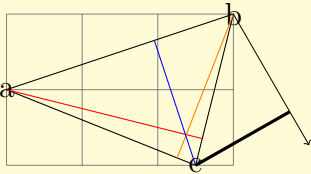
An angle in a distance modifier.



```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \coordinate (a) at (1,0);
  \coordinate (b) at (3,1);
  \draw (a)--(b);
  \coordinate (c) at ($(a)!.25!(b)$);
  \coordinate (d) at ($(c)!1cm!90:(b)$);
  \draw[<->] (c) -- (d) node [sloped,midway,above] {1cm};
\end{tikzpicture}

```



Using projection modifiers.

```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \coordinate (a) at (0,1);
  \coordinate (b) at (3,2);
  \coordinate (c) at (2.5,0);
  \draw (a) node {a}-- (b) node{b}-- (c) node{c}-- cycle;
  \draw[red] (a) -- ($ (b)! (a)! (c) $);
  \draw[orange] (b) -- ($ (a)! (b)! (c) $);
  \draw[blue] (c) -- ($ (a)! (c)! (b) $);
  \draw[very thick] (c) -- ($ (b)! (c)! 30:(3,0) $);
  \draw[very thin,->] (b) -- +(30-90:2);
\end{tikzpicture}
```

2.4 Syntax for Path Specifications

	<p>Options with effect in the middle of a path.</p> <pre>\tikz\draw (0,0) -- (1,1) [rounded corners] -- (2,0) -- (3,1) [sharp corners] -- (3,0) -- (2,1);</pre>
--	---

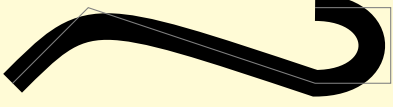
	<p>Scoping an option in a path.</p> <pre>\tikz\draw (0,0) -- (1,1) {[rounded corners] -- (2,0) -- (3,1)} -- (3,0) -- (2,1);</pre>
--	---

	<p>Other options only can apply to the whole path.</p> <pre>\tikz\draw (0,0) -- (1,1) [color=red] -- (2,0) -- (3,1) [color=blue] -- (3,0) -- (2,1); \tikz\draw (0,0) -- (1,1); \draw [color=red] (2,0) -- (3,1); \draw [color=blue] (3,0) -- (2,1);</pre>
--	---

	<p>Use of the every path style.</p> <pre>\begin{tikzpicture} [fill=yellow, every path/.style={draw}] \fill (0,0) rectangle +(1,1); \shade (2,0) rectangle +(1,1); \path (4,0) rectangle +(1,1); \end{tikzpicture}</pre>
--	---

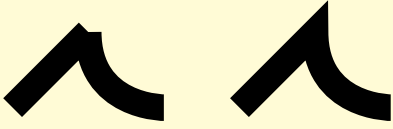
	<p>There is a difference between isolated segments and a complete sequence of line-to operations.</p> <pre>\begin{tikzpicture}[line width=10pt] \draw (0,0) --(1,1) (1,1) --(2,0); \draw (3,0) --(4,1) --(5,0); \useasboundingbox (0,1.5);%high a little the bounding box \end{tikzpicture}</pre>
--	---

	<p>Connecting points by horizontal and vertical lines.</p> <pre>\begin{tikzpicture} \draw (0,0) node(a) [draw] {A} (1,1) node(b) [draw] {B}; \draw (a.north) - (b.west); \draw [color=red] (a.east) - (2,1.5) - (b.north); \end{tikzpicture}</pre>
--	---



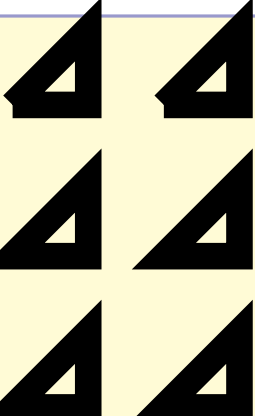
Drawing Bezier curves.

```
\begin{tikzpicture}
\draw[line width=10pt] (0,0) .. controls (1,1) .. (4,0)
.. controls (5,0) and (5,1) .. (4,1);
\draw[color=gray] (0,0) --(1,1) --(4,0) --(5,0) --(5,1) --(4,1);
\end{tikzpicture}
```



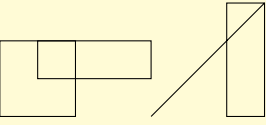
Joints with Bezier curves.

```
\begin{tikzpicture}[line width=10pt]
\draw (0,0) -- (1,1) (1,1) .. controls (1,0) and (2,0) .. (2,0);
\draw (3,0) -- (4,1) .. controls (4,0) and (5,0) .. (5,0);
\end{tikzpicture}
```



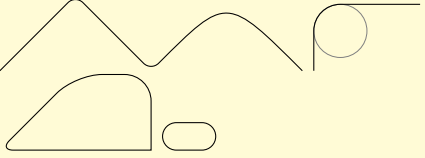
The cycle operation.

```
\begin{tikzpicture}[line width=10pt]
\draw (0,0) -- (1,1) -- (1,0) -- (0,0)
(2,0) -- (3,1) -- (3,0) -- (2,0);
\draw (0,-2) -- +(1,1) -- +(1,0) -- cycle
+(2,0) -- +(3,1) -- +(3,0) -- cycle;
\draw (0,-4) -- +(1,1) -- +(1,0) -- +(0,0) -- cycle
+(2,0) -- +(3,1) -- +(3,0) -- +(2,0) -- cycle;
\end{tikzpicture}
```



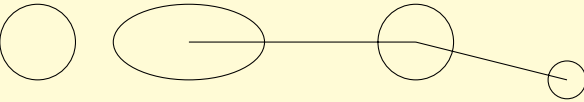
The rectangle operation.

```
\begin{tikzpicture}
\draw (0,0) rectangle (1,1);
\draw (.5,1) rectangle (2,0.5)
(3,0) rectangle (3.5,1.5) -- (2,0);
\end{tikzpicture}
```



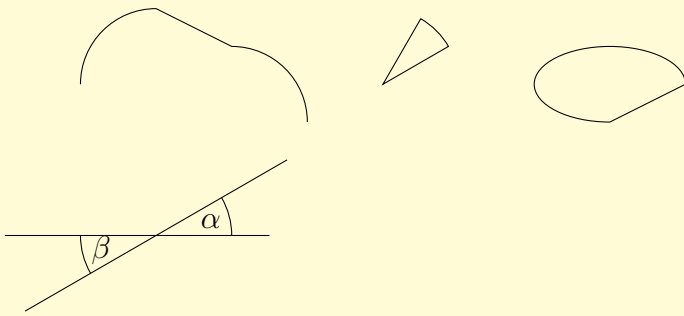
Drawing rounding corners.

```
\tikz\draw[rounded corners] (0,0) -- (1,1)
-- (2,0) .. controls (3,1) .. (4,0);
\begin{tikzpicture}
\draw[color=gray,very thin] (10pt,15pt) circle (10pt);
\draw[rounded corners=10pt] (0,0) -- (0pt,25pt) -- (40pt,25pt);
\end{tikzpicture}
\begin{tikzpicture}
\draw (0,0) [rounded corners=10pt] -- (1,1) -- (2,1)
[sharp corners] -- (2,0)
[rounded corners=5pt] -- cycle;
\end{tikzpicture}
\tikz\draw[rounded corners=1ex] (0,0) rectangle (20pt,2ex);
```



The Circle and Ellipse operations.

```
\begin{tikzpicture}
\draw (1,0) circle (.5cm);
\draw (3,0) ellipse (1cm and .5cm) -- ++(3,0) circle (.5cm)
-- ++(2,-.5) circle (.25cm);
\end{tikzpicture}
```

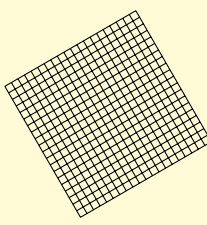


The Arc operation.

```

\begin{tikzpicture}
  \draw (0,0) arc (180:90:1cm) -- (2,.5) arc (90:0:1cm);
  \draw (4,0) -- +(30:1cm) arc (30:60:1cm) --cycle;
  \draw (8,0) arc (0:270:1cm and .5cm) -- cycle;
\begin{scope}[yshift=-2cm]
  \draw (-1,0) -- +(3.5,0);
  \draw (1,0) ++(210:2cm) -- +(30:4cm);
  \draw (1,0)+(0:1cm) arc (0:30:1cm);
  \draw (1,0) +(180:1cm) arc (180:210:1cm);
  \path (1,0) ++(15:.75cm) node{\alpha};
  \path (1,0) ++(15:-.75cm) node{\beta};
\end{scope}
\end{tikzpicture}

```

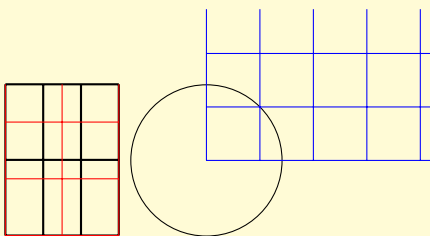


The grid operation.

```

\tikz[rotate=30] \draw[step=1mm] (0,0) grid (2,2);
\begin{tikzpicture}[x=.5cm]
  \draw[thick] (0,0) grid [step=1] (3,2);
  \draw[red] (0,0) grid [step=.75cm] (3,2);
\end{tikzpicture}
\begin{tikzpicture}
  \draw (0,0) circle (1);
  \draw[blue] (0,0) grid[step=(45:1)](3,2);
\end{tikzpicture}
\tikz\draw (3,3) grid[step={(1,.5)}] (5,5);
\tikz\draw (0,0) grid[xstep=.5,ystep=.75] (3,2);

```

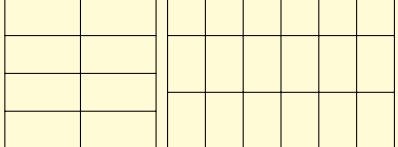


Controlling the step in a grid.

```

\begin{tikzpicture}[x=.5cm]
  \draw[thick] (0,0) grid [step=1] (3,2);
  \draw[red] (0,0) grid [step=.75cm] (3,2);
\end{tikzpicture}
\begin{tikzpicture}
  \draw (0,0) circle (1);
  \draw[blue] (0,0) grid[step=(45:1)](3,2);
\end{tikzpicture}

```

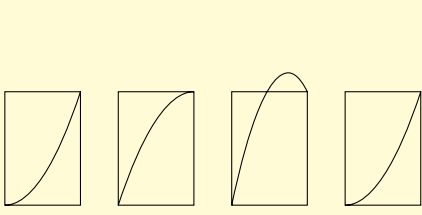


Controlling the steps in each dimension.

```

\tikz\draw (3,3) grid[step={(1,.5)}] (5,5);
\tikz\draw (0,0) grid[xstep=.5,ystep=.75] (3,2);

```

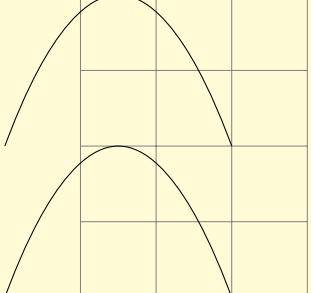


The parabola operation.

```

\begin{tikzpicture}
  \draw (0,0) rectangle (1,1.5)
    (0,0) parabola (1,1.5);
  \draw[xshift=1.5cm] (0,0) rectangle (1,1.5)
    (0,0) parabola[bend at end] (1,1.5);
  \draw[xshift=3cm] (0,0) rectangle (1,1.5)
    (0,0) parabola bend (.75,1.75) (1,1.5);
  \draw[xshift=4.5cm] (0,0) rectangle (1,1.5)
    (0,0) parabola[bend at start] (1,1.5);
\end{tikzpicture}

```

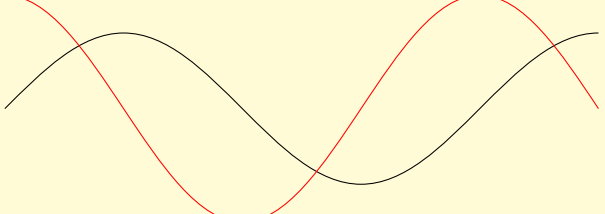


Controlling the bending in a parabola.

```

\begin{tikzpicture}
  \draw[help lines] (0,-2) grid (3,2);
  \draw (-1,0) parabola[bend pos=0.5] bend +(0,2) +(3,0);
  \draw (-1,-2) parabola[parabola height=2cm] +(3,0);
\end{tikzpicture}

```

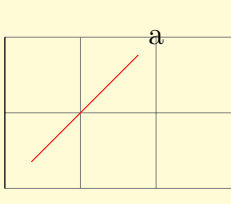


The Sine and Cosine operations.

```

\begin{tikzpicture}[xscale=1.57]
  \draw (0,0) sin (1,1) cos (2,0)
        sin (3,-1) cos (4,0) sin (5,1);
  \draw[color=red] (0,1.5) cos (1,0) sin (2,-1.5)
        cos (3,0) sin (4,1.5) cos (5,0);
\end{tikzpicture}

```

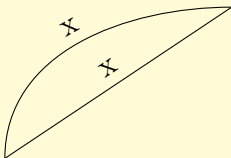


Using the to path operation.

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw (0,0) to (0,2);
  \node (a) at (2,2) {a};
  \draw[red] (10pt,10pt) to (a);
\end{tikzpicture}

```

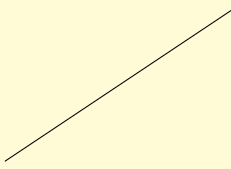


Nodes on tos.

```

\begin{tikzpicture}
  \draw (0,0) to node [sloped,above] {x} (3,2);
  \draw (0,0) to[out=90,in=180] node[sloped,above] {x} (3,2);
\end{tikzpicture}

```

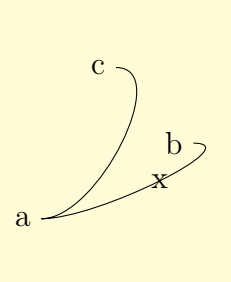


The every to style. *draw* has no effect in *to*, must be in the path.

```

\tikz[every to/.style={dashed}]\path[draw] (0,0) to (3,2);
\tikz[every to/.style={draw,dashed}]\path (0,0) to[sloped] node {to} (2,1);

```

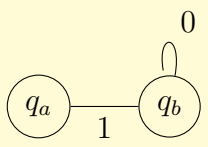


Using to path=... to change the meaning of to.

```

\begin{tikzpicture}[to path={
  .. controls +(1,0) and +(1,0) ..
  (\tikztotarget) \tikztonodes}]
  \node (a) at (0,0) {a};
  \node (b) at (2,1) {b};
  \node (c) at (1,2) {c};
  \draw (a) to node {x} (b)
        (a) to (c);
\end{tikzpicture}

```

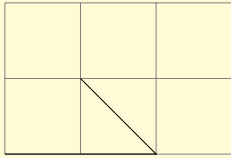


Another use of to path.

```

\tikzset{
  my loop/.style={->,to path={
    .. controls +(80:1) and +(100:1) ..
    (\tikztotarget) \tikztonodes}},
  my state/.style={circle,draw}}
\begin{tikzpicture}[shorten >=2pt]
  \node [my state] (a) at (210:1) {$q_a$};
  \node [my state] (b) at (330:1) {$q_b$};
  \draw (a) to node[below] {1} (b)
    to [my loop] node[above right] {0} (b);
\end{tikzpicture}

```

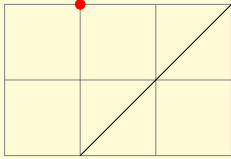


The let operation: p

```

\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw let \p{foo}=(1,1), \p2=(2,0) in
    (0,0) -- (\p2) -- (\p{foo});
\end{tikzpicture}

```

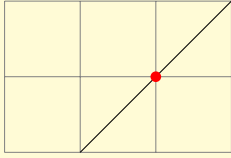


The let operation: x and y

```

\begin{tikzpicture}
  \draw [help lines] (0,0) grid (3,2);
  \draw (1,0) coordinate (first point)
    -- (3,2) coordinate (second point);
  \fill[red] let \p1=(first point),
    \p2=(second point) in
    (\x1,\y2) circle (2pt);
\end{tikzpicture}

```

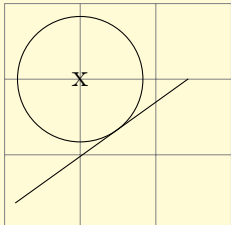


The let operation: Saving the coordinate for later.

```

\begin{tikzpicture}
  \draw [help lines] (0,0) grid (3,2);
  \path let
    \p1=(1,0),
    \p2=(3,2),
    \p{center}=(\p1)!.5!(\p2)
  in
    coordinate (p1) at (\p1)
    coordinate (p2) at (\p2)
    coordinate (center) at (\p{center});
  \draw (p1) -- (p2);
  \fill[red] (center) circle (2pt);
\end{tikzpicture}

```



The let operation: n

```

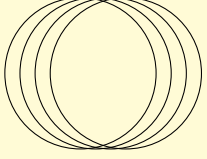
\begin{tikzpicture}
  \draw [help lines] (0,0) grid (3,3);
  \coordinate (a) at (rnd,rnd);
  \coordinate (b) at (3-rnd,3-rnd);
  \draw (a) -- (b);
  \node (c) at (1,2) {X};
  \draw let \p1=(a)!(c)!(b) - (c)$,
    \n1={veclen(\x1,\y1)} in
    (c) circle (\n1);
\end{tikzpicture}

```


To temporarily suspend the construction of the path and execute \TeX code.

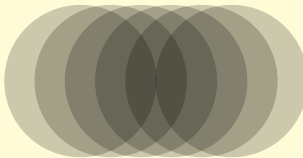
```
\rule{1pt}{1cm}\rule[1cm]{1pt}{1cm}%  
\newdimen\mydim  
\begin{tikzpicture}  
  \mydim=1cm  
  \draw (Opt,\mydim) \pgfextra{\mydim=2cm} -- (Opt,\mydim);  
\end{tikzpicture}  
\begin{tikzpicture}  
  \mydim=1cm  
  \draw (Opt,\mydim) \pgfextra{\mydim=2cm}\endpgfextra  
  -- (Opt,\mydim);  
\end{tikzpicture}
```

2.5 Actions on Paths




You can specify the action in any part of the path.

```
\begin{tikzpicture}
\path [draw] (0,0) circle (1cm);
\path (.2,0) [draw] circle (1cm);
\path (.4,0) circle (1cm) [draw];
\draw (.6,0) circle (1cm);
\end{tikzpicture}
```



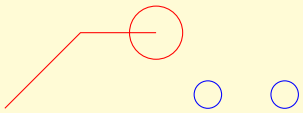
The same circle written in many ways.

```
\begin{tikzpicture}[opacity=0.2]
\path [draw,fill] (0,0) circle (1cm);
\path [draw] [fill] (.4,0) circle (1cm);
\path [fill] (.8,0) circle (1cm) [draw];
\draw [fill] (1.2,0) circle (1cm);
\fill (1.6,0) [draw] circle (1cm);
\filldraw (2,0) circle (1cm);
\end{tikzpicture}
```




Coloring a path. Unrecognized options are tried as colors.

```
\tikz{\fill[color=red!20] (0,0) circle (1ex);
\fill[red!20] (3ex,0) circle (1ex);}
```




With `draw=color` sets the color for drawing the lines which compose the path. `draw=none` turns drawing off.


```
\tikz\path[draw=red] (0,0) -- (1,1) -- (2,1) circle (10pt);
\tikz\path[draw=blue] (0,0) circle (1ex);
\tikz\path[draw=none] (0,0) circle (1ex);
\tikz\path[draw=blue] (0,0) circle (1ex);
```

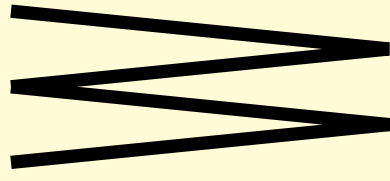


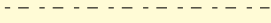
Line width.

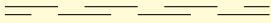
```
\begin{tikzpicture}
\draw[line width=5pt] (0,0) -- +(1cm,.5ex);
\draw[ultra thin] (0,-1ex) -- +(1cm,.5ex);%0.1
\draw[very thin] (0,-1ex) -- +(1cm,.5ex);%0.2
\draw[thin] (0,-1ex) -- +(1cm,.5ex);%0.4
\draw[semithick] (0,-1ex) -- +(1cm,.5ex);%0.6
\draw[thick] (0,-1ex) -- +(1cm,.5ex);%0.8
\draw[very thick] (0,-1ex) -- +(1cm,.5ex);%1.2
\draw[ultra thick] (0,-1ex) -- +(1cm,.5ex);%1.6
\end{tikzpicture}
```

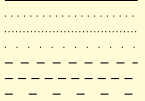
	<p style="text-align: center;">Specifying how lines end.</p> <pre> \begin{tikzpicture} \begin{scope}[line width=10pt] \draw[line cap=rect] (0,0) -- (1,0); \draw[line cap=butt] (0,.5) -- (1,.5);%initial \draw[line cap=round] (0,1) -- (1,1); \end{scope} \draw[white,line width=1pt] (0,0) -- (1,0) (0,.5) -- (1,.5) (0,1) -- (1,1); \end{tikzpicture} </pre>
---	--

	<p style="text-align: center;">Specifying how lines join.</p> <pre> \begin{tikzpicture}[line width=10pt] \draw[line join=round] (0,0) -- ++(.5,1) -- ++(.5,-1); \draw[line join=bevel] (1.25,0) -- ++(.5,1) -- ++(.5,-1); \draw[line join=mitter] (2.25,0) -- ++(.5,1) -- ++(.5,-1);%initial \useasboundingbox (0,1.5); \end{tikzpicture} </pre>
---	--

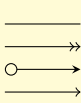
	<p style="text-align: center;">For the mitter join type, a limit factor to the length.</p> <pre> \begin{tikzpicture}[line width=5pt] \draw (0,0) -- ++(5,.5) -- ++(-5,.5); \draw[miter limit=25] (0,-1) -- ++(5,.5) -- ++(-5,.5); \useasboundingbox (5cm+5pt*1.25,0); \end{tikzpicture} </pre>
--	--

	<p style="text-align: center;">dash pattern.</p> <pre> \begin{tikzpicture}[dash pattern=on 2pt off 3pt on 4pt off 4pt] \draw (0pt,0pt) -- (3.5cm,0pt); \end{tikzpicture} </pre>
---	---

	<p style="text-align: center;">dash phase.</p> <pre> \begin{tikzpicture} [dash pattern=on 20pt off 10pt] \draw[dash phase=0pt] (0pt,3pt) -- (3.5cm,3pt); \draw[dash phase=10pt] (0pt,0pt) -- (3.5cm,0pt); \end{tikzpicture} </pre>
---	--

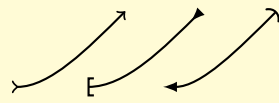
	<p style="text-align: center;">dash patterns.</p> <pre> \begin{tikzpicture} \draw[solid] (0,0) -- +(50pt,0pt); \draw[dotted] (0,-0.5em) -- +(50pt,0pt); \draw[densely dotted] (0,-1.0em) -- +(50pt,0pt); \draw[loosely dotted] (0,-1.5em) -- +(50pt,0pt); \draw[dashed] (0,-2.0em) -- +(50pt,0pt); \draw[densely dashed] (0,-2.5em) -- +(50pt,0pt); \draw[loosely dashed] (0,-3.0em) -- +(50pt,0pt); \end{tikzpicture} </pre>
---	---

Setting arrows, with `arrows=...` or simply by something containing a `-`.



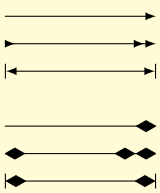
```
\begin{tikzpicture}[arrows=>>]
  \draw[->] (0,0) -- (1,0);
  \draw[o->] (0,0.3) -- +(1,0);
  \draw (0,0.6) -- +(1,0);
  \draw[-] (0,0.9) -- +(1,0);
\end{tikzpicture}
```

Combining arrow tips.



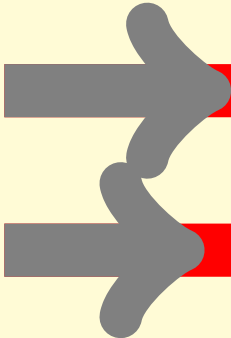
```
\begin{tikzpicture}[thick]
  \draw[to reversed-to]
    (0,0) .. controls +(0.5,0) and
    +(-0.5,-0.5) .. +(1.5,1);
  \draw[[-latex reversed]]
    (1,0) .. controls +(0.5,0) and
    +(-0.5,-0.5) .. +(1.5,1);
  \draw[latex-]
    (2,0) .. controls +(0.5,0) and
    +(-0.5,-0.5) .. +(1.5,1);
  \useasboundingbox (-1,-1)
    rectangle (3.1,1.1);
\end{tikzpicture}
```

Defining the meaning of the arrow `>`.



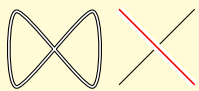
```
\begin{tikzpicture}[scale=2]
  \begin{scope}[>=latex]
    \draw[->] (0pt,6ex) -- +(1cm,0);
    \draw[>->] (0pt,5ex) -- +(1cm,0);
    \draw[|<->|] (0pt,4ex) -- +(1cm,0);
  \end{scope}
  \begin{scope}[>=diamond]
    \draw[->] (0pt,2ex) -- +(1cm,0);
    \draw[>->] (0pt,1ex) -- +(1cm,0);
    \draw[|<->|] (0pt,0ex) -- +(1cm,0);
  \end{scope}
\end{tikzpicture}
```

`shorten > <`.

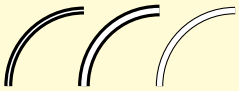


```
\begin{tikzpicture}[line width=20pt]
  \useasboundingbox (0,-1.5) rectangle (3.5,1.5);
  \draw[red] (0,0) -- (3,0);
  \draw[gray,->] (0,0) -- (3,0);
  \draw[red] (0,-60pt) -- +(3,0);
  \draw[shorten >=10pt,gray,->] (0,-60pt) -- +(3,0);
\end{tikzpicture}
```

double lines.

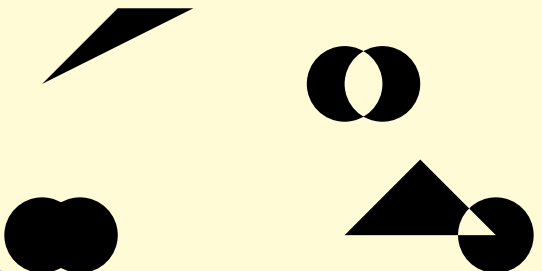


```
\tikz\draw[double] plot[smooth cycle]
  coordinates{(0,0) (1,1) (1,0) (0,1)};
\begin{tikzpicture}
  \draw (0,0) -- (1,1);
  \draw[draw=white,double=red,very thick]
    (0,1) -- (1,0);
\end{tikzpicture}
```



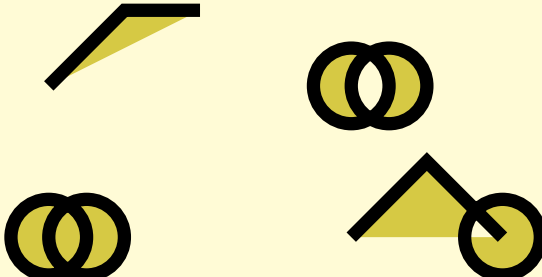
double distance.

```
\begin{tikzpicture}
\draw[very thick,double] (0,0) arc (180:90:1cm);
\draw[very thick,double distance=2pt] (1,0) arc (180:90:1cm);
\draw[thin,double distance=2pt] (2,0) arc (180:90:1cm);
\end{tikzpicture}
```



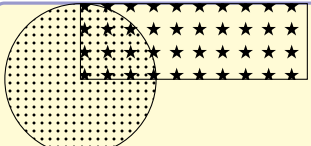
Filling a path. Can be disabled with `fill=None`.

```
\begin{tikzpicture}
\fill (0,0) -- +(1,1) -- +(2,1);
\fill (0,-2) circle (.5cm) +(1.5,0) circle (.5cm);
\fill[even odd rule] (4,0) circle (.5cm)
+(.5,0) circle (.5cm);
\fill (4,-2) -- +(1,1) -- +(2,0) circle (.5cm);
\path (0,1.5);
\end{tikzpicture}
```

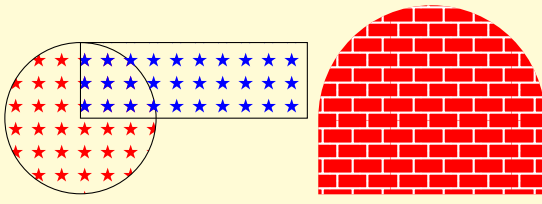


`filldraw`.

```
\begin{tikzpicture}[fill=yellow!80!black, line width=5pt]
\filldraw (0,0) -- +(1,1) -- +(2,1);
\filldraw (0,-2) circle (.5cm) +(1.5,0) circle (.5cm);
\filldraw[even odd rule] (4,0) circle (.5cm)
+(.5,0) circle (.5cm);
\filldraw (4,-2) -- +(1,1) -- +(2,0) circle (.5cm);
\path (0,1.5);
\end{tikzpicture}
```

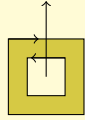
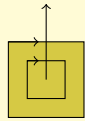


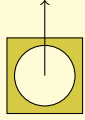
filling with a pattern, requires library `patterns`.




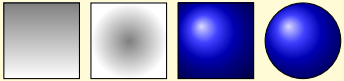
Pattern color.


```
\begin{tikzpicture}
\draw[pattern color=red,pattern=fivepointed stars] (0,0) circle (1cm);
\draw[pattern color=blue,pattern=fivepointed stars]
(0,0) rectangle (3,1);
\end{tikzpicture}
\begin{tikzpicture}
\def\mypath{(0,0) -- +(0,1) arc (180:0:1.5cm)
-- +(0,-1)}
\fill [red] \mypath;
\pattern [pattern color=white,pattern=bricks] \mypath;
\end{tikzpicture}
```

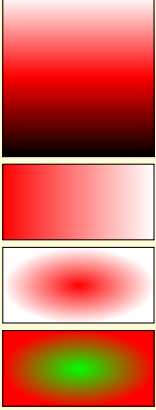

<p>crossings: $-1 + 1 = 0$</p>  <p>crossings: $1 + 1 = 2$</p> 	<h3>Filling with the nonzero rule.</h3> <pre> \begin{tikzpicture}[fill=yellow!80!black] \filldraw %Clockwise rectangle (0,0) -- (0,1) -- (1,1) -- (1,0) -- cycle %Counter-clockwise rectangle (0.25,0.25) -- (0.75,0.25) -- (0.75,0.75) -- (0.25,0.75) -- cycle; \draw[->] (0,1) -- (.4,1); \draw[->] (0.75,0.75) -- (0.3,.75); \draw[->] (.5,.5) -- +(0,1) node[above] {crossings: $-1+1=0$}; \begin{scope}[yshift=-3cm] \filldraw %Clockwise rectangle (0,0) -- (0,1) -- (1,1) -- (1,0) -- cycle %Counter-clockwise rectangle (0.25,0.25) -- (0.25,0.75) -- (0.75,0.75) -- (0.75,0.25) -- cycle; \draw[->] (0,1) -- (.4,1); \draw[->] (0.25,0.75) -- (0.4,.75); \draw[->] (.5,.5) -- +(0,1) node[above] {crossings: $1+1=2$}; \end{scope} \end{tikzpicture} </pre>
--	--

<p>crossings: $1 + 1 = 2$</p> 	<h3>Filling with the even odd rule.</h3> <pre> \begin{tikzpicture} \filldraw[fill=yellow!80!black,even odd rule] (0,0) rectangle (1,1) (0.5,0.5) circle (0.4cm); \draw[->] (.5,.5) -- +(0,1) [above] node {crossings: $1+1=2$}; \end{tikzpicture} </pre>
---	--

	<h3>shading.</h3> <pre> \tikz\shade (0,0) circle (1ex); \tikz\shadedraw (0,0) circle (1ex); </pre>
---	--

	<h3>shading type.</h3> <pre> \tikz\shadedraw[shading=axis] (0,0) rectangle (1,1); \tikz\shadedraw[shading=radial] (0,0) rectangle (1,1); \tikz\shadedraw[shading=ball] (0,0) rectangle (1,1); \tikz\shadedraw[shading=ball] (0,0) circle (.5cm); </pre>
---	---

	<h3>Shading angle rotates the shade.</h3> <pre> \tikz\shadedraw[shading=axis,shading angle=90] (0,0) rectangle (1,1); </pre>
---	--

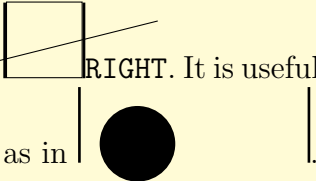



Shading colors.

```

\begin{tikzpicture}
\shadedraw[top color=red] (0,0) rectangle +(2,1);
\shadedraw[top color=white,bottom color=black,middle color=red] (0,-1.1) rectangle +(2,1);
\shadedraw[left color=red] (0,-2.2) rectangle +(2,1);
\shadedraw[inner color=red] (0,-3.3) rectangle +(2,1);
\shadedraw[outer color=red, inner color=green] (0,-4.4) rectangle +(2,1);
\shade[ball color=white] (0,-5.5) circle (2ex);
\shade[ball color=red] (1,-5.5) circle (2ex);
\shade[ball color=black] (2,-5.5) circle (2ex);
\end{tikzpicture}
                
```

We can control the bounding box:LEFT



as in

We can control the bounding box:LEFT

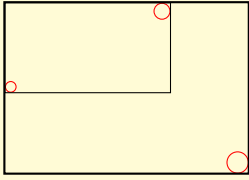
```

\begin{tikzpicture}
\draw[use as bounding box] (2,0) rectangle (3,1);
\draw (1,0) -- (4,.75);
\end{tikzpicture}
                
```

It is useful to control white space as in

```

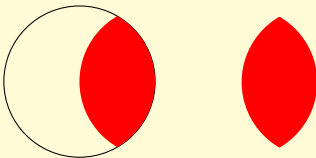
\begin{tikzpicture}
\useasboundingbox (0,0) rectangle (3,1);
\fill (.75,.25) circle (.5cm);
\end{tikzpicture}
                
```



Using the current bounding box.

```

\begin{tikzpicture}
\draw[red] (0,0) circle (2pt);
\draw[red] (2,1) circle (3pt);
\draw (current bounding box.south west)
rectangle
(current bounding box.north east);
\draw[red] (3,-1) circle (4pt);
\draw[thick] (current bounding box.south west)
rectangle
(current bounding box.north east);
\end{tikzpicture}
                
```



Clipping.

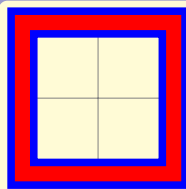
```

\begin{tikzpicture}
\draw[clip] (0,0) circle (1cm);
\fill[red] (1,0) circle (1cm);
\end{tikzpicture}
\begin{tikzpicture}
\clip (0,0) circle (1cm);
\fill[red] (1,0) circle (1cm);
\end{tikzpicture}
                
```

Making local clipping by using scopes.

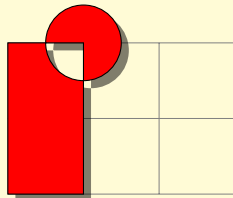


```
\begin{tikzpicture}
  \draw (0,0) -- (0:1cm);
  \draw (0,0) -- (10:1cm);
  \draw (0,0) -- (20:1cm);
  \draw (0,0) -- (30:1cm);
  \begin{scope}[fill=red]
    \fill[clip] (0.2,0.2) rectangle (0.5,0.5);
    \draw (0,0) -- (40:1cm);
    \draw (0,0) -- (50:1cm);
    \draw (0,0) -- (60:1cm);
  \end{scope}
  \draw (0,0) -- (70:1cm);
  \draw (0,0) -- (80:1cm);
  \draw (0,0) -- (90:1cm);
\end{tikzpicture}
```



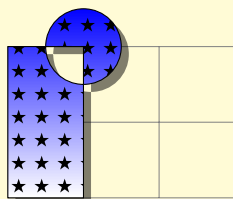
Preaction.

```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw[preaction={draw,line width=4mm,blue}]
    [line width=2mm,red] (0,0) rectangle (2,2);
\end{tikzpicture}
```



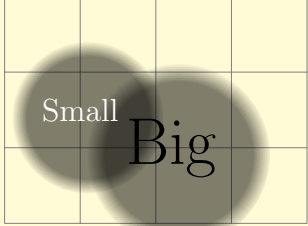
Creating a shadow with a preaction and a canvas transformation.

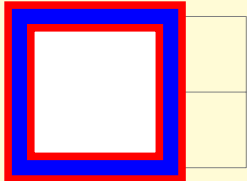
```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw[preaction={fill=black,opacity=.5,
    transform canvas={xshift=1mm,yshift=-1mm}}]
    [fill=red] (0,0) rectangle (1,2)
    (1,2) circle (5mm);
\end{tikzpicture}
```

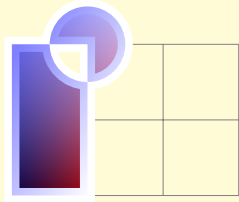


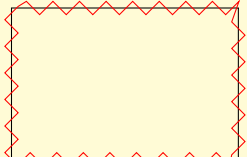
Combining multiples preactions.

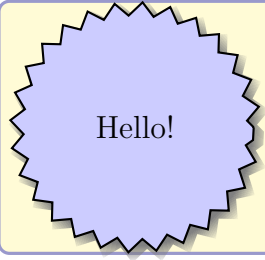
```
\begin{tikzpicture}
  \draw[help lines] (0,0) grid (3,2);
  \draw[pattern=fivepointed stars]
    [preaction={fill=black,opacity=.5,
    transform canvas={xshift=1mm,yshift=-1mm}}]
    [preaction={top color=blue,bottom color=white}]
    (0,0) rectangle (1,2)
    (1,2) circle (5mm);
\end{tikzpicture}
```


	<p>A complex preaction example.</p> <pre> \begin{tikzpicture} [button/.style={ %fuzzy shadow preaction={fill=black, path fading=circle with fuzzy edge 20 percent, opacity=.5,transform canvas={ xshift=1mm,yshift=-1mm}}, %background pattern preaction={pattern=#1, path fading=circle with fuzzy edge 15 percent}, %make background shiny preaction={top color=white,bottom color=black!50, shading angle=45, path fading=circle with fuzzy edge 15 percent, opacity=0.2}, %make edge speacially shiny preaction={path fading=fuzzy ring 15 percent, top color=black!5,bottom color=black!80, shading angle=45}, inner sep=2ex }, button/.default=horizontal lines light blue, circle }] \draw [help lines] (0,0) grid (4,3); \node[button] at (2.2,1) {\Huge Big}; \node[button=crosshatch dots light steel blue, text=white] at (1,1.5) {Small}; \end{tikzpicture} </pre>
---	---

	<p>Postaction.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw[postaction={draw,line width=2mm,blue}] [line width=4mm,red,fill=white] (0,0) rectangle (2,2); \end{tikzpicture} </pre>
--	---

	<p>Colorizing a path with postactions.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw [postaction={path fading=south,fill=white}] [postaction={path fading=south,fading angle=45, fill=blue,opacity=.5}] [left color=black,right color=red,draw=white, line width=2mm] (0,0) rectangle (1,2) (1,2) circle (5mm); \end{tikzpicture} </pre>
---	--

	<p>Decorating (morphing) a path.</p> <pre> \begin{tikzpicture} \draw(0,0) rectangle (3,2); \draw [red,decorate,decoration=zigzag] (0,0) rectangle (3,2); \end{tikzpicture} </pre>
---	---



Decorating a node.

```
\begin{tikzpicture}
  \node[circular drop shadow={shadow scale=1.05},
        minimum size=3.13cm,decorate,decoration=zigzag,
        fill=blue!20,draw,thick,circle]
        {Hello!};
\end{tikzpicture}
```

2.6. NODES AND EDGES

2.6 Nodes and Edges

	<p>Drawing nodes.</p> <pre>\tikz\fill[fill=yellow!80!black] (0,0) node {first node} -- (1,1) node {second node} -- (0,2) node {third node};</pre>
--	---

	<p>Explicitly specifying the position with at.</p> <pre>\tikz\fill[fill=yellow!80!black] (0,0) node[at={(0,-.3)}] {first node} -- (1,1) node[draw] {second node} -- (0,2) node[fill=red!20,draw,double,rounded corners] {third node};</pre>
--	---

	<p>Selecting the shape of the node. Requires the library shapes.</p> <pre>\tikz\fill[fill=yellow!80!black] (0,0) node {first node} -- (1,1) node[shape=ellipse,draw] {second node} -- (0,2) node[shape=circle,fill=red!20] {third node};</pre>
--	--

	<p>every node.</p> <pre>\begin{tikzpicture}[every node/.style=draw] \draw(0,0) node {A} -- (1,1) node {B}; \end{tikzpicture}</pre>
--	--

	<p>every shape node.</p> <pre>\begin{tikzpicture} [every rectangle node/.style=draw, every circle node/.style={draw,double}] \draw (0,0) node[rectangle] {A} -- (1,1) node[circle] {B}; \end{tikzpicture}</pre>
--	---

	<p>coordinate versus node.</p> <pre>\begin{tikzpicture}[every node/.style=draw] \path[yshift=1.5cm,shape=rectangle] (0,0) node(a1){} (1,0) node(a2){} (1,1) node(a3){} (0,1) node(a4){}; \filldraw[fill=yellow!80!black] (a1)--(a2)--(a3)--(a4); \path[shape=coordinate] (0,0) node(a1){} (1,0) node(a2){} (1,1) node(a3){} (0,1) node(a4){}; \filldraw[fill=yellow!80!black] (a1)--(a2)--(a3)--(a4); \end{tikzpicture}</pre>
--	---

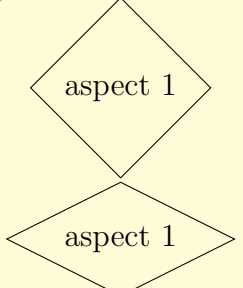
default	Additional separation inside of the shape. Starts at .3333em (-).
loose	<pre>\begin{tikzpicture} \draw (0,0) node[inner sep=0pt,draw] {tight}; \draw (0,2em) node[inner sep=5pt,draw] {loose}; \draw (0,4em) node[fill=yellow!80!black] {default}; \end{tikzpicture}</pre>
tight	

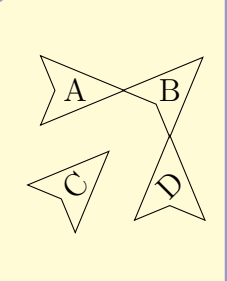
	<p>The <code>outer sep</code> adds space outside the shape, displacing the anchors.</p> <pre>\begin{tikzpicture} \draw[line width=5pt] (0,0) node[fill=yellow!80!black] (f) {filled} (2,0) node[draw=red] (d) {drawn}; \draw[->] (1,-1) -- (f); \draw[->] (1,-1) -- (d); \end{tikzpicture} \begin{tikzpicture} \draw[line width=5pt] (0,0) node[outer sep=0pt,fill=yellow!80!black] (f) {filled} (2,0) node[inner sep=.5\pgflinewidth+2pt,draw=red] (d) {drawn}; \draw[->] (1,-1) -- (f); \draw[->] (1,-1) -- (d); \end{tikzpicture}</pre>
--	--

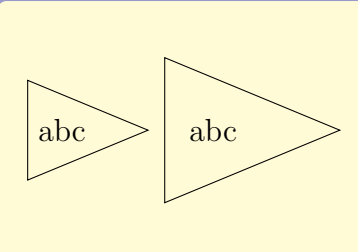
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin: 5px;">1cm</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;">0cm</div> </div>	<p>minimum height.</p> <pre>\begin{tikzpicture} \draw (0,0) node[minimum height=1cm,draw] {1cm} (2,0) node[minimum height=0cm,draw] {0cm}; \end{tikzpicture}</pre>
---	--

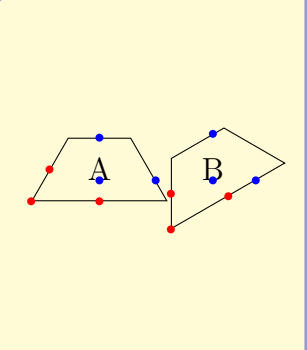
<div style="border: 1px solid black; padding: 10px; text-align: center; width: 60px; margin: auto;"> 3×2 </div>	<p>minimum width.</p> <pre>\begin{tikzpicture} \node[minimum height=2cm,minimum width=3cm, draw] {\$3\times 2\$}; \end{tikzpicture}</pre>
---	---

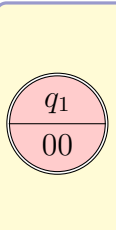
<div style="border: 1px solid black; padding: 5px; margin: 5px; width: 60px; text-align: center;">square</div> <div style="border: 1px solid black; border-radius: 50%; width: 60px; height: 60px; margin: 5px; margin-left: auto; margin-right: auto; text-align: center; line-height: 60px;">circle</div>	<p>minimum size, both width and height.</p> <pre>\begin{tikzpicture} \draw (0,0) node[minimum size=2cm,draw] {square}; \draw (0,-2) node[minimum size=2cm,draw, circle] {circle}; \end{tikzpicture}</pre>
---	---

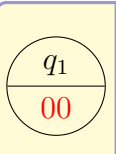
	<p>Ratio between width and height.</p> <pre>\begin{tikzpicture} \draw (0,0) node[shape aspect=1,diamond,draw] {aspect 1}; \draw (0,-2) node[shape aspect=2,diamond,draw] {aspect 1}; \end{tikzpicture}</pre>
---	--

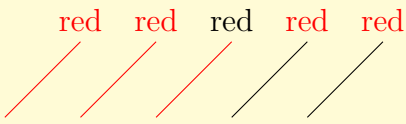
	<p>Rotation of the shape, without affecting the contents.</p> <pre>\tikzstyle{every node}=[dart, shape border uses incircle, inner sep=1pt,draw] \begin{tikzpicture} \foreach \a/\b/\c in {A/0/0,B/45/0,C/0/45,D/45/45} \node[shape border rotate=\b, rotate=\c] at (\b/36,-\c/36) {\a}; \end{tikzpicture}</pre>
---	--

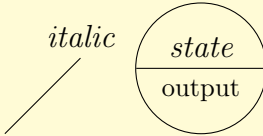
	<p>To make rotation easier we can set the separation calculated by the inner circumference.</p> <pre>\tikzstyle{every node}=[isosceles triangle,draw] \begin{tikzpicture} \node {abc}; \node[shape border uses incircle] at (2,0) {abc}; \end{tikzpicture}</pre>
--	--

	<p>The text anchors does not rotate, the others do.</p> <pre>\begin{tikzpicture} \node at (0,0) (A) {A}; \node [shape border rotate=30] at (1.5,0) (B) {B}; \foreach \s/\t in {left side/base east, bottom side/north, bottom left corner/base}{ \fill[red] (A.\s) circle(1.5pt) (B.\s) circle(1.5pt); \fill[blue] (A.\t) circle(1.5pt) (B.\t) circle(1.5pt); } \end{tikzpicture}</pre>
---	---

	<p>Multi-part nodes.</p> <pre>\begin{tikzpicture} \node[circle split,draw,double,fill=red!20] {q_1\$ %this is the text part \nodepart{lower} \$00\$ }; \end{tikzpicture}</pre>
---	--

	<p>styles for each part of a multi-part node.</p> <pre>\tikz[every lower node part/.style=red] \node[circle split,draw] {q_1\$\nodepart{lower}\$00\$};</pre>
---	--

	<p>Coloring a node versus coloring the path.</p> <pre>\begin{tikzpicture} \draw[red] (0,0) -- +(1,1) node[above] {red}; \draw[color=red] (1,0) -- +(1,1) node[above] {red}; \draw[draw=red] (2,0) -- +(1,1) node[above] {red}; \draw[text=red] (3,0) -- +(1,1) node[above] {red}; \draw (4,0) -- +(1,1) node[above,red] {red}; \end{tikzpicture}</pre>
---	--

	<p>Set a font command for a node.</p> <pre>\tikz\draw[font=\itshape] (1,0) -- +(1,1) node[above] {italic}; \tikz[every text node part/.style={font=\itshape}, every lower node part/.style={font=\footnotesize}] \node [circle split,draw] {state \nodepart{lower} output};</pre>
--	---

<p>This is a demonstration text for showing how line breaking works.</p>	<p>Making text several lines long. As typically will be narrow will be ragged instead of justified. A minipage is created.</p> <pre>\tikz\draw(0,0)node[fill=yellow!80!black, text width=3cm] {This is a demonstration text for showing how line breaking works.};</pre>
--	--

This is a demonstration text for showing how line breaking works.

This is a demonstration text for showing how line breaking works.

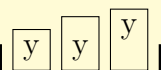
This is a demonstration text for showing how line breaking works.

This is a demonstration text for showing how line breaking works.

This is a demonstration text for showing how line breaking works.

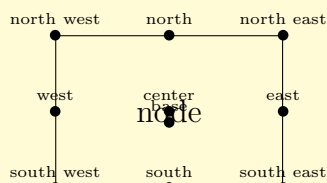
alignment of multiline text.

```
\begin{tikzpicture}
%text justified
\draw(0,0)node(a)[fill=yellow!80!black,
text width=3cm,text justified]
{This is a demonstration text for showing
how line breaking works.};
%text ragged (default)
\draw node(a)[below=.5em of a,anchor=north,fill=yellow!80!black,
text width=3cm,text ragged]
{This is a demonstration text for showing
how line breaking works.};
%text badly ragged
\draw node(a)[below=.5em of a,anchor=north,fill=yellow!80!black,
text width=3cm,text badly ragged]
{This is a demonstration text for showing
how line breaking works.};
%text centered
\draw node(a)[below=.5em of a,anchor=north,fill=yellow!80!black,
text width=3cm,text centered]
{This is a demonstration text for showing
how line breaking works.};
%text badly centered
\draw node(a)[below=.5em of a,anchor=north,fill=yellow!80!black,
text width=3cm,text badly centered]
{This is a demonstration text for showing
how line breaking works.};
\end{tikzpicture}
```



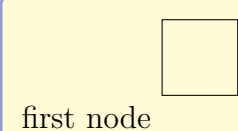
text height and depth.

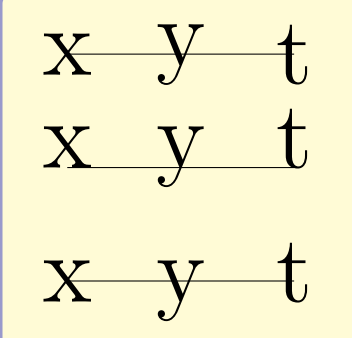
```
\rule{1pt}{10pt}
\tikz\node[draw] {y};
\tikz\node[draw,text height=10pt] {y};
\tikz\node[draw,text depth=10pt] {y};
\rule{1pt}{10pt}
```

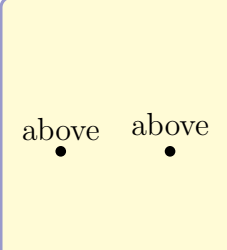


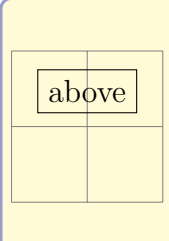
Some anchor positions in a node.

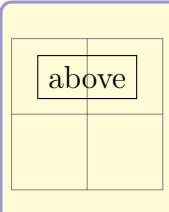
```
\begin{tikzpicture}[little/.style={font=\tiny,above}]
\node[draw,rectangle,minimum width=3cm,
minimum height=2cm] (A) {node};
\fill (A.north west) circle (2pt) node[little]{north west};
\fill (A.north east) circle (2pt) node[little]{north east};
\fill (A.south west) circle (2pt) node[little]{south west};
\fill (A.south east) circle (2pt) node[little]{south east};
\fill (A.north) circle (2pt) node[little]{north};
\fill (A.south) circle (2pt) node[little]{south};
\fill (A.west) circle (2pt) node[little]{west};
\fill (A.east) circle (2pt) node[little]{east};
\fill (A.base) circle (2pt) node[little]{base};
\fill (A.center) circle (2pt) node[little]{center};
\end{tikzpicture}
```

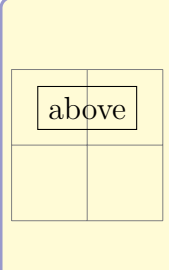
	<p>second node</p> <p>first node</p> <p>Anchoring nodes.</p> <pre>\tikz\draw(0,0) node[anchor=north east] {first node} rectangle (1,1) node[anchor=west] {second node};</pre>
---	---

	<p>Anchoring at center, base and mid.</p> <pre>\begin{tikzpicture}[scale=3,transform shape] \draw[anchor=center] (0,1) node{x} --(0.5,1) node{y} --(1,1) node{t}; \draw[anchor=base] (0,.5) node{x} --(0.5,.5) node{y} --(1,.5) node{t}; \draw[anchor=mid] (0,0) node{x} --(0.5,0) node{y} --(1,0) node{t}; \end{tikzpicture}</pre>
---	---

<p>above above</p> 	<p>Relative placement to current coordinate. Possible values are above, below, left, right. The following does not admit offset unless positioning is loaded: above right, below left, below right.</p> <pre>\tikz\fill circle(2pt) node[above]{above}; \tikz\fill circle(2pt) node[above=2pt]{above};</pre>
---	--

	<p>With positioning, if the offset is a dimension, sets the anchor and displace by the dimension.</p> <pre>\begin{tikzpicture} \draw[help lines] (0,0) grid (2,2); \node at (1,1) [above=2pt+3pt,draw] {above}; \end{tikzpicture}</pre>
---	---

	<p>With positioning, if the offset is a number displace by the corresponding vector.</p> <pre>\begin{tikzpicture} \draw[help lines] (0,0) grid (2,2); \node at (1,1) [above=.2,draw] {above}; \end{tikzpicture}</pre>
---	---

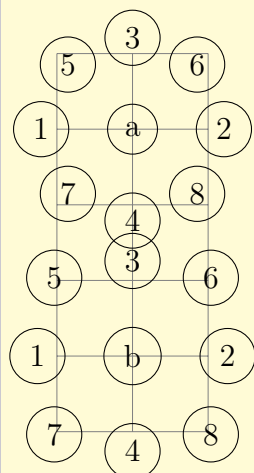
	<p>With positioning, with two dimensions or number. With above shifts by the vertical component of (dim2,dim1). Does not make a lot of sense for this case...</p> <pre>\begin{tikzpicture} \draw[help lines](0,0) grid(2,2); \node at (1,1) [above=.2 and 3mm,draw] {above}; \end{tikzpicture}</pre>
---	--

	<p>Too with positioning: above of coordinate.</p> <pre> \begin{tikzpicture}[every node/.style=draw] \draw[help lines](0,0) grid (2,2); \node (somenode) at (1,1) {some node}; \node [above=5mm of somenode.north east] {\tiny 5mm of somenode.north east}; \node [above=1cm of somenode.north] {\tiny 5mm of somenode.north}; \node [below=0 of somenode.south] {\tiny below of somenode.south}; \end{tikzpicture} </pre>
--	---

	<p>Too with positioning: above of coordinate.</p> <pre> \begin{tikzpicture}[every node/.style=draw] \draw[help lines](0,0) grid (2,2); \node (some node) at (1,1) {some node}; \node (other node) [above=1cm of some node] {\tiny above=1cm of some node}; \draw[<->] (some node.north) --(other node.south) node [midway,right,draw=none] {1cm}; \end{tikzpicture} </pre>
--	--

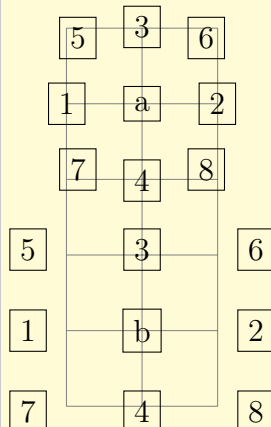
	<p>Altering the behavior of above=of by the key on grid. Makes the dimension to be the distance between centers.</p> <pre> \begin{tikzpicture}[every node/.style=draw] \draw[help lines](0,0)grid(2,3); \node(a1) at (0,0) {not gridded}; \node(b1) [above=1cm of a1] {fooy}; \node(c1) [above=1cm of b1] {a}; \node(a2) at (2,0) {gridded}; \node(b2) [on grid,above=1cm of a2] {fooy}; \node(c2) [on grid,above=1cm of b2] {a}; \end{tikzpicture} </pre>
--	--

	<p>Changing the default distance between nodes. Initially 1cm and 1cm.</p> <pre> \begin{tikzpicture}[every node/.style=draw,node distance=5mm] \draw[help lines](0,0)grid(4,3); \node(a1) at (0,0) {not gridded}; \node(b1) [above=1cm of a1] {fooy}; \node(c1) [above=1cm of b1] {a}; \begin{scope}[on grid] \node(a2) at (2,0) {gridded}; \node(b2) [above=of a2] {fooy}; \node(c2) [above=of b2] {a}; \end{scope} \begin{scope}[on grid,node distance=1cm and 1cm] \node(a3) at (4,0) {gridded}; \node(b3) [above=of a3] {fooy}; \node(c3) [above=of b3] {a}; \end{scope} \end{tikzpicture} </pre>
--	---



In above left of the two dimensions are relevant. With only a dimension is a shift in the direction of that length. With two dimensions, the first is the vertical shift and the second the horizontal one.

```
\begin{tikzpicture}[every node/.style={draw,circle}]
\draw[help lines] (0,0) grid (2,5);
\begin{scope}[node distance=5mm]
\node (a) at (1,4) {a};
\node [left=of a] {1};
\node [right=of a] {2};
\node [above=of a] {3};
\node [below=of a] {4};
\node [above left=of a] {5};
\node [above right=of a] {6};
\node [below left=of a] {7};
\node [below right=of a] {8};
\end{scope}
\begin{scope}[node distance=5mm and 5mm]
\node (b) at (1,1) {b};
\node [left=of b] {1};
\node [right=of b] {2};
\node [above=of b] {3};
\node [below=of b] {4};
\node [above left=of b] {5};
\node [above right=of b] {6};
\node [below left=of b] {7};
\node [below right=of b] {8};
\end{scope}
\end{tikzpicture}
```



above left of with rectangles, in which is easier to see the effect.

```
\begin{tikzpicture}[every node/.style={draw,rectangle}]
\draw[help lines] (0,0) grid (2,5);
\begin{scope}[node distance=5mm]
\node (a) at (1,4) {a};
\node [left=of a] {1};
\node [right=of a] {2};
\node [above=of a] {3};
\node [below=of a] {4};
\node [above left=of a] {5};
\node [above right=of a] {6};
\node [below left=of a] {7};
\node [below right=of a] {8};
\end{scope}
\begin{scope}[node distance=5mm and 10mm]
\node (b) at (1,1) {b};
\node [left=of b] {1};
\node [right=of b] {2};
\node [above=of b] {3};
\node [below=of b] {4};
\node [above left=of b] {5};
\node [above right=of b] {6};
\node [below left=of b] {7};
\node [below right=of b] {8};
\end{scope}
\end{tikzpicture}
```

above left of with a grid.

```

\begin{tikzpicture}[every node/.style={draw,rectangle},on grid]
\draw[help lines] (0,0) grid (4,4);
\begin{scope}[node distance=1]
\node (a) at (2,3) {a};
\node [left=of a] {1};
\node [right=of a] {2};
\node [above=of a] {3};
\node [below=of a] {4};
\node [above left=of a] {5};
\node [above right=of a] {6};
\node [below left=of a] {7};
\node [below right=of a] {8};
\end{scope}
\begin{scope}[node distance=1 and 1]
\node (b) at (2,0) {b};
\node [left=of b] {1};
\node [right=of b] {2};
\node [above=of b] {3};
\node [below=of b] {4};
\node [above left=of b] {5};
\node [above right=of b] {6};
\node [below left=of b] {7};
\node [below right=of b] {8};
\end{scope}
\end{tikzpicture>

```

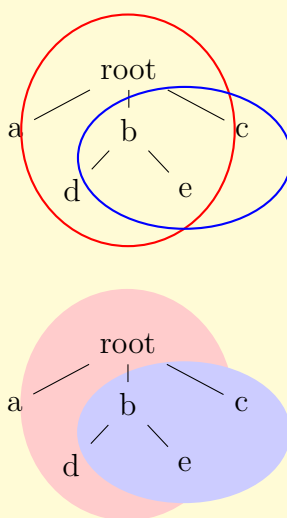
We can align too by the base and mid.

```

\begin{tikzpicture}[node distance=1ex]
\draw[help lines] (0,-1) grid (3,1);
\huge
\node (X) at (0,1) {X};
\node (a) [right=of X] {a};
\node (y) [right=of a] {y};
\draw[dotted] (X.base) +(-1,0) -- +(3,0);
\node (X) at (0,0) {X};
\node (a) [base right=of X] {a};
\node (y) [base right=of a] {y};
\draw[dotted] (X.base) +(-1,0) -- +(3,0);
\node (X) at (0,-1) {X};
\node (a) [mid right=of X] {a};
\node (y) [mid right=of a] {y};
\draw[dotted] (X.base) +(-1,0) -- +(3,0);
\end{tikzpicture>

```

Fitting nodes to a set of coordinates. Requires the `fit` library, for the background layer is required the library `backgrounds`.



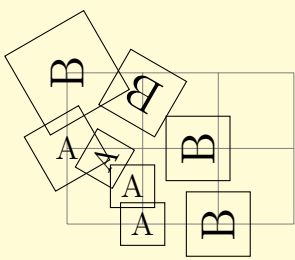
```

\begin{tikzpicture}[Level distance=8mm]
  \node (root) {root}
  child { node (a) {a} }
  child { node (b) {b} }
  child { node (c) {c} }
  child { node (d) {d} }
  child { node (e) {e} }
  ;
  \node[draw=red,inner sep=0pt,thick,ellipse,
        fit=(root) (b) (d) (e)] {};
  \node[draw=blue,inner sep=0pt,thick,ellipse,
        fit=(b) (c) (e)] {};
\end{tikzpicture}

\begin{tikzpicture}[Level distance=8mm]
  \node (root) {root}
  child { node (a) {a} }
  child { node (b) {b} }
  child { node (c) {c} }
  child { node (d) {d} }
  child { node (e) {e} }
  ;
  \begin{pgfonlayer}{background}
  \node[fill=red!20,inner sep=0pt,thick,ellipse,
        fit=(root) (b) (d) (e)] {};
  \node[fill=blue!20,inner sep=0pt,thick,ellipse,
        fit=(b) (c) (e)] {};
  \end{pgfonlayer}
\end{tikzpicture}

```

With `transform shape` we get transformations of the path to be applied to the node.



```

\begin{tikzpicture}[every node/.style=draw]
  \draw[help lines] (0,0) grid (3,2);
  \draw (1,0) node{A};
  \draw (2,0) node[rotate=90,scale=1.5]{B};
  \draw[rotate=30] (1,0) node{A};
  \draw (2,0) node[rotate=90,scale=1.5]{B};
  \draw[rotate=60] (1,0) node[transform shape]{A};
  \draw (2,0) node[transform shape,rotate=90,scale=1.5]{B};
  \draw[rotate=90] (1,0) node[shape=regular polygon,regular polygon sides=4,shape border uses incircle,shape border uses outcircle]{A};
  \draw (2,0) node[rotate=90,shape=regular polygon,regular polygon sides=4,shape border uses incircle,shape border uses outcircle]{B};
\end{tikzpicture}

```

Positioning nodes in a line.

```

\begin{tikzpicture}
\draw(0,0)--(3,1) node[pos=0]{0}
  node[pos=.5]{1/2} node[pos=0.9]{9/10};
\draw(0,-3.5) .. controls +(right:3.5cm) and +(right:3.5cm) .. +(0,3)
  \foreach \p in {0,.125,...,1} {node[pos=\p]{\p}};
\draw(0,-5)|-(3,1)
  node[pos=0]{0} node[pos=.5]{1/2} node[pos=.9]{9/10};
\draw(0,-6.5)-|-(3,1)
  node[pos=0]{0} node[pos=.5]{1/2} node[pos=.9]{9/10};
\end{tikzpicture}

```

Selecting the anchor automatically for nodes placed in a line.

```

\begin{tikzpicture}
[scale=.8,auto=left,every node/.style={circle,fill=blue!20}]
\node(a) at (-1,-2) {a};
\node(b) at (1,-2) {b};
\node(c) at (2,-1) {c};
\node(d) at (2,1) {d};
\node(e) at (1,2) {e};
\node(f) at (-1,2) {f};
\node(g) at (-2,1) {g};
\node(h) at (-2,-1) {h};
\foreach \from/\to in {a/b,b/c,c/d,d/e,e/f,f/g,g/h,h/a}
{
\draw[->] (\from) -- (\to)
  node[midway,fill=red!20] {\from--\to};
\draw[->] (\from) -- (\to)
  node[auto=right,midway,fill=green!80!black] {\from--\to};
}
\end{tikzpicture}

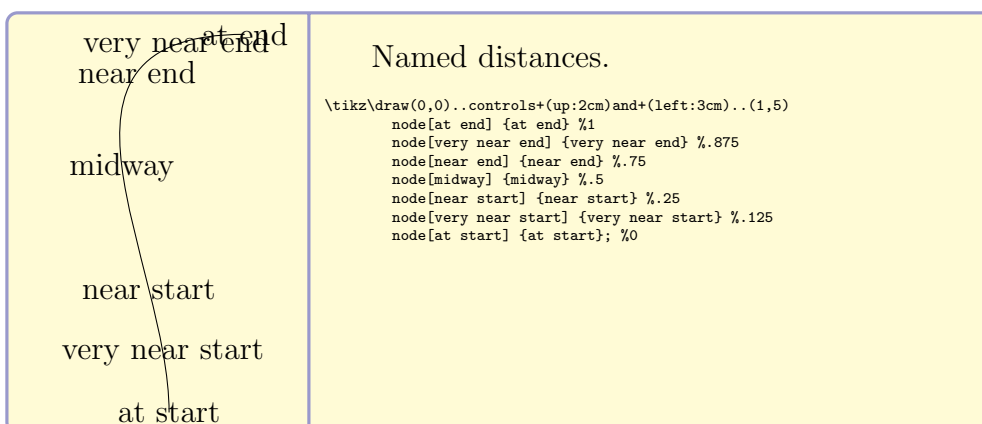
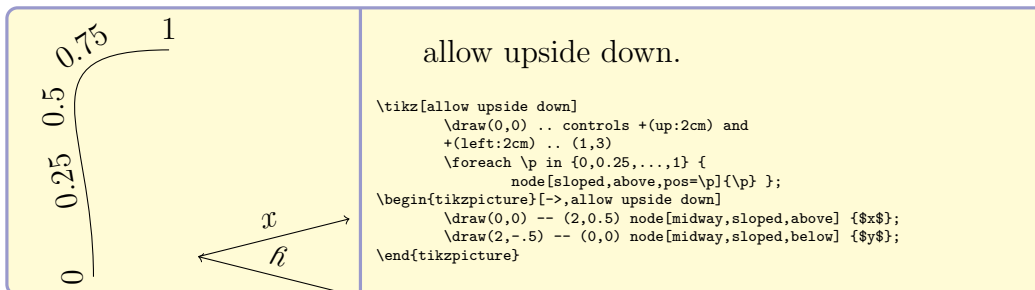
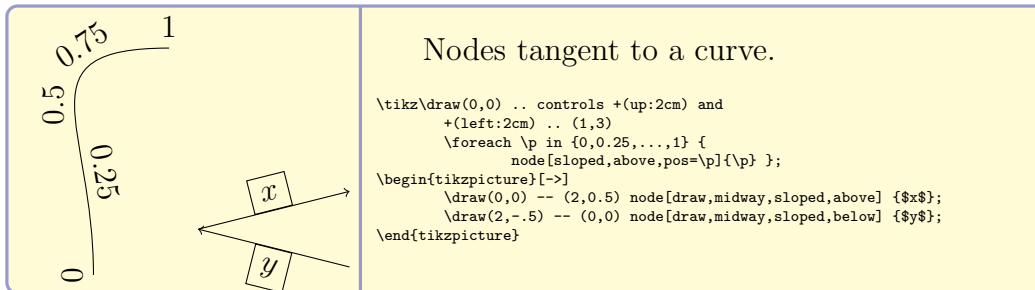
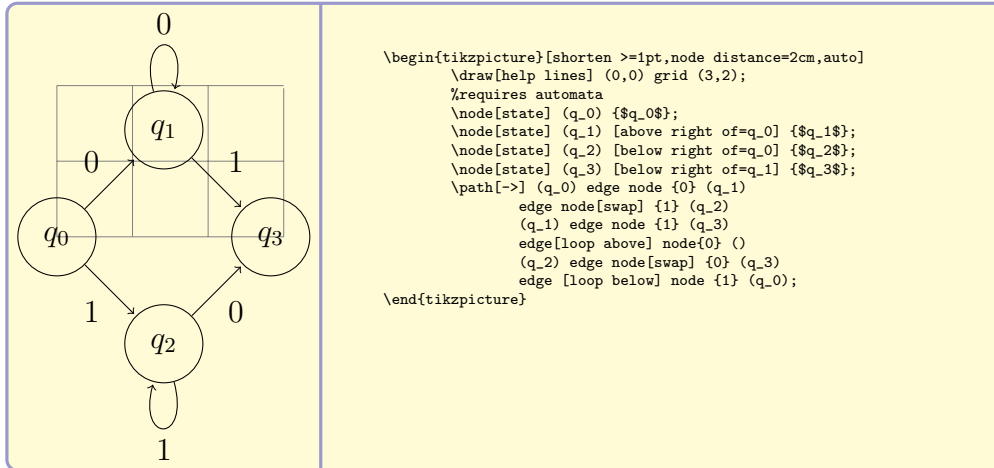
```

swap changes auto from right to left and viceversa.

```

\begin{tikzpicture}[auto]
\draw[help lines,use as bounding box]
(0,-.5) grid (4,5);
\draw (0.5,0) ..controls (9,6)and(-5,6) .. (3.5,0)
  \foreach \pos in {0,0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9,1}
  {node[pos=\pos,swap,fill=red!20] {\pos}}
  \foreach \pos in {0.025,0.2,0.4,0.6,0.8,0.975}
  {node[pos=\pos,fill=blue!20] {\pos}};
\end{tikzpicture}

```



	<p>Positioning a node in a line implicitly.</p> <pre> \begin{tikzpicture} \begin{scope}[near end] \draw(0,0em)-- +(3cm,0) node{A}; \draw(0,-1em)-- node{B} +(3cm,0); \draw(0,-2em)-- node[midway]{C} +(3cm,0); \draw(0,-3em)-- +(3cm,0) node[midway] {D}; \end{scope} \draw(0,-4em)-- node{E} +(3cm,0); \draw(0,-5em)-- node{F} node{G}+(3cm,0); \draw(0,-6em)-- node[at start]{H} node[near end]{I} +(3cm,0); \draw(0,-7em)-- +(3cm,0); \draw(0,-8em).. node[very near start]{0} node[very near end]{1} controls +(1,1) and +(-1,-1) .. node{half} +(4,0); \end{tikzpicture} </pre>
--	--

	<p>label creates a node near another.</p> <pre> \tikz\node[circle,draw,label=60:\$60^\circ\$]{my circle}, label=below:\$-90^\circ\$ {my circle}; \tikz\node[circle,draw,label={red}above:X]{my circle}; \begin{tikzpicture} \node[circle,draw, label={name=label node}above left:\$a,b\$]{}; \draw (label node)--+(1,1); \end{tikzpicture} </pre>
--	---

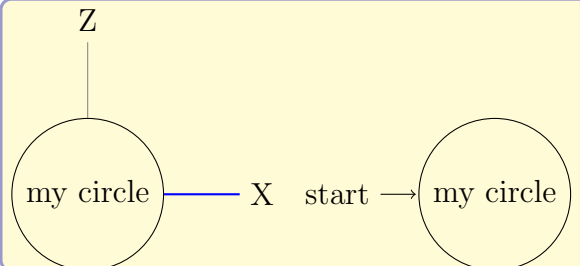
	<p>label distance.</p> <pre> \tikz[label distance=5mm] \node[circle,draw,label=right:X, label=above right:Y, label=above:Z] {my circle}; </pre>
--	---

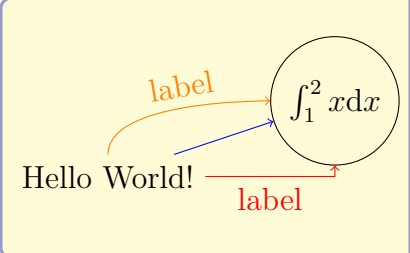
	<p>every label.</p> <pre> \tikz[every label/.style={fill=red!20,circle}] \node[circle,draw,label=right:X, label=above right:Y, label=above:Z] {my circle}; </pre>
--	---

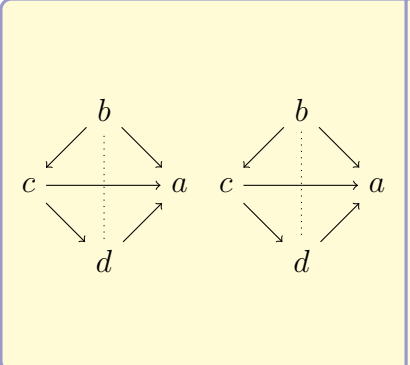
	<p>pin are like label but with an edge.</p> <pre> \tikz\node[circle,fill=blue!50,minimum size=1cm, pin=60:\$q_0\$]{}; </pre>
--	--

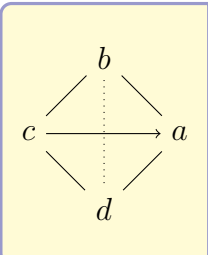
	<p>pin distance.</p> <pre> \tikz[pin distance=1cm] \node[circle,draw,pin=right:X, pin=above right:Y, pin=above:Z] {my circle}; </pre>
--	---

	<p>every pin, every pin edge.</p> <pre>\tikz[every pin/.style={fill=red!20,circle}, every pin edge/.style={decorate,decoration=zigzag}] \node[circle,draw,pin=right:X, pin=above right:Y, pin=above:Z] {my circle};</pre>
---	---

	<p>pin edge.</p> <pre>\tikz[pin distance=10mm] \node[circle,draw,pin={[pin edge={blue,thick}]right:X}, pin=above:Z] {my circle}; \tikz[every pin edge/.style={}, initial/.style={pin={[pin distance=5mm, pin edge={<- ,shorten <=1pt]}left:start}}] \node [circle,draw,initial] {my circle};</pre>
---	--

	<p>Connecting nodes.</p> <pre>\begin{tikzpicture} \path (0,0) node (x) {Hello World!} (3,1) node[circle,draw] (y) {\int_1^2 x \mathrm{d} x}; \draw[->,blue] (x) -- (y); \draw[->,red] (x) - node[near start,below] {label} (y); \draw[->,orange] (x) .. controls +(up:1cm) and +(left:1cm) .. node[above,sloped] {label} (y); \end{tikzpicture}</pre>
--	---

	<p>Using edge.</p> <pre>\begin{tikzpicture} \node (a) at (0:1) {\$a\$}; \node (b) at (90:1) {\$b\$} edge[->] (a); \node (c) at (180:1) {\$c\$} edge[->] (a) edge[<-] (b); \node (d) at (270:1) {\$d\$} edge [->] (a) edge[dotted] (b) edge[<-] (c); \end{tikzpicture} \begin{tikzpicture} \foreach \name/\angle in {a/0,b/90,c/180,d/270} \node (\name) at (\angle:1) {\$\name\$}; \path[->] (b) edge (a) edge (c) edge[-,dotted] (d) (c) edge (a) edge (d) (d) edge (a); \end{tikzpicture}</pre>
---	---

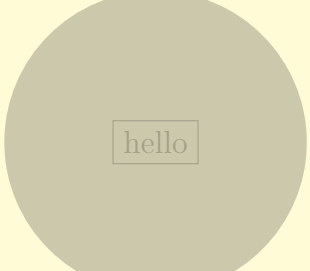
	<p>A similar picture with to.</p> <pre>\begin{tikzpicture} \foreach \name/\angle in {a/0,b/90,c/180,d/270} \node (\name) at (\angle:1) {\$\name\$}; %only one arrow! \draw[->] (a) to (b) to (c) to (d) to (a) (c) to (a); \draw[dotted] (b) to (d); \end{tikzpicture}</pre>
---	---


	<p>edge inherits from the path and you can overrule locally.</p> <pre> \begin{tikzpicture} \foreach \name/\angle in {a/0,b/90,c/180,d/270} \node (\name) at (\angle:1.5) {\$\name\$}; \path[->] (b) edge node[above right] {\$5\$} (a) edge (c) edge [-,dotted] node[below,sloped] {missing} (d) (c) edge (a) edge (d) (d) edge[red] node[above,sloped] {very} node[below,sloped] {bad} (a); \end{tikzpicture} </pre>
--	--

	<p>every edge, initially draw.</p> <pre> \begin{tikzpicture}[every edge/.style={draw,dashed}] \path (0,0) edge (3,2); \draw (3,0) node(B) {B} (0,2) node {A} edge (B); \end{tikzpicture} </pre>
--	---

<p>A circle ● and a square ■. We can now reference them like circle square .</p>	<p>With remember picture we remember locations for future use. With overlay we disable the bounding box, so we can draw outside the picture, connecting disperse elements. remember picture can need an additional compilation.</p> <p>The circle:</p> <pre> \tikz[remember picture]\node[circle,fill=red!50] (n1) {}; </pre> <p>The square:</p> <pre> \tikz[remember picture] \node[fill=blue!50] (n2){}; </pre> <p>The connections:</p> <pre> \begin{tikzpicture}[remember picture,baseline=(t1.base),node distance=.5ex] \node(t1) {circle}; \node[base right=of t1](t2) {square}; \begin{scope}[overlay] \path (t1) edge[->,out=90,draw=red] (n1) (t2) edge[->,out=200,draw=blue] (n2) (n1) edge[dotted,in=45,out=135] (n2); \end{scope} \end{tikzpicture}. </pre>
--	--

<p>This is an absolutely positioned text in the lower left corner. No shipout-hackery is used.</p>	<h3>Utilizing the current page node.</h3> <pre> \begin{tikzpicture}[remember picture,overlay] \node [xshift=1cm,yshift=1cm] at (current page.south west) [text width=7cm,fill=red!20,rounded corners, above right] { This is an absolutely positioned text in the lower left corner. No shipout-hackery is used. }; \end{tikzpicture} \begin{tikzpicture}[remember picture,overlay] \draw[line width=1mm,opacity=.25] (current page.center) circle (3cm); \node[rotate=60,scale=10,text opacity=.2] at (current page.center) {Example}; \end{tikzpicture} </pre>
--	--

	<p>The value of <code>after node path</code> is added to the path right after the node.</p> <pre> \tikz\fill[opacity=0.2] node[draw,after node path={ (\tikzlastnode) circle (2cm)}] {hello}; </pre>
---	--

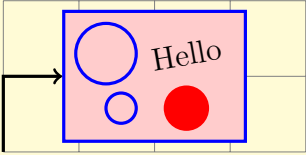
<p>world</p> 	<p>Using <code>late options</code>. You cannot change the node appearance. You can use <code>label</code> and <code>chain</code> for example.</p> <pre> \begin{tikzpicture} \node (a) [draw,circle] {hello}; \path (a) [late options={label=above:world}]; \end{tikzpicture} </pre>
--	---

This is an absolutely positioned text in the lower left corner. No shipout-hackery is used.

2.7. MATRICES AND ALIGNMENT

2.7 Matrices and Alignment

Matrices as special nodes.

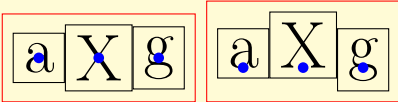


```

\begin{tikzpicture}
\draw[help lines] (0,0) grid (4,2);
\node [matrix,fill=red!20,draw=blue,very thick]
(my matrix) at (2,1)
{
\draw (0,0) circle (4mm); &\node[rotate=10]{Hello};\
\draw (.2,0) circle (2mm);&\fill[red] (0,0) circle(3mm);\
};
\draw[very thick,->] (0,0) |- (my matrix.west);
\end{tikzpicture}

```

anchoring in a matrix.

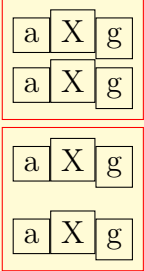


```

\begin{tikzpicture}
[every node/.style={draw=black,font=\huge}]
\matrix[draw=red]
{
\node {a}; \fill[blue] (0,0) circle(2pt);&
\node {X}; \fill[blue] (0,0) circle(2pt);&
\node {g}; \fill[blue] (0,0) circle(2pt);\
};
\end{tikzpicture}
\begin{tikzpicture}
[every node/.style={draw=black,anchor=base,font=\huge}]
\matrix[draw=red]
{
\node {a}; \fill[blue] (0,0) circle(2pt);&
\node {X}; \fill[blue] (0,0) circle(2pt);&
\node {g}; \fill[blue] (0,0) circle(2pt);\
};
\end{tikzpicture}

```

row sep.

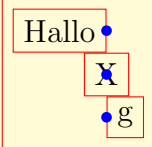


```

\begin{tikzpicture}
[every node/.style={draw=black,anchor=base}]
\matrix[draw=red]
{
\node {a};&\node {X};&\node {g};\
\node {a};&\node {X};&\node {g};\
};
\matrix[row sep=3mm,draw=red] at (0,-2)
{
\node {a};&\node {X};&\node {g};\
\node {a};&\node {X};&\node {g};\
};
\end{tikzpicture}

```

Alignment.



```

\begin{tikzpicture}[every node/.style=draw]
\matrix[draw=red]
{
\node[left] {Hallo};
\fill[blue] (0,0) circle (2pt);\
\node {X};
\fill[blue] (0,0) circle (2pt);\
\node[right] {g};
\fill[blue] (0,0) circle (2pt);\
};
\end{tikzpicture}

```

8	1	6
3	5	7
4	9	2

column separation.

```

\begin{tikzpicture}[every node/.style=draw]
  \matrix[draw=red,column sep=1cm]
  {
    \node {8}; & \node{1}; & \node{6};\\
    \node {3}; & \node{5}; & \node{7};\\
    \node {4}; & \node{9}; & \node{2};\\
  };
\end{tikzpicture}

```

column sep.

```

\begin{tikzpicture}
  \matrix[draw,column sep=1cm,nodes=draw]
  {
    \node(a) {123}; & \node(b) {1}; & \node{1};\\
    \node {12}; & \node {12}; & \node{1};\\
    \node(c) {1}; & \node(d) {123}; & \node{1};\\
  };
  \draw[red,thick] (a.east) -- (a.east|-c)
    (d.west) -- (d.west|-b);
  \draw[<->,red,thick] (a.east) -- (d.west|-b)
    node[above,midway] {1cm};
\end{tikzpicture}

```

column sep between origins.

```

\begin{tikzpicture}
  \matrix[draw,column sep={1cm,between origins},
    nodes=draw]
  {
    \node(a) {123}; & \node(b) {1}; & \node{1};\\
    \node {12}; & \node {12}; & \node{1};\\
    \node {1}; & \node {123}; & \node{1};\\
  };
  \draw[<->,red,thick] (a.center) -- (b.center)
    node[above,midway] {1cm};
\end{tikzpicture}

```

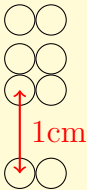
row separation, between borders or between origins.

```

\begin{tikzpicture}
  \matrix[draw, row sep=1cm,nodes=draw]
  {
    \node(a) {123}; & \node {1}; & \node{1};\\
    \node(b) {12}; & \node {12}; & \node{1};\\
  };
  \draw[<->,red,thick] (a.south) -- (b.north)
    node[right,midway] {1cm};
\end{tikzpicture}
\begin{tikzpicture}
  \matrix[draw, row sep={1cm,between origins},nodes=draw]
  {
    \node(a) {123}; & \node {1}; & \node{1};\\
    \node(b) {12}; & \node {12}; & \node{1};\\
  };
  \draw[<->,red,thick] (a.center) -- (b.center)
    node[right,midway] {1cm};
\end{tikzpicture}

```

Declaring the row separation in the row-end command.

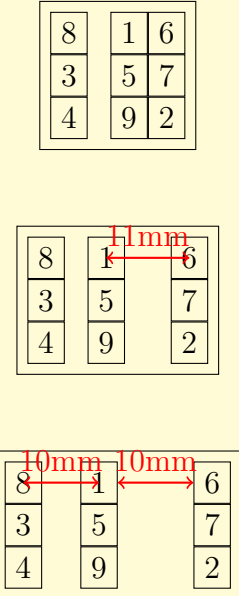


```

\begin{tikzpicture}
  \matrix[row sep=1mm]
  {
    \draw(0,0) circle(2mm); &
    \draw(0,0) circle(2mm); \\
    \draw(0,0) circle(2mm); &
    \draw(0,0) circle(2mm); \\
    \draw(0,0) circle(2mm); &
    \draw(0,0) circle(2mm); \\
    \draw(0,0) coordinate (a) circle (2mm); &
    \draw(0,0) circle(2mm); \\
    \draw(0,0) coordinate (b) circle(2mm); &
    \draw(0,0) circle (2mm); \\
  };
  \draw[<->,red,thick] (a.center) -- (b.center) node
  [right,midway] {1cm};
\end{tikzpicture}

```

Column separation in the cell-separation command.

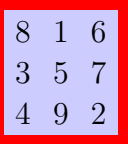


```

\begin{tikzpicture}
  \matrix(P)[draw,nodes=draw,column sep=1mm]
  {
    \node{8};&[2mm] \node{1};&[-1mm] \node{6}; \\
    \node{3};&\node{5};&\node{7}; \\
    \node{4};&\node{9};&\node{2}; \\
  };
  \matrix(Q)[below=of P,draw,nodes=draw,column sep=1mm]
  {
    \node{8};&[2mm] \node(a){1};&[1cm,between origins] \node(b){6}; \\
    \node{3};&\node{5};&\node{7}; \\
    \node{4};&\node{9};&\node{2}; \\
  };
  \draw[<->,red,thick] (a.center) -- (b.center)
  node[above,midway] {1mm};
  \matrix[below=of Q,draw,nodes=draw,column sep={1cm,between origins}]
  {
    \node(a){8};&\node(b){1};&[between borders] \node(c){6}; \\
    \node{3};&\node{5};&\node{7}; \\
    \node{4};&\node{9};&\node{2}; \\
  };
  \draw[<->,red,thick] (a.center) -- (b.center)
  node[above,midway] {10mm};
  \draw[<->,red,thick] (b.east) -- (c.west)
  node[above,midway] {10mm};
\end{tikzpicture}

```

Giving a style to the matrix nodes with nodes.



```

\begin{tikzpicture}
  \matrix[fill=red,nodes={fill=blue!20,minimum size=5mm}]
  {
    \node{8};&\node{1};&\node{6}; \\
    \node{3};&\node{5};&\node{7}; \\
    \node{4};&\node{9};&\node{2}; \\
  };
\end{tikzpicture}

```

<pre> 8 1 6 3 5 7 4 9 2 123 456 789 12 45 78 1 4 7 </pre>	<p>Styles per row or column.</p> <pre> \begin{tikzpicture} \matrix(P) [row 1/.style={red}, column 2/.style={green!50!black}, row 3 column 3/.style={blue}] { \node{8};&\node{1};&\node{6};\\ \node{3};&\node{5};&\node{7};\\ \node{4};&\node{9};&\node{2};\\ }; \matrix[below=of P, column 1/.style={anchor=base west}, column 2/.style={anchor=base east}, column 3/.style={anchor=base}] { \node{123};&\node{456};&\node{789};\\ \node{12};&\node{45};&\node{78};\\ \node{1};&\node{4};&\node{7};\\ }; \end{tikzpicture} </pre>
---	---

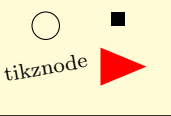
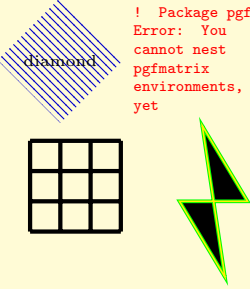
<pre> 8 1 6 3 5 7 4 9 2 8 1 - 3 - 7 - - 2 </pre>	<p>cell execution.</p> <pre> \begin{tikzpicture} \matrix(P)[execute at begin cell=\node\bgroup, execute at end cell=\egroup;] { 8&1&6\\ 3&5&7\\ 4&9&2\\ }; \matrix[below=of P,execute at begin cell=\node\bgroup, execute at end cell=\egroup;, execute at empty cell=\node{--}] { 8&1& \\ 3& &7\\ & &2\\ }; \end{tikzpicture} </pre>
---	---

<pre> 123 12 1 123 12 1 </pre>	<p>matrix anchor is an anchor for the matrix which is not inherit by the cells.</p> <pre> \begin{tikzpicture} \matrix[matrix anchor=west] at (0,0) { \node{123};\\ \node{12};\\ \node{1};\\ }; \matrix[anchor=west] at (0,-2) { \node{123};\\ \node{12};\\ \node{1};\\ }; \end{tikzpicture} </pre>
---------------------------------	--

	<p>Using as anchor a node in a cell. For anchor or matrix anchor.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \matrix[matrix anchor=inner node.south, anchor=base,row sep=3mm] at (1,1) { \node{a};&\node{b};&\node{c};&\node{d};\\ \node{a};&\node{inner node}{b};&\node{c};&\node{d};\\ \node{a};&\node{b};&\node{c};&\node{d};\\ }; \draw(inner node.south) circle (1pt); \end{tikzpicture} </pre>
--	---

	<p>ampersand replacement and pgfmatrixnextcell.</p> <pre> \tikz\matrix[ampersand replacement=\&] { \draw(0,0) circle (4mm); \& \node[rotate=10]{Hello};\\ \draw(.2,0) circle (2mm); \pgfmatrixnextcell \fill[red] (0,0) circle(3mm);\\ }; </pre>
--	--

	<p>An example requiring the matrix library.</p> <pre> \begin{tikzpicture}[>=stealth,->,shorten >=2pt, looseness=.5,auto] \matrix[matrix of math nodes, column sep={2cm,between origins}, row sep={3cm,between origins}, nodes={circle,draw,minimum size=7.5mm}] { & (A) A & \\ (B) B & (E) E & (C) C \\ & (D) D & \\ }; \begin{scope}[every node/.style={font=\small\itshape}] \draw (A) to[bend left] (B) node[midway] {g}; \draw (B) to[bend left] (A) node[midway] {f}; \draw (D) -- (B) node[midway] {c}; \draw (E) -- (B) node[midway] {b}; \draw (E) -- (C) node[near end] {a}; \draw [-,line width=8pt,draw=white] (D) to[bend right,looseness=1] (A); \draw (D) to[bend right,looseness=1] (A) node [near start] {b} node[near end]{e}; \end{scope} \end{tikzpicture} </pre>
--	---

<p>text</p>	 <p>tikznode</p>
 <p>diamond</p> <p>! Package pgf Error: You cannot nest pgfmatrix environments, yet</p>	<p>more text</p>

A matrix node inside a tabular environment. A matrix cannot be inside another matrix.

```

\begin{tabular}{|c|c|}
text &
\tikz\matrix[ampersand replacement=\&]
{
\draw(0,0) circle(1ex); \& \fill (0,0) rectangle (1ex,1ex);\&
\node[rotate=10,font=\scriptsize] {tikznode}; \& \node[isosceles triangle,fill=red]{};
};\&
\hline
\begin{tikzpicture}[font=\tiny]
\matrix[ampersand replacement=\&]
{
\node[diamond,pattern color=blue!80!black,pattern=north west lines] {diamond};
%XXX bug with text with in matrices?? weird additional space
\node[draw,text width=20ex,color=red]{\tt ! Package pgf Error: You cannot nest pgfmatrix environments, yet};
%\matrix
%{
%\node{Hello}\&
%};
%\&
%\&
\draw[ultra thick,scale=0.4] (-1,-1) grid (2,2);\&
\fill[draw=green,double=yellow,x=3mm,y=5mm] (-1,0) -- +(3,0) -- +(1,2) -- +(2,2) -- +(-1,2) -- +(-1,0);
};
\end{tikzpicture}
&more text\&
\end{tabular}\&

```


2.8. MAKING TREES GROW

2.8 Making Trees Grow

<pre> graph TD root --- left root --- right right --- child1[child] right --- child2[child] </pre>	<p>A simple tree, growing downward as good computer scientist.</p> <pre> \begin{tikzpicture} \node{root} child {node {left}} child {node {right}} child {node {child}} child {node {child}} }; \end{tikzpicture} </pre>
--	---

<pre> graph BT root --- left root --- right right --- child1[child] right --- child2[child] </pre>	<p>A simple tree, growing upward as good mathematician.</p> <pre> \begin{tikzpicture} \node{root} [grow=up] child {node {left}} child {node {right}} child {node {child}} child {node {child}} }; \end{tikzpicture} </pre>
--	--

	<p>Generating nodes with child foreach.</p> <pre> \begin{tikzpicture} [level distance=4mm,level/.style={sibling distance=8mm/#1}] \coordinate child foreach \x in {0,1} {child foreach \y in {0,1} {child foreach \z in {0,1} }}; \end{tikzpicture} </pre>
--	--

	<p>Working with child nodes.</p> <pre> \begin{tikzpicture} \node[rectangle,draw] {root} child {node[circle,draw] (left node) {left}} child {node[ellipse,draw] (right node) {right}}; \draw[dashed,->] (left node) -- (right node); \end{tikzpicture} </pre>
--	---

	<p>In each child path the coordinate (0,0) is the proper child position and you are moved to it.</p> <pre> \begin{tikzpicture} \node{root} child{[fill] circle (2pt)} child{[fill] --(0,0) circle (2pt)}; \end{tikzpicture} </pre>
--	--

	<h3>Naming child nodes.</h3> <pre> \begin{tikzpicture} \node (root) {root} child child { child{coordinate (special)} child }; \node at (root-1) {root-1}; \node at (root-2) {root-2}; \node at (special) {special}; \node at (root-2-2) {root-2-2}; \end{tikzpicture} </pre>
--	--

	<h3>Options are inherited by children.</h3> <pre> \begin{tikzpicture} [thick,level 2/.style={sibling distance=10mm}] \coordinate child[red] {child child} child[green] {child child[blue]}; \end{tikzpicture} </pre>
--	--

	<h3>Root options are not inherit.</h3> <pre> \begin{tikzpicture} \node[red] (a) {root} child child; \node[red,below=of a] {root} [green] %for children child child; \end{tikzpicture} </pre>
--	--

	<h3>The parametrized style level.</h3> <pre> \begin{tikzpicture} [level/.style={sibling distance=20mm/#1}] \node {root} child { child child } child { child child child }; \end{tikzpicture} </pre>
--	---

	<h3>The styles level number.</h3> <pre> \begin{tikzpicture} [level 1/.style={sibling distance=20mm}, level 2/.style={sibling distance=5mm}] \node {root} child { child child } child { child child child }; \end{tikzpicture} </pre>
--	--

	<p>Default growth function.</p> <pre> \begin{tikzpicture} \path[help lines] node(root){root} [grow=-10] child {node {1}} child {node {2}} child {node {3}} child {node {4}}; \draw[ultra thin,opacity=.5] (\$ (root-1.center)!-.1!(root-4.center)\$ --(\$ (root-1.center)!1.1!(root-4.center)\$); \draw[<->,thick] (root-1.center) --node[above,sloped] {sibling distance} (root-2.center); \draw[<->,thick] (root.center) --node[above,sloped] {level distance} +(-10:\tikzleveldistance); \end{tikzpicture} </pre>
--	--

	<p>level distance, initially 15mm (————).</p> <pre> \begin{tikzpicture} \node(a){root} [level distance=20mm] child child { [level distance=5mm] child child child } child[level distance=10mm] {child}; \path[level 1/.style={level distance=10mm}, level 2/.style={level distance=5mm}] node[below=30mm of a] {root} child child { child child[level distance=10mm] child } child; \end{tikzpicture} </pre>
--	--

level distance, initially 15mm (———).

```

\begin{tikzpicture}
\begin{scope}[level distance=4mm,
level/.style={sibling distance=8mm/(2^(#1-1))}]
\coordinate
\child{
\child{child child}
\child{child child}
}
\child{
\child{child child}
\child{child child}
}
};
\end{scope}
\begin{scope}[level distance=10mm,yshift=-20mm,
every node/.style={fill=red!60,circle,inner sep=1pt},
level/.style={sibling distance=40mm/2^#1},
level 1/.style={nodes={fill=red!45}},
level 2/.style={nodes={fill=red!30}},
level 3/.style={nodes={fill=red!25}}]
\node {31}
\child{node {30}
\child{node {20}
\child{node {5}}
\child{node {4}}
}
}
\child{node {10}
\child{node {9}}
\child{node {1}}
}
}
\child{node {20}
\child{node {19}
\child{node {1}}
\child{missing}
}
}
\child{node {18}}
};
\end{scope}
\end{tikzpicture}

```

$$\begin{array}{c}
 \text{H} \quad \text{H} \\
 | \quad | \\
 \text{H} - \text{C} = \text{C} - \text{H} \\
 | \quad | \\
 \text{H} \quad \text{H}
 \end{array}$$

This is wrong!
the middle is here

start node

end

Growing.

```

\begin{tikzpicture}
\node(A){root} [grow=right] child child;
\node[right=30mm of A](B){root} [grow=south west] child child;
\node[below right=20mm and 5mm of A](C){root} [grow=down,level distance=10mm,sibling distance=5mm]
\child child
\child{grow=right}{
\child child child
}
\child;
\node[below=20mm of C](D){C}
[level distance=2em]
\child[grow=up] {node {H}}
\child[grow=left] {node {H}}
\child[grow=down] {node {H}}
\child[grow=right] {node {C}
\child[grow=up] {node{H}}
\child[grow=right] {node{H}}
\child[grow=down] {node{H}}
edge from parent[double]
coordinate (wrong)
};
\draw[<-,red] ([yshift=-2mm]wrong) -- +(0,-1)
node[below]{This is wrong!};
\node[rectangle,draw,below=35 of D] (a) {start node};
\node[rectangle,draw] (b) at ($(a)+(2,1)$) {end};
\draw (a) -- (b) node[coordinate,midway] {}
\child[grow=100,<-]{
node[above]{the middle is here}
};
\end{tikzpicture}

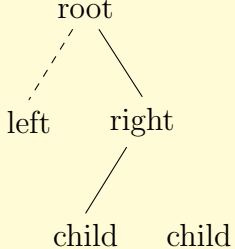
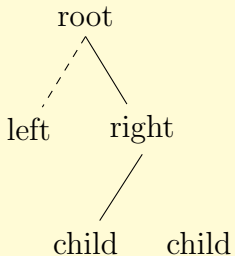
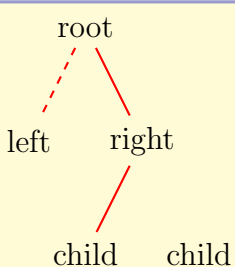
```

	<p>Reversed grow.</p> <pre>\tikz[grow'=down]\node{root} child{node{A}} child{node{B}} child{node{C}} child{node{D}} [grow'=left] child{node{E}} child{node{F}} child{node{G}} };</pre>
--	--

	<p>missing children.</p> <pre>\begin{tikzpicture}[level distance=10mm,sibling distance=5mm] \node{root} [grow=down] child {node {1}} child {node {2}} child[missing] {node {3}} child {node {4}} child { node { %this would be executed \typeout{Rendered node}\typein{} } } child[missing] { node { %this is not executed \typeout{Missing node}\typein{} } } child {node {7}} child {node {8}}; \end{tikzpicture}</pre>
--	---

	<p>Growth parent anchor.</p> <pre>\begin{tikzpicture} \begin{scope}[level distance=1cm] \node[rectangle,draw] (a) at (0,0) {root} [growth parent anchor=south] child; \node[rectangle,draw] (b) at (2,0) {root} [growth parent anchor=north east] child; \draw[red,thick,dashed] (a.south) -- (a-1); \draw[red,thick,dashed] (b.north east) -- (b-1); \end{scope} \begin{scope}[level distance=2cm,yshift=-20mm, growth parent anchor=north, every node/.style={anchor=north,rectangle,draw} every child node/.style={anchor=south}] \node at (0,0) {root} child{node{small}}; \node at (2,0) {big root} child{node{\Large big}}; \end{scope} \end{tikzpicture}</pre>
--	---

	<p>Edge from parent path.</p> <pre>%Initially (\tikzparentnode\tikzparentanchor) -- (\tikzchildnode\tikzchildanchor) \begin{tikzpicture}[edge from parent path= {(\tikzparentnode.south).. controls +(0,-1) and +(0,1) ..(\tikzchildnode.north)}] \node {root} child {node{left}} child {node{right}} child {node {child}} child {node {child}} }; \end{tikzpicture}</pre>
--	--

 <pre> graph TD root --- dashed left root --- right right --- child </pre>	<p>child anchor.</p> <pre> \begin{tikzpicture} \node{root}[child anchor=north] child {node{left} edge from parent[dashed]} child {node {right} child{node {child}} child{node {child} edge from parent[draw=none]} }; \end{tikzpicture} </pre>
 <pre> graph TD root --- dashed left root --- right right --- child </pre>	<p>parent anchor.</p> <pre> \begin{tikzpicture} \node{root}[parent anchor=south] child {node{left} edge from parent[dashed]} child {node {right} child{node {child}} child{node {child} edge from parent[draw=none]} }; \end{tikzpicture} </pre>
 <pre> graph TD root --- dashed,red left root --- red right right --- red child </pre>	<p>edge from parent.</p> <pre> \begin{tikzpicture} [edge from parent/.style={draw,red,thick}] \node{root} child {node {left} edge from parent[dashed]} child {node {right} child {node{child}} child {node{child} edge from parent[draw=none]} }; \end{tikzpicture} </pre>

	<p>Plotting points given inline.</p> <pre>\tikz\draw plot coordinates {(0,0) (1,1) (2,0) (3,1) (2,1) (10:2cm) };</pre>
--	--

	<p>We can use <code>--plot</code>.</p> <pre>\begin{tikzpicture} \end{tikzpicture}</pre>
--	---

	<p>Using an external file, which had been generated with <code>gnuplot</code>.</p> <pre>\tikz\draw plot [mark=x,smooth] file {sine.table}</pre>
--	---

	<p>Drawing using the <code>pgfmath</code> system.</p> <pre>\begin{tikzpicture} \draw[very thin,color=gray] (-0.1,-1.1) grid (3.9,3.9); \draw[->] (-0.2,0) -- (4.2,0) node[above] {\$x\$}; \draw[->] (0,-1.2) -- (0,4.2) node[above] {\$f(x)\$}; \draw[color=red] plot (\x,\x) node[right] {\$f(x)=x\$}; \draw[color=orange] plot (\x,{\sin(\x r)}) node[right] {\$f(x)=\frac{1}{20}\mathrm{e}^x\$}; \draw[color=blue] plot (\x,{0.05*\exp(\x)}) node[right] {\$f(x)=\sin x\$}; \end{tikzpicture}</pre>
--	--

	<p>Some drawing options.</p> <pre>\tikz\draw[scale=0.5,domain=-pi:pi,smooth,variable=\t] plot({\t*\sin(\t r)},{\t*\cos(\t r)});</pre>
--	---

	<p>Drawing calling to gnuplot.</p> <pre> \begin{tikzpicture}[domain=0:4] \draw[very thin,color=gray] (-0.1,-1.1) grid (3.9,3.9); \draw[->] (-0.2,0) -- (4.2,0) node[right] {\$x\$}; \draw[->] (0,-1.2) -- (0,4.2) node[above] {\$f(x)\$}; \draw[color=red] plot[id=x] function{x} node[right] {\$f(x)=x\$}; \draw[color=blue] plot[id=sin] function{sin(x)} node[right] {\$f(x)=\sin x\$}; \draw[color=orange] plot[id=exp] function{0.05*exp(x)} node[right] {\$f(x)=\frac{1}{20}\mathit{m}}\$}; \end{tikzpicture} </pre>
--	--



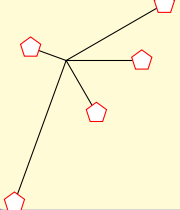
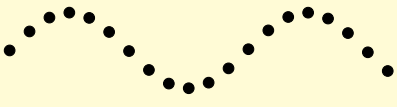
	<p>Using marks.</p> <pre> \begin{tikzpicture}[x=.5cm,y=.5cm] \draw[red] plot[mark=*,smooth] file {sine.table}; \draw[green] plot[mark=+,smooth,yshift=-.5cm] file {sine.table}; \draw[blue] plot[mark=x,smooth,yshift=-1cm] file {sine.table}; \end{tikzpicture} </pre>
--	---

	<p>Selecting the marks to be drawn.</p> <pre> \begin{tikzpicture}[x=.5cm,y=.5cm] \draw[red] plot[mark=x,smooth,mark repeat=3] file {sine.table}; \draw[green] plot[mark=x,smooth,yshift=-.5cm,mark repeat=3,mark phase=4] file {sine.table}; \draw[blue] plot[mark=x,smooth,yshift=-1.0cm,mark repeat=3,mark indices={1,4,...,10,11,12,...,16,20}] file {sine.table}; \end{tikzpicture} </pre>
--	--


	<p>Size of marks.</p> <pre> \begin{tikzpicture}[x=.5cm,y=.5cm] \draw plot[mark=*,smooth,mark size=5] file {sine.table}; \end{tikzpicture} </pre>
--	--

	<p>Passing options to marks.</p> <pre> \usetikzlibrary{plotmarks} \begin{tikzpicture}[x=.5cm,y=.5cm] \fill[blue!20] plot[mark=triangle*,smooth,mark options={color=blue,rotate=180}] file {sine.table} - (0,0); \end{tikzpicture} </pre>
--	---

	<p>Using marks.</p> <pre> \begin{tikzpicture}[x=.5cm,y=.5cm,smooth cycle] \draw[red] plot[mark=x,sharp plot] coordinates{(0,0) (1,1) (2,0) (1,-1)}; \draw[green] plot[mark=x,smooth,yshift=-1.0cm] coordinates{(0,0) (1,1) (2,0) (1,-1)}; \draw[blue] plot[mark=x,tension=0.2,yshift=-2.0cm] coordinates{(0,0) (1,1) (2,0) (1,-1)}; \draw[brown] plot[mark=x,tension=0.55,yshift=-3.0cm] coordinates{(0,0) (1,1) (2,0) (1,-1)}; \draw[orange] plot[mark=x,tension=0.9,yshift=-4.0cm] coordinates{(0,0) (1,1) (2,0) (1,-1)}; \end{tikzpicture} </pre>
--	--

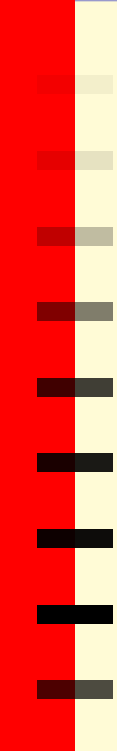
	<p>The ycomb.</p> <pre>\begin{tikzpicture}[x=.5cm,y=.5cm] \draw[ultra thick] plot[mark=*,ycomb,thin] file {sine.table}; \end{tikzpicture}</pre>
	<p>The xcomb.</p> <pre>\tikz\draw plot[xcomb,mark=x] coordinates{ (1,0) (0.8,0.2) (0.6,0.4) (0.2,1)};</pre>
	<p>The polar comb.</p> <pre>\tikz\draw plot[polar comb,mark=pentagon*, mark options={fill=white,draw=red},mark size=4pt] coordinates {(0:1cm) (30:1.5cm) (160:.5cm) (250:2cm) (-60:.8cm)};</pre>
	<p>only marks.</p> <pre>\begin{tikzpicture}[x=.5cm,y=.5cm] \draw plot[mark=*,only marks] file {sine.table}; \end{tikzpicture}</pre>

2.10 Transparency



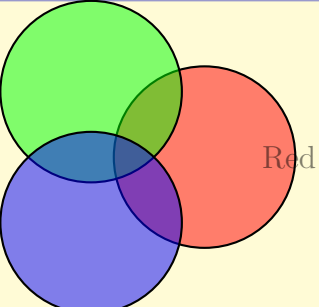
draw opacity.

```
\begin{tikzpicture}[line width=1ex]
\draw (0,0) -- (3,1);
\filldraw[fill=yellow!80!black,draw opacity=0.5]
(1,0) rectangle (2,1);
\end{tikzpicture}
```



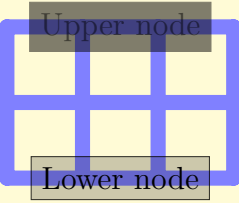
opacity.

```
\begin{tikzpicture}
\fill[red] (0,0) rectangle (1,-10);
\fill[transparent] (0.5,-0.0) rectangle +(1.0,-0.25);
\fill[ultra nearly transparent] (0.5,-1.0) rectangle +(1.0,-0.25);
\fill[very nearly transparent] (0.5,-2.0) rectangle +(1.0,-0.25);
\fill[nearly transparent] (0.5,-3.0) rectangle +(1.0,-0.25);
\fill[semitransparent] (0.5,-4.0) rectangle +(1.0,-0.25);
\fill[nearly opaque] (0.5,-5.0) rectangle +(1.0,-0.25);
\fill[very nearly opaque] (0.5,-6.0) rectangle +(1.0,-0.25);
\fill[ultra nearly opaque] (0.5,-7.0) rectangle +(1.0,-0.25);
\fill[opaque] (0.5,-8.0) rectangle +(1.0,-0.25);
\fill[opacity=0.7] (0.5,-9.0) rectangle +(1.0,-0.25);
\end{tikzpicture}
```



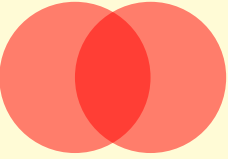
fill opacity.

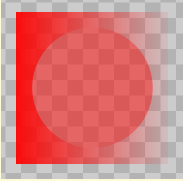
```
\begin{tikzpicture}[thick,fill opacity=0.5]
\filldraw[fill=red] (0:1cm) circle (12mm);
\filldraw[fill=green] (120:1cm) circle (12mm);
\filldraw[fill=blue] (-120:1cm) circle (12mm);
\node at (2.12cm,0) {Red};
\end{tikzpicture}
```




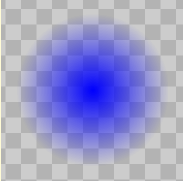
text opacity. Making the text opaque while the background is transparent.

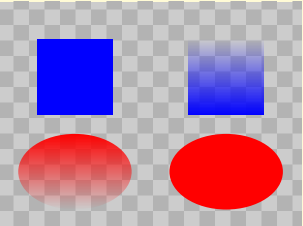
```
\begin{tikzpicture}[every node/.style={fill,draw}]
\draw[line width=2mm,blue!50,line cap=round] (0,0) grid (3,2);
\node[opacity=0.5] at (1.5,2) {Upper node};
\node[draw opacity=0.8,fill opacity=0.2,text opacity=1]
at (1.5,0) {Lower node};
\end{tikzpicture}
```

	<p>Note how works the intersection of transparent regions.</p> <pre>\begin{tikzpicture}[fill opacity=0.5] \fill[red] (0,0) circle (1); \fill[red] (1,0) circle (1); \end{tikzpicture}</pre>
---	---

	<p>Creating and using a fading.</p> <pre>\begin{tikzfadingfrompicture}[name=fade right] \shade[left color=transparent!0, right color=transparent!100] (0,0) rectangle (2,2); \fill[transparent!50] (1,1) circle (0.7); \end{tikzfadingfrompicture} \begin{tikzpicture} \fill[black!20] (-1.2,-1.2) rectangle (1.2,1.2); \pattern[pattern=checkerboard,pattern color=black!30] (-1.2,-1.2) rectangle (1.2,1.2); \fill[path fading=fade right,red] (-1,-1) rectangle (1,1); \end{tikzpicture}</pre>
---	---

	<p>fading text.</p> <pre>\begin{tikzfadingfrompicture}[name=tikz] \node[transparent!20] {\fontfamily{ptm}\fontsize{45}{45}\bfseries% \selectfont Ti\emph{k}Z}; \end{tikzfadingfrompicture} \begin{tikzpicture} \fill[black!20] (-2,-1) rectangle (2,1); \pattern[pattern=checkerboard,pattern color=black!30] (-2,-1) rectangle (2,1); \fill[path fading=tikz,right color=black] (-2,-1) rectangle (2,1); \end{tikzpicture}</pre>
--	---

	<p>tikzfading (like shading)</p> <pre>\tikzfading[name=fade out, inner color=transparent!0, outer color=transparent!100] \begin{tikzpicture} \fill[black!20] (-1.2,-1.2) rectangle (1.2,1.2); \pattern[pattern=checkerboard,pattern color=black!30] (-1.2,-1.2) rectangle (1.2,1.2); \fill[blue,path fading=fade out] (-1,-1) rectangle (1,1); \end{tikzpicture}</pre>
---	--

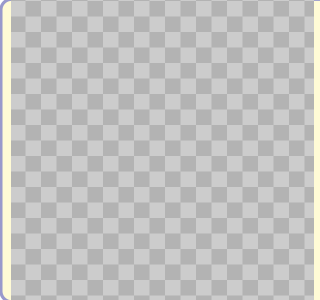
	<p>path fading.</p> <pre>\panelhorizontal{50ex}{ \begin{tikzpicture}[path fading=south] \fill[black!20] (0,0) rectangle (4,3); \pattern[pattern=checkerboard,pattern color=black!30] (0,0) rectangle (4,3); \fill[color=blue] (0.5,1.5) rectangle +(1,1); \fill[color=blue,path fading=north] (2.5,1.5) rectangle +(1,1); \fill[color=red,path fading] (1,0.75) ellipse (.75 and .5); \fill[color=red] (3,0.75) ellipse (.75 and .5); \end{tikzpicture}</pre>
---	---

You can fade a shading.

```

\begin{tikzpicture}
  \fill[black!20] (0,0) rectangle (4,4);
  \pattern[pattern=checkerboard,pattern color=black!30]
    (0,0) rectangle (4,4);
  \shade[ball color=blue,path fading=south]
    (2,2) circle (1.8);
\end{tikzpicture}

```

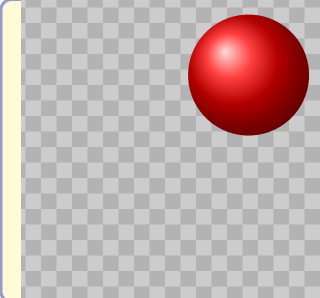


fading a shade inside.

```

\begin{tikzpicture}
  \fill[black!20] (0,0) rectangle (4,4);
  \pattern[pattern=checkerboard,pattern color=black!30]
    (0,0) rectangle (4,4);
  \shade[ball color=red] (3,3) circle (0.8);
  \shade[ball color=white,path fading=fade inside]
    (2,2) circle (1.8);
\end{tikzpicture}

```

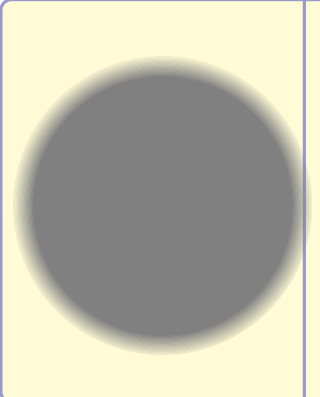


weird effects.

```

\tikzfading[name=middle,
  top color=transparent!50,
  bottom color=transparent!50,
  middle color=transparent!20]
\begin{tikzpicture}
  \node[circle,circular drop shadow,
    pattern=horizontal lines dark blue,
    path fading=south,
    minimum size=3.6cm] {};
  \pattern[path fading=north,
    pattern=horizontal lines dark gray]
    (0,0) circle (1.8cm);
  \pattern[path fading=middle,
    pattern=crosshatch dots light steel blue]
    (0,0) circle (1.8cm);
\end{tikzpicture}

```

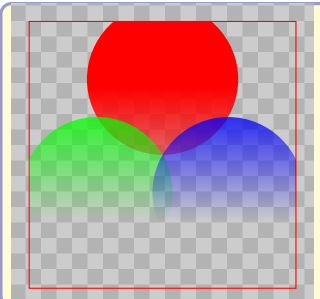


fading several paths.

```

\begin{tikzpicture}
  \fill[black!20] (-2,-2) rectangle (2,2);
  \pattern[pattern=checkerboard,pattern color=black!30]
    (-2,-2) rectangle (2,2);
  \draw [red] (-50bp,-50bp) rectangle (50bp,50bp);
  \path[scope fading=south,fit shading=false] (0,0);
  \fill[red] (90:1) circle (1);
  \fill[green] (210:1) circle (1);
  \fill[blue] (330:1) circle (1);
\end{tikzpicture}

```

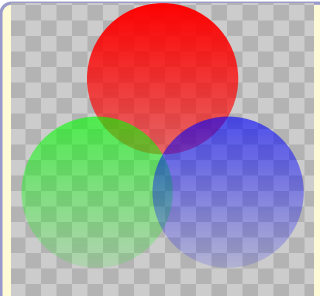




fading several paths along the whole picture.

```

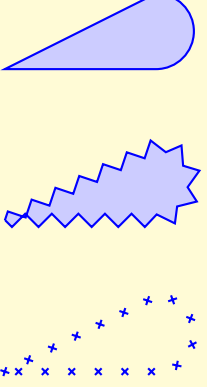
\begin{tikzpicture}
  \fill[black!20] (-2,-2) rectangle (2,2);
  \pattern[pattern=checkerboard,pattern color=black!30]
    (-2,-2) rectangle (2,2);
  \path[scope fading=south] (-2,-2) rectangle (2,2);
  \fill[red] (90:1) circle (1);
  \fill[green] (210:1) circle (1);
  \fill[blue] (330:1) circle (1);
\end{tikzpicture}

```



<p>This is some text that will fade out as we go right and down. It is pretty hard to achieve this effect in other ways.</p>	<p>Fading a node.</p> <pre>\tikz\node[scope fading=south,fading angle=45,text width=3.5cm] { This is some text that will fade out as we go right and down. It is pretty hard to achieve this effect in other ways. };</pre>
	<p>Without transparency groups.</p> <pre>\begin{tikzpicture} \begin{scope}[opacity=.5,line width=5mm] \draw (0,0) -- (2,2); \draw (2,0) -- (0,2); \end{scope} \begin{scope}[yshift=-2cm] \node at (0,0) [forbidden sign, line width=2ex, draw=red,fill=white] {Smoking}; \node[opacity=.5] at (2,0) [forbidden sign, line width=2ex, draw=red,fill=white] {Smoking}; \end{scope} \end{tikzpicture}</pre>
	<p>With transparency groups.</p> <pre>\begin{tikzpicture} \begin{scope}[opacity=.5,transparency group] %line width need to be inside \draw[line width=5mm] (0,0) -- (2,2); \draw[line width=5mm] (2,0) -- (0,2); \end{scope} \begin{scope}[yshift=-2cm] \node at (0,0) [forbidden sign, line width=2ex, draw=red,fill=white] {Smoking}; \begin{scope}[transparency group,opacity=.5] \node at (2,0) [forbidden sign, line width=2ex, draw=red,fill=white] {Smoking}; \end{scope} \end{scope} \end{tikzpicture}</pre>

2.11 Decorated Paths



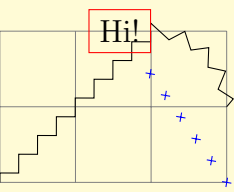
Normal, with a path morphing, with path replacing and with path removing.

```

\begin{tikzpicture}
\fill[fill=blue!20,draw=blue,thick] (0,0) -- +(2,1) arc (90:-90:.5) -- cycle;
\fill[decorate,decoration=zigzag,fill=blue!20,draw=blue,thick] (0,-2) -- +(2,1) arc (90:-90:.5) -- cycle;
\fill[decorate,decoration=crosses,fill=blue!20,draw=blue,thick] (0,-4) -- +(2,1) arc (90:-90:.5) -- cycle;
\fill[decorate,decoration={text along path,text=This is a text along a path. Note how the path is lost.},fill=blue!20,draw=blue,thick] (0,-6) -- +(2,1) arc (90:-90:.5) -- cycle;
\end{tikzpicture}

```

This is a text along a path. Note how the path is lost.




Decorating a (sub)path.

```

\begin{tikzpicture}
\draw[help lines] grid (3,2);
\draw decorate[decoration={name=zigzag}] (0,0) -- (2,2) node (hi) [left,draw=red] {Hi!} arc (90:0:1);
\draw[blue] decorate [decoration={crosses}] (3,0) -- (hi);
\end{tikzpicture}

```

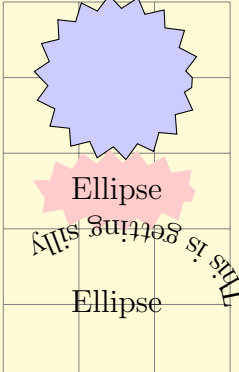


Nesting decorations.

```

\begin{tikzpicture}[decoration=Koch snowflake,draw=blue,fill=blue!20,thick]
\filldraw (0,0)--+(60:1) -- ++(-60:1) -- cycle;
\filldraw decorate{(0,-1)--+(60:1) -- ++(-60:1) -- cycle};
\filldraw decorate{decorate{(0,-2.5)--+(60:1) -- ++(-60:1) -- cycle}};
\end{tikzpicture}

```

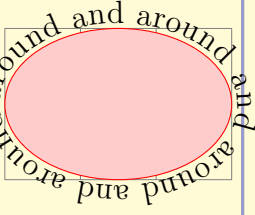


Decorating a complete path.

```

\begin{tikzpicture}[decoration=zigzag]
\draw[help lines] (0,0) grid (3,5);
\draw[fill=blue!20,decorate] (1.5,4) circle (1cm);
\node at (1.5,2.5) [fill=red!20,decorate,ellipse] {Ellipse};
\node at (1.5,1) [inner sep=6mm,fill=red,decorate,ellipse,decoration={text along path,text={This is getting silly}}] {Ellipse};
\end{tikzpicture}

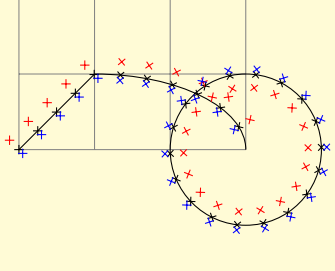
```



decorating in a postaction.

```

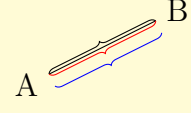
\begin{tikzpicture}
\draw[help lines] grid (3,2);
\fill[draw=red,fill=red!20,
postaction={decorate,decoration={raise=2pt,text along path,
text= around and around and around and around we go}}]
(0,1) arc (180:-180:1.5cm and 1cm);
\end{tikzpicture}
    
```



raise. Move the decoration to the left of the path. So it moves up a segment drawn from left to right.

```

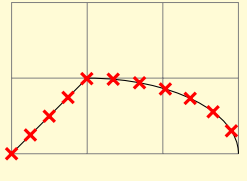
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) arc (90:0:2 and 1) circle (1);
\draw decorate [decoration=crosses]
{ (0,0) -- (1,1) arc (90:0:2 and 1) circle (1) };
\draw[red] decorate [decoration=crosses,raise=5pt]
{ (0,0) -- (1,1) arc (90:0:2 and 1) circle (1)};
\draw[blue] decorate [decoration=crosses,raise=-2pt]
{ (0,0) -- (1,1) arc (90:0:2 and 1) circle (1)};
\end{tikzpicture}
    
```



mirroring along the path.

```

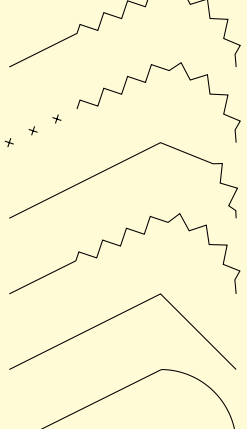
\begin{tikzpicture}
\node (a) {A};
\node (b) at (2,1) {B};
\draw (a)--(b);
\draw[decorate,decoration=brace] (a)--(b);
\draw[decorate,decoration={brace,mirror},red] (a)--(b);
\draw[decorate,decoration={brace,mirror,raise=5pt},blue] (a)--(b);
\end{tikzpicture}
    
```



Applying general transformations.

```

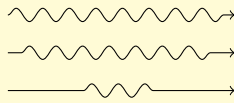
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) arc (90:0:2 and 1);
\draw[red,very thick] decorate [decoration={
crosses,transform=shift only},shape size=1.5mm]
{ (0,0) -- (1,1) arc (90:0:2 and 1);
\end{tikzpicture}
    
```



Changing decoration at borders.

```

\begin{tikzpicture}
\draw[decoration={zigzag,pre=lineto, pre length=1cm},decorate]
(0,0) -- ++(2,1) arc (90:0:1);
\draw[decoration={zigzag,pre=crosses, pre length=1cm},decorate]
(0,-1) -- ++(2,1) arc (90:0:1);
\draw[decoration={zigzag, pre length=3cm},decorate]
(0,-2) -- ++(2,1) arc (90:0:1);
\draw[decoration={zigzag,pre=curveto, pre length=1cm},decorate]
(0,-3) -- ++(2,1) arc (90:0:1);
\draw[decoration={lineto},decorate]
(0,-4) -- ++(2,1) arc (90:0:1);
\draw[decoration={curveto},decorate]
(0,-5) -- ++(2,1) arc (90:0:1);
\end{tikzpicture}
    
```



pre and post.

```
\begin{tikzpicture}[decoration=snake,line around/.style={
decoration={pre length=#1,post length=#1}}]
\draw[->,decorate] (0,0) -- ++(3,0);
\draw[->,decorate,line around=5pt] (0,-5mm) -- ++(3,0);
\draw[->,decorate,line around=1cm] (0,-1cm) -- ++(3,0);
\end{tikzpicture}
```

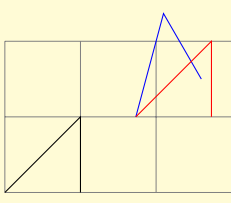

	<p>Setting the value of x/y to a dimension.</p> <pre>\begin{tikzpicture} \draw[x=1.5cm, help lines] (0,0) grid (2,2); \draw (0,0) -- +(1,1); \draw[x=2cm,color=red] (0,0) -- +(1,1); \draw[y=2cm,color=blue] (0,0) -- +(1,1); \end{tikzpicture}</pre>
--	---

	<p>Setting x/y to vectors.</p> <pre>\begin{tikzpicture}[smooth] \draw[x={(.707cm,.707cm)},help lines] (0,0) grid (4,4); \draw plot coordinates{(1,0) (2,0.5) (3,0) (3,1)}; \draw[x={(0cm,1cm)},y={(1cm,0cm)},color=red] plot coordinates{(1,0) (2,0.5) (3,0) (3,1)}; \end{tikzpicture}</pre>
--	--

	<p>The z coordinate.</p> <pre>\begin{tikzpicture}[z=-1cm,->,thick] \draw[color=red] (0,0,0) -- (1,0,0); \draw[color=blue] (0,0,0) -- (0,1,0); \draw[color=orange] (0,0,0) -- (0,0,1); \end{tikzpicture}</pre>
--	--

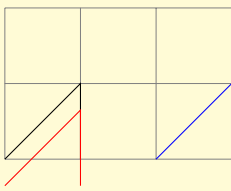
	<p>transformations apply immediately when in the middle of a path.</p> <pre>\tikz\draw(0,0) racetrangle (1,0.5) [xshift=2cm] (0,0) rectangle(1,0.5);</pre>
--	--

	<p>shift</p> <pre>\begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[shift={(1,1)},blue] (0,0) -- (1,1) -- (1,0); \draw[shift={(30:1cm)},red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture}</pre>
--	--



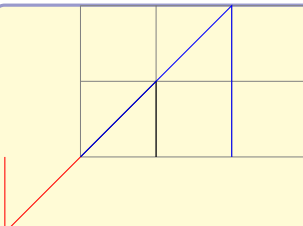
shift only cancels all current transformations except for shifting.

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[rotate=30,xshift=2cm,blue] (0,0) -- (1,1) -- (1,0);
\draw[rotate=30,xshift=2cm,shift only,red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```



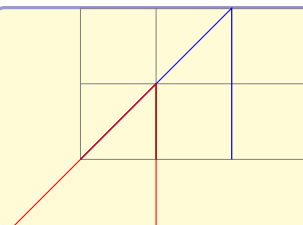
xshift, yshift

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[xshift=2cm,blue] (0,0) -- (1,1) -- (1,0);
\draw[xshift=-10pt,red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```



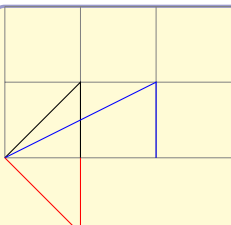
scale.

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[scale=2,blue] (0,0) -- (1,1) -- (1,0);
\draw[scale=-1,red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```



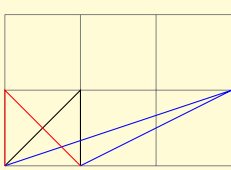
Scaling around another point as origin.

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[scale=2,blue] (0,0) -- (1,1) -- (1,0);
\draw[scale around={2:(1,1)},red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```



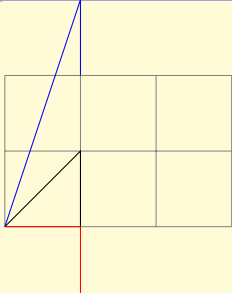
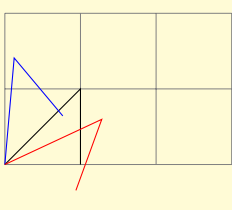
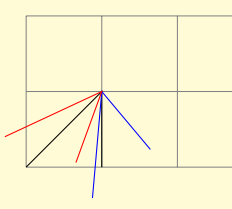
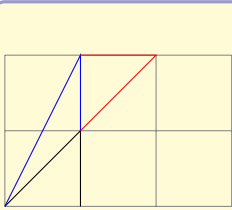
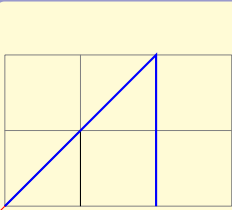
xscale,yscale.

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[xscale=2,blue] (0,0) -- (1,1) -- (1,0);
\draw[yscale=-1,red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```



xslant.

```
\begin{tikzpicture}
\draw[help lines] (0,0) grid (3,2);
\draw (0,0) -- (1,1) -- (1,0);
\draw[xslant=2,blue] (0,0) -- (1,1) -- (1,0);
\draw[xslant=-1,red] (0,0) -- (1,1) -- (1,0);
\end{tikzpicture}
```

	<p>yslant.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[yslant=2,blue] (0,0) -- (1,1) -- (1,0); \draw[yslant=-1,red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture} </pre>
	<p>rotating.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[rotate=40,blue] (0,0) -- (1,1) -- (1,0); \draw[rotate=-20,red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture} </pre>
	<p>rotate around another point.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[rotate around={40:(1,1)},blue] (0,0) -- (1,1) -- (1,0); \draw[rotate around=-20:(1,1),red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture} </pre>
	<p>apply $\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} t_x \\ t_y \end{pmatrix}$.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[cm={1,1,0,1,(0,0)},blue] (0,0) -- (1,1) -- (1,0); \draw[cm={0,1,1,0,(1cm,1cm)},red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture} </pre>
	<p>Canvas transformation. Affect only to the visual representation. Use with care.</p> <pre> \begin{tikzpicture} \draw[help lines] (0,0) grid (3,2); \draw (0,0) -- (1,1) -- (1,0); \draw[transform canvas={scale=2},blue] (0,0) -- (1,1) -- (1,0); \draw[transform canvas={rotate=180},red] (0,0) -- (1,1) -- (1,0); \end{tikzpicture} </pre>