Contents

1 快速参考

1.1 线型

———	solid: 默认	———	ultra thin 0.1pt	⟶	to
·····	dotted	———	very thin 0.2pt	→	latex
·····	densely dotted	———	thin 0.4pt	↠	stealth
· · · · ·	loosely dotted	———	semithick 0.6pt	⊢—⊣	|
- - - - -	dashed	———	thick 0.8pt	—○	o
- - - - - -	densely dashed	———	very thick 1.2pt	⟶	)
- - - -	loosely dashed	———	ultra thick 1.6pt		
═══	double	也可以通过 line width 直接定义			

1.2 文本的距离

at star=0 very near start=0.123 near start=0.25 near end=0.75 very near end=0.875 at end=1

1.3 标签

label=above label=below label=left label=right
above left above right below left below right

1.4 calc library

($ (A)+sin(60)∗(B) $)	coordinate calculations
($ (A) ! 0.25 ! (B) $)	partway calculations
($ (A) ! 3cm ! (B) $)	3cm from (A) in direction of (B)
($ (A) ! 1.2 ! 30:(B) $)	stretch by 1.2, then rotate by 30°
($ (A) ! (B) ! (C) $)	projection of point B onto line AC
($ (A) ! (B) ! 30:(C) $)	project B onto line AC, then rotate by 30°

1.5 Let-operations

\path	...	let \p1 = ($ (B)-(A) $) in ...	save a point's coordinates
	...	\x1	x-coordinate of point \p1
	...	\y1	y-coordinate of point \p1
	...	\p1	string containing coordinates of \p1
	...	{veclen(\x1,\y1)}	length of vector (x, y)
\path	...	let \n1 ={sin(60)} in ...	save a number

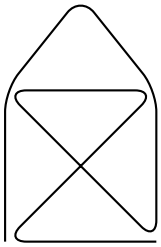
1.6 Layers

```
\pgfdeclarelayer{background}
\pgfdeclarelayer{foreground}
\pgfsetlayers{background,main,foreground}

\begin{pgfonlayer}{background}
\node {This node will appear on the background layer.};
\end{pgfonlayer}
```

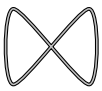
1.7 等价命令

```
\draw = \path[draw], \fill = \path[fill], \clip = \path[clip]
\filldraw = \path[fill,draw], \shade = \path[shade], ...
```

2 基本图形

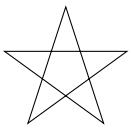


```
\tikz \draw[thick,rounded corners=8pt]% 此处默认是
4pt
(0,0)--(0,2)--(1,3.25)--(2,2)--(2,0)--(0,2)--(2,2)--(0,0)--(2,0);
```

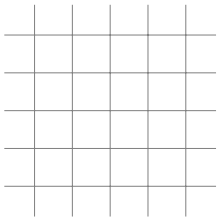


```
\tikz \draw[double,draw=black,double=lightgray]
plot[smooth cycle] coordinates{(0,0) (1,1) (1,0)
(0,1)};
```

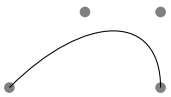
```
\tikz\draw(0,0)rectangle(1,1);
```



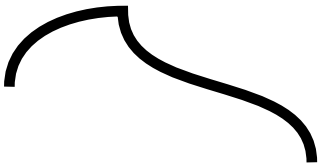
```
\tikz\draw(0,0)--(72:1.618)--(1,0)--(108:1)--(36:1.618)--cycle;
```



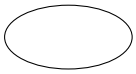
```
\tikz \draw[step=.5cm,gray,very thin] (-1.4,-1.4)
grid (1.4,1.4);
```



```
\begin{tikzpicture}
\draw (0,0)..controls(1,1)and(2,1)..(2,0);
\foreach\x in(0,0),(1,1),(2,1),(2,0)
\fill[black,opacity=0.5]\x circle(2pt);
\end{tikzpicture}
```



```
\begin{tikzpicture}[scale=.5]
\draw[line width=4pt] (0,0) to [out=90,
in=180] (3,2)
to [out=-90, in=90] (8,-2);
```



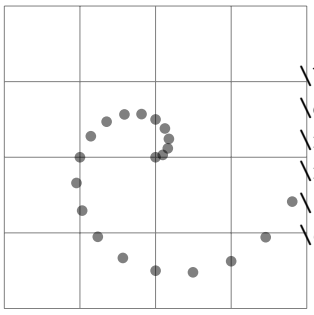
```
\tikz \draw (0,0) ellipse (2pc and 1pc);
```

```
\tikz \draw(0,0)arc(0:270:1.75pc and 1pc);
```

```
\tikz \draw[x=2pt,y=2pt] (0,0) parabola bend
(4,16) (6,12);
```

```
\tikz \draw[x=3.14ex,y=2ex] (0,0) sin (1,1) cos
(2,0) sin (3,-1) cos (4,0)
(0,1) cos (1,0) sin (2,-1) cos (3,0) sin (4,1);
```

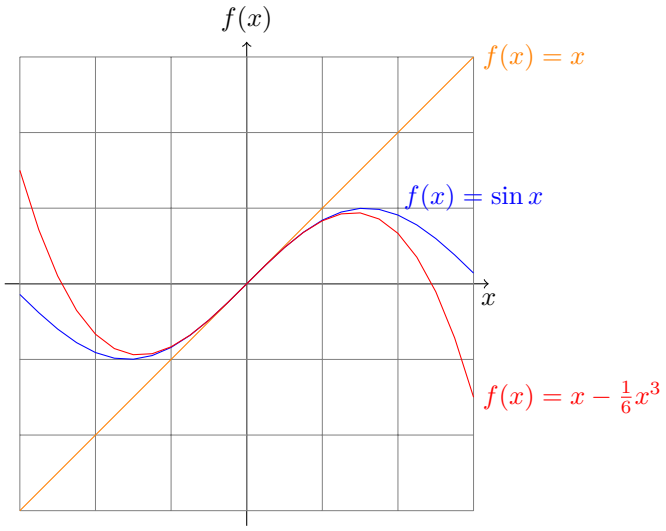
3 特殊图形



```
\begin{tikzpicture}
\draw [help lines] (0,0) grid (4,4);
\foreach \i in 0,0.1,...,2
\fill       [black,opacity=0.5]($(2,2)       !\i!
\i*180:(3,2)$) circle (2pt);
\end{tikzpicture}
```

4 命令示例

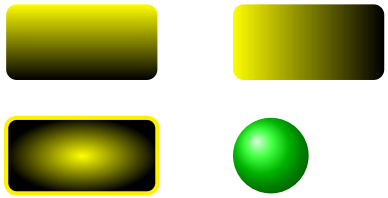
4.1 Plot




```
\begin{tikzpicture}[domain=-3:3]
\draw[->] (-3.2,0) -- (3.2,0) node[below] {$x$};
\draw[->] (0,-3.2) -- (0,3.2) node[above] {$f(x)$};
\draw[very thin,color=gray] (-3,-3) grid (3,3);
\draw[color=orange] plot (\x,\x) node[right] {$f(x)=x$};
\draw[color=blue] plot (\x,{sin(\x r)})
  node[above=7mm] {$f(x)=\sin x$};
\draw[color=red] plot(\x,{\x-(1/6)*(\x)^3})
  node[right]{$f(x)=x-\frac{1}{6}x^3$};
```

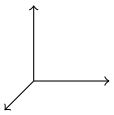
4.2 Shading

```
\tikz \shade (0,0) rectangle (2,1) (3,0.5) circle
(0.5);
```

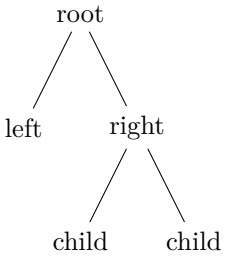


```
\begin{tikzpicture}[rounded corners,ultra
thick]
\shade[top color=yellow,bottom
color=black]
(0,0) rectangle +(2,1);
\shade[left color=yellow,right
color=black]
(3,0) rectangle +(2,1);
\shadedraw[inner color=yellow,outer
color=black,draw=yellow]
(6,0) rectangle +(2,1);
\shade[ball color=green] (9,.5)
circle(.5cm);
```

4.3 XYZ

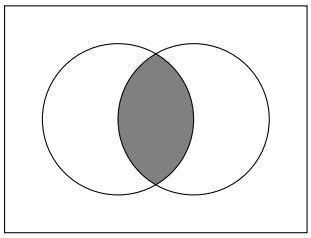


```
\begin{tikzpicture}[->]
\draw (0,0) -- (xyz cs:x=1);
\draw (0,0) -- (xyz cs:y=1);
\draw (0,0) -- (xyz cs:z=1);
```




```
\tikz\noderoot
child node left
child node right
child node child
child node child
;
```

4.4 scope



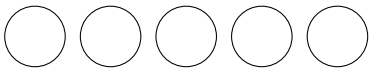
```
\begin{tikzpicture} \draw (-2, 1.5)
rectangle (2, -1.5); \begin{scope} \clip
(-0.5, 0) circle (1); \clip ( 0.5, 0) circle
(1); \fill[color=gray] (-2,1.5) rectangle
(2,-1.5); \end{scope} \draw (-0.5, 0)
circle (1); \draw ( 0.5, 0) circle (1);
\end{tikzpicture}
```

4.5 even odd rule

```
\begin{tikzpicture}[
  even odd rule,rounded corners=2pt,x=10pt,y=10pt]
\filldraw[fill=yellow!80!black] (0,0) rectangle (1,1)
[xshift=5pt,yshift=5pt] (0,0) rectangle (1,1)
[rotate=30] (-1,-1) rectangle (2,2);
\end{tikzpicture}
```

4.6 Foreach

$x = 1$, $x = 2$, $x = 3$, `\foreach \x in{1,2,3} {$x=\x$, }`



```
\tikz \foreach \x in {1,...,10} \draw (\x,0) circle (0.4);
```

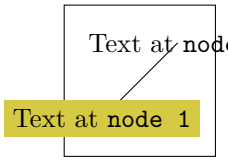
1,5	2,5	3,5	4,5	5,5	7,5	8,5	9,5	10,5	11,5
1,4	2,4	3,4	4,4	5,4	7,4	8,4	9,4	10,4	11,4
1,3	2,3	3,3	4,3	5,3	7,3	8,3	9,3	10,3	11,3
1,2	2,2	3,2	4,2	5,2	7,2	8,2	9,2	10,2	11,2
1,1	2,1	3,1	4,1	5,1	7,1	8,1	9,1	10,1	11,1

```
\begin{tikzpicture}
\foreach \x in {1,2,...,5,7,8,...,12}
\foreach \y in {1,...,5}
{ \draw (\x,\y) +(-.5,-.5)
  rectangle +(.5,.5);
\draw (\x,\y) node{\x,\y}; }
\end{tikzpicture}
```

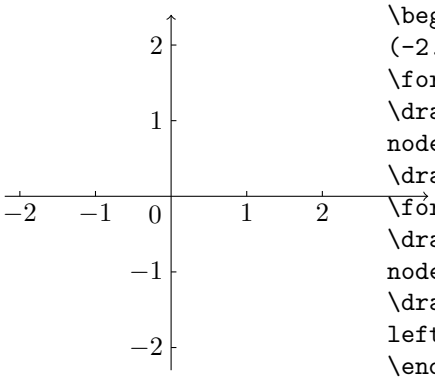
4.7 Node

node 命令的可选项 left，right，above，below 用于控制插入文本的位置。此外还有 above right，below right，above left，below left 等。文本对齐用 align=left，

align=right，align=center 来控制在 node 里面用 includegraphics 命令可以插入图片




```
\begin{tikzpicture} \draw (0,0) rectangle (2,2);
\draw (.5,.5) node[fill=yellow!80!black]Text at
node 1 --(1.5,1.5) nodeText at node 2;
```




```
\begin{tikzpicture} \draw[->]
(-2.2,0)--(3.4,0);
\foreach \x/\xtext in {-2,-1,1,2}
\draw (\x,0pt)--(\x,2pt)
node[near start,below]{$\xtext$};
\draw[->] (0,-2.3)--(0,2.4);
\foreach \y in {-2,-1,1,2}
\draw (0pt,\y)--(2pt,\y)
node[near start,left]{$\y$};
\draw (0,0) node[very near start,below
left]{$0$};
\end{tikzpicture}
```

4.8 Style

```
\tikzset{help lines/.style= {step=0.5cm,color=gray!40,very thin}}

\tikzset{style001/.style={color=red,fill=red!20}}
\tikzset{help lines/.append style=blue!50}%原样式修改

\tikz \path (top-left) ++(1,-2) coordinate (name-point);%定义相对点
```

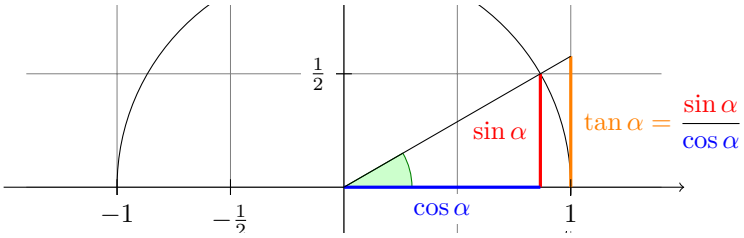
这种形式 (p1 |- xline) 表示取第一个点的 x 和第二个点的 y 组成一个新的点。
如果是 (p1 -| xline) 表示取第二个点的 x 和第一个点的 y 组成一个新的点。

```
shorten >=-0.4cm,shorten <=-0.4cm
```

可以通过类似上面的选项让两个点确定的线条延长，
不过这种延长是不能用 intersection 方法处理的。
其中 >= 表示到第二个点超过
的部分，负值表示超过；然后 <= 表示到第一个点超过的部分，正值则缩回去了。

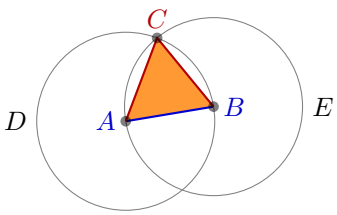
5 实例

5.1 三角函数




```
\begin{tikzpicture}[scale=3]
\clip (-2,-0.2) rectangle (2,0.8); %设定画图范围
\draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
\filldraw[fill=green!20,draw=green!50!black] (0,0) -- (3mm,0mm)
arc [start angle=0, end angle=30, radius=3mm] -- cycle;
\draw[->] (-1.5,0) -- (1.5,0) coordinate (x axis);
\draw[->] (0,-1.5) -- (0,1.5) coordinate (y axis);
\draw (0,0) circle [radius=1cm];
\draw[very thick,red]
(30:1cm) -- node[left=1pt,fill=white] {$\sin \alpha$}
(30:1cm |- x axis); %|-表示画垂线
\draw[very thick,blue]
(30:1cm |- x axis) -- node[below=2pt,fill=white] {$\cos \alpha$} (0,0);
\path [name path=upward line] (1,0) -- (1,1); % 命名路径
\path [name path=sloped line] (0,0) -- (30:1.5cm);
\draw [name intersections={of=upward line and sloped line, by=t}] %交点
[very thick,orange] (1,0) --
node [right=1pt,fill=white]
{$\displaystyle\tan\alpha\color{black}=
  \frac{{\color{red}\sin\alpha}}{\color{blue}\cos\alpha}$}(t);
\draw (0,0) -- (t);
\foreach \x/\xtext in {-1, -0.5/-\frac{1}{2}, 1}%注意1/2的表示法
\draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north,fill=white] {$\xtext$};
\foreach \y/\ytext in {-1, -0.5/-\frac{1}{2}, 0.5/\frac{1}{2}, 1}
\draw (1pt,\y cm) -- (-1pt,\y cm) node[anchor=east,fill=white] {$\ytext$};
\end{tikzpicture}
```

5.2 等边三角形

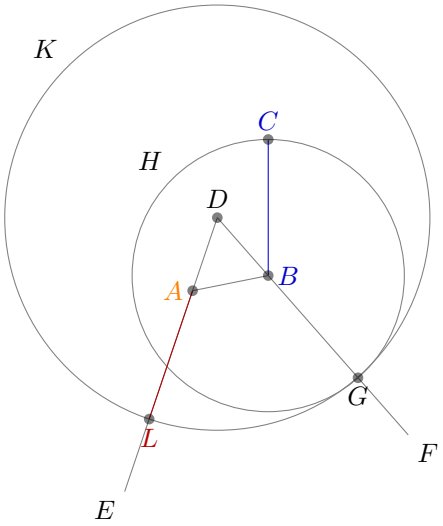


Proposition I

To construct an equilateral triangle on a given finite straight line.

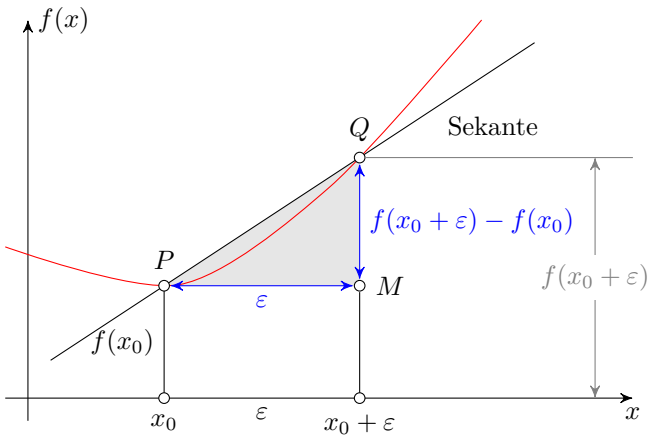
Let AB be the given finite straight line. ...

```
\begin{tikzpicture}[thick]
\tikzset{help lines/.style={thin,draw=black!50}}
\def\A{\textcolor{input}{$A$}}  \def\B{\textcolor{input}{$B$}}
\def\C{\textcolor{output}{$C$}} \def\D{$D$}  \def\E{$E$}
\colorlet{input}{blue!80!black} \colorlet{output}{red!70!black}
\colorlet{triangle}{orange}

\coordinate[label=left:\A](A)at($(0,0)+.1*(rand,rand)$);
\coordinate[label=right:\B](B)at($(1.25,0.25)+.1*(rand,rand)$);
\draw [input](A)--(B);
\node[name path=D,help lines,draw,label=left:\D](D)at(A)[circle through=(B)]{};
\node[name path=E,help lines,draw,label=right:\E](E)at(B)[circle through=(A)]{};
\path[name  intersections={of=D and E,by={[label=above:\C]C}}];
\draw[output](A)--(C)--(B);
\foreach \point in {A,B,C}\fill[black,opacity=.5](\point)circle(2pt);

\begin{pgfonlayer}{background}
\fill[triangle!80] (A) -- (C) -- (B) -- cycle;
\end{pgfonlayer}

\node [below right, text width=10cm,align=justify] at (4,2) {
\small\textbf{Proposition I}\par
\emph{To construct an \textcolor{triangle}{equilateral triangle}
on a given \textcolor{input}{finite straight line}.}
\par\vskip1em
Let \A\B\ be the given \textcolor{input}{finite straight line}. \dots
};
\end{tikzpicture}
```




```
\begin{tikzpicture}
\tikzset{help lines/.style={thin,draw=black!50}}
\def\A{\textcolor{orange}{$A$}} \def\B{\textcolor{input}{$B$}}
\def\C{\textcolor{input}{$C$}}  \def\L{\textcolor{output}{$L$}}
\colorlet{input}{blue!80!black} \colorlet{output}{red!70!black}

\coordinate[label=left:\A](A)at(0,0);
\coordinate[label=right:\B](B)at(1,0.2);
\coordinate[label=above:\C](C)at(1,2);
\draw[input](B)--(C);
\draw[help lines](A)--(B);
\coordinate[label=above:\D](D)at($(A)!.5!(B)!{sin(60)*2}!90:(B)$);

\draw[help lines](D)--($(D)!3.75!(A)$) coordinate[label=-135:\E](E);
\draw[help lines](D)--($(D)!3.75!(B)$) coordinate[label=-45:\F](F);
\node[name path=H,help lines,circle through=(C),draw,label=135:\H](H)at(B){};

\path[name path=B--F](B)--(F);
\path[name intersections={of=H and B--F,by={[label=below:\G]G}}];
\node(K)at(D)[name path=K,help lines,circle through=(G),draw,label=135:\K]{};

\path[name path=A--E](A)--(E);
\path[name intersections={of=K and A--E,by={[label=below:\L]L}}];
\draw[output](A)--(L);
```

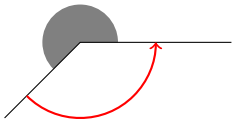
```
\foreach \point in {A,B,C,D,G,L}
\fill[black,opacity=.5](\point)circle(2pt);
\end{tikzpicture}
```




```
\begin{tikzpicture}
\tikzset{thick,>=stealth',dot/.style={draw,fill=white,circle,inner sep=0pt,minimum size=4pt}}
\coordinate (O) at (0,0);
\draw[->] (-0.3,0)--(8,0) coordinate[label={below:$x$}] (xmax);
\draw[->] (0,-0.3)--(0,5) coordinate[label={right:$f(x)$}] (ymax);
\path[name path=x] (0.3,0.5) -- (6.7,4.7);
\path[name path=y] plot[smooth] coordinates {(-0.3,2) (2,1.5) (4,2.8) (6,5)};
\begin{scope}[name intersections = {of= x and y,name = i}]
\fill[gray!20] (i-1) -- (i-2 |- i-1) -- (i-2) -- cycle;
\draw (0.3,0.5) -- (6.7,4.7) node[pos=0.8,below right] {Sekante};
\draw[red] plot[smooth] coordinates {(-0.3,2) (2,1.5) (4,2.8) (6,5)};
\draw (i-1) node[dot,label={above:$P$}] (i-1) {} -- node[left] {$f(x_0)$} (i-1 |- O) node[dot,label={bel
\path (i-2) node[dot,label={above:$Q$}] (i-2) {} -- (i-2 |- i-1) node[dot,label={right:$M$}] (i-12) {};
\draw (i-12) -- (i-12 |- O) node[dot,label={below:$x_0 + \varepsilon$}] {};
\draw[blue,<->] (i-2) -- node[right] {$f(x_0 + \varepsilon) - f(x_0)$} (i-12);
\draw[blue,<->] (i-1) -- node[below] {$\varepsilon$} (i-12);
\path (i-1 |- O) -- node[below] {$\varepsilon$} (i-2 |- O);
\draw[gray] (i-2) -- (i-2 -| xmax);
\draw[gray,<->] ([xshift=-0.5cm]i-2 -| xmax) -- node[fill=white] {$f(x_0 + \varepsilon)$} ([xshift=-0.5
\end{scope}
\end{tikzpicture}
```

6 Library

6.1 Angels

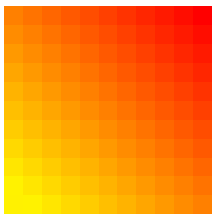


```
\tikz \draw (2,0) coordinate(A)--(0,0)coordinate(B)--(-1,-1)coordinate(C)
pic [fill=black!50] {angle = A--B--C}
pic [draw,->,red,thick,angle radius=1cm] {angle = C--B--A};
```

6.2 Math

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765,

```
\tikzmath{function fibonacci(\n){
if \n == 0 then {return 0;}
else {return fibonacci2(\n, 0, 1);};
};
function fibonacci2(\n, \p, \q){
if \n == 1 then {return \q;}
else {return fibonacci2(\n-1, \q, \p+\q);};
};
int \f, \i;
for \i in {0,1,...,20}{\f= fibonacci(\i); print {\f,};
};}
```

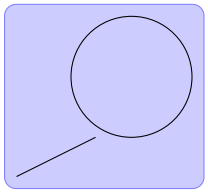


```
\tikz[x=0.25cm,y=0.25cm,evaluate={
int \i, \j;
for \i in {0,...,10}{
for \j in {0,...,10}{
\a{\i,\j} = (\i+\j)*5;};};}]
\foreach \i in {0,...,10}
\foreach \j in {0,...,10}
\fill [red!\a{\i,\j}!yellow] (\i,\j) rectangle ++(1, 1);
```

$4^0 = 1$,$4^1 = 4$,$4^2 = 16$,$4^3 = 64$,$4^4 = 256$,$4^5 = 1024$,$4^6 = 4096$,

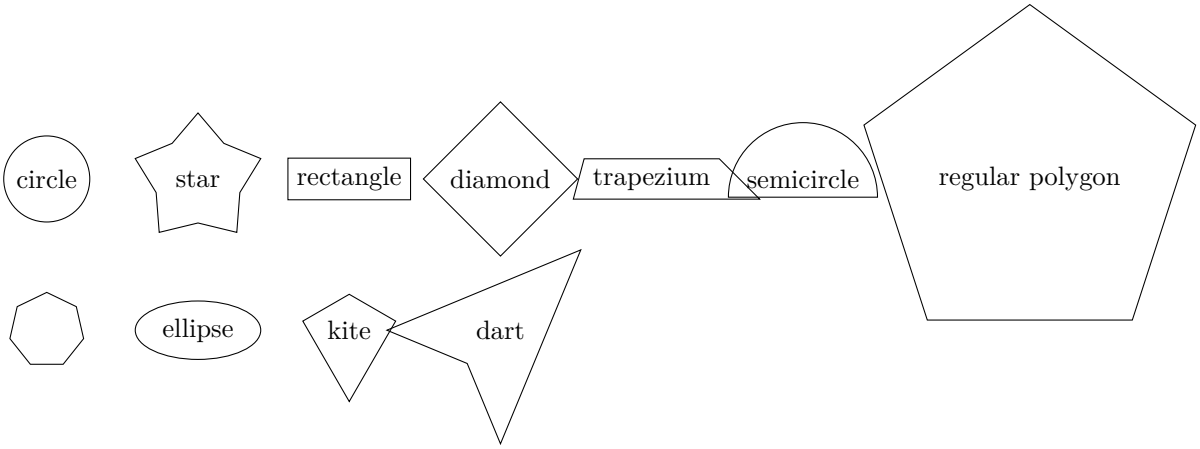
```
\tikzmath{ int \x, \y, \z;
\x=random(2,5);
for \y in {0,...,6}{\z=\x^\y; print{$\x^\y=\z$,};};}
```

6.3 backgrounds



```
\begin{tikzpicture}[ scale=.8,background rectangle/.style=
{draw=blue!50,fill=blue!20,rounded corners=1ex},show background rectangle]
\draw (2,2) circle (1);
\draw (1 mm, 10 pt) -- (4 em, 1);
```

6.4 shapes



7 变换

xscale=-1 或者 yscale=-1 就刚好相对 y 轴或 x 轴反对称。