

# TikZ reference

Yi-Chen Zhang

October 19, 2019

The TikZ commands can be inside the environment `\begin{tikzpicture} ... \end{tikzpicture}` or simply use `\tikz` clause. We run `pdflatex` or `latex` followed by `dvips` to execute the TikZ commands.

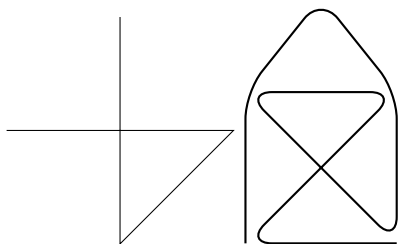
## 1 Straight Path Construction

Usage:

```
\draw[options] (x1,y1) -- (x2,y2) -- (x3,y3);
```

Example:

```
\begin{tikzpicture}
  \draw (-1.5,0) -- (1.5,0) -- (0,-1.5) -- (0,1.5);
  \draw[thick, rounded corners=10pt] (0,0) -- (0,2) -- (1,3.25) --
    (2,2) -- (2,0) -- (0,2) -- (2,2) -- (0,0) -- (2,0);
\end{tikzpicture}
```



## 2 Circle Path Construction

Usage:

```
\draw[options] (x,y) circle (radius);
\draw[options] (x,y) ellipse (x.radius and y.radius);
```

Example:

```
\begin{tikzpicture}
  \draw (0,0) circle (2pt);
  \draw[red] (1,0) circle (3pt);
  \draw[fill=red] (2,0) circle (4pt);
  \draw[red,fill=red] (3,0) ellipse (10pt and 5pt);
  \filldraw[blue,rotate=30] (3.5,-2) ellipse (10pt and 5pt); % another way
\end{tikzpicture}
```



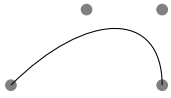
## 3 Curved Path Construction

Usage:

```
\draw[options] (x1,y1) .. controls (x2,y2) and (x3,y3) .. (x4,y4);
```

Example:

```
\begin{tikzpicture}
  \filldraw[gray] (0,0) circle (2pt) (1,1) circle (2pt)
    (2,1) circle (2pt) (2,0) circle (2pt);
  \draw (0,0) .. controls (1,1) and (2,1) .. (2,0);
\end{tikzpicture}
```



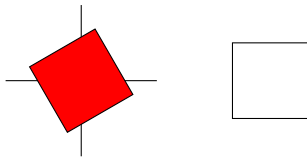
## 4 Rectangle Path Construction

Usage:

```
\draw[options] (x1,y1) rectangle (x2,y2);
\draw[options] (x,y) rectangle +(width,height);
```

Example:

```
\begin{tikzpicture}
  \draw (-1,0) -- (1,0);
  \draw (0,-1) -- (0,1);
  \draw[rotate=30, fill=red] (-0.5,-0.5) rectangle (-1,-1);
  \draw (2,-0.5) rectangle +(1,1);
\end{tikzpicture}
```



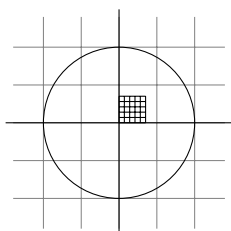
## 5 Grid Path Construction

Usage:

```
\draw[options] (x1,y1) grid (x2,y2);
```


















Example:

```
\begin{tikzpicture}
  \draw[step=.5cm, gray, very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw[step=2pt] (0,0) grid (10pt,10pt);
\end{tikzpicture}
```










## 6 Drawing Options







There are some drawing options that one can use to control the color, thickness, and line type.











- color: blue , black , brown , cyan , gray , green , lightgray , lime , magenta , orange , pink , purple , red , yellow , teal , violet , white .

Note: Colors can also be mixed. The color `[blue!40!white]` means 40% blue and 60% white mixed together.

- thickness: ultra thin , very thin , thin , semithick , thick , very thick , ultra thick .

Note: `[help lines]=[gray,very thin]`. Line thickness can be also specified by `[line width]` option, say `[line width=0.5cm]`.

- line type: loosely dashed , dashed , densely dashed , loosely dotted , dotted , densely dotted .

- arrow: `<-` , `<<-` , `<-|` , `<<-|` , `->` , `->>` , `|->` , `|->>` , `<->` , `<<->>` , `<<>`.

Note: You can also add `>=stealth` in the options, which changes the arrow to 'stealth-like' style.

Usage:

```
\draw[color, thickness, line type, arrow] (x1,y1) -- (x2,y2);
```

Example:

```
\begin{tikzpicture}
  \draw[red, very thin, densely dashed, <-] (0,0) -- (0.9,0);
  \draw[green, ultra thick, loosely dotted, |->] (1.1,0) -- (1.9,0);
  \draw[blue, semithick, <->, >=stealth] (2.1,0) -- (2.9,0);
  \draw[purple, line width=0.3cm] (3.1,0) -- (3.9,0);
\end{tikzpicture}
```



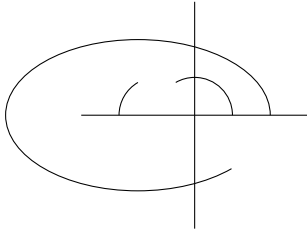
## 7 Arc Path Construction

Usage:

```
\draw (x,y) arc (angle1:angle2:radius);
\draw (x,y) arc [start angle=angle1, end angle=angle2, radius=radius];
\draw (x,y) arc (angle1:angle2:x.radius and y.radius);
\draw (x,y) arc [start angle=angle1, end angle=angle2, x radius=rx, y radius=ry]
```

Example:

```
\begin{tikzpicture}
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0.5,0) arc (0:120:0.5cm);
  \draw (1,0) arc (0:315:1.75cm and 1cm);
  \draw (-1,0) arc [start angle=180, end angle=120, radius=0.5cm];
  % The above is not a recommend way.
\end{tikzpicture}
```



## 8 Adding a Touch Style

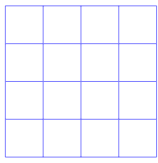
Styles are predefined sets of options that can be used to organize how a graphic is drawn. To define a style globally, we can use the `\tikzset` command at the beginning of the document.

Usage:

```
\tikzset{style_name/.style={options}}
```

Example:

```
\tikzset{blue_thin_lines/.style={color=blue!50,very thin}}
\begin{tikzpicture}
  \draw[blue_thin_lines] (0,0) grid (5,5);
\end{tikzpicture}
```



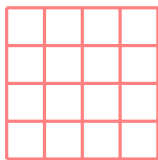
To define a style locally, we use a pair of square bracket “[ ]” to define styles at the beginning of a picture.

Usage:

```
[style_name/.style={options}]
```

Example:

```
\begin{tikzpicture}
  [red_thick_lines/.style={color=red!50,very thick}];
  \draw[step=0.5cm, red_thick_lines] (0,0) grid (2,2);
\end{tikzpicture}
```



One can also define styles hierarchically.

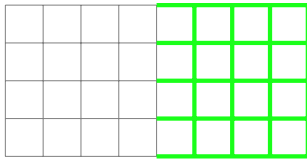
Usage:

```
\tikzset{style_name1/.style={style_name2, options}}
```

Example:

```
\tikzset{green_help_lines/.style={help lines, color=green!90}}
\begin{tikzpicture}
```

```
\draw[step=0.5cm, green_help_lines] (0,0) grid (5,5);
\end{tikzpicture}
```



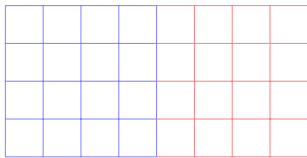
Styles can also be used with a parameter.

Usage:

```
[style_name/.style={options}, style_name/.default={options}]
```

Example:

```
\begin{tikzpicture}
  [para_color/.style={help lines,color=#1!50}, para_color/.default=blue]
  \draw[step=0.5cm, para_color] (0,0) grid (2,2);
  \draw[step=0.5cm, para_color=red] (2,0) grid (4,2);
\end{tikzpicture}
```



## 9 Clipping a Path

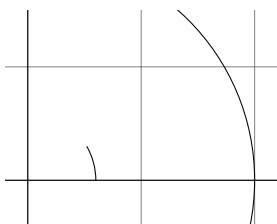
The `\clip` command clip all subsequent drawing.

Usage:

```
\clip[options] (x1,y1) rectangle (x2,y2);
```

Example:

```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,0.75);
  \draw[step=.5cm, help lines] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw (3mm,0mm) arc (0:30:3mm);
\end{tikzpicture}
```

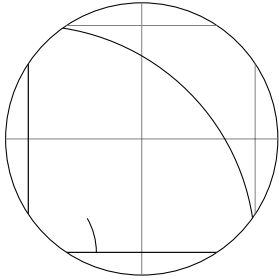


Usage:

```
\clip (x1,y1) circle (radius);
```

Example:

```
\begin{tikzpicture}[scale=3]
  \clip[draw] (0.5,0.5) circle (.6cm);
  \draw[step=.5cm, help lines] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw (3mm,0mm) arc (0:30:3mm);
\end{tikzpicture}
```



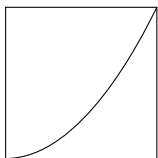
## 10 Parabola Path Construction

Usage:

```
\draw[options] (x1,y1) parabola (x2,y2);
```

Example:

```
\begin{tikzpicture}[scale=3]
  \draw (0,0) rectangle (1,1) (0,0) parabola (1,1);
\end{tikzpicture}
```



Usage:

```
\draw[options] (x1,y1) parabola bend (x2,y2) (x3,y3);
```

Example:

```
\begin{tikzpicture}
  \draw[x=0.2cm,y=0.2cm] (0,0) parabola bend (4,10) (6,6);
\end{tikzpicture}
```



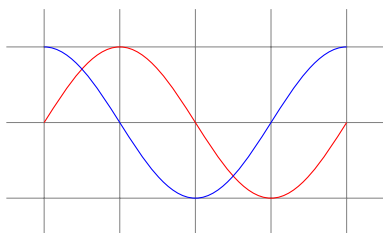
## 11 Sine and Cosine Path Construction

Usage:

```
\draw[options] (x1,y1) sin (x2,y2);  
\draw[options] (x1,y1) cos (x2,y2);
```

Example:

```
\begin{tikzpicture}  
  \draw[help lines] (-0.5,-1.5) grid (4.5,1.5);  
  \draw[red] (0,0) sin (1,1) cos (2,0) sin (3,-1) cos (4,0);  
  \draw[blue] (0,1) cos (1,0) sin (2,-1) cos (3,0) sin (4,1);  
\end{tikzpicture}
```



## 12 Filling and Drawing

Usage:

```
\fill[options] (x1,y1) -- (x2,y2) arc (angle1:angle2:radius) -- (x3,y3);  
\fill[options] (x1,y1) -- (x2,y2) arc (angle1:angle2:radius) -- cycle; % better  
\filldraw[options] (x1,y1) -- (x2,y2) arc (angle1:angle2:radius) -- cycle;
```

Example:

```
\begin{tikzpicture}[line width=5pt]  
  \fill[blue!80] (0,0) -- (3,0) arc (0:30:2) -- (0,0);  
  \draw (4,0) -- (5,0) -- (5,1) -- (4,0);  
  \draw (6,0) -- (7,0) -- (7,1) -- cycle;  
  \filldraw[fill=green!20!white, draw=green!50!black]  
    (8,0) -- (11,0) arc (0:45:3) -- cycle;  
\end{tikzpicture}
```



## 13 Shading

Usage:

```
\shade[options] (x1,y1) rectangle (x2,y2);  
\shadedraw[options] (x1,y1) circle (radius);
```

Example:

```
\begin{tikzpicture}[rounded corners,ultra thick]
```

```

\shade (0,0) rectangle (2,1);
\shadedraw (3,0.5) circle (.5cm);
\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);
\shadedraw[left color=gray,right color=green, draw=green!50!black]
(10,0.3) -- +(1,0) arc (0:30:1) -- cycle;
\end{tikzpicture}

```



## 14 Specifying Coordinates

Usage:

```

(xpt,ycm): xpt in x-direction and ycm in y-directions.
(xdegree:ycm): ycm in direction x degree.
+(x,y): xcm above and ycm right from the previous specified position.
++(x,y): xcm above and ycm right from the previous specified position
and making this the new specified position.
(x1,y1) -- (x2,y2): straight line from (x1,y1) to (x2,y2);
(x1,y1) -| (x2,y2): a horizontal and vertical line from (x1,y1) to (x2,y2);
(x1,y1) |- (x2,y2): a vertical and horizontal line from (x1,y1) to (x2,y2);

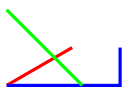
```

Example:

```

\begin{tikzpicture}
\draw[red,very thick] (30:1cm) -- (0,0);
\draw[blue,very thick] (0,0) -| +(1.5,0.5) ;
\draw[green,very thick] (0,0) |- ++(0,1) -- (1,0);
\end{tikzpicture}

```



## 15 Scoping

Usage:

```

\begin{scope}[options]
% only apply graphic options inside this scope, but not to anything outside.
\end{scope}

```

Example:

```

\begin{tikzpicture}[ultra thick]
\draw (0,0) -- (0,1);
\begin{scope}[thin]
\draw (1,0) -- (1,1);
\end{scope}
\end{tikzpicture}

```



```
\draw (2,0) -- (2,1);
\end{tikzpicture}
```



## 16 Transformations

Usage:

[xshift=x,yshift=y]: allows you to shift all subsequent points by x and y amount.  
 [shift={(x,y)}] or [shift={+(x,y)}];

[rotate=angle]: rotating by a certain angle.

[rotate around={angle:(x,y)}]: rotating around a given point by a certain angle.

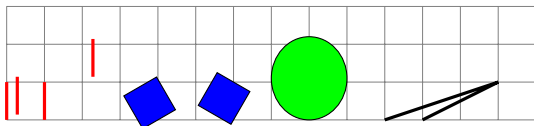
[xscale=unit1,yscale=unit2]: scaling the x-direction or y-direction.

[scale=unit]: scaling by a certain factor

[xslant=unit1,yshlant=unit2]: slanting the x-direction or y-direction.

Example:

```
\begin{tikzpicture}
\draw[help lines, step=0.5] (0,0) grid (7,1.5);
\draw[red, very thick] (0,0) -- (0,0.5)
[shift={(4pt,2pt)}] (0,0) -- (0,0.5);
\draw[red, very thick] (0.5,0) -- (0.5,0.5)
[shift={+(4pt,2pt)}] (0.5,0) -- (0.5,0.5);
\draw[rotate=30,fill=blue] (1.5,-1) rectangle (2,-0.5);
\draw[rotate around={60:(3,0.5)},fill=blue] (2.5,0.25) rectangle (3,0.75);
\draw[xscale=1,yscale=1.1,fill=green] (4,0.5) circle (0.5);
\draw[xslant=2,very thick] (5,0) -- (5.5,0.5) -- (5.5,0);
\end{tikzpicture}
```



```
\begin{tikzpicture}
\filldraw[fill=red] (0,0) rectangle (1,1)
[xshift=5pt,yshift=5pt] (0,0) rectangle (1,1)
[rotate=30] (-1,-1) rectangle (2,2);
\end{tikzpicture}
```



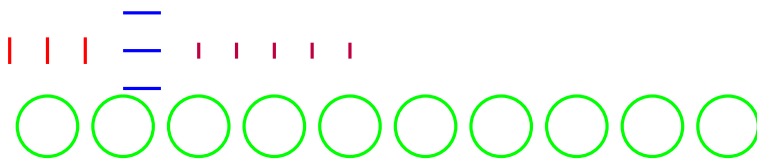
## 17 For-Loops

Usage:

```
\foreach \variable in {list of values}{
  \commands ;
}
```

Example:

```
\begin{tikzpicture}
  \foreach \x in {-0.5cm,0cm,0.5cm}{
    \draw[red,very thick] (\x,-5pt) -- (\x,5pt);
  }
  \foreach \y in {-0.5cm,0cm,0.5cm}{
    \draw[blue,very thick] (1cm,\y) -- (1.5cm,\y);
  }
  \foreach \x in {0,...,9}{
    \draw[green,very thick] (\x,-1) circle (0.4cm);
  }
  \foreach \x in {2,2.5,...,4}{
    \draw[purple,very thick] (\x cm,-3pt) -- (\x cm,3pt);
  }
\end{tikzpicture}
```



```
\begin{tikzpicture}
  \foreach \x in {1,2,...,5,7,8,...,12}{
    \foreach \y in {1,...,5}{
      \draw (\x,\y) +(-0.5,-0.5) rectangle +(0.5,0.5);
      \draw (\x,\y) node{\x,\y};
    }
  }
\end{tikzpicture}
```

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

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

## 18 Adding Text

Usage:

```

\draw (x,y) node[options] {text};
\draw (x,y) node[options] {text};
\node[options] at (x,y) {text};
options: above,below,left,right, or anchor=north,south,west,east.

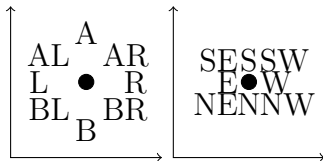
```

Example:

```

\begin{tikzpicture}[scale=2]
  \draw[<->] (0,1) -- (0,0) -- (1,0);
  \draw[fill] (0.5,0.5) circle (0.05);
  \draw (0.5,0.5) node[above=10pt] {A} node[left=10pt] {L}
    node[below=10pt] {B} node[right=10pt] {R};
  \draw (0.5,0.5) node[above left=2pt] {AL} node[below left=2pt] {BL}
    node[below right=2pt] {BR} node[above right=2pt] {AR};
\end{tikzpicture}
\begin{tikzpicture}[scale=2]
  \draw[<->] (0,1) -- (0,0) -- (1,0);
  \draw[fill] (0.5,0.5) circle (0.05);
  \draw (0.5,0.5) node[anchor=north] {N} node[anchor=west] {W}
    node[anchor=south] {S} node[anchor=east] {E};
  \draw (0.5,0.5) node[anchor=north west] {NW} node[anchor=south west] {SW}
    node[anchor=south east] {SE} node[anchor=north east] {NE};
\end{tikzpicture}

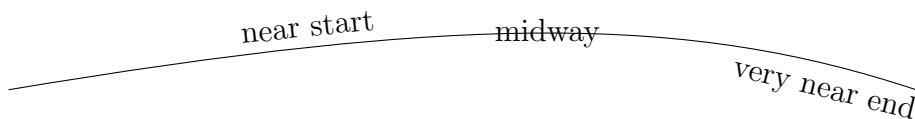
```



```

\begin{tikzpicture}
  \draw (0,0) .. controls (6,1) and (9,1) ..
    node[near start,sloped,above] {near start}
    node {midway}
    node[very near end,sloped,below] {very near end} (12,0);
\end{tikzpicture}

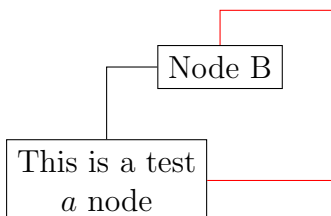
```



```

[scale=1.5]
\begin{tikzpicture}
  \draw (0,0) node(a) [draw,align=center] {This is a test\\$a$ node}
    (1,1) node(b) [draw] {Node B};
  \draw (a.north) |- (b.west);
  \draw[color=red] (a.east) -| (2,1.5) -| (b.north);
\end{tikzpicture}

```



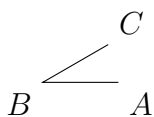
## 19 Coordinate

Usage:

```
\coordinate (name) at (x,y);
```

Example:

```
\begin{tikzpicture}
  \coordinate (A) at (1,0);
  \coordinate (B) at (0,0);
  \coordinate (C) at (30:1cm);
  \draw (A) -- (B) -- (C);
\end{tikzpicture}
```



## 20 Trangency

Usage:

```
\draw (x1,y1) to [out=degree1,in=degree2] (x2,y2);
```

Example:

```
\begin{tikzpicture}
  \draw [help lines] (0,0) grid (4,4);
  \draw [<->] (5,0) -- (0,0) -- (0,5);
  \draw (3,0) -- (0,3);
  \draw [dashed, ultra thick] (0.5,3.5) to [out=280,in=135] (1.5,1.5);
  \draw [dashed, ultra thick] (1.5,1.5) to [out=315,in=170] (3.5,0.5);
\end{tikzpicture}
```

