Ti*k*Z reference

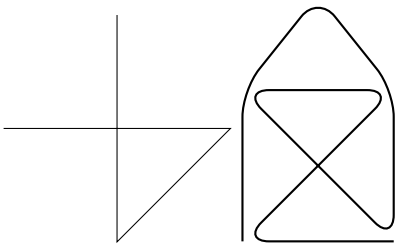
Yi-Chen Zhang

January 14, 2018

The Ti*k*Z 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 Ti*k*Z commends.

1 Straight Path Construction

```
Useage:
  \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 (raidus);
  \draw[options] (x,y) ellipse (x.raidus anda 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}
```

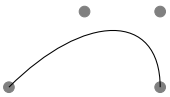
3 Curved Path Construction

```
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}
```



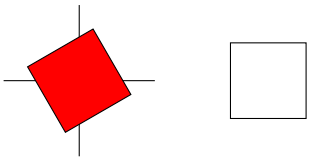
4 Rectangle Path Construction

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}
```



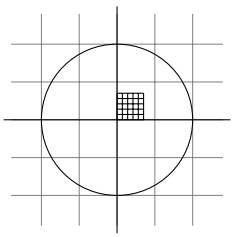
5 Grid Path Construction

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]`.

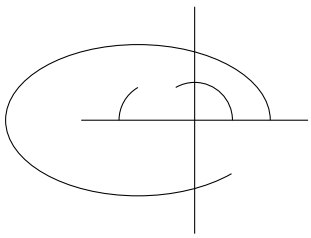
- line type: loosely dashed, dashed, densely dashed, loosely dotted, dotted, densely dotted.

- 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

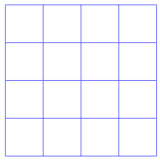
```
Usage:
  \draw (x,y) arc (angle1:angle2:radius);
  \draw (x,y) arc [start angle=angle1, end angle=angle2, radius=radius];
  \draw (x,y) arc (angle1:angle2:x.radius and y.radius);
  \draw (x,y) arc [start angle=angle1, end angle=angle2, x radius=rx, y radius=ry]

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 recommand way.
  \end{tikzpicture}
```



8 Adding a Touch Style

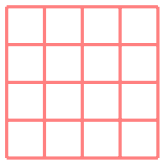
Styles are predefined sets of options that can be used to organize how a graphic is drawn. To define a style globally, we can use the \tikzset command at the beginning of the document.

```
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.

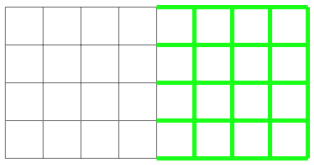
```
Usage:
  [style_name/.style={options}]

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.

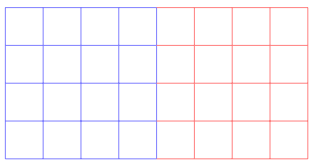
```
Usage:
  \tikzset{style_name1/.style={style_name2, options}}

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.

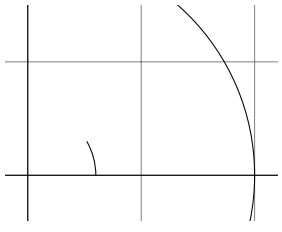
```
Usage:
  [style_name/.style={options}, style_name/.default={options}]

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.

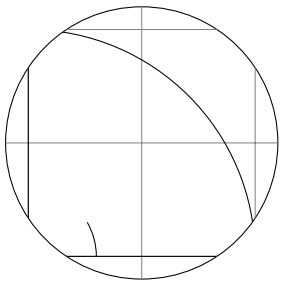
```
Usage:
  \clip[options] (x1,y1) rectangle (x2,y2);

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}
```



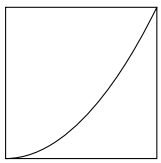
10 Parabola Path Construction

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:

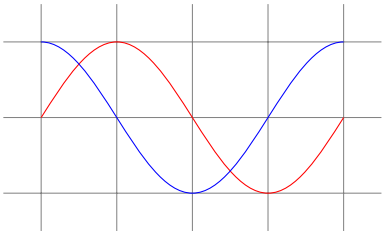
```
\draw[options] (x1,y1) parabola bend (x2,y2) (x3,y3);
```

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}
```

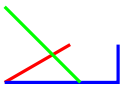
13 Shading

```
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}
```



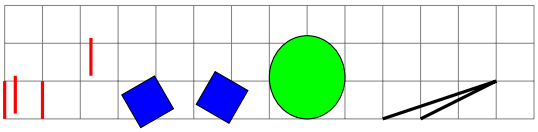
15 Scoping

```
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}
```

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

16 Transformations

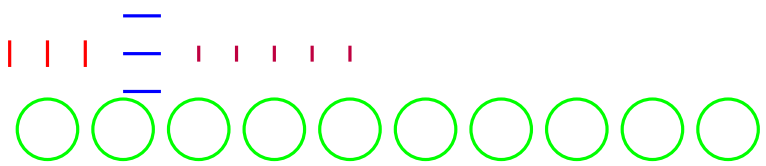
```
Usage:
  [xshift=x,yshift=y]: allows you to shift all subsequent points by x and y amount.
  [shift={(x,y)}] or [shift={+(x,y)}];

  [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,yslant=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}
```

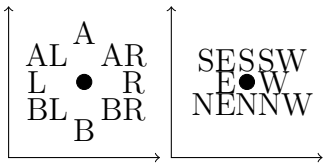
1,5	2,5	3,5	4,5	5,5
1,4	2,4	3,4	4,4	5,4
1,3	2,3	3,3	4,3	5,3
1,2	2,2	3,2	4,2	5,2
1,1	2,1	3,1	4,1	5,1

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

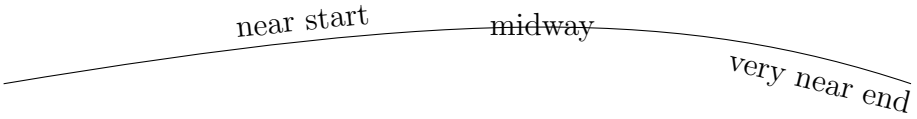
18 Adding Text

```
Usage:
```

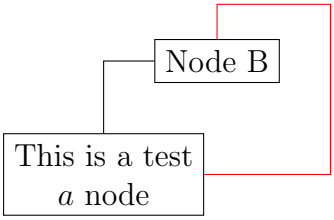
```
  \draw (x,y) node[options] {text};
  \draw (x,y) node[options] {text};
  \node[options] at (x,y) {text};
  options: above,below,left,right, or anchor=north,south,west,east.

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}
```

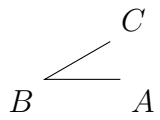



```
[scale=1.5]
  \begin{tikzpicture}
    \draw (0,0) node(a) [draw,align=center] {This is a test\\$a$ node}
          (1,1) node(b) [draw] {Node B};
    \draw (a.north) |- (b.west);
    \draw[color=red] (a.east) -| (2,1.5) -| (b.north);
  \end{tikzpicture}
```



19 Coordinate

```
Useage:
  \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}
```