TikZ - Pgfplots

TikZ-Pgfplots Notes

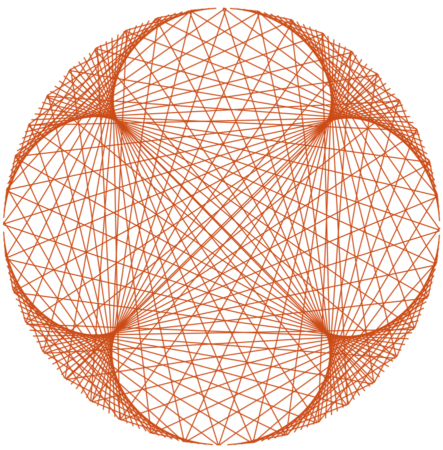
continued

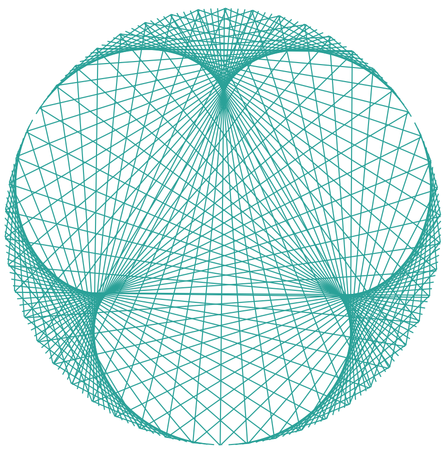
{TikZ-Pgfplotsapplication}

TkZ & euclide 绘图应用

Version 实用（进阶）篇

Contents





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前言

最近整理了一份 LaTeX 绘图笔记，内容主要侧重于绘制中学学习教材上用到的大部分图，对于 LaTeX 绘图的入门，初学者可以进入 LaTeX 工作室官网寻找一些 TikZ 的绘图入门，其中有 TikZ 绘图入门基础、TikZ 学习笔记、TikZ/PGF manual 以及 TikZ 绘图宏包的学习手册。相关的资源可以关注公众号动态，以及工作室官方网站。

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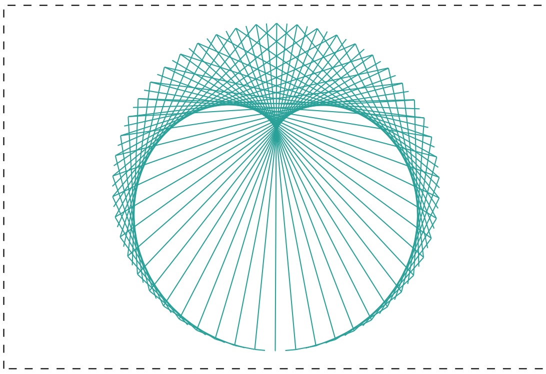
分享

在学习 TikZ 绘图过程中，偶尔看见别人用 Blender 结合 Python 绘制心线图的动画视频，于是常识了用 LaTeX 中 TikZ 宏包去实现，最后绘制出来了，这里进行代码分享！

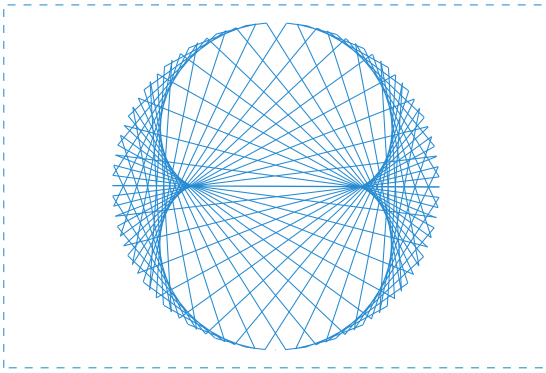
首先是心线图的绘制：

```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
  \draw
      [
       draw=cyan, % 绘制线条颜色
       rotate=-124 % 旋转角度
      ]
      ($(0,0) !1! \i*180:
      (3,2)$)--($(0,0) !1! \i*360:(3,2)$);
      % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它2倍
      %的点，最后形成心线！
\end{tikzpicture}
```



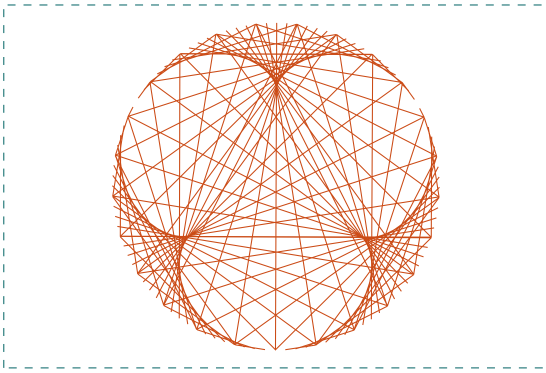
类似地，我们连接的点变成 3 倍、4 倍甚至 n 倍，以及小数点倍会是怎样的感觉呢，下面来看看：

```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
  \draw
      [
       draw=cyan, % 绘制线条颜色
       rotate=-124 % 旋转角度
      ]
      ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*540:(3,2)$);
      % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
      %的点，最后形成心线！
\end{tikzpicture}
```



连接点数是其标记点数 4 倍的时候是这样的，图像如下：

```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
  \draw
      [
       draw=cyan, % 绘制线条颜色
       rotate=-124 % 旋转角度
      ]
      ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*720:(3,2)$);
      % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
      %的点，最后形成心线！
\end{tikzpicture}
```

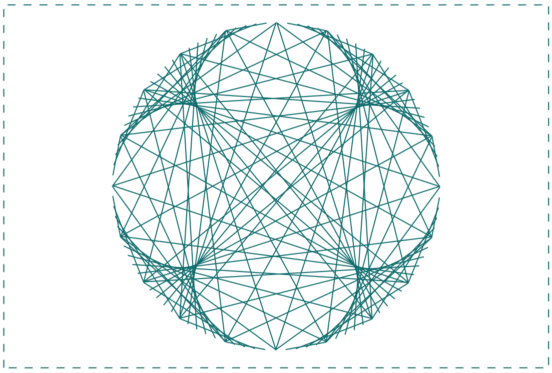


下列代码运行生成多页 PDF 格式文档，运用宏包 animate 制作动画：

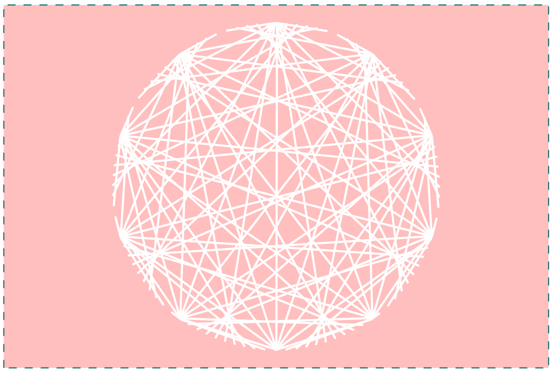
```
\documentclass{ctexart}
\usepackage{ctex}
\usepackage{amsmath}
\usepackage{tikz}
\usetikzlibrary{calc}\tikzset{>=latex}
\usepackage{pgfplots}
\usepackage[active,tightpage]{preview}
```

```
\PreviewEnvironment{tikzpicture}
\setlength\PreviewBorder{0pt}
\definecolor{myback}{RGB}{53,64,89}
\definecolor{mycolor}{RGB}{51,51,51}
\definecolor{Orange}{RGB}{102,51,0}
\definecolor{Green}{RGB}{0,102,51}
\definecolor{Blue}{RGB}{15,107,108}
\definecolor{Yellow}{RGB}{153,151,51}
\begin{document}
       \foreach \N in {0.1,0.0995,...,0}{
             \begin{tikzpicture}
              \draw[fill=myback](-6,-4) rectangle (6,5);
              \draw[fill=myback](-6,-4) rectangle (6,4);
                  \foreach \i in {0,\N,...,2}
              \draw[draw=orange!60!yellow,rotate=-124]($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*400:(2,2)$);
             \end{tikzpicture}}
\end{document}
```

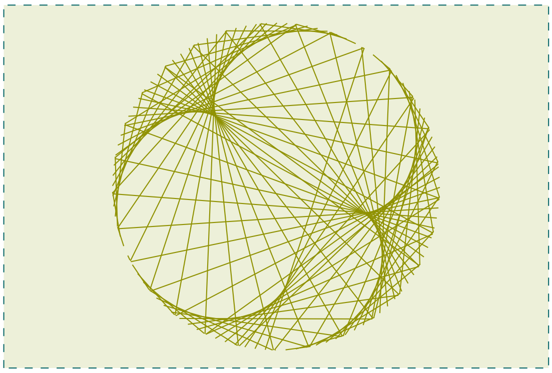
```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
   \draw
       [
        draw=cyan, % 绘制线条颜色
        rotate=-124 % 旋转角度
       ]
       ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*900:(3,2)$);
       % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
       %的点，最后形成心线！
\end{tikzpicture}
```



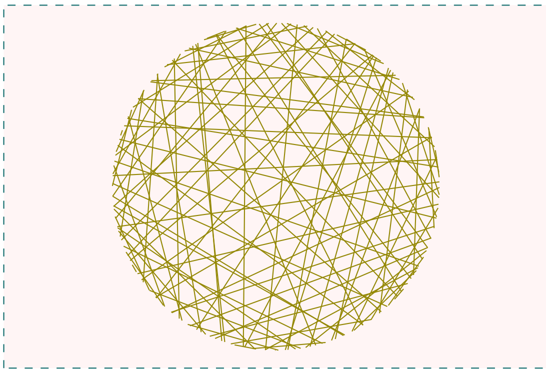
```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
   \draw
       [
        draw=cyan, % 绘制线条颜色
        rotate=-124 % 旋转角度
       ]
       ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*1800:(3,2)$);
       % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
       %的点，最后形成心线！
\end{tikzpicture}
```



```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
   \draw
       [
        draw=cyan, % 绘制线条颜色
        rotate=-124 % 旋转角度
       ]
       ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*620:(3,2)$);
       % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
       %的点，最后形成心线！
\end{tikzpicture}
```



```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2}
 \draw[
 draw=orange!80!red!20!green,
 rotate=-124
 ]($(0,0)
 !1! \i*180:(3,2)$)--($(0,0) !1!
 \i*7120:(3,2)$);
\end{tikzpicture}
```



内容简要

这部分我整理了在绘图学习中一些 **Tikz** 绘图的笔记，部分图是学习手册上的、部分是自己绘制的、也有自己搜集的其他人绘制的图，这些图主要的特点就是在生活工作尤其是教育教学，科研学术上用到，具体的内容包括：

1. **TikZ/PGFplots 曲线图绘制**
2. **TikZ/PGFplots 柱状图/立体图绘制**
3. **TikZ/PGFplots + Animate 动图绘制案例收集**
4. **Pgfplots 学术绘图**

图片来源：https://codeload.github.com/livro-aberto/fracoes_livro_piloto/zip/master

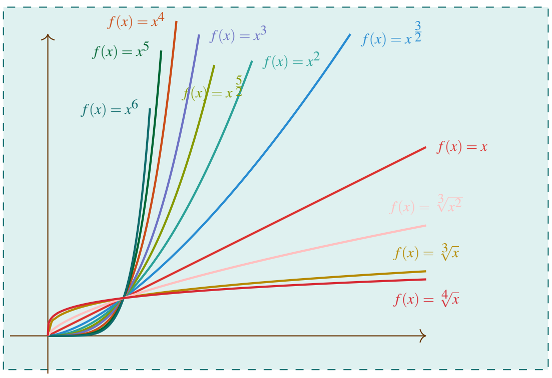
1 TikZ/PGFplots 曲线的绘制

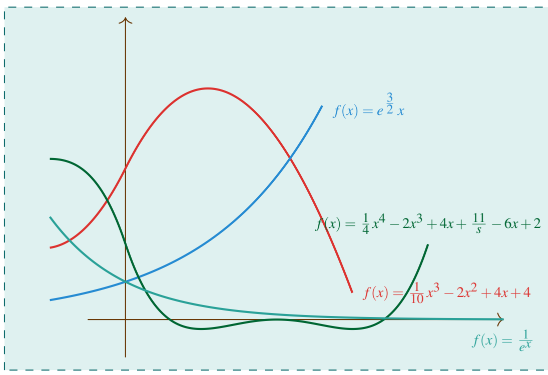
1.1 一般函数曲线的绘制

曲线的绘制，我认为能够根据函数表达式，在确定好自变量区间，然后选择适当的坐标轴比例，就可以绘制是最方便的，毕竟不需要描点连线等繁琐的步骤，至于对绘图最后装饰则需要根据你自己的需要即可，根据函数表达式绘图，我们给出一些案例：

多项式函数的绘制

```
 % \definecolor{myback}{RGB}{53,64,89}
 % \definecolor{mycolor}{RGB}{51,51,51}
 % \definecolor{Orange}{RGB}{102,51,0}
 % \definecolor{Green}{RGB}{0,102,51}
 % \definecolor{Blue}{RGB}{15,107,108}
 % \definecolor{Yellow}{RGB}{153,151,51}
\begin{tikzpicture}[yscale=0.5]
 \draw[->,Orange](-0.5,0)--(5,0);
 \draw[->,Orange](0,-1)--(0,8);
 \draw[color=red, thick, domain=0:5,smooth,samples=100] plot ({\x},{\x}) node[right] {\tiny\(f(x)=x\)};
 \draw[color=blue,thick,domain=0:4,smooth,samples=100] plot ({\x},{\x^(3/2)}) node[right] {\tiny\(f(x)=x^\frac{3}{2}\)};
 \draw[color=cyan, thick, domain=0:2.7,smooth, samples=100] plot ({\x},{\x^(2)}) node[right] {\tiny\(f(x)=x^2\)};
 \draw[color=green,thick,domain=0:2.2,smooth,samples=100]plot({\x},{\x^(5/2)}) node[below] {\tiny\(f(x)=x^\frac{5}{2}\)};
 \draw[color=violet, thick, domain=0:2,smooth, samples=100] plot ({\x},{\x^(3)}) node[right] {\tiny\(f(x)=x^3\)};
 \draw[color=orange, thick, domain=0:1.7,smooth, samples=100] plot ({\x},{\x^(4)}) node[left] {\tiny\(f(x)=x^4\)};
 \draw[color=Green, thick, domain=0:1.5,smooth, samples=100] plot ({\x},{\x^(5)}) node[left] {\tiny\(f(x)=x^5\)};
 \draw[color=Blue, thick, domain=0:1.35,smooth, samples=100] plot ({\x},{\x^(6)}) node[left] {\tiny\(f(x)=x^6\)};
 \draw[color=yellow,thick,domain=0:5,smooth, samples=100] plot ({\x},{\x^(1/3)}) node[above] {\tiny\(f(x)=\sqrt[3]{x}\)};
 \draw[color=pink, thick,domain=0:5,smooth,samples=100] plot ({\x},{\x^(2/3)}) node[above] {\tiny\(f(x)=\sqrt[3]{x^2}\)};
 \draw[color=purple,thick,domain=0:5,smooth,samples=600] plot ({\x},{\x^(1/4)}) node[below] {\tiny\(f(x)=\sqrt[4]{x}\)};
 % 右边三个函数图像的绘制
 \draw[color=red, thick, domain=-1:3,smooth, samples=100] plot ({\x},{(1/10)*\x^(3)-2*\x^(2)+4*\x+4}) node[right] {\tiny\
     (f(x)=\frac{1}{10}x^3-2x^2+4x+4\)};
 \draw[color=blue, thick, domain=-1:2.6,smooth, samples=100] plot ({\x},{e^((2/3)*\x)}) node[right] {\tiny\(f(x)=e^\frac
     {3}{2}x\)};
 \draw[color=Green, thick, domain=-1:4,smooth, samples=100] plot ({\x},{(1/4)*\x^(4)-2*\x^(3)+(11/2)*\x^2-6*\x+2}) node[
     above] {\tiny\(f(x)=\frac{1}{4}x^4-2x^3+4x+\frac{11}{s}-6x+2\)};
 \draw[color=cyan,thick,domain=-1:5,smooth,samples=100] plot ({\x},{e^(-\x)}) node[below] {\tiny\(f(x)=\frac{1}{e^x}\)};
\end{tikzpicture}
```





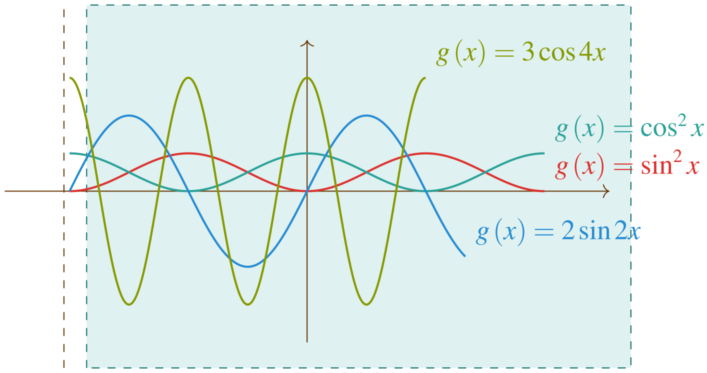
三角函数图像的绘制

三角函数基本绘图命令：

```
\begin{tikzpicture}[yscale=0.5]
\draw[->,Orange](-4,0)--(4,0);
\draw[->,Orange](0,-4)--(0,4);
\draw[color=red, thick, domain=-pi:pi,smooth, samples=200] plot ({\x},{(sin(\x r))^2}) node[above right] {\(g\left(x\right
    )=\sin^2 x\)};
```

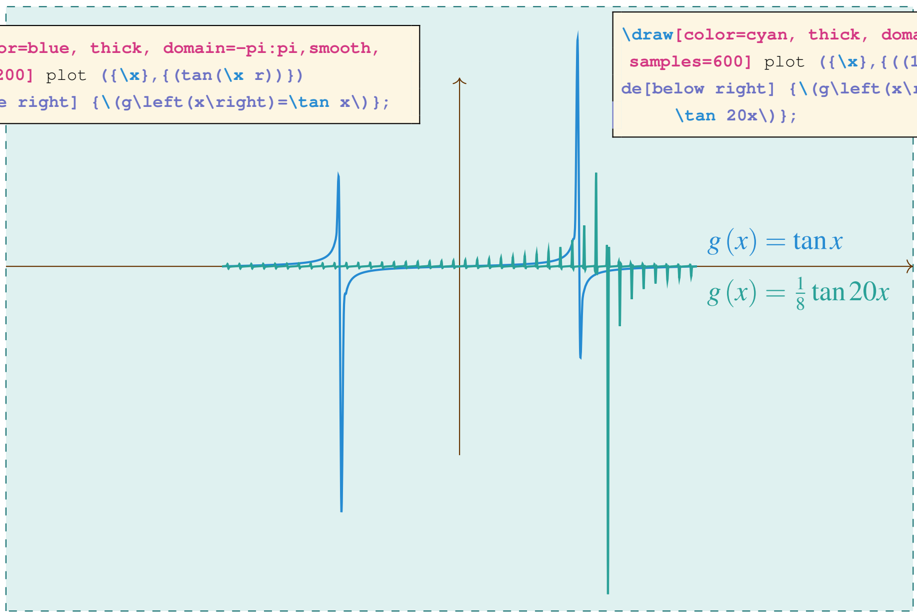
```
\draw[color=cyan, thick, domain=-pi:pi,smooth, samples=200] plot ({\x},{(cos(\x r))^2}) node[above right] {\(g\left(
     x\right)=\cos^2 x\)};
\draw[color=blue, thick, domain=-pi:(2/3)*pi,smooth, samples=200] plot ({\x},{(2*sin(2*\x r))}) node[above right] {\(
     g\left(x\right)=2\sin 2 x\)};
\draw[color=green, thick, domain=-pi:(1/2)*pi,smooth, samples=200] plot ({\x},{(3*cos(4*\x r))}) node[above right] {\(
     g\left(x\right)=3\cos 4 x\)};
\draw[color=gray, thick, domain=-(1/4)*pi:(1/4)*pi,smooth, samples=200] plot ({\x},{(tan(\x r))}) node[above right] {\(
     g\left(x\right)=3\cos 4 x\)};
\end{tikzpicture}
```

```
\begin{tikzpicture}
 \foreach \i in {0,0.02,...,2} % foreach 循环语句
   \draw
      [
       draw=cyan, % 绘制线条颜色
       rotate=-124 % 旋转角度
      ]
      ($(0,0) !1! \i*180:(3,2)$)--($(0,0) !1! \i*620:(3,2)$);
      % 在圆上标记100个等分点，依次从0标记到99，每个点连接标记是它3倍
      %的点，最后形成心线！
\end{tikzpicture}
```

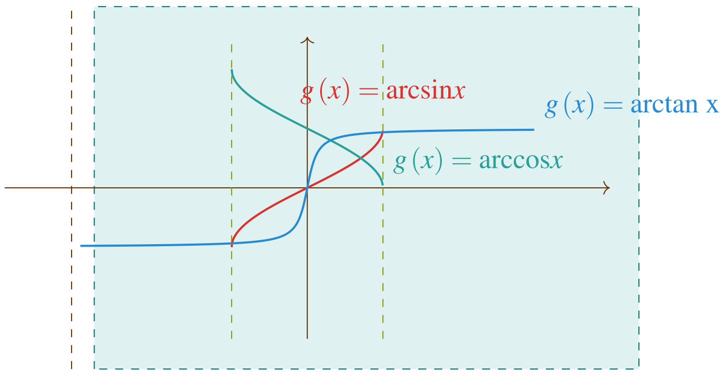



```
\draw[color=blue, thick, domain=-pi:pi,smooth,
 samples=200] plot ({\x},{(tan(\x r))})
node[above right] {\(g\left(x\right)=\tan x\)};
```

```
\draw[color=cyan, thick, domain=-pi:pi,smooth,
 samples=600] plot ({\x},{((1/8)*tan(20*\x r))})
de[below right] {\(g\left(x\right)=\frac{1}{8}
     \tan 20x\)};
```

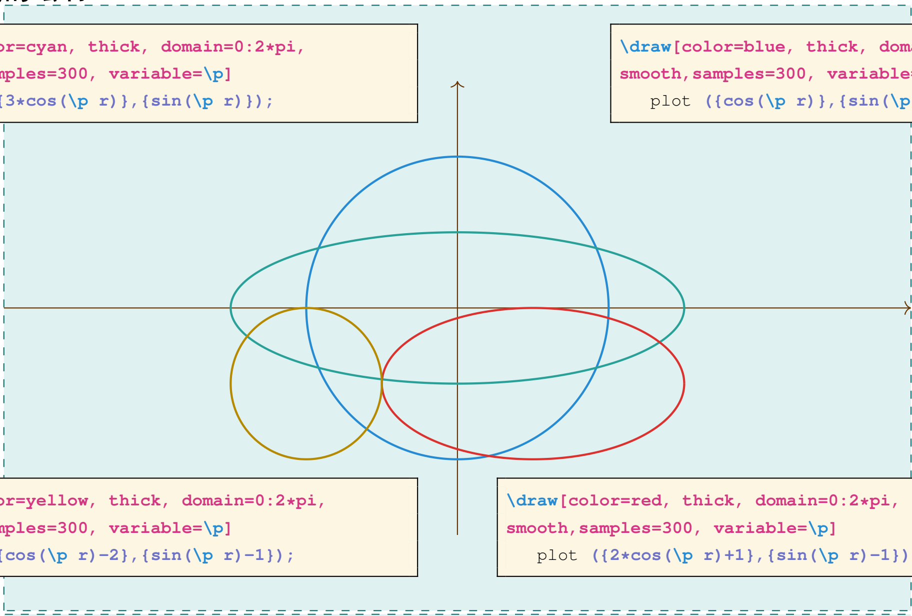



```
in{tikzpicture}[yscale=0.5]
w[color=red, thick, domain=-1:1,smooth, samples=200] plot ({\x
     },{(rad(sin(\x r)))}) node[above right] {\(g\left(x\right
     )=\text{arcsin}^2 x\)};
w[color=cyan, thick, domain=-1:1,smooth, samples=200] plot ({
     \x},{rad(acos(\x r))}) node[above right] {\(g\left(
     x\right)=\text{arccos}^2 x\)};
w[color=blue, thick, domain=-50:50,smooth, samples=200,xscale
     =0.1] plot ({\x},{rad(atan(\x r))}) node[above right] {\(
     g\left(x\right)=\text{arctan x}\)};
ikzpicture}
```



1.2 封闭曲线及参数表达式函数曲线的绘制

封闭曲线的绘制

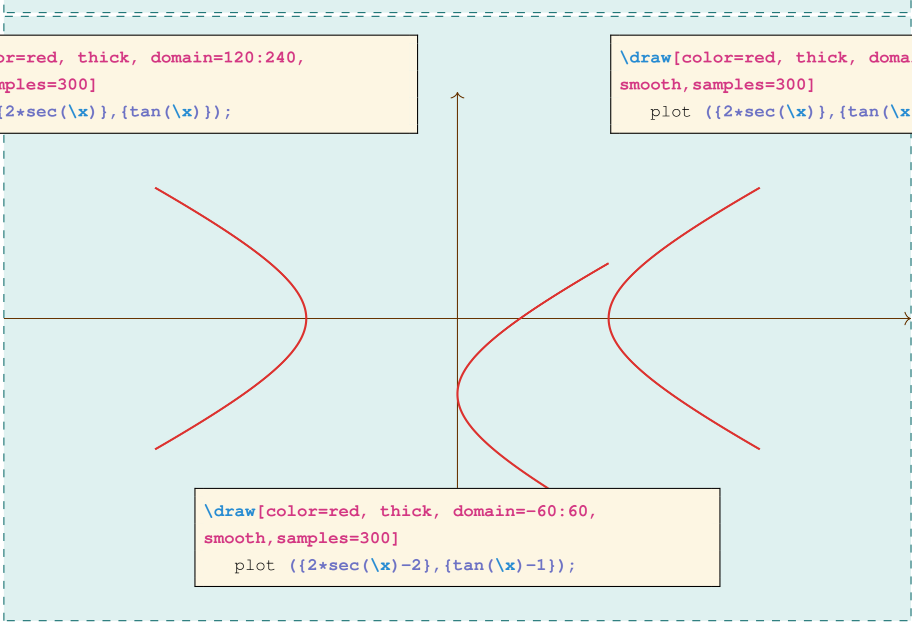


```
\draw[color=cyan, thick, domain=0:2*pi,
smooth,samples=300, variable=\p]
   plot ({3*cos(\p r)},{sin(\p r)});
```

```
\draw[color=blue, thick, domain=0:2*pi,
smooth,samples=300, variable=\p]
   plot ({cos(\p r)},{sin(\p r)});
```

```
\draw[color=yellow, thick, domain=0:2*pi,
smooth,samples=300, variable=\p]
   plot ({cos(\p r)-2},{sin(\p r)-1});
```

```
\draw[color=red, thick, domain=0:2*pi,
smooth,samples=300, variable=\p]
   plot ({2*cos(\p r)+1},{sin(\p r)-1});
```

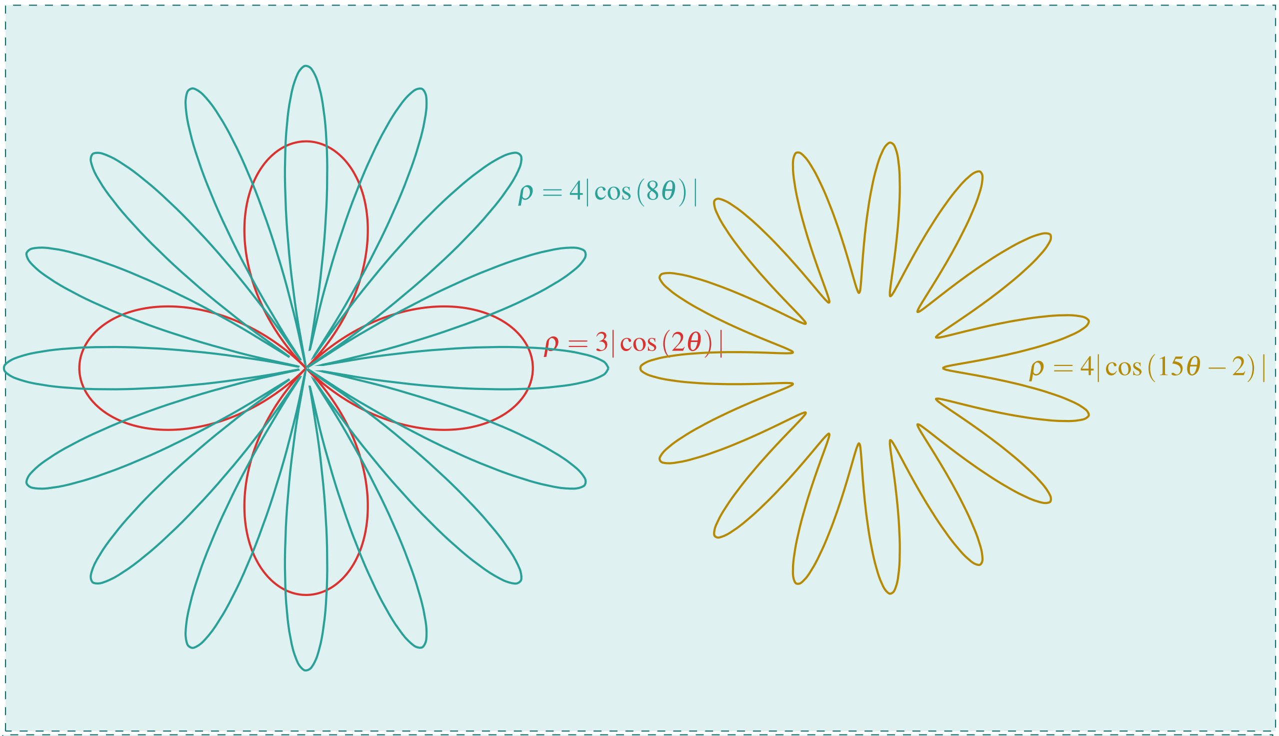


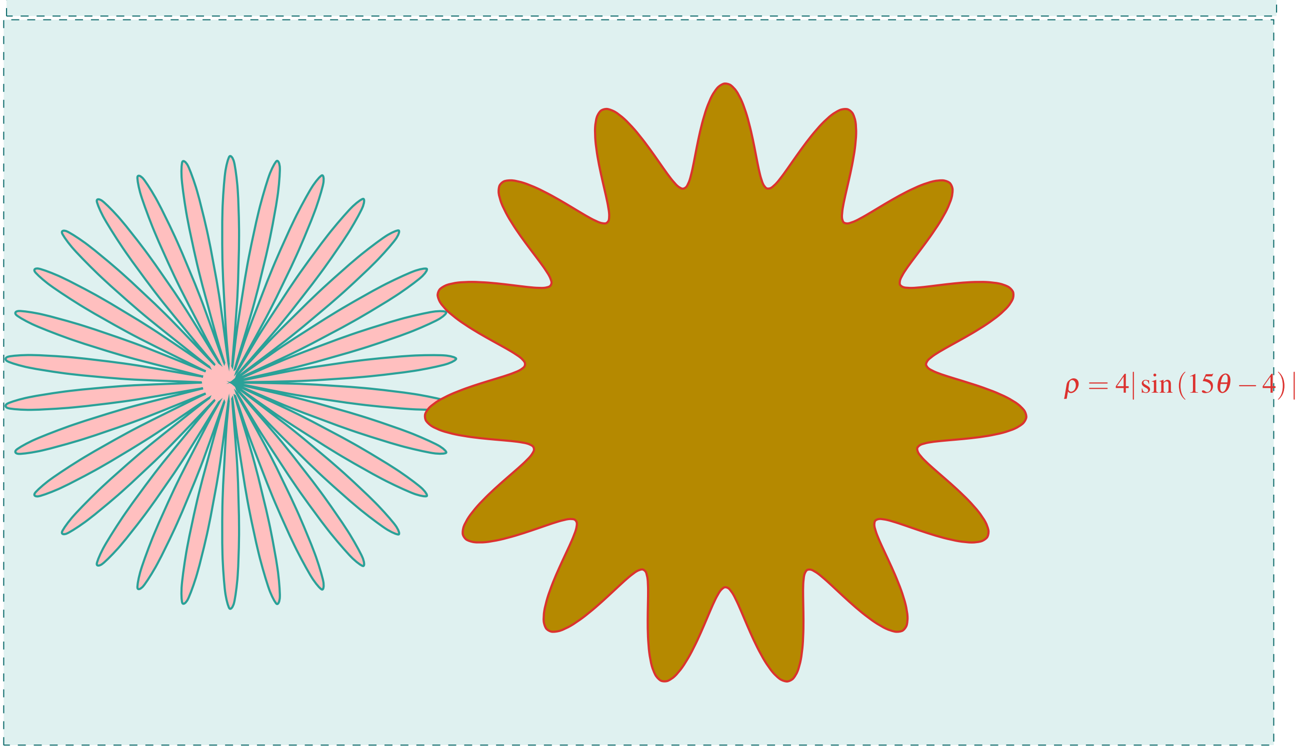
```
\draw[color=red, thick, domain=120:240,
smooth,samples=300]
   plot ({2*sec(\x)},{tan(\x)});
```

```
\draw[color=red, thick, domain=-60:60,
smooth,samples=300]
   plot ({2*sec(\x)},{tan(\x)});
```

```
\draw[color=red, thick, domain=-60:60,
smooth,samples=300]
   plot ({2*sec(\x)-2},{tan(\x)-1});
```

```
 \begin{tikzpicture}[yscale=0.5]
 \draw[->,Orange](-4,0)--(4,0);
 \draw[->,Orange](0,-4)--(0,4);
 \draw[color=red, thick, domain=0:360,smooth,samples=300, variable=\t]plot ({\t}:{3*abs(cos(2*\t))}) node[above right]{\(
      \rho=3|\cos\left(2\theta\right)|\)};
 \draw[color=cyan, thick, domain=0:360,smooth,samples=300, variable=\t]plot ({\t}:{4*abs((cos(8*\t))}) node[above=2cm]{\(
      \rho=4|\cos\left(8\theta\right)|\)};
 \draw[color=yellow, thick, domain=0:360,smooth,samples=300, variable=\t]plot ({\t}:{abs((cos(15*(\t))-2}) node[right=1
      cm]{\(\rho=4|\cos\left(15\theta-2\right)|\)};
{tikzpicture}
```

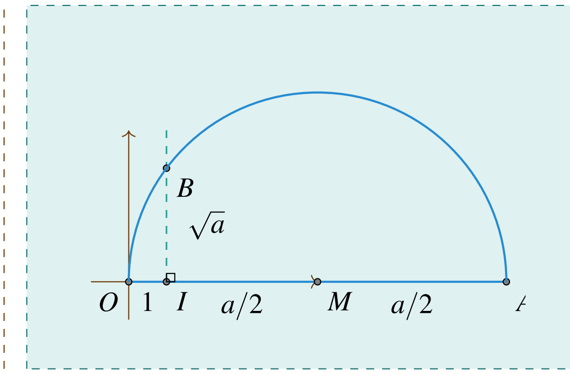

$\rho = 4|\cos(8\theta)|$
$\rho = 3|\cos(2\theta)|$
$\rho = 4|\cos(15\theta - 2)|$


$\rho = 4|\sin(15\theta - 4)|$

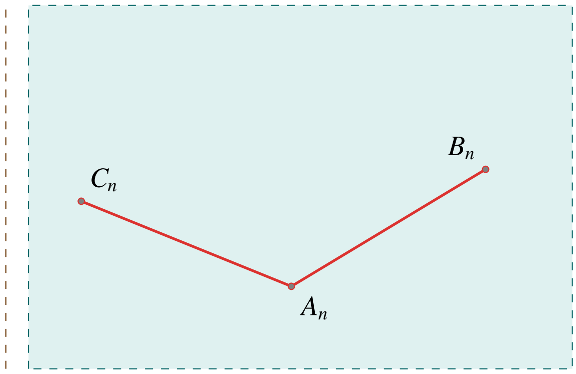
2 TikZ/PGFplots 绘制平面几何

2.1 平面的绘制

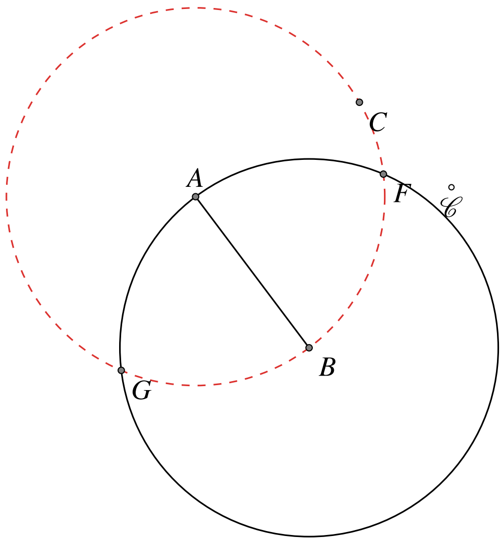
```
\begin{tikzpicture}[scale=0.5]
 \draw[->,Orange](-1,0)--(5,0);\draw[->,Orange](0,-1)--(0,4);
 \tkzInit[ymin=-1,ymax=6,xmin=-1,xmax=10]\tkzClip[space=.5]
\tkzDefPoint(0,0){O}\tkzDefPoint(1,0){I}\tkzDefPoint(10,0){A}
\tkzDefMidPoint(O,A) \tkzGetPoint{M}
\tkzDefPointWith[orthogonal](I,M)
\tkzGetPoint{H}\tkzInterLC(I,H)(M,A)\tkzGetSecondPoint{B}
 \tkzDrawSegment(O,A)\tkzDrawSegment[style=dashed](I,H)
 \tkzDrawPoints(O,I,A,B,M)\tkzDrawArc(M,A)(O)
 \tkzMarkRightAngle(A,I,B)
 \tkzLabelSegment[right=4pt](I,B){$\sqrt{a}$}
 \tkzLabelSegment[below](O,I){$1$}
 \tkzLabelSegment[below](I,M){$a/2$}
 \tkzLabelSegment[below](M,A){$a/2$}
 \tkzLabelPoints(I,M,B,A)
 \tkzLabelPoint[below left](O){$O$}
 \end{tikzpicture}
```



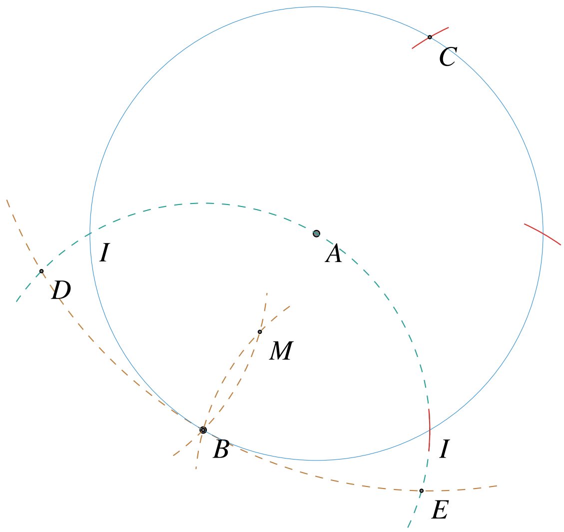

```
\begin{tikzpicture}
\tkzDefPoint[label=-60:$A_n$](2,3){A}
\tkzDefPoint[shift={(2,3)},
label=above left:$B_n$](31:3){B}
\tkzDefPoint[shift={(2,3)},%
label=above right:$C_n$](158:3){C}
\tkzDrawSegments[color=red,%
line width=1pt](A,B A,C)
\tkzDrawPoints[color=red](A,B,C)
\end{tikzpicture}
```



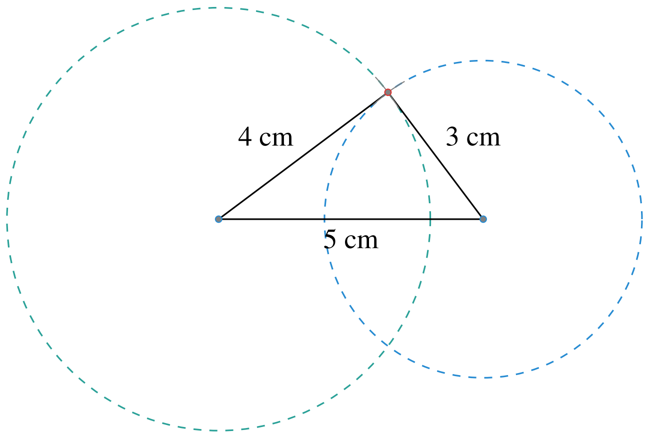

```
\begin{tikzpicture}[scale=.5]\coordinate(A)at(2,3);
\coordinate(B)at(5,-1);\tkzDefPoint[label=below:$\mathcal{C}$,
shift={(2,3)}](-30:5.5){E}\draw(E)circle(2pt);
\begin{scope}[shift=(A)]\tkzDefPoint(30:5){C}
\end{scope}
\tkzCalcLength[cm](A,B)\tkzGetLength{rAB}
\tkzDrawCircle[R,dashed,draw=red](A,\rAB cm)
\tkzDrawCircle(B,A)\tkzInterCC(A,B)(B,A)\tkzGetPoints{F}{G}
\tkzLabelPoints(F,G)\tkzDrawPoints(F,G)\tkzDrawSegment(A,B)
\tkzDrawPoints(A,B,C)\tkzLabelPoints(B,C)\tkzLabelPoints[
     above](A)
\end{tikzpicture}
```



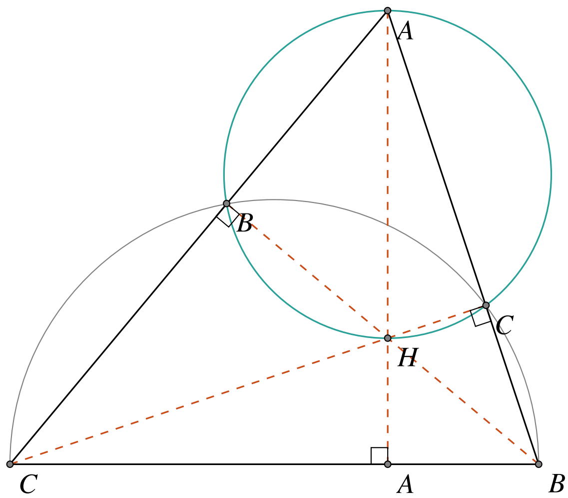
```
\begin{tikzpicture}[scale=.75]\tkzDefPoint(0,0){A}
\tkzGetRandPointOn[circle= center A radius 4cm]{B}
\tkzDrawPoints(A,B)
\tkzDefPointBy[rotation= center A angle 180](B)
\tkzGetPoint{C}\tkzInterCC[R](A,4 cm)(B,4 cm)
\tkzGetPoints{I}{I’}\tkzInterCC[R](A,4 cm)(I,4 cm)
\tkzGetPoints{J}{B}\tkzInterCC(B,A)(C,B)
\tkzGetPoints{D}{E}\tkzInterCC(D,B)(E,B)
\tkzGetPoints{M}{M’}\tikzset{arc/.style
={color=brown,style=dashed,delta=10}}
\tkzDrawArc[arc](C,D)(E)\tkzDrawArc[arc,color=cyan](B,E)(D)
\tkzDrawCircle[color=blue,line width=.2pt](A,B)
\tkzDrawArc[arc](D,B)(M)\tkzDrawArc[arc](E,M)(B)
\tkzCompass[color=red,style=solid](B,II,J J,C)
\tkzDrawPoints(B,C,D,E,M)\tkzLabelPoints(A,B,C,D,E,M,I,I’)
\end{tikzpicture}
```



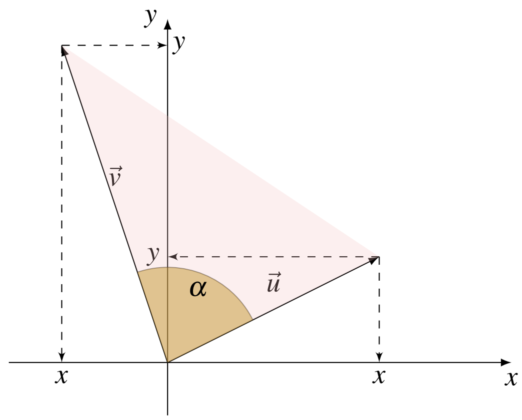

```
\begin{tikzpicture}[scale=.8]
\tkzDefPoint(0,0){A}
\tkzDefPoint(5,0){B}
\tkzDrawCircle[R,dashed](A,4 cm)
\tkzDrawCircle[R,dashed](B,3 cm)
\tkzInterCC[R](A,4 cm)(B,3 cm)
\tkzGetPoints{C}{D}
\tkzDrawPolygon(A,B,C)
\tkzCompass(A,C B,C)
\tkzLabelSegment[below](A,B){$5$ cm}
\tkzLabelSegment[above left](A,C){$4$ cm}
\tkzLabelSegment[above
right](B,C){$3$ cm}
\tkzDrawPoints[color=red](C)
\tkzDrawPoints[color=blue](A,B)
\end{tikzpicture}
```



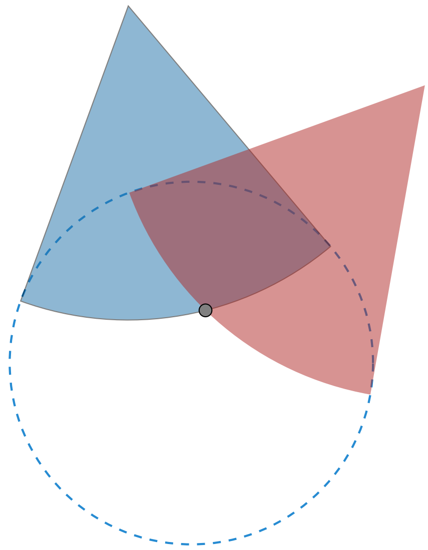

```
\begin{tikzpicture}[scale=1.25]
\tkzInit[xmin= 0,xmax=8 ,ymin=0 ,ymax=7 ] \tkzClip[space=.5]
\tkzDefPoint(0,0){C}\tkzDefPoint(7,0){B}
\tkzDefPoint(5,6){A}\tkzDrawPolygon(A,B,C)
\tkzDefMidPoint(C,B)\tkzGetPoint{I}
\tkzDrawArc(I,B)(C)\tkzInterLC(A,C)(I,B)
\tkzGetSecondPoint{B’ }\tkzInterLC(A,B)(I,B)
\tkzGetFirstPoint{C’ }\tkzInterLL(B,B’ )(C,C’ )
\tkzGetPoint{H}\tkzInterLL(A,H)(C,B)\tkzGetPoint{A’ }
\tkzDrawCircle[circum,color=red](A,B’ ,C’ )
\tkzDrawSegments[color=orange](B,B’  C,C’  A,A’ )
\tkzMarkRightAngles(C,B’ ,B B,C’ ,C C,A’ ,A)
\tkzDrawPoints(A,B,C,A’ ,B’ ,C’ ,H)
\tkzLabelPoints(A,B,C,A’ ,B’ ,C’ ,H)
\end{tikzpicture}
```



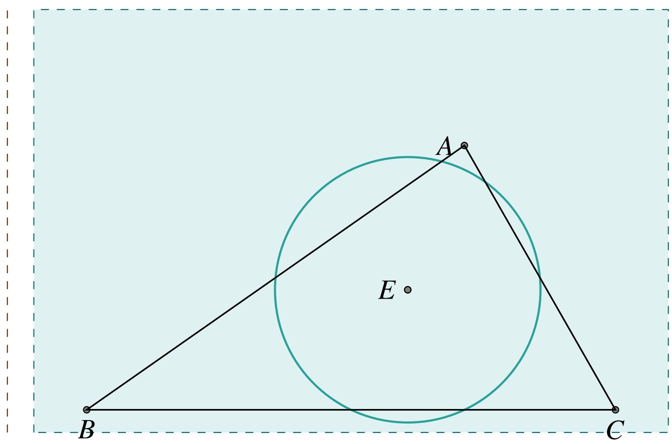
```
\begin{tikzpicture}[scale=0.7]
\tkzInit[xmin=-3,xmax=6,ymin=-1,ymax=6]
\tkzDrawX[noticks]\tkzDrawY[noticks]
\tkzDefPoint(0,0){O}\tkzDefPoint(4,2){A}
\tkzDefPoint(-2,6){B}
\tkzPointShowCoord[xlabel=$x$,ylabel=$y$](A)
%%显示点的坐标
\tkzPointShowCoord[xlabel=$x’$,ylabel=$y’$,%
ystyle={right=2pt}](B)\tkzDrawVectors(O,A O,B)
\tkzLabelSegment[above=3pt](O,A){$\vec{u}$}
\tkzLabelSegment[above=3pt](O,B){$\vec{v}$}
\tkzMarkAngle[fill=yellow,size=1.8cm,%opacity=.5](A,O,B)
\tkzFillPolygon[red!30,opacity=0.25](A,B,O)
\tkzLabelAngle[pos =
1.5](A,O,B){$\alpha$}
\end{tikzpicture}
```



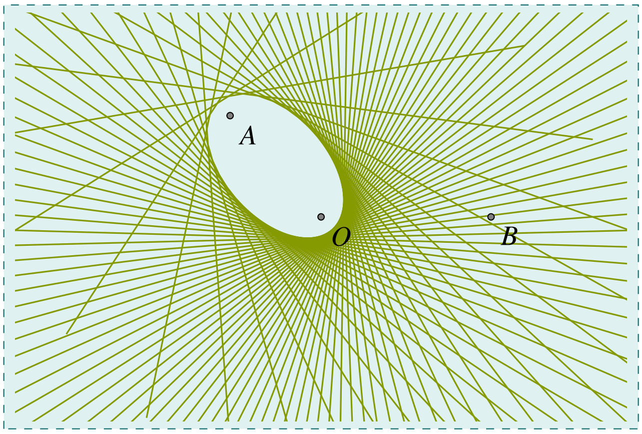

```
\begin{tikzpicture}[scale=0.6]
\tkzInit[xmin=-4.1,xmax=5.2,ymin=-4.1,ymax=8]
\tkzClip[space=.5]
\tkzDefPoint(100:8){A}\tkzDefPoint(50:8){B}
\tkzDefPoint(0,0){C}
\tkzDefPoint(0,4){R}
\tkzDrawCircle(C,R)
\tkzTangent[from = A](C,R)
\tkzGetPoints{D}{E}
\tkzTangent[from = B](C,R)
\tkzGetPoints{F}{G}
\tkzDrawSector[fill=blue!80!black,opacity=0.5](A,D)(E)
\tkzFillSector[color=red!80!black,opacity=0.5](B,F)(G)
\tkzInterCC(A,D)(B,F)
\tkzGetSecondPoint{I}
\tkzDrawPoint[color=black](I)
\end{tikzpicture}
```



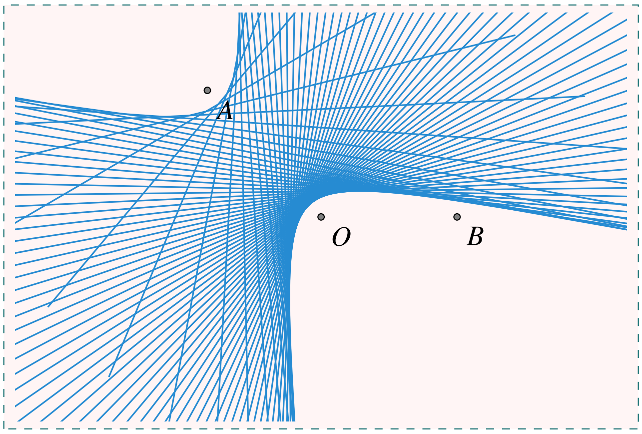
```
\begin{tikzpicture}
\tkzInit[xmin=-1,ymin=-1,xmax=8,ymax=6]
\tkzClip
\tkzDefPoint(5,3.5){A}
\tkzDefPoint(0,0){B}
\tkzDefPoint(7,0){C}
\tkzDefCircle[euler](A,B,C)
\tkzGetPoint{E}
\tkzGetLength{rEuler}
\tkzDrawPoints(A,B,C,E)
\tkzDrawCircle[R,draw=cyan,thick]
(E,\rEuler pt)
\tkzDrawPolygon(A,B,C)
\tkzLabelPoints[below](B,C)
\tkzLabelPoints[left](A,E)
\end{tikzpicture}
```



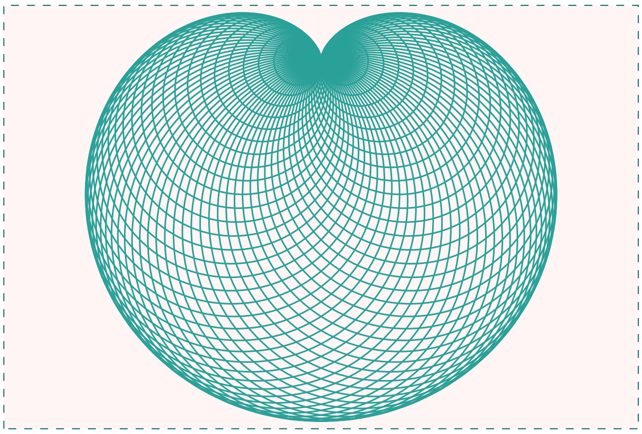
```
\begin{tikzpicture}[scale=0.45]
\tkzInit[xmin=-9,ymin=-6,xmax=9,ymax=6]
\tkzClip
\tkzDefPoint(0,0){O}
\tkzDefPoint(132:4){A}
\tkzDefPoint(5,0){B}
\foreach \ang in {5,10,...,360}{%
\tkzDefPoint(\ang:5){M}
\tkzDefLine[mediator](A,M)
\tkzDrawLine[color=blue,add= 4 and
4](tkzFirstPointResult,
tkzSecondPointResult)}
\tkzDrawPoints(O,A,B)
\tkzLabelPoints(O,A,B)
\end{tikzpicture}
```




```
\begin{tikzpicture}[scale=0.45]
\tkzInit[xmin=-9,ymin=-6,xmax=9,ymax=6]
\tkzClip
\tkzDefPoint(0,0){O}
\tkzDefPoint(132:4){A}
\tkzDefPoint(5,0){B}
\foreach \ang in {5,10,...,360}{%
\tkzDefPoint(\ang:5){M}
\tkzDefLine[mediator](A,M)
\tkzDrawLine[color=blue,add= 4 and
4](tkzFirstPointResult,
tkzSecondPointResult)}
\tkzDrawPoints(O,A,B)
\tkzLabelPoints(O,A,B)
\end{tikzpicture}
```

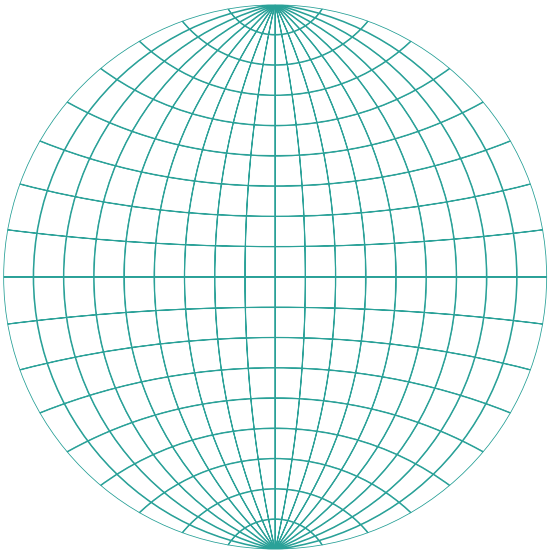


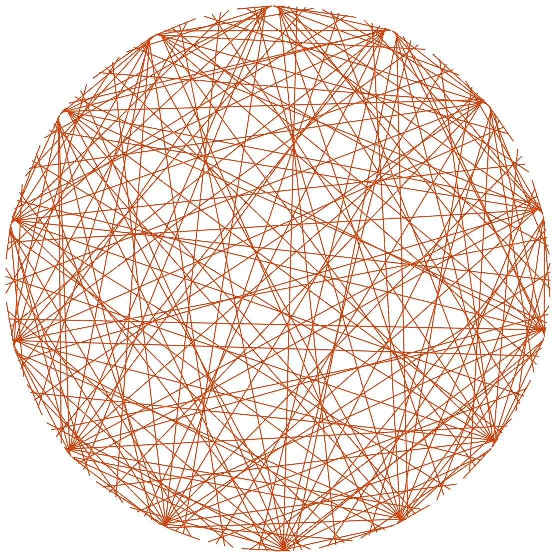

```
\begin{tikzpicture}[scale=0.7]
\draw[Orange,dashed](-6.5,-4)--(-6.5,4);
\draw[draw=Blue,dashed,
fill=pink!15!white](-6,-4) rectangle (6,4);
\node[scale=1] at (0,0) {
\begin{tikzpicture}[scale=0.8]
\tkzDefPoint(0,0){O}
\tkzDefPoint(2,0){A}
\foreach \ang in {5,10,...,360}{
\tkzDefPoint(\ang:2){M}
\tkzDrawCircle[draw=cyan](M,A)
}
\end{tikzpicture}
};
\end{tikzpicture}
```



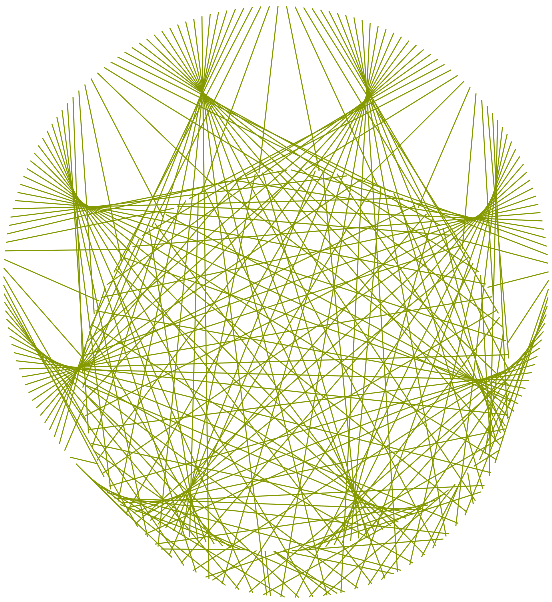
```
\begin{tikzpicture}[scale=.333]\tkzInit[xmin=-10,xmax=10,ymin=-10,ymax=10]
\tkzDefPoint(0 , 0){O}\tkzDefPoint(9,0){A}
\tkzDefPoint(-9, 0){C}\tkzDefPoint(0,9){B}
\tkzDefPoint(0 ,-9){D}\tkzClipCircle(O,A)
\foreach \pti in {1,2,...,8}{
\tkzDefPoint(10*\pti:9){P\pti}\tkzDefPoint(90:\pti){MP\pti}
\tkzDefPoint(0: \pti){NP\pti}\tkzDefLine[mediator](MP\pti,P\pti)
\tkzInterLL(B,D)(tkzFirstPointResult,tkzSecondPointResult)
\tkzDrawCircle[color=cyan](tkzPointResult,P\pti)}
\foreach \pti in {-1,-2,...,-8}{\tkzDefPoint(10*\pti:9){P\pti}
\tkzDefPoint(-90:-\pti){MP\pti}\tkzDefPoint(0: -\pti){NP\pti}
\tkzDefLine[mediator](MP\pti,P\pti)
```

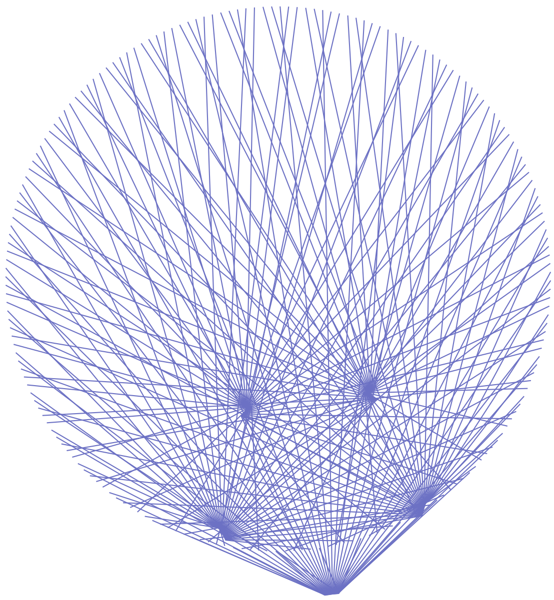
```
\tkzInterLL(B,D)(tkzFirstPointResult,tkzSecondPointResult)
\tkzDrawCircle[color=cyan](tkzPointResult,P\pti)}
\foreach \pti in {1,2,...,8}{\tkzDefLine[mediator](B,NP\pti)
\tkzInterLL(A,C)(tkzFirstPointResult,tkzSecondPointResult)
\tkzDrawCircle[color=cyan](tkzPointResult,NP\pti)}
\foreach \pti in {1,2,...,8}{\tkzDefPoint(0: -\pti){NP\pti}
\tkzDefLine[mediator](B,NP\pti)
\tkzInterLL(A,C)(tkzFirstPointResult,tkzSecondPointResult)
\tkzDrawCircle[color=cyan](tkzPointResult,NP\pti)}
\tkzDrawCircle[R,color=cyan](O,9cm)\tkzDrawSegments[color=cyan](A,CB,D)
\end{tikzpicture}
```





```
egin{tikzpicture}[scale=1]
oreach \i in {0,0.01,...,2}\draw[draw=green,rotate=-124]($(0,0) !1! \i*180:(3,2)$)--($(1,1) !1! \i*1620:(3,3)$);
nd{tikzpicture}
```

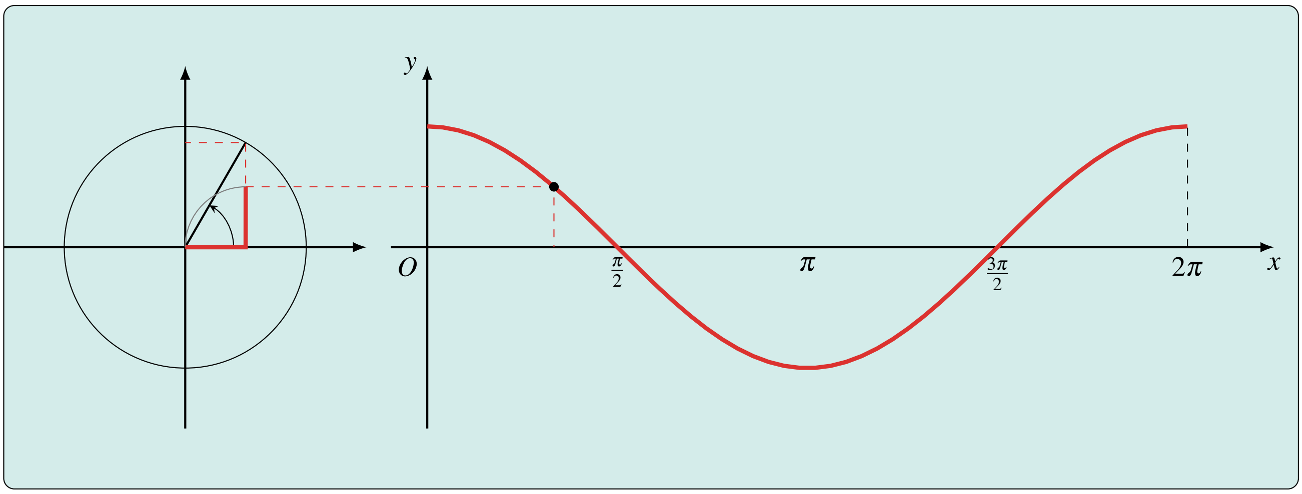





```
egin{tikzpicture}[scale=1]
oreach \i in {0,0.01,...,2}\draw[draw=green,rotate=-124]($(0,0) !1! \i*180:(3,2)$)--($(1,1) !1! \i*1620:(3,3)$);
nd{tikzpicture}
```

3 TikZ/PGFplots + Animate 绘制动画

```
\documentclass{beamer}
\usepackage{tikz, tkz-euclide}
\usepackage{animate}
\usetikzlibrary{math, calc}
\begin{document}
\begin{animateinline}[poster=31, controls={play,step,stop}]{24}
 \multiframe{361}{rtheta=0+1}
 {\begin{tikzpicture}[scale=1]
        \path[use as bounding box] (-3.5,-2) rectangle (7.2,2;
        \draw[rounded corners] (-3.5,-2) rectangle (7.2,2);
        \tikzmath{function fCosseno(\x){return cos(\x);};
          function degreeToRad(\d){ return {pi}*\d/180;};}
        \draw[->,>=latex,thick] (-0.3,0) -- (7,0)node[below]{\(x\)};
        \draw[->,>=latex,thick] (0,-1.5) -- (0,1.5)node[left]{\(y\)};
        \draw[ultra thick, red, samples=50, domain=0:{2*pi}] plot (\x, {cos(\x r)});
        \node at (0,0) [below left]{\(O\)};
        \node at ({pi/2},0) [below]{\(\frac{\pi}{2}\)};
        \node at ({pi},0) [below]{\(\pi\)};
        \node at ({3*pi/2},0) [below]{\(\frac{3\pi}{2}\)};
        \node at ({2*pi},0) [below]{\(2\pi\)};
        \draw[thin, dashed] ({2*pi}, 0) -- ({2*pi},1);\draw (-2,0) circle (1cm);
        \draw[->,>=latex,thick] (-3.5,0) -- (-0.5,0);
        \draw[->,>=latex,thick] (-2,-1.5) -- (-2,1.5);
        \coordinate (A) at (-2,0);\coordinate (B) at (-2,1);
        \coordinate (C) at (-2,-1);\coordinate (D) at (-3,0);
        \coordinate (E) at (-1,0);\coordinate (P) at ($(A) + (\rtheta:1)$);
        \draw[thick] (A) -- (P);
        \draw[thin, dashed, red] ($(D)!(P)!(E)$) -- (P) -- ($(B)!(P)!(C)$);
        \draw[->, >=stealth] (-1.6,0) arc [start angle=0, end angle=\rtheta, radius=0.4];
        \coordinate (Q) at ($(A) + ({fCosseno(\rtheta)},0)$);
        \coordinate (R) at ($({-2+fCosseno(\rtheta)}, {fCosseno(\rtheta)})$);
        \draw[ultra thick, red] (A) -- (Q) -- (R);
        \tkzDrawArc[thin, red](Q,R)(A)
        \draw[thin, red, dashed] (R) -- ({degreeToRad(\rtheta)}, {fCosseno(\rtheta)}) -- ({degreeToRad(\rtheta)},0);
        \draw[fill=black] ({degreeToRad(\rtheta)}, {fCosseno(\rtheta)}) circle (1pt);
      \end{tikzpicture}}
 \end{animateinline}
\end{document}
```



4 TikZ/PGFplots 科学绘图

4.1 PGFplots 数据绘图

4.2 PGFplots 函数绘图