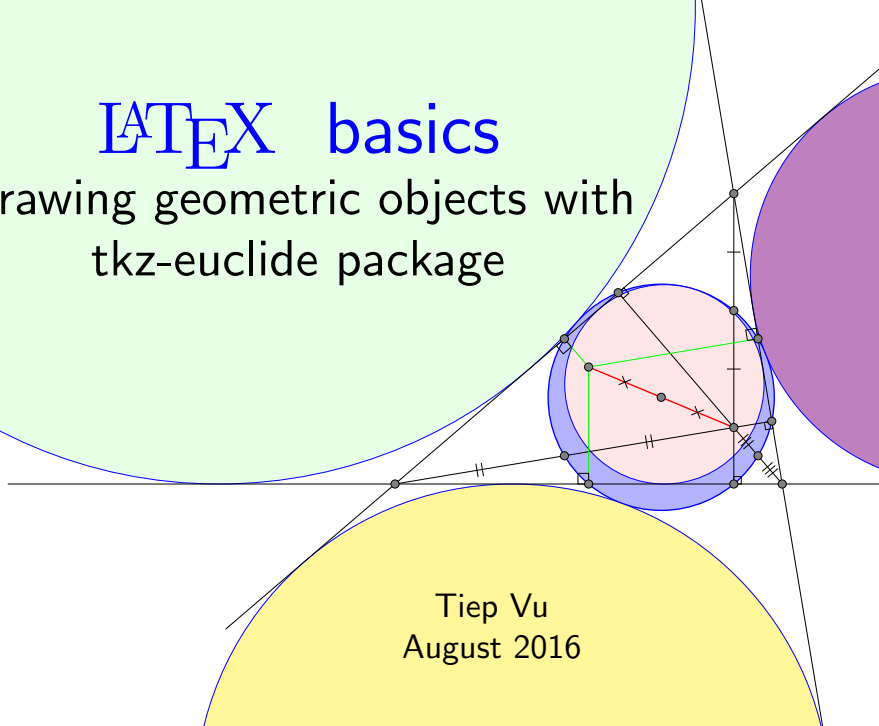# LATEX basics

Drawing geometric objects with tkz-euclide package

Tiep Vu
August 2016

Outline

1 Points
    Points in Cartesian coordinate system
    Polar coordinate system
    Relative coordinates

2 Lines, Segments, Rays
    Connect points
    Intersections
    Orthogonal and Parallel

3 Angles
    Specifying angle
    Labeling and Markers
    Angle bisector

4 Circles
    Drawing Circles
    Circle Intersection
    Circle and Tangents

5 Triangles
    Drawing triangles
    Centroid, Orthocenter, Circumcircle, Inscribed Circle

Drawing in LaTeX

Packages for drawing in LaTeX:

- TikZ
- PSTricks
- ...

Sources: What graphics packages are there for creating graphics in LaTeX documents?
GUI tools for vector graphics:

- GeoGebra (online GeoGebra)
- Inkscape
- . . .

In the following videos, I'll focus on drawing **Euclidean** geometric shapes using tkz-euclide package.

Points
○○○○○

Lines, Segments, Rays
○○○○○○

Angles
○○○○

Circles
○○○○

Triangles
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tkz-euclide

- documentclass

```
\documentclass{standalone}
%\documentclass{article}
```

- package

```
\usepackage{tkz-euclide}
\usetkzobj{all}
```

- main body

```
\begin{document}
% \begin{figure}
\begin{tikzpicture}
    ....
\end{tikzpicture}
% \end{figure}
\end{document}
```
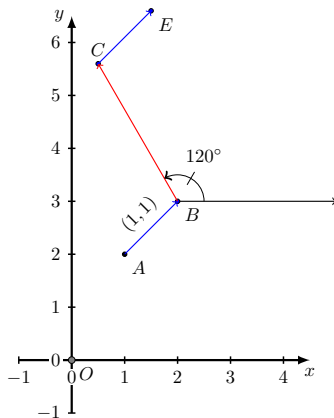
See tkz-euclide examples here.

C

B

A

D

Points
○○○○○

Lines, Segments, Rays
○○○○○○

Angles
○○○○

Circles
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Triangles
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Learn LaTeX

Drawing geometric objects with tkz-euclide package

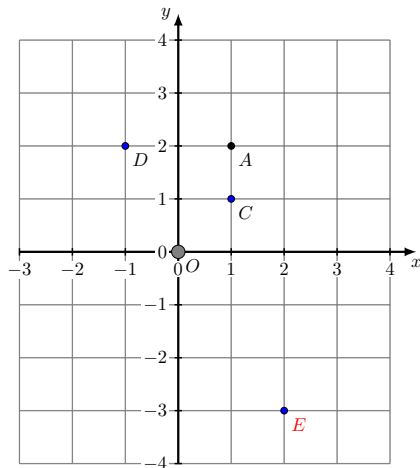# Points

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Points in Cartesian coordinate system

```
%% def_point_Cartesian.tex
...
\begin{document}
\begin{tikzpicture}
   ...
   % Cartesian coordinate (x,y)
   \coordinate (O) at (0, 0);
   \coordinate (A) at (1, 2);
   % using tkz-euclide
   \tkzDefPoint(1,1){C}
   \tkzDefPoints{-1/2/D, 2/-3/E}
   ...
\end{tikzpicture}
\end{document}
```
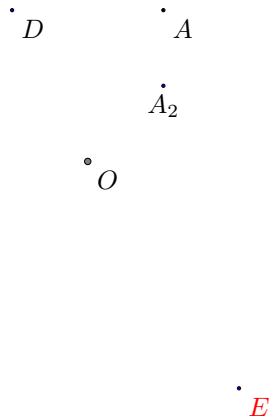
See more here.

Points
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Lines, Segments, Rays
○○○○○○

Angles
○○○○

Circles
○○○○

Triangles
○○○○○○○

Drawing and Labeling points

```
%% draw_label_points.tex
...
\begin{tikzpicture}
  ...
  % drawing points
  \tkzDrawPoints(O)
  \tkzDrawPoints[size=3, fill=black](A)
  \tkzDrawPoints[size=3, fill=blue](D,E)
  % labeling points
  \tkzLabelPoints(O,A,D)
  \tkzLabelPoints[red](E)
  % labeling in mathmode
  \tkzDefPoint[label = below:$A_2$](1,1){A2}
  \tkzDrawPoints[size=3, fill=blue](A2)
\end{tikzpicture}
```

D

A

A_2

O

E

Points
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Lines, Segments, Rays
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Angles
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Circles
0000

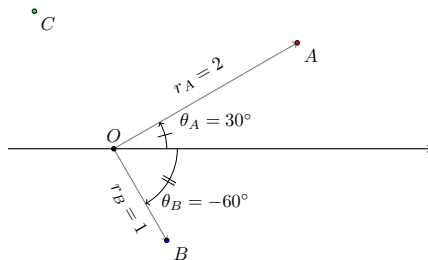Triangles
0000000

Points in polar coordinate system

```
%% def_point_polar.tex
...
\begin{document}
\begin{tikzpicture}
    ...
    \coordinate (O) at (0, 0);
    % polar coordinate, (theta:r)
    \coordinate (A) at (30:2);
    \coordinate (B) at (−60:1);

    \tkzDefPoint(120:1.5){C}
    ...
\end{tikzpicture}
\end{document}
```
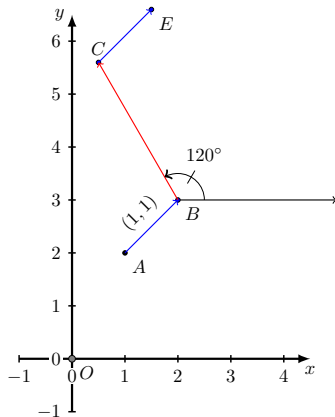
Relative coordinates

```
%% relative_coordinate.tex
% ...
\usepackage{calc}
\begin{document}
\begin{tikzpicture}
    % ...
    \coordinate (O) at (0, 0);
    \coordinate (A) at (1, 2);
    \coordinate (B) at ($(A) + (1, 1)$);
    \coordinate (C) at ($(B) + (120:3)$);
    \coordinate (E) at ($(C)+(B)-(A)$);
    % ...
\end{tikzpicture}
\end{document}
```
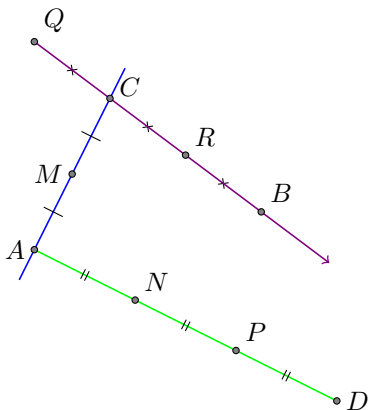
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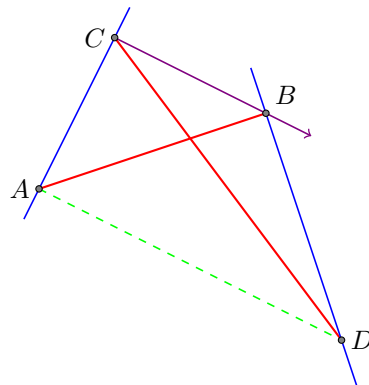
Lines, Segments, Rays

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Line, Segment, Ray, connecting two points

```
%% line_segment_ray.tex
\begin{tikzpicture}
    % ...
    % drawing red segments
    \tkzDrawSegments[red, thick](A,B C,D)
    % drawing dashed green segment
    \tkzDrawSegments[green,dashed](A,D)
    % drawing blue line
    \tkzDrawLines[draw=blue](A,C B,D)
    % array with arrow
    \tkzDrawLines[add = 0 and 0.3, ...
        draw=violet, arrows=->](C,B)
    % ...
\end{tikzpicture}
```
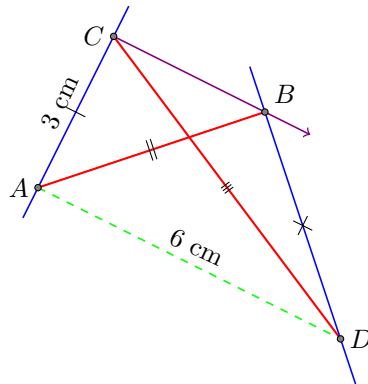
See more here.

Labeling and Markers

```
%% lsr_label_marker.tex
\begin{tikzpicture}
    % ...
    % labeling
    \tkzLabelSegment[above=1pt, ...
        rotate=65](A,C){3 cm}
    \tkzLabelSegment[above=0pt, ...
        rotate=-25](A,D){6 cm}
    % markers
    \tkzMarkSegment[mark=|](A,C)
    \tkzMarkSegment[mark=||](A,B)
    \tkzMarkSegment[mark=|||, size = ...
        2](C,D)
    \tkzMarkSegment[mark=x](B,D)
    % ...
\end{tikzpicture}
```
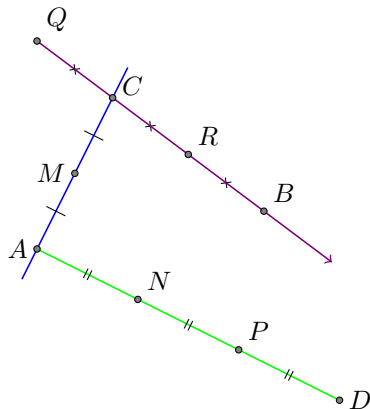
Define a point between two points for a given length ratio

```
%% ratio_point.tex
\begin{tikzpicture}
    % ...
    % middle points
    \tkzDefMidPoint(A,C)\tkzGetPoint{M}
    % others
    \coordinate (N) at ($(A)!1/3!(D)$);
    \coordinate (P) at ($(A)!2/3!(D)$);
    \coordinate (Q) at ($(C)!-1/2!(B)$);
    \coordinate (R) at ($(C)!1/2!(B)$);
    % ...
\end{tikzpicture}
```
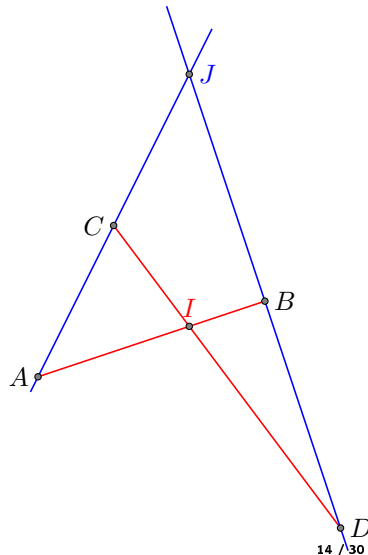
Intersection of two lines

```
%% intersection1.tex
...
\begin{tikzpicture}
   %% defining points
   % InterLL for intersection of ...
       `Line' and `Line'
   \tkzInterLL(A,B)(C,D)  \tkzGetPoint{I}
   \tkzInterLL(A,C)(B,D)  \tkzGetPoint{J}
   %% showing points
\end{tikzpicture}
```
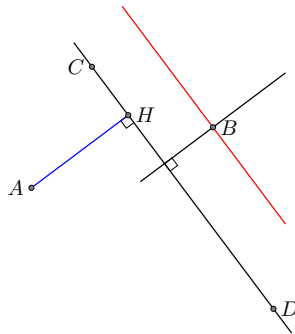
Orthogonal and Parallel lines

```
%% orthogonal_parallel.tex
...
\begin{tikzpicture}
    % ...
    %% orthogonal
    \tkzDefPointBy[projection=onto C--D](A)
    \tkzGetPoint{H}
    \tkzDefLine[orthogonal=through B](C,D)
    \tkzGetPoint{K}
    %% parallel
    \tkzDefLine[parallel=through B](C,D)
    \tkzDrawLine[draw = red, add = .5 and ...
        --.6](B,tkzPointResult)
    % ...
\end{tikzpicture}
```
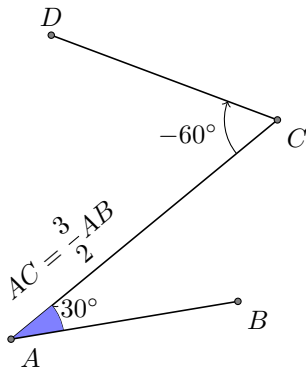
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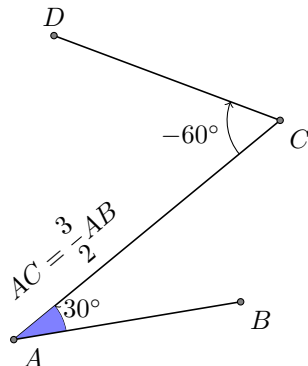
Angles

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Angles

```
%% angle.tex
...
\begin{tikzpicture}
    % ...
    \coordinate (C) at ($(A)!1.5!30:(B)$);
    \coordinate (D) at ($(C)!.7!-60:(A)$);
    % ...
\end{tikzpicture}
```
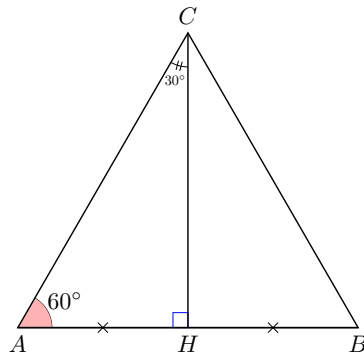
Labeling and Markers

```
%% angle_label_marks.tex
...
\begin{tikzpicture}
    % ...
    % marker
    \tkzMarkAngle[size = .5, fill = ...
        red!30](B,A,C)
    \tkzMarkAngle[size = .5, mark = ...
        ||,mksize=2](A,C,H)
    % labeling
    \tkzLabelAngle[pos=.8](B,A,C){ ...
        $60^\circ$}
    \tkzLabelAngle[pos=1.2,scale = ...
        .6](A,C,H){$30^\circ$}
    % right angle marker
    \tkzMarkRightAngle[draw =blue](A,H,C)
    % ...
\end{tikzpicture}
```
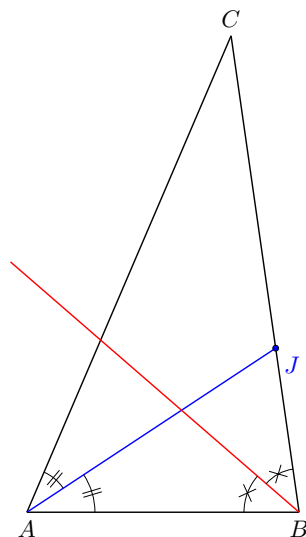
Angle Bisector

```
%% angle_bisector.tex
...
\begin{tikzpicture}
   % ...
   \tkzDefLine[bisector](C,B,A)
   \tkzGetPoint{i}

   \tkzDrawBisector[draw=blue](C,A,B)
   \tkzGetPoint{J}
   % ...
\end{tikzpicture}
```
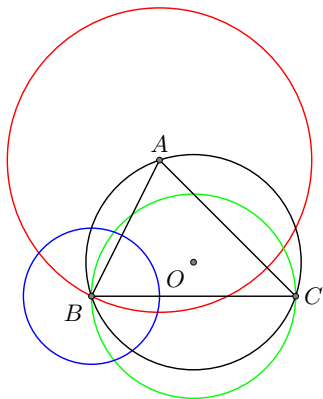
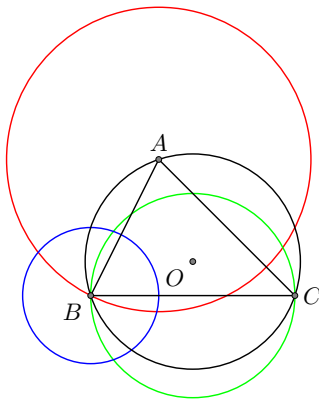Learn LaTeX
Drawing geometric objects with tkz-euclide package

Circles

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Drawing Circles

```
%% circle_1.tex
...
\begin{tikzpicture}
    % ...
    % center A, passing B
    \tkzDrawCircle[draw = red](A,B)
    % diameter BC
    \tkzDrawCircle[diameter, draw = ...
        green](B,C)
    % center B, radius 1 cm
    \tkzDrawCircle[R, draw = blue](B, ...
        1 cm)
    % passing A, B, C
    \tkzDrawCircle[circum](A,B,C)
    % get its center
    \tkzCircumCenter(A,B,C)\tkzGetPoint{O}
    % ...
\end{tikzpicture}
```
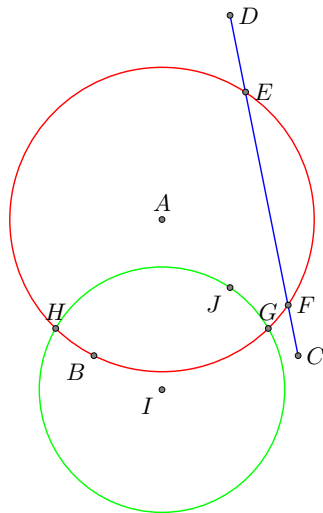
See More Examples here.

Circle Intersection

```
%% circle_intersection.tex
...
\begin{tikzpicture}
    % ...
    % Line—Circle intersection
    \tkzInterLC(C,D)(A,B)
    \tkzGetPoints{E}{F}
    % Circle—Circle intersection
    \tkzInterCC(A,B)(I,J)
    \tkzGetPoints{G}{H}
    % ...
\end{tikzpicture}
```

See More Examples here.

Points
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Lines, Segments, Rays
○○○○○○

Angles
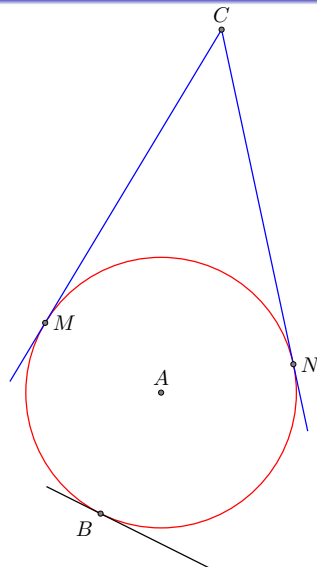○○○○

Circles
○○○●

Triangles
○○○○○○○

Circle and Tangents

```
%% circle_tangent.tex
...
\begin{tikzpicture}
    % ...
    \tkzDrawCircle[draw = red](A,B)
    % from a point on the circle
    \tkzTangent[at=B](A) \tkzGetPoint{h}
    % from a point outside the circle
    \tkzTangent[from=C](A,B)
    \tkzGetPoints{M}{N}
    % ...
\end{tikzpicture}
```
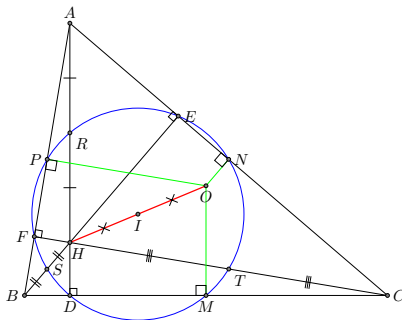
See More Examples here.

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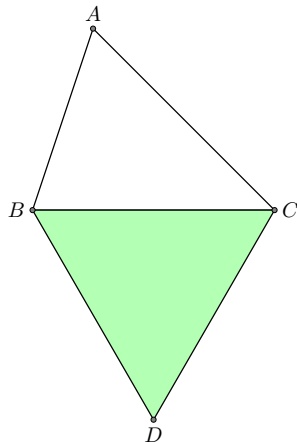
Triangles

Tiep Vu Huu

Drawing triangles

```
%% triangle_1.tex
...
\begin{tikzpicture}
    % ...
    % connecting 3 points
    \tkzDrawPolygon(A,B,C)
    % equilateral triangles
    \tkzDefTriangle[equilateral](C,B)
    \tkzGetPoint{D}
    \tkzDrawPolygon[fill=green!30](B,C,D)
    % ...
\end{tikzpicture}
```
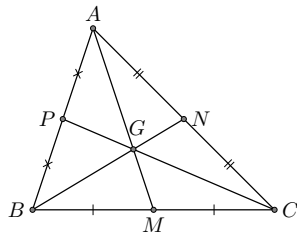
Centroid

```
%% triangle_centroid.tex
...
\begin{tikzpicture}
    % ...
    % get centroid
    \tkzCentroid(A,B,C)\tkzGetPoint{G}
    % drawing median lines
    \tkzDrawLines[add = 0 and 1/2](A,G ...
        B,G C,G)
    % ...
\end{tikzpicture}
```
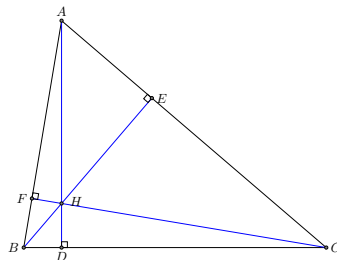
Orthocenter

```
%% triangle_orthocenter.tex
...
\begin{tikzpicture}
   % ...
   % drawing altitudes
  \tkzDrawAltitude[draw ...
      =blue](B,C)(A) \tkzGetPoint{D}
  \tkzDrawAltitude[draw ...
      =blue](A,C)(B) \tkzGetPoint{E}
  \tkzDrawAltitude[draw ...
      =blue](B,A)(C) \tkzGetPoint{F}
  % get the orthocenter
  \tkzInterLL(A,D)(B,E) \tkzGetPoint{H}
   % ...
\end{tikzpicture}
```
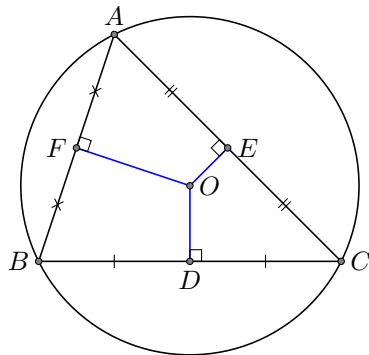
Circumcircle

```
%% triangle_circumcircle.tex
...
\begin{tikzpicture}
   % ...
   % draw the circumcircle
   \tkzDrawCircle[circum](A,B,C)
   % get its center
   \tkzCircumCenter(A,B,C)\tkzGetPoint{O}
   % draw perpendicular bisector lines
   \tkzDrawAltitude[draw ...
       =blue](B,C)(O) \tkzGetPoint{D}
   \tkzDrawAltitude[draw ...
       =blue](A,C)(O) \tkzGetPoint{E}
   \tkzDrawAltitude[draw ...
       =blue](B,A)(O) \tkzGetPoint{F}
   % ...
\end{tikzpicture}
```
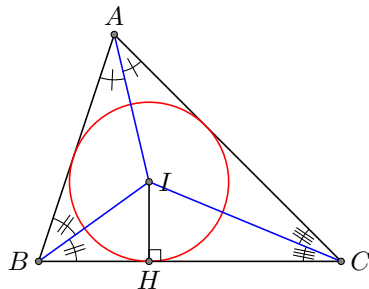
Inscribed circle

```
%% triangle_inscribedcircle.tex
...
\begin{tikzpicture}
   % ...
  % get the inscbided center
  \tkzInCenter(A,B,C) \tkzGetPoint{I}
  % project it into one edge
  \tkzDrawAltitude(B,C)(I) ...
      \tkzGetPoint{H}
  % draw the circle
  \tkzDrawCircle[draw = red](I,H)
   % ...
\end{tikzpicture}
```

Euler circle