tkz-euclide 3.05c

AlterMundus

tkz-euclide

tool for

Euclidean Geometry

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March 21, 2020 Documentation V.3.05c

http://altermundus.fr

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☞ The `tkz-euclide` is a set of convenient macros for drawing in a plane (fundamental two-dimensional object) with a Cartesian coordinate system. It handles the most classic situations in Euclidean Geometry. `tkz-euclide` is built on top of PGF and its associated front-end Ti*k*Z and is a (La)TeX-friendly drawing package. The aim is to provide a high-level user interface to build graphics relatively simply. It uses a Cartesian coordinate system orthogonal provided by the **tkz-base** package as well as tools to define the unique coordinates of points and to manipulate them. The idea is to allow you to follow step by step a construction that would be done by hand as naturally as possible.
Now the package needs the version 3.0 of Ti*k*Z. English is not my native language so there might be some errors.

☞ Firstly, I would like to thank **Till Tantau** for the beautiful LaTeX package, namely Ti*k*Z.

☞ I received much valuable advice, remarks, corrections and examples from **Jean-Côme Charpentier**, **Josselin Noirel**, **Manuel Pégourié-Gonnard**, **Franck Pastor**, **David Arnold**, **Ulrike Fischer**, **Stefan Kottwitz**, **Christian Tellechea**, **Nicolas Kisselhoff**, **David Arnold**, **Wolfgang Büchel**, **John Kitzmiller**, **Dimitri Kapetas**, **Gaétan Marris**, **Mark Wibrow**, **Yves Combe** for his work on a protractor, **Paul Gaborit** and **Laurent** for all his corrections, remarks and questions.

☞ I would also like to thank Eric Weisstein, creator of MathWorld: MathWorld.

☞ You can find some examples on my site: altermundus.fr. under construction!

Please report typos or any other comments to this documentation to: Alain Matthes.

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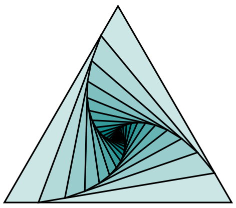
1 Presentation and Overview



```
\begin{tikzpicture}[scale=.25]
\tkzDefPoints{00/0/A,12/0/B,6/12*sind(60)/C}
\foreach \density in {20,30,...,240}{%
  \tkzDrawPolygon[fill=teal!\density](A,B,C)
  \pgfnodealias{X}{A}
  \tkzDefPointWith[linear,K=.15](A,B) \tkzGetPoint{A}
  \tkzDefPointWith[linear,K=.15](B,C) \tkzGetPoint{B}
  \tkzDefPointWith[linear,K=.15](C,X) \tkzGetPoint{C}}
\end{tikzpicture}
```

1.1 Why tkz-euclide?

My initial goal was to provide other mathematics teachers and myself with a tool to quickly create Euclidean geometry figures without investing too much effort in learning a new programming language. Of course, **tkz-euclide** is for math teachers who use LaTeX and makes it possible to easily create correct drawings by means of LaTeX.

It appeared that the simplest method was to reproduce the one used to obtain construction by hand. To describe a construction, you must, of course, define the objects but also the actions that you perform. It seemed to me that syntax close to the language of mathematicians and their students would be more easily understandable; moreover, it also seemed to me that this syntax should be close to that of LaTeX. The objects, of course, are points, segments, lines, triangles, polygons and circles. As for actions, I considered five to be sufficient, namely: define, create, draw, mark and label.

The syntax is perhaps too verbose but it is, I believe, easily accessible. As a result, the students like teachers were able to easily access this tool.

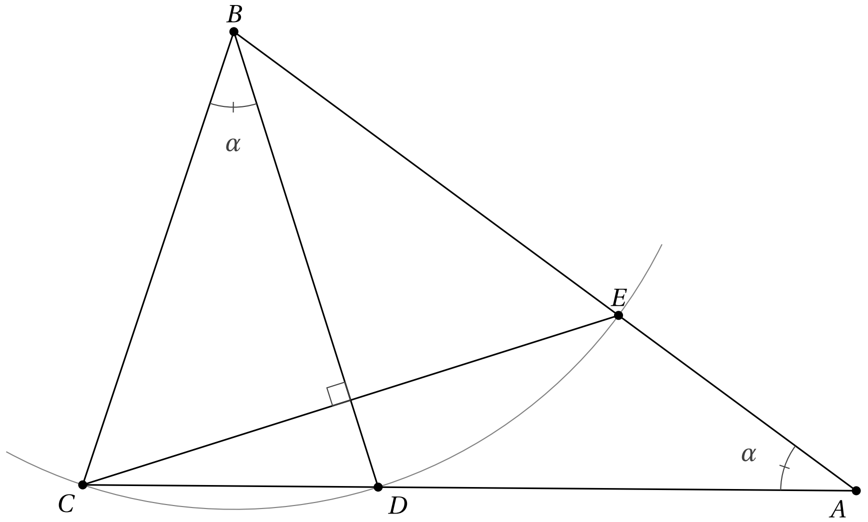
1.2 tkz-euclide vs TikZ

I love programming with Ti*k*Z, and without Ti*k*Z I would never have had the idea to create **tkz-euclide** but never forget that behind it there is Ti*k*Z and that it is always possible to insert code from Ti*k*Z. **tkz-euclide** doesn't prevent you from using Ti*k*Z. That said, I don't think mixing syntax is a good thing.

There is no need to compare Ti*k*Z and **tkz-euclide**. The latter is not addressed to the same audience as Ti*k*Z. The first one allows you to do a lot of things, the second one only does geometry drawings. The first one can do everything the second one does, but the second one will more easily do what you want.

1.3 How it works

1.3.1 Example Part I: gold triangle



Let's analyze the figure

1. CBD and DBE are isosceles triangles;
2. $BC = BE$ and (BD) is a bisector of the angle CBE;
3. From this we deduce that the CBD and DBE angles are equal and have the same measure α

$$\widehat{BAC} + \widehat{ABC} + \widehat{BCA} = 180^\circ \text{ in the triangle } BAC$$

$$3\alpha + \widehat{BCA} = 180^\circ \text{ in the triangle } CBD$$

then

$$\alpha + 2\widehat{BCA} = 180^\circ$$

or

$$\widehat{BCA} = 90^\circ - \alpha/2$$

4. Finally

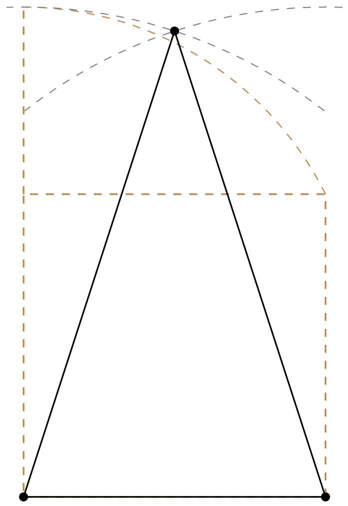
$$\widehat{CBD} = \alpha = 36^\circ$$

the triangle CBD is a "gold" triangle.

How construct a gold triangle or an angle of 36°?

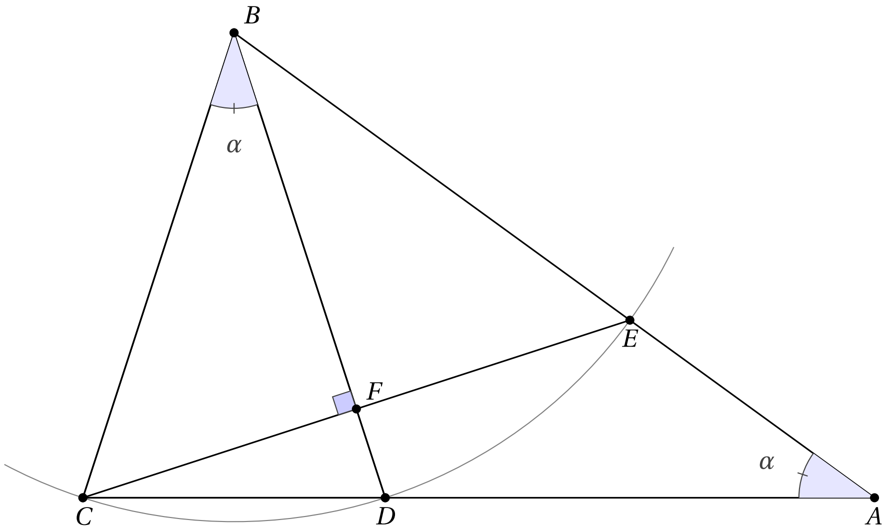
1. We place the fixed points C and D. `\tkzDefPoint(0,0){C}` and `\tkzDefPoint(4,0){D}`;
2. We construct a square $CDef$ and we construct the midpoint m of $[Cf]$;

   We can do all of this with a compass and a rule;
3. Then we trace an arc with center m through e. This arc cross the line (Cf) at n;
4. Now the two arcs with center C and D and radius Cn define the point B.



```
\begin{tikzpicture}
\tkzDefPoint(0,0){C}
\tkzDefPoint(4,0){D}
\tkzDefSquare(C,D)
\tkzGetPoints{e}{f}
\tkzDefMidPoint(C,f)
\tkzGetPoint{m}
\tkzInterLC(C,f)(m,e)
\tkzGetSecondPoint{n}
\tkzInterCC[with nodes](C,C,n)(D,C,n)
\tkzGetFirstPoint{B}
\tkzDrawSegment[brown,dashed](f,n)
\pgfinterruptboundingbox
\tkzDrawPolygon[brown,dashed](C,D,e,f)
\tkzDrawArc[brown,dashed](m,e)(n)
\tkzCompass[brown,dashed,delta=20](C,B)
\tkzCompass[brown,dashed,delta=20](D,B)
\endpgfinterruptboundingbox
\tkzDrawPoints(C,D,B)
\tkzDrawPolygon(B,...,D)
\end{tikzpicture}
```

After building the golden triangle BCD, we build the point A by noticing that $BD = DA$. Then we get the point E and finally the point F. This is done with already intersections of defined objects (line and circle).




```
\begin{tikzpicture}
  \tkzDefPoint(0,0){C}
  \tkzDefPoint(4,0){D}
  \tkzDefSquare(C,D)
  \tkzGetPoints{e}{f}
  \tkzDefMidPoint(C,f)
  \tkzGetPoint{m}
  \tkzInterLC(C,f)(m,e)
  \tkzGetSecondPoint{n}
  \tkzInterCC[with nodes](C,C,n)(D,C,n)
  \tkzGetFirstPoint{B}
  \tkzInterLC(C,D)(D,B) \tkzGetSecondPoint{A}
```

```
  \tkzInterLC(B,A)(B,D) \tkzGetSecondPoint{E}
  \tkzInterLL(B,D)(C,E) \tkzGetPoint{F}
  \tkzDrawPoints(C,D,B)
  \tkzDrawPolygon(B,...,D)
  \tkzDrawPolygon(B,C,D)
  \tkzDrawSegments(D,A A,B C,E)
  \tkzDrawArc[delta=10](B,C)(E)
  \tkzDrawPoints(A,...,F)
  \tkzMarkRightAngle[fill=blue!20](B,F,C)
  \tkzFillAngles[fill=blue!10](C,B,D E,A,D)
  \tkzMarkAngles(C,B,D E,A,D)
  \tkzLabelAngles[pos=1.5](C,B,D E,A,D){$\alpha$}
  \tkzLabelPoints[below](A,C,D,E)
  \tkzLabelPoints[above right](B,F)
\end{tikzpicture}
```

1.3.2 Example Part II: two others methods gold and euclide triangle

tkz-euclide knows how to define a "gold" or "euclide" triangle. We can define BCD and BCA like gold triangles.

```
\begin{tikzpicture}
  \tkzDefPoint(0,0){C}
  \tkzDefPoint(4,0){D}
  \tkzDefTriangle[euclide](C,D)
  \tkzGetPoint{B}
  \tkzDefTriangle[euclide](B,C)
  \tkzGetPoint{A}
  \tkzInterLC(B,A)(B,D) \tkzGetSecondPoint{E}
  \tkzInterLL(B,D)(C,E) \tkzGetPoint{F}
  \tkzDrawPoints(C,D,B)
  \tkzDrawPolygon(B,...,D)
  \tkzDrawPolygon(B,C,D)
  \tkzDrawSegments(D,A A,B C,E)
  \tkzDrawArc[delta=10](B,C)(E)
  \tkzDrawPoints(A,...,F)
  \tkzMarkRightAngle[fill=blue!20](B,F,C)
  \tkzFillAngles[fill=blue!10](C,B,D E,A,D)
  \tkzMarkAngles(C,B,D E,A,D)
  \tkzLabelAngles[pos=1.5](C,B,D E,A,D){$\alpha$}
  \tkzLabelPoints[below](A,C,D,E)
  \tkzLabelPoints[above right](B,F)
\end{tikzpicture}
```

Here is a final method that uses rotations:

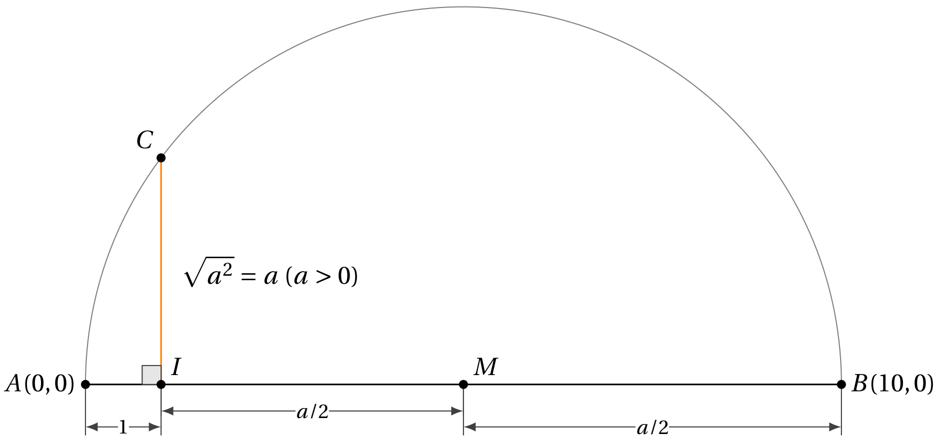
```
\begin{tikzpicture}
\tkzDefPoint(0,0){C} % possible
% \tkzDefPoint[label=below:$C$](0,0){C}
% but don't do this
\tkzDefPoint(2,6){B}
% We get D and E with a rotation
\tkzDefPointBy[rotation= center B angle 36](C) \tkzGetPoint{D}
\tkzDefPointBy[rotation= center B angle 72](C) \tkzGetPoint{E}
% To get A we use an intersection of lines
\tkzInterLL(B,E)(C,D) \tkzGetPoint{A}
\tkzInterLL(C,E)(B,D) \tkzGetPoint{H}
% drawing
```

```
\tkzDrawArc[delta=10](B,C)(E)
\tkzDrawPolygon(C,B,D)
\tkzDrawSegments(D,A B,A C,E)
% angles
\tkzMarkAngles(C,B,D E,A,D) %this is to draw the arcs
\tkzLabelAngles[pos=1.5](C,B,D E,A,D){$\alpha$}
\tkzMarkRightAngle(B,H,C)
\tkzDrawPoints(A,...,E)
% Label only now
\tkzLabelPoints[below left](C,A)
\tkzLabelPoints[below right](D)
\tkzLabelPoints[above](B,E)
\end{tikzpicture}
```

1.3.3 Complete but minimal example

A unit of length being chosen, the example shows how to obtain a segment of length $\sqrt{a}$ from a segment of length a, using a ruler and a compass.

$IB = a$, $AI = 1$



Comments

– The Preamble

Let us first look at the preamble. If you need it, you have to load **xcolor** before **tkz-euclide**, that is, before Ti*k*Z. Ti*k*Z may cause problems with the active characters, but... provides a library in its latest version that's supposed to solve these problems babel.

```
\documentclass{standalone} % or another class
   % \usepackage{xcolor} % before tikz or tkz-euclide if necessary
\usepackage{tkz-euclide} % no need to load TikZ
   % \usetkzobj{all}  is no longer necessary
   % \usetikzlibrary{babel}  if there are problems with the active characters
```

The following code consists of several parts:

– Definition of fixed points: the first part includes the definitions of the points necessary for the construction, these are the fixed points. The macros `\tkzInit` and `\tkzClip` in most cases are not necessary.

```
\tkzDefPoint(0,0){A}
\tkzDefPoint(1,0){I}
```

– The second part is dedicated to the creation of new points from the fixed points; a B point is placed at 10 cm from A. The middle of $[AB]$ is defined by M and then the orthogonal line to the (AB) line is searched for at the I point. Then we look for the intersection of this line with the semi-circle of center M passing through A.

```
\tkzDefPointBy[homothety=center A ratio  10 ](I)
   \tkzGetPoint{B}
\tkzDefMidPoint(A,B)
   \tkzGetPoint{M}
\tkzDefPointWith[orthogonal](I,M)
   \tkzGetPoint{H}
\tkzInterLC(I,H)(M,A)
   \tkzGetSecondPoint{B}
```

– The third one includes the different drawings;

```
\tkzDrawSegment[style=orange](I,H)
\tkzDrawPoints(O,I,A,B,M)
\tkzDrawArc(M,A)(O)
\tkzDrawSegment[dim={$1$,-16pt,}](O,I)
\tkzDrawSegment[dim={$a/2$,-10pt,}](I,M)
\tkzDrawSegment[dim={$a/2$,-16pt,}](M,A)
```

– Marking: the fourth is devoted to marking;

```
\tkzMarkRightAngle(A,I,B)
```

– Labelling: the latter only deals with the placement of labels.

```
\tkzLabelPoint[left](O){$A(0,0)$}
\tkzLabelPoint[right](A){$B(10,0)$}
\tkzLabelSegment[right=4pt](I,B){$\sqrt{a^2}=a \ (a>0)$}
```

– The full code:

```
\begin{tikzpicture}[scale=1,ra/.style={fill=gray!20}]
   % fixed points
   \tkzDefPoint(0,0){A}
   \tkzDefPoint(1,0){I}
   % calculation
   \tkzDefPointBy[homothety=center A ratio  10 ](I) \tkzGetPoint{B}
   \tkzDefMidPoint(A,B)              \tkzGetPoint{M}
   \tkzDefPointWith[orthogonal](I,M) \tkzGetPoint{H}
   \tkzInterLC(I,H)(M,B)             \tkzGetSecondPoint{C}
   \tkzDrawSegment[style=orange](I,C)
   \tkzDrawArc(M,B)(A)
   \tkzDrawSegment[dim={$1$,-16pt,}](A,I)
   \tkzDrawSegment[dim={$a/2$,-10pt,}](I,M)
   \tkzDrawSegment[dim={$a/2$,-16pt,}](M,B)
   \tkzMarkRightAngle[ra](A,I,C)
   \tkzDrawPoints(I,A,B,C,M)
   \tkzLabelPoint[left](A){$A(0,0)$}
   \tkzLabelPoints[above right](I,M)
   \tkzLabelPoints[above left](C)
   \tkzLabelPoint[right](B){$B(10,0)$}
   \tkzLabelSegment[right=4pt](I,C){$\sqrt{a^2}=a \ (a>0)$}
```

```
\end{tikzpicture}
```

1.4 The Elements of tkz code

In this paragraph, we start looking at the ”rules” and ”symbols” used to create a figure with **tkz-euclide**.

The primitive objects are points. You can refer to a point at any time using the name given when defining it. (it is possible to assign a different name later on).

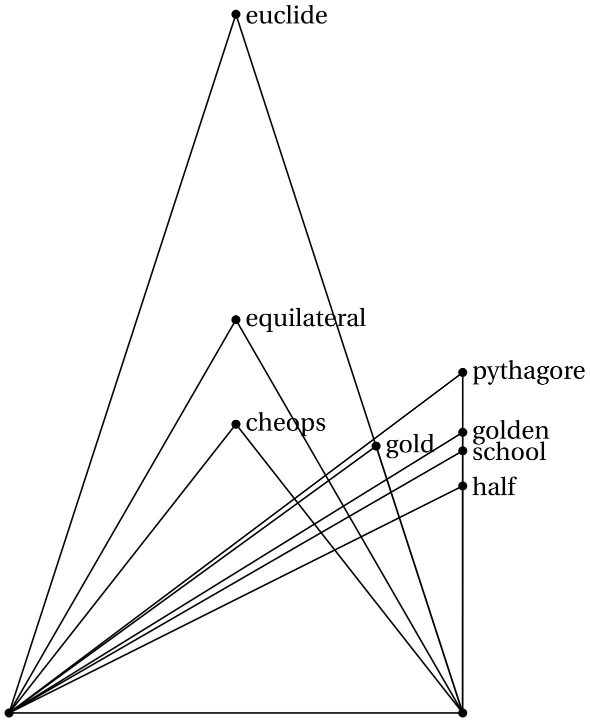
In general, **tkz-euclide** macros have a name beginning with tkz. There are four main categories starting with: `\tkzDef...` `\tkzDraw...` `\tkzMark...` and `\tkzLabel...`

Among the first category, `\tkzDefPoint` allows you to define fixed points. It will be studied in detail later. Here we will see in detail the macro `\tkzDefTriangle`.

This macro makes it possible to associate to a pair of points a third point in order to define a certain triangle `\tkzDefTriangle(A,B)`. The obtained point is referenced `tkzPointResult` and it is possible to choose another reference with `\tkzGetPoint{C}` for example. Parentheses are used to pass arguments. In `(A,B)` *A* and *B* are the points with which a third will be defined.

However, in `{C}` we use braces to retrieve the new point. In order to choose a certain type of triangle among the following choices: `equilateral`, `half`, `pythagoras`, `school`, `golden or sublime`, `euclide`, `gold`, `cheops`... and `two angles` you just have to choose between hooks, for example:

`\tkzDefTriangle[euclide](A,B) \tkzGetPoint{C}`




```
\begin{tikzpicture}[scale=.75]
\tkzDefPoints{0/0/A,8/0/B}
\foreach \tr in {equilateral,half,pythagore,%
        school,golden,euclide, gold,cheops}
{\tkzDefTriangle[\tr](A,B) \tkzGetPoint{C}
\tkzDrawPoint(C)
\tkzLabelPoint[right](C){\tr}
\tkzDrawSegments(A,C C,B)}
\tkzDrawPoints(A,B)
\tkzDrawSegments(A,B)
\end{tikzpicture}
```

1.5 Notations and conventions

I deliberately chose to use the geometric French and personal conventions to describe the geometric objects represented. The objects defined and represented by **tkz-euclide** are points, lines and circles located in a plane. They are the primary objects of Euclidean geometry from which we will construct figures.

According to **Euclidian** these figures will only illustrate pure ideas produced by our brain. Thus a point has no dimension and therefore no real existence. In the same way the line has no width and therefore no existence in the real world. The objects that we are going to consider are only representations of ideal mathematical objects.

tkz-euclide will follow the steps of the ancient Greeks to obtain geometrical constructions using the ruler and the compass.

Here are the notations that will be used:

– The points are represented geometrically either by a small disc or by the intersection of two lines (two straight lines, a straight line and a circle or two circles). In this case, the point is represented by a cross.


```
\begin{tikzpicture}
  \tkzDefPoints{0/0/A,4/2/B}
  \tkzDrawPoints(A,B)
  \tkzLabelPoints(A,B)
\end{tikzpicture}
```

or else


```
\begin{tikzpicture}
  \tkzSetUpPoint[shape=cross, color=red]
  \tkzDefPoints{0/0/A,4/2/B}
  \tkzDrawPoints(A,B)
  \tkzLabelPoints(A,B)
  \end{tikzpicture}
```

The existence of a point being established, we can give it a label which will be a capital letter (with some exceptions) of the Latin alphabet such as A, B or C. For example:

- O is a center for a circle, a rotation, etc.;
- M defined a midpoint;
- H defined the foot of an altitude;
- P' is the image of P by a transformation ;

It is important to note that the reference name of a point in the code may be different from the label to designate it in the text. So we can define a point A and give it as label P. In particular the style will be different, point A will be labeled A.


```
\begin{tikzpicture}
  \tkzDefPoints{0/0/A}
  \tkzDrawPoints(A)
  \tkzLabelPoint(A){$P$}
\end{tikzpicture}
```

Exceptions: some points such as the middle of the sides of a triangle share a characteristic, so it is normal that their names also share a common character. We will designate these points by M_a, M_b and M_c or M_A, M_B and M_C.

In the code, these points will be referred to as: M_A, M_B and M_C.

Another exception relates to intermediate construction points which will not be labelled. They will often be designated by a lowercase letter in the code.

– The line segments are designated by two points representing their ends in square brackets: $[AB]$.

– The straight lines are in Euclidean geometry defined by two points so A and B define the straight line (AB). We can also designate this stright line using the Greek alphabet and name it (δ) or (Δ). It is also possible to designate the straight line with lowercase letters such as d and d'.

– The semi-straight line is designated as follows $[AB)$.

– Relation between the straight lines. Two perpendicular (AB) and (CD) lines will be written $(AB) \perp (CD)$ and if they are parallel we will write $(AB) \parallel (CD)$.

– The lengths of the sides of triangle ABC are AB, AC and BC. The numbers are also designated by a lowercase letter so we will write: $AB = c$, $AC = b$ and $BC = a$. The letter a is also used to represent an angle, and r is frequently used to represent a radius, d a diameter, l a length, d a distance.

– Polygons are designated afterwards by their vertices so ABC is a triangle, $EFGH$ a quadrilateral.

– Angles are generally measured in degrees (ex 60°) and in an equilateral ABC triangle we will write $\widehat{ABC} = \widehat{B} = 60^\circ$.

– The arcs are designated by their extremities. For example if A and B are two points of the same circle then $\wideparen{AB}$.

– Circles are noted either $\mathscr{C}$ if there is no possible confusion or $\mathscr{C}(O\,;\,A)$ for a circle with center O and passing through the point A or $\mathscr{C}(O\,;\,1)$ for a circle with center O and radius 1 cm.

– Name of the particular lines of a triangle: I used the terms bisector, bisector out, mediator (sometimes called perpendicular bisectors), altitude, median and symmedian.

– (x_1,y_1) coordinates of the point A_1, (x_A,y_A) coordinates of the point A.

1.6 How to use the tkz-euclide package ?

1.6.1 Let's look at a classic example

In order to show the right way, we will see how to build an equilateral triangle. Several possibilities are open to us, we are going to follow the steps of Euclid.

– First of all you have to use a document class. The best choice to test your code is to create a single figure with the class **standalone**.

```
\documentclass{standalone}
```

– Then load the **tkz-euclide** package:

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

You don't need to load TikZ because the **tkz-euclide** package works on top of TikZ and loads it.

– ~~\usetkzobjall~~ With the new version 3.03 you don't need this line anymore. All objects are now loaded.

– Start the document and open a TikZ picture environment:

```
\begin{document}
\begin{tikzpicture}
```

– Now we define two fixed points:

```
\tkzDefPoint(0,0){A}
\tkzDefPoint(5,2){B}
```

– Two points define two circles, let's use these circles:

circle with center A through B and circle with center B through A. These two circles have two points in common.

```
\tkzInterCC(A,B)(B,A)
```

We can get the points of intersection with

```
\tkzGetPoints{C}{D}
```

– All the necessary points are obtained, we can move on to the final steps including the plots.

```
\tkzDrawCircles[gray,dashed](A,B B,A)
\tkzDrawPolygon(A,B,C)% The triangle
```

– Draw all points A, B, C and D:

```
\tkzDrawPoints(A,...,D)
```

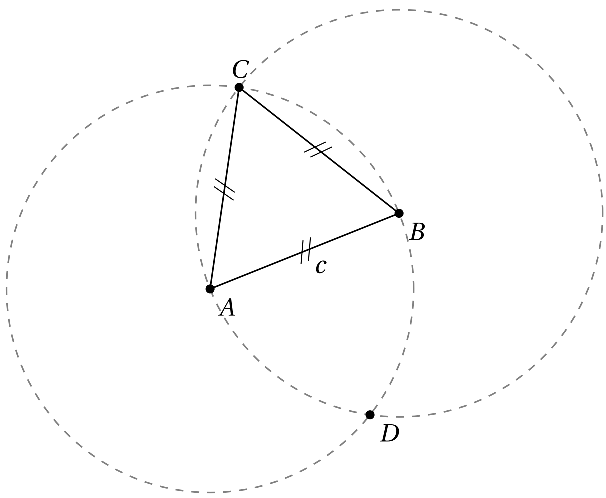
– The final step, we print labels to the points and use options for positioning:

```
\tkzLabelSegments[swap](A,B){$c$}
\tkzLabelPoints(A,B,D)
\tkzLabelPoints[above](C)
```

– We finally close both environments

```
\end{tikzpicture}
\end{document}
```

– The complete code




```
\begin{tikzpicture}[scale=.5]
  % fixed points
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,2){B}
  % calculus
  \tkzInterCC(A,B)(B,A)
  \tkzGetPoints{C}{D}
  % drawings
  \tkzDrawCircles[gray,dashed](A,B B,A)
  \tkzDrawPolygon(A,B,C)
  \tkzDrawPoints(A,...,D)
  % marking
  \tkzMarkSegments[mark=s||](A,B B,C C,A)
  % labelling
  \tkzLabelSegments[swap](A,B){$c$}
  \tkzLabelPoints(A,B,D)
  \tkzLabelPoints[above](C)
\end{tikzpicture}
```

1.6.2 Set, Calculate, Draw, Mark, Label

The title could have been: `Separation of Calculus and Drawings`

When a document is prepared using the LaTeX system, the source code of the document can be divided into two parts: the document body and the preamble. Under this methodology, publications can be structured, styled and typeset with minimal effort. I propose a similar methodology for creating figures with **tkz-euclide**.

The first part defines the fixed points, the second part allows the creation of new points. These are the two main parts. All that is left to do is to draw, mark and label.

2 Installation

tkz-euclide and tkz-base are now on the server of the CTAN[1]. If you want to test a beta version, just put the following files in a texmf folder that your system can find. You will have to check several points:

- The tkz-base and tkz-euclide folders must be located on a path recognized by **latex**.
- The xfp[2], numprint and tikz 3.00 must be installed as they are mandatory, for the proper functioning of tkz-euclide.
- This documentation and all examples were obtained with **lualatex-dev** but **pdflatex** should be suitable.

2.1 List of folder files tkzbase and tkzeuclide

In the folder **base**:

- **tkz-base.cfg**
- **tkz-base.sty**
- **tkz-lib-marks.tex**
- **tkz-obj-axes.tex**
- **tkz-obj-grids.tex**
- **tkz-obj-marks.tex**
- **tkz-obj-points.tex**
- **tkz-obj-rep.tex**
- **tkz-tools-arith.tex**
- **tkz-tools-base.tex**
- **tkz-tools-BB.tex**
- **tkz-tools-misc.tex**
- **tkz-tools-modules.tex**
- **tkz-tools-print.tex**
- **tkz-tools-text.tex**
- **tkz-tools-utilities.tex**

In the folder **euclide**:

- **tkz-euclide.sty**
- **tkz-obj-eu-angles.tex**
- **tkz-obj-eu-arcs.tex**
- **tkz-obj-eu-circles.tex**
- **tkz-obj-eu-compass.tex**
- **tkz-obj-eu-draw-circles.tex**
- **tkz-obj-eu-draw-lines.tex**
- **tkz-obj-eu-draw-polygons.tex**
- **tkz-obj-eu-draw-triangles.tex**

1 tkz-base and tkz-euclide are part of TeXLive and tlmgr allows you to install them. These packages are also part of MiKTeX under Windows.
2 xfp replaces fp.

- tkz-obj-eu-lines.tex
- tkz-obj-eu-points-by.tex
- tkz-obj-eu-points-rnd.tex
- tkz-obj-eu-points-with.tex
- tkz-obj-eu-points.tex
- tkz-obj-eu-polygons.tex
- tkz-obj-eu-protractor.tex
- tkz-obj-eu-sectors.tex
- tkz-obj-eu-show.tex
- tkz-obj-eu-triangles.tex
- tkz-tools-angles.tex
- tkz-tools-intersections.tex
- tkz-tools-math.tex

Now **tkz-euclide** loads all the files.

3 News and compatibility

Some changes have been made to make the syntax more homogeneous and especially to distinguish the definition and search for coordinates from the rest, i.e. drawing, marking and labelling. In the future, the definition macros being isolated, it will be easier to introduce a phase of coordinate calculations using **Lua**.

An important novelty is the recent replacement of the `fp` package by `xfp`. This is to improve the calculations a little bit more and to make it easier to use.

Here are some of the changes.

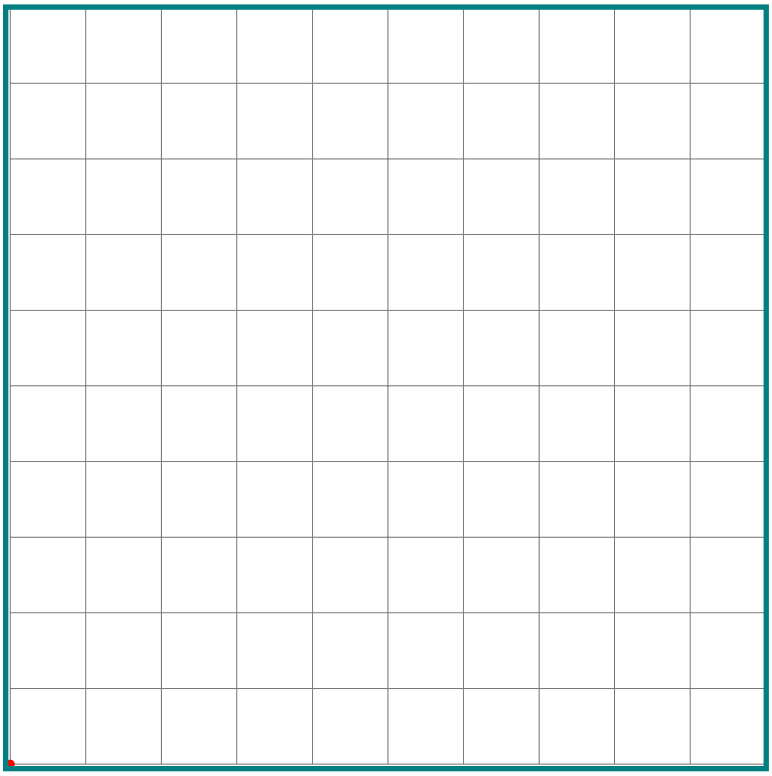
- Improved code and bug fixes;
- With **tkz-euclide** loads all objects, so there's no need to place `\usetkzobj{all}`;
- The bounding box is now controlled in each macro (hopefully) to avoid the use of `\tkzInit` followed by `\tkzClip`;
- Added macros for the bounding box: `\tkzSaveBB` `\tkzClipBB` and so on;
- Logically most macros accept Ti*k*Z options. So I removed the "duplicate" options when possible thus the "label options" option is removed;
- Random points are now in `tkz-euclide` and the macro `\tkzGetRandPointOn` is replaced by `\tkzDefRandPointOn`. For homogeneity reasons, the points must be retrieved with `\tkzGetPoint`;
- The options `end` and `start` which allowed to give a label to a straight line are removed. You now have to use the macro `\tkzLabelLine`;
- Introduction of the libraries `quotes` and `angles`; it allows to give a label to a point, even if I am not in favour of this practice;
- The notion of vector disappears, to draw a vector just pass "->" as an option to `\tkzDrawSegment`;
- Many macros still exist, but are obsolete and will disappear:
  - `\tkzDrawMedians` trace and create midpoints on the sides of a triangle. The creation and drawing separation is not respected so it is preferable to first create the coordinates of these points with `\tkzSpcTriangle[median]` and then to choose the ones you are going to draw with `\tkzDrawSegments` or `\tkzDrawLines`;
  - `\tkzDrawMedians(A,B)(C)` is now spelled `\tkzDrawMedians(A,C,B)`. This defines the median from C;
  - Another example `\tkzDrawTriangle[equilateral]` was handy but it is better to get the third point with `\tkzDefTriangle[equilateral]` and then draw with `\tkzDrawPolygon`;
  - `\tkzDefRandPointOn` is replaced by `\tkzGetRandPointOn`;
  - now `\tkzTangent` is replaced by `\tkzDefTangent`;
  - You can use `global path name` if you want find intersection but it's very slow like in Ti*k*Z.
- Appearance of the macro `\usetkztool` which allows to load new "tools".

4 Definition of a point

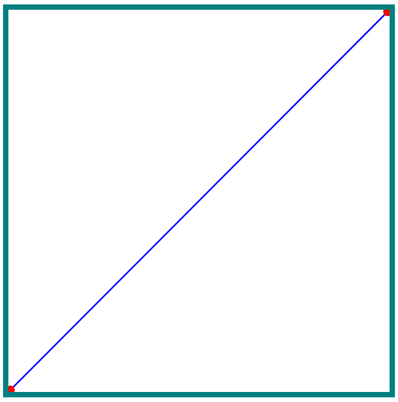
Points can be specified in any of the following ways:

- Cartesian coordinates;
- Polar coordinates;
- Named points;
- Relative points.

Even if it's possible, I think it's a bad idea to work directly with coordinates. Preferable is to use named points. A point is defined if it has a name linked to a unique pair of decimal numbers. Let (x, y) or $(a : d)$ i.e. (x abscissa, y ordinate) or (a angle: d distance). This is possible because the plan has been provided with an orthonormed Cartesian coordinate system. The working axes are supposed to be (ortho)normed with unity equal to 1 cm or something equivalent like 0.39370 in. Now by default if you use a grid or axes, the rectangle used is defined by the coordinate points: $(0, 0)$ and $(10, 10)$. It's the macro `\tkzInit` of the package `tkz-base` that creates this rectangle. Look at the following two codes and the result of their compilation:



```
\begin{tikzpicture}
\tkzGrid
\tkzDefPoint(0,0){O}
\tkzDrawPoint[red](O)
\tkzShowBB[line width=2pt,teal]
\end{tikzpicture}
```

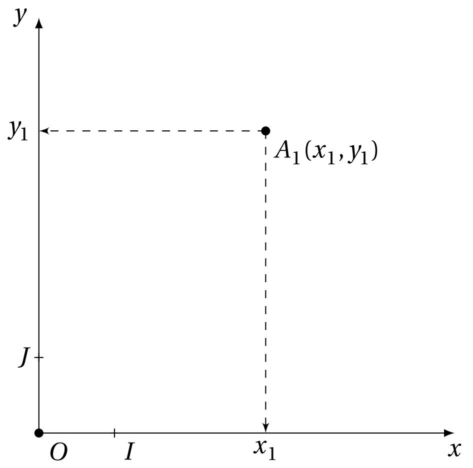


```
\begin{tikzpicture}
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(5,5){A}
 \tkzDrawSegment[blue](O,A)
 \tkzDrawPoints[red](O,A)
 \tkzShowBB[line width=2pt,teal]
\end{tikzpicture}
```

The Cartesian coordinate (a,b) refers to the point a centimeters in the x-direction and b centimeters in the y-direction.

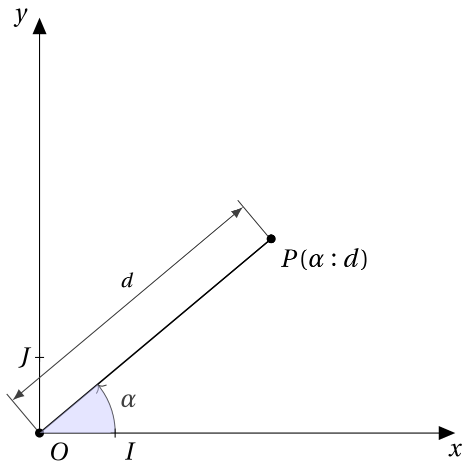
A point in polar coordinates requires an angle α, in degrees, and a distance d from the origin with a dimensional unit by default it's the `cm`.

Cartesian coordinates




```
\begin{tikzpicture}[scale=1]
  \tkzInit[xmax=5,ymax=5]
  \tkzDefPoints{0/0/O,1/0/I,0/1/J}
  \tkzDrawXY[noticks,>=latex]
  \tkzDefPoint(3,4){A}
  \tkzDrawPoints(O,A)
  \tkzLabelPoint(A){$A_1 (x_1,y_1)$}
  \tkzShowPointCoord[xlabel=$x_1$,
                     ylabel=$y_1$](A)
  \tkzLabelPoints(O,I)
  \tkzLabelPoints[left](J)
  \tkzDrawPoints[shape=cross](I,J)
\end{tikzpicture}
```

Polar coordinates




```
\begin{tikzpicture}[,scale=1]
  \tkzInit[xmax=5,ymax=5]
  \tkzDefPoints{0/0/O,1/0/I,0/1/J}
  \tkzDefPoint(40:4){P}
  \tkzDrawXY[noticks,>=triangle 45]
  \tkzDrawSegment[dim={$d$,
                  16pt,above=6pt}](O,P)
  \tkzDrawPoints(O,P)
  \tkzMarkAngle[mark=none,->](I,O,P)
  \tkzFillAngle[fill=blue!20,
                opacity=.5](I,O,P)
  \tkzLabelAngle[pos=1.25](I,O,P){$\alpha$}
  \tkzLabelPoint(P){$P  (\alpha : d )$}
  \tkzDrawPoints[shape=cross](I,J)
  \tkzLabelPoints(O,I)
  \tkzLabelPoints[left](J)
\end{tikzpicture}
```

The **`\tkzDefPoint`** macro is used to define a point by assigning coordinates to it. This macro is based on **`\coordinate`**, a macro of Ti*k*Z. It can use Ti*k*Z-specific options such as **`shift`**. If calculations are required then the `xfp` package is chosen. We can use Cartesian or polar coordinates.

4.1 Defining a named point \tkzDefPoint

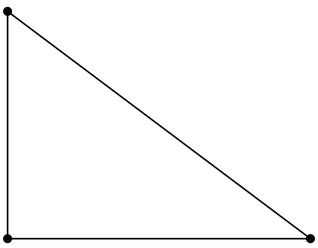
`\tkzDefPoint[⟨local options⟩](⟨x,y⟩){⟨name⟩} or (⟨α:d⟩){⟨name⟩}`

arguments	default	definition
(x,y)	no default	x and y are two dimensions, by default in cm.
$(\alpha:d)$	no default	α is an angle in degrees, d is a dimension
{name}	no default	Name assigned to the point: A, T_a ,$P1$ etc ...

The obligatory arguments of this macro are two dimensions expressed with decimals, in the first case they are two measures of length, in the second case they are a measure of length and the measure of an angle in degrees.

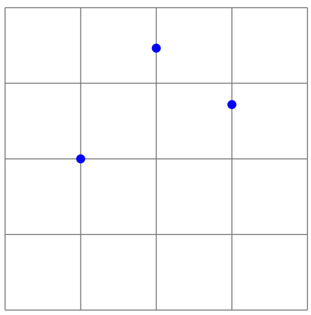
options	default	definition
label	no default	allows you to place a label at a predefined distance
shift	no default	adds (x,y) or $(\alpha:d)$ to all coordinates

4.1.1 Cartesian coordinates



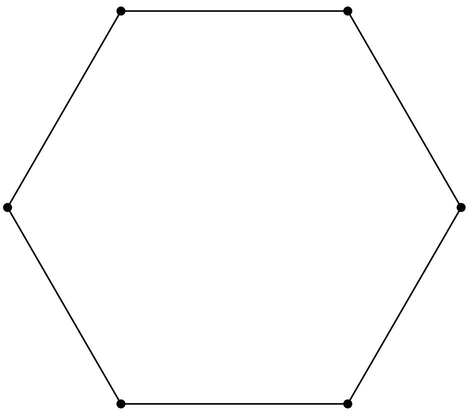
```
\begin{tikzpicture}
\tkzInit[xmax=5,ymax=5]
\tkzDefPoint(0,0){A}
\tkzDefPoint(4,0){B}
\tkzDefPoint(0,3){C}
\tkzDrawPolygon(A,B,C)
\tkzDrawPoints(A,B,C)
\end{tikzpicture}
```

4.1.2 Calculations with xfp



```
\begin{tikzpicture}[scale=1]
  \tkzInit[xmax=4,ymax=4]
  \tkzGrid
  \tkzDefPoint(-1+2,sqrt(4)){O}
  \tkzDefPoint({3*ln(exp(1))},{exp(1)}){A}
  \tkzDefPoint({4*sin(pi/6)},{4*cos(pi/6)}){B}
  \tkzDrawPoints[color=blue](O,B,A)
\end{tikzpicture}
```

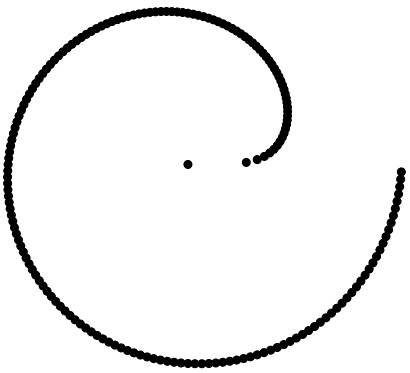
4.1.3 Polar coordinates



```
\begin{tikzpicture}
\foreach \an [count=\i] in {0,60,...,300}
 { \tkzDefPoint(\an:3){A_\i}}
\tkzDrawPolygon(A_1,A_...,A_6)
\tkzDrawPoints(A_1,A_...,A_6)
\end{tikzpicture}
```

4.1.4 Calculations and coordinates

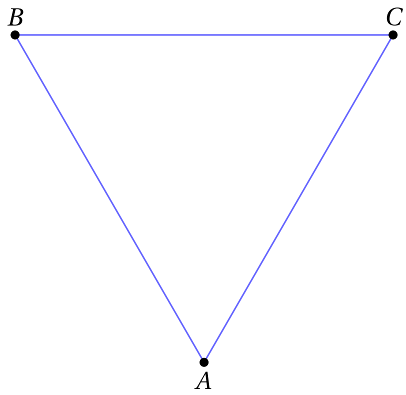
You must follow the syntax of `xfp` here. It is always possible to go through `pgfmath` but in this case, the coordinates must be calculated before using the macro `\tkzDefPoint`.



```
\begin{tikzpicture}[scale=.5]
\foreach \an [count=\i] in {0,2,...,358}
 { \tkzDefPoint(\an:sqrt(sqrt(\an mm))){A_\i}}
 \tkzDrawPoints(A_1,A_...,A_180)
\end{tikzpicture}
```

4.1.5 Relative points

First, we can use the **scope** environment from TikZ. In the following example, we have a way to define an equilateral triangle.




```
\begin{tikzpicture}[scale=1]
  \tkzSetUpLine[color=blue!60]
 \begin{scope}[rotate=30]
  \tkzDefPoint(2,3){A}
  \begin{scope}[shift=(A)]
     \tkzDefPoint(90:5){B}
     \tkzDefPoint(30:5){C}
  \end{scope}
 \end{scope}
 \tkzDrawPolygon(A,B,C)
\tkzLabelPoints[above](B,C)
\tkzLabelPoints[below](A)
\tkzDrawPoints(A,B,C)
\end{tikzpicture}
```

4.2 Point relative to another: \tkzDefShiftPoint

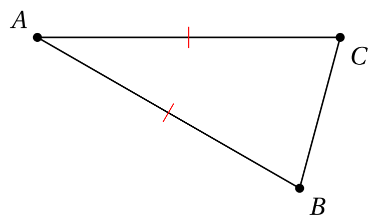
\tkzDefShiftPoint[⟨Point⟩](⟨x,y⟩){⟨name⟩} or (⟨$\alpha:d$⟩){⟨name⟩}

arguments	default	definition
(x,y)	no default	x and y are two dimensions, by default in cm.
($\alpha:d$)	no default	α is an angle in degrees, d is a dimension

options	default	definition
[pt]	no default	\tkzDefShiftPoint[A](0:4){B}

4.2.1 Isosceles triangle with \tkzDefShiftPoint

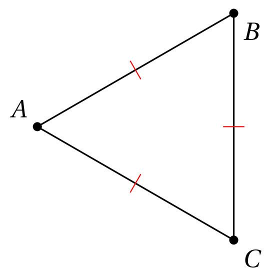
This macro allows you to place one point relative to another. This is equivalent to a translation. Here is how to construct an isosceles triangle with main vertex A and angle at vertex of 30°.




```
\begin{tikzpicture}[rotate=-30]
 \tkzDefPoint(2,3){A}
 \tkzDefShiftPoint[A](0:4){B}
 \tkzDefShiftPoint[A](30:4){C}
 \tkzDrawSegments(A,B B,C C,A)
 \tkzMarkSegments[mark=|,color=red](A,B A,C)
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints(B,C)
 \tkzLabelPoints[above left](A)
\end{tikzpicture}
```

4.2.2 Equilateral triangle

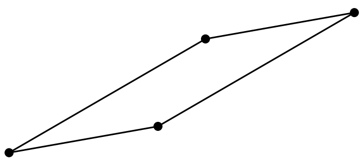
Let's see how to get an equilateral triangle (there is much simpler)




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoint(2,3){A}
 \tkzDefShiftPoint[A](30:3){B}
 \tkzDefShiftPoint[A](-30:3){C}
 \tkzDrawPolygon(A,B,C)
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints(B,C)
 \tkzLabelPoints[above left](A)
 \tkzMarkSegments[mark=|,color=red](A,B A,C B,C)
\end{tikzpicture}
```

4.2.3 Parallelogram

There's a simpler way



```
\begin{tikzpicture}
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(30:3){B}
 \tkzDefShiftPointCoord[B](10:2){C}
 \tkzDefShiftPointCoord[A](10:2){D}
 \tkzDrawPolygon(A,...,D)
 \tkzDrawPoints(A,...,D)
\end{tikzpicture}
```

4.3 Definition of multiple points: \tkzDefPoints

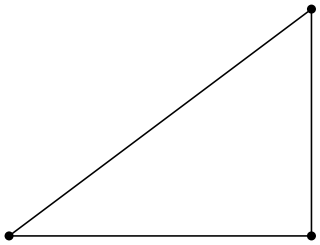
\tkzDefPoints[⟨local options⟩]{⟨$x_1/y_1/n_1,x_2/y_2/n_2$, ...⟩}

x_i and y_i are the coordinates of a referenced point n_i

arguments	default	example
$x_i/y_i/n_i$		\tkzDefPoints{0/0/O,2/2/A}

options	default	definition
shift	no default	Adds (x,y) or $(\alpha:d)$ to all coordinates

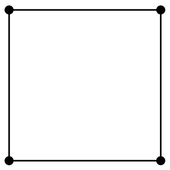
4.4 Create a triangle



```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/A,4/0/B,4/3/C}
 \tkzDrawPolygon(A,B,C)
 \tkzDrawPoints(A,B,C)
\end{tikzpicture}
```

4.5 Create a square

Note here the syntax for drawing the polygon.



```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/A,2/0/B,2/2/C,0/2/D}
 \tkzDrawPolygon(A,...,D)
 \tkzDrawPoints(A,B,C,D)
\end{tikzpicture}
```

5 Special points

The introduction of the dots was done in `tkz-base`, the most important macro being `\tkzDefPoint`. Here are some special points.

5.1 Middle of a segment `\tkzDefMidPoint`

It is a question of determining the middle of a segment.

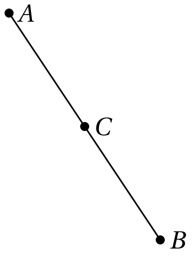
`\tkzDefMidPoint(⟨pt1,pt2⟩)`

The result is in `tkzPointResult`. We can access it with `\tkzGetPoint`.

arguments	default	definition
(pt1,pt2)	no default	pt1 and pt2 are two points

5.1.1 Use of `\tkzDefMidPoint`

Review the use of `\tkzDefPoint` in `tkz-base`.




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoint(2,3){A}
 \tkzDefPoint(4,0){B}
 \tkzDefMidPoint(A,B) \tkzGetPoint{C}
 \tkzDrawSegment(A,B)
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints[right](A,B,C)
\end{tikzpicture}
```

5.2 Barycentric coordinates

$pt_1, pt_2, \ldots, pt_n$ being n points, they define n vectors $\overrightarrow{v_1}, \overrightarrow{v_2}, \ldots, \overrightarrow{v_n}$ with the origin of the referential as the common endpoint. $\alpha_1, \alpha_2, \ldots \alpha_n$ are n numbers, the vector obtained by:

$$\frac{\alpha_1 \overrightarrow{v_1} + \alpha_2 \overrightarrow{v_2} + \cdots + \alpha_n \overrightarrow{v_n}}{\alpha_1 + \alpha_2 + \cdots + \alpha_n}$$

defines a single point.

`\tkzDefBarycentricPoint(⟨pt1=α1,pt2=α2,...⟩)`

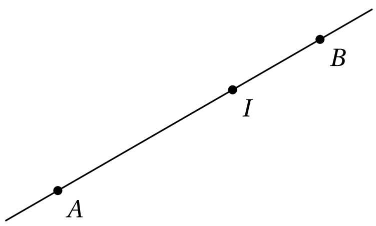
arguments	default	definition
(pt1=α_1,pt2=α_2,...)	no default	Each point has a assigned weight

You need at least two points.

5.2.1 Using \tkzDefBarycentricPoint with two points

In the following example, we obtain the barycentre of points A and B with coefficients 1 and 2, in other words:

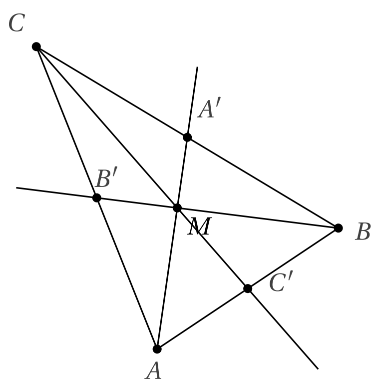
$$\overrightarrow{AI} = \frac{2}{3}\overrightarrow{AB}$$




```
\begin{tikzpicture}
  \tkzDefPoint(2,3){A}
  \tkzDefShiftPointCoord[2,3](30:4){B}
  \tkzDefBarycentricPoint(A=1,B=2)
  \tkzGetPoint{I}
  \tkzDrawPoints(A,B,I)
  \tkzDrawLine(A,B)
  \tkzLabelPoints(A,B,I)
\end{tikzpicture}
```

5.2.2 Using \tkzDefBarycentricPoint with three points

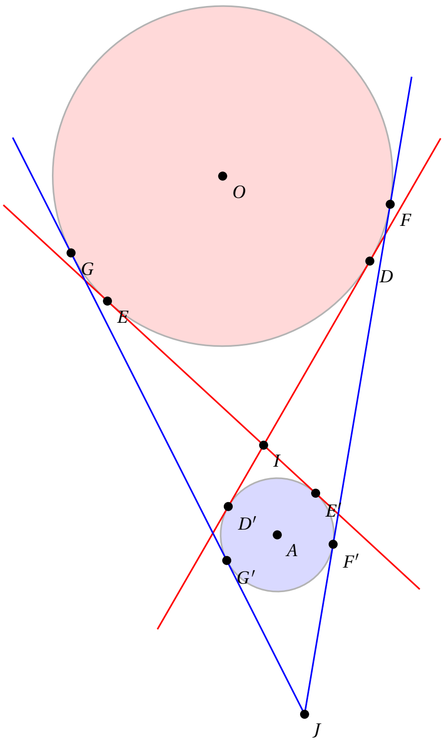
This time M is simply the centre of gravity of the triangle. For reasons of simplification and homogeneity, there is also `\tkzCentroid`.




```
\begin{tikzpicture}[scale=.8]
  \tkzDefPoint(2,1){A}
  \tkzDefPoint(5,3){B}
  \tkzDefPoint(0,6){C}
  \tkzDefBarycentricPoint(A=1,B=1,C=1)
  \tkzGetPoint{M}
  \tkzDefMidPoint(A,B)  \tkzGetPoint{C'}
  \tkzDefMidPoint(A,C)  \tkzGetPoint{B'}
  \tkzDefMidPoint(C,B)  \tkzGetPoint{A'}
  \tkzDrawPolygon(A,B,C)
  \tkzDrawPoints(A',B',C')
  \tkzDrawPoints(A,B,C,M)
  \tkzDrawLines[add=0 and 1](A,M B,M C,M)
  \tkzLabelPoint(M){$M$}
  \tkzAutoLabelPoints[center=M](A,B,C)
  \tkzAutoLabelPoints[center=M,above right](A',B',C')
\end{tikzpicture}
```

5.3 Internal Similitude Center

The centres of the two homotheties in which two circles correspond are called external and internal centres of similitude.




```
\begin{tikzpicture}[scale=.75,rotate=-30]
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(4,-5){A}
 \tkzDefIntSimilitudeCenter(O,3)(A,1)
 \tkzGetPoint{I}
 \tkzExtSimilitudeCenter(O,3)(A,1)
 \tkzGetPoint{J}
 \tkzDefTangent[from with R= I](O,3 cm)
 \tkzGetPoints{D}{E}
 \tkzDefTangent[from with R= I](A,1 cm)
 \tkzGetPoints{D'}{E'}
 \tkzDefTangent[from  with R= J](O,3 cm)
 \tkzGetPoints{F}{G}
 \tkzDefTangent[from with R= J](A,1 cm)
 \tkzGetPoints{F'}{G'}
 \tkzDrawCircle[R,fill=red!50,opacity=.3](O,3 cm)
 \tkzDrawCircle[R,fill=blue!50,opacity=.3](A,1 cm)
 \tkzDrawSegments[add = .5 and .5,color=red](D,D' E,E')
 \tkzDrawSegments[add= 0 and 0.25,color=blue](J,F J,G)
 \tkzDrawPoints(O,A,I,J,D,E,F,G,D',E',F',G')
 \tkzLabelPoints[font=\scriptsize](O,A,I,J,D,E,F,G,D',E',F',G')
\end{tikzpicture}
```

6 Special points relating to a triangle

6.1 Triangle center: \tkzDefTriangleCenter

This macro allows you to define the center of a triangle.

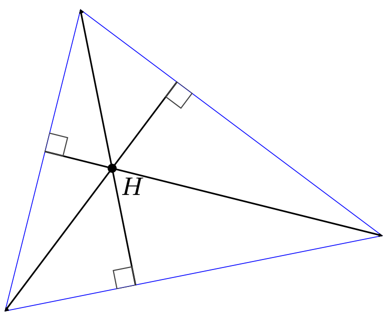
`\tkzDefTriangleCenter[⟨local options⟩](⟨A,B,C⟩)`

Be careful, the arguments are lists of three points. This macro is used in conjunction with **\tkzGetPoint** to get the center you are looking for. You can use **tkzPointResult** if it is not necessary to keep the results.

arguments	default	definition
(pt1,pt2,pt3)	no default	three points
options	**default**	**definition**
ortho	circum	intersection of the altitudes of a triangle
centroid	circum	centre of gravity. Intersection of the medians
circum	circum	circle center circumscribed
in	circum	center of the circle inscribed in a triangle
ex	circum	center of a circle exinscribed to a triangle
euler	circum	center of Euler's circle
symmedian	circum	Lemoine's point or symmedian centre or Grebe's point
spieker	circum	Spieker Circle Center
nagel	circum	Nagel Center
mittenpunkt	circum	also called the middlespoint
feuerbach	circum	Feuerbach Point

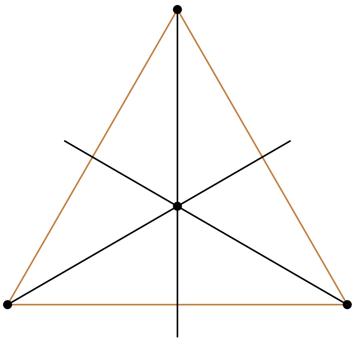
6.1.1 Option ortho or orthic

The intersection H of the three altitudes of a triangle is called the orthocenter.



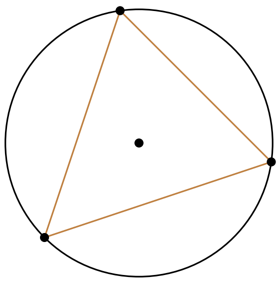

```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,1){B}
  \tkzDefPoint(1,4){C}
  \tkzClipPolygon(A,B,C)
  \tkzDefTriangleCenter[ortho](B,C,A)
    \tkzGetPoint{H}
  \tkzDefSpcTriangle[orthic,name=H](A,B,C){a,b,c}
  \tkzDrawPolygon[color=blue](A,B,C)
  \tkzDrawPoints(A,B,C,H)
  \tkzDrawLines[add=0 and 1](A,Ha B,Hb C,Hc)
  \tkzLabelPoint(H){$H$}
  \tkzAutoLabelPoints[center=H](A,B,C)
  \tkzMarkRightAngles(A,Ha,B B,Hb,C C,Hc,A)
\end{tikzpicture}
```

6.1.2 Option centroid



```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoints{-1/1/A,5/1/B}
  \tkzDefEquilateral(A,B)
  \tkzGetPoint{C}
  \tkzDefTriangleCenter[centroid](A,B,C)
      \tkzGetPoint{G}
  \tkzDrawPolygon[color=brown](A,B,C)
  \tkzDrawPoints(A,B,C,G)
  \tkzDrawLines[add = 0 and 2/3](A,G B,G C,G)
\end{tikzpicture}
```

6.1.3 Option circum

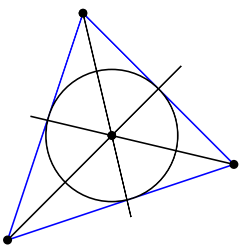


```
\begin{tikzpicture}
 \tkzDefPoints{0/1/A,3/2/B,1/4/C}
 \tkzDefTriangleCenter[circum](A,B,C)
 \tkzGetPoint{G}
 \tkzDrawPolygon[color=brown](A,B,C)
 \tkzDrawCircle(G,A)
 \tkzDrawPoints(A,B,C,G)
\end{tikzpicture}
```

6.1.4 Option in

In geometry, the incircle or inscribed circle of a triangle is the largest circle contained in the triangle; it touches (is tangent to) the three sides. The center of the incircle is a triangle center called the triangle's incenter. The center of the incircle, called the incenter, can be found as the intersection of the three internal angle bisectors. The center of an excircle is the intersection of the internal bisector of one angle (at vertex A, for example) and the external bisectors of the other two. The center of this excircle is called the excenter relative to the vertex A, or the excenter of A. Because the internal bisector of an angle is perpendicular to its external bisector, it follows that the center of the incircle together with the three excircle centers form an orthocentric system.(`https://en.wikipedia.org/wiki/Incircle_and_excircles_of_a_triangle`)

We get the centre of the inscribed circle of the triangle. The result is of course in **`tkzPointResult`**. We can retrieve it with **`\tkzGetPoint`**.

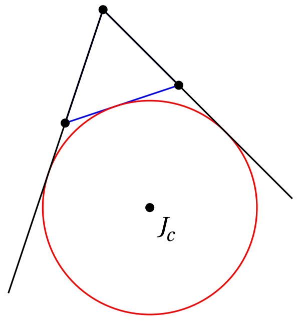


```
\begin{tikzpicture}
  \tkzDefPoints{0/1/A,3/2/B,1/4/C}
  \tkzDefTriangleCenter[in](A,B,C)\tkzGetPoint{I}
  \tkzDefPointBy[projection=onto A--C](I)
  \tkzGetPoint{Ib}
  \tkzDrawPolygon[color=blue](A,B,C)
  \tkzDrawPoints(A,B,C,I)
  \tkzDrawLines[add = 0 and 2/3](A,I B,I C,I)
  \tkzDrawCircle(I,Ib)
\end{tikzpicture}
```

6.1.5 Option ex

An excircle or escribed circle of the triangle is a circle lying outside the triangle, tangent to one of its sides and tangent to the extensions of the other two. Every triangle has three distinct excircles, each tangent to one of the triangle's sides. (https://en.wikipedia.org/wiki/Incircle_and_excircles_of_a_triangle)

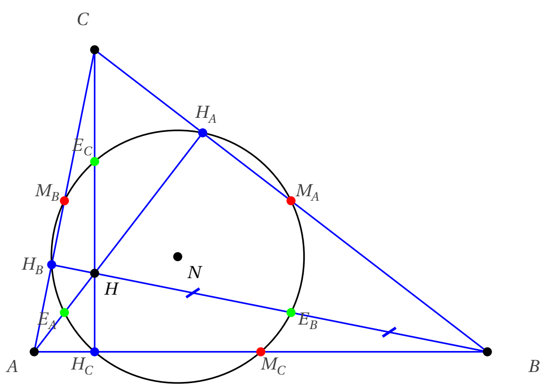
We get the centre of an inscribed circle of the triangle. The result is of course in **tkzPointResult**. We can retrieve it with **\tkzGetPoint**.




```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoints{0/1/A,3/2/B,1/4/C}
  \tkzDefTriangleCenter[ex](B,C,A)
  \tkzGetPoint{J_c}
  \tkzDefPointBy[projection=onto A--B](J_c)
  \tkzGetPoint{Tc}
  %or
  % \tkzDefCircle[ex](B,C,A)
  % \tkzGetFirstPoint{J_c}
  % \tkzGetSecondPoint{Tc}
  \tkzDrawPolygon[color=blue](A,B,C)
  \tkzDrawPoints(A,B,C,J_c)
  \tkzDrawCircle[red](J_c,Tc)
  \tkzDrawLines[add=1.5 and 0](A,C B,C)
  \tkzLabelPoints(J_c)
\end{tikzpicture}
```

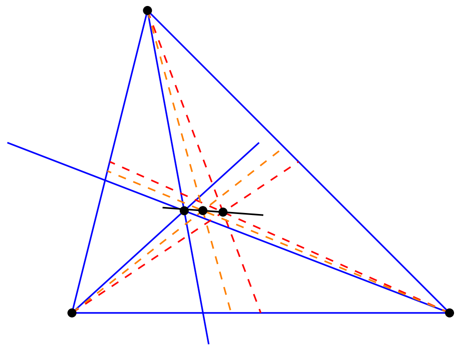
6.1.6 Option euler

This macro allows to obtain the center of the circle of the nine points or euler's circle or Feuerbach's circle. The nine-point circle, also called Euler's circle or the Feuerbach circle, is the circle that passes through the perpendicular feet H_A, H_B, and H_C dropped from the vertices of any reference triangle ABC on the sides opposite them. Euler showed in 1765 that it also passes through the midpoints M_A, M_B, M_C of the sides of ABC. By Feuerbach's theorem, the nine-point circle also passes through the midpoints E_A, E_B, and E_C of the segments that join the vertices and the orthocenter H. These points are commonly referred to as the Euler points. (http://mathworld.wolfram.com/Nine-PointCircle.html)




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
 \tkzDefSpcTriangle[medial,
     name=M](A,B,C){_A,_B,_C}
 \tkzDefTriangleCenter[euler](A,B,C)
    \tkzGetPoint{N} % I= N nine points
 \tkzDefTriangleCenter[ortho](A,B,C)
    \tkzGetPoint{H}
 \tkzDefMidPoint(A,H) \tkzGetPoint{E_A}
 \tkzDefMidPoint(C,H) \tkzGetPoint{E_C}
 \tkzDefMidPoint(B,H) \tkzGetPoint{E_B}
 \tkzDefSpcTriangle[ortho,name=H](A,B,C){_A,_B,_C}
 \tkzDrawPolygon[color=blue](A,B,C)
 \tkzDrawCircle(N,E_A)
 \tkzDrawSegments[blue](A,H_A B,H_B C,H_C)
 \tkzDrawPoints(A,B,C,N,H)
 \tkzDrawPoints[red](M_A,M_B,M_C)
 \tkzDrawPoints[blue]( H_A,H_B,H_C)
 \tkzDrawPoints[green](E_A,E_B,E_C)
 \tkzAutoLabelPoints[center=N,
  font=\scriptsize](A,B,C,%
   M_A,M_B,M_C,%
   H_A,H_B,H_C,%
   E_A,E_B,E_C)
 \tkzLabelPoints[font=\scriptsize](H,N)
 \tkzMarkSegments[mark=s|,size=3pt,
     color=blue,line width=1pt](B,E_B E_B,H)
\end{tikzpicture}
```

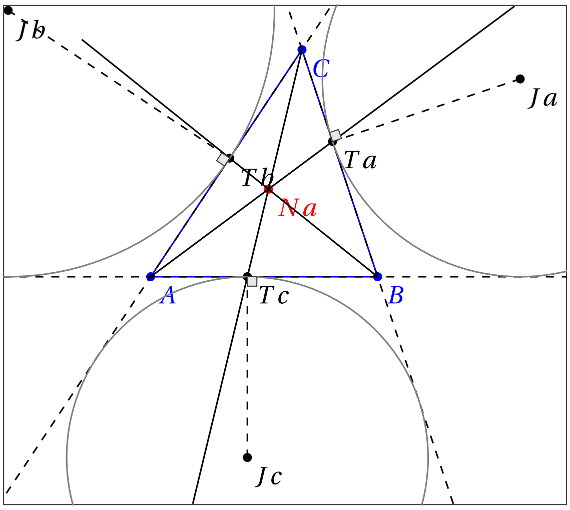
6.1.7 Option symmedian



```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,0){B}
  \tkzDefPoint(1,4){C}
  \tkzDefTriangleCenter[symmedian](A,B,C)\tkzGetPoint{K}
  \tkzDefTriangleCenter[median](A,B,C)\tkzGetPoint{G}
  \tkzDefTriangleCenter[in](A,B,C)\tkzGetPoint{I}
  \tkzDefSpcTriangle[centroid,name=M](A,B,C){a,b,c}
  \tkzDefSpcTriangle[incentral,name=I](A,B,C){a,b,c}
  \tkzDrawPolygon[color=blue](A,B,C)
  \tkzDrawLines[add = 0 and 2/3,blue](A,K B,K C,K)
  \tkzDrawSegments[red,dashed](A,Ma B,Mb C,Mc)
  \tkzDrawSegments[orange,dashed](A,Ia B,Ib C,Ic)
  \tkzDrawLine[add=2 and 2](G,I)
  \tkzDrawPoints(A,B,C,K,G,I)
\end{tikzpicture}
```

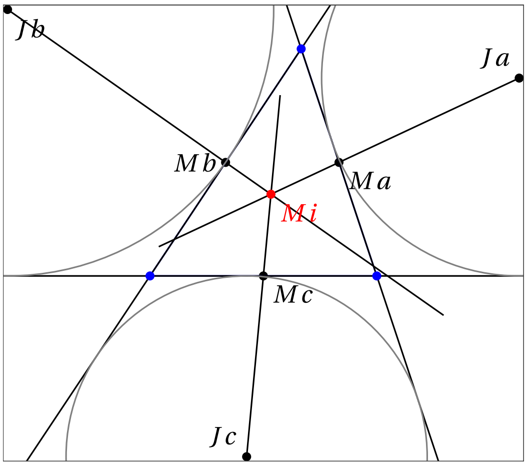
6.1.8 Option nagel

Let Ta be the point at which the excircle with center Ja meets the side BC of a triangle ABC, and define Tb and Tc similarly. Then the lines ATa, BTb, and CTc concur in the Nagel point Na. Weisstein, Eric W. "Nagel point." From MathWorld–A Wolfram Web Resource.




```
\begin{tikzpicture}[scale=.5]
\tkzDefPoints{0/0/A,6/0/B,4/6/C}
\tkzDefSpcTriangle[ex](A,B,C){Ja,Jb,Jc}
\tkzDefSpcTriangle[extouch](A,B,C){Ta,Tb,Tc}
\tkzDrawPoints(Ja,Jb,Jc,Ta,Tb,Tc)
\tkzLabelPoints(Ja,Jb,Jc,Ta,Tb,Tc)
\tkzDrawPolygon[blue](A,B,C)
\tkzDefTriangleCenter[nagel](A,B,C) \tkzGetPoint{Na}
\tkzDrawPoints[blue](B,C,A)
\tkzDrawPoints[red](Na)
\tkzLabelPoints[blue](B,C,A)
\tkzLabelPoints[red](Na)
\tkzDrawLines[add=0 and 1](A,Ta B,Tb C,Tc)
\tkzShowBB\tkzClipBB
\tkzDrawLines[add=1 and 1,dashed](A,B B,C C,A)
\tkzDrawCircles[ex,gray](A,B,C C,A,B B,C,A)
\tkzDrawSegments[dashed](Ja,Ta Jb,Tb Jc,Tc)
\tkzMarkRightAngles[fill=gray!20](Ja,Ta,C
            Jb,Tb,A Jc,Tc,B)
\end{tikzpicture}
```

6.1.9 Option mittenpunkt




```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoints{0/0/A,6/0/B,4/6/C}
 \tkzDefSpcTriangle[centroid](A,B,C){Ma,Mb,Mc}
 \tkzDefSpcTriangle[ex](A,B,C){Ja,Jb,Jc}
 \tkzDefSpcTriangle[extouch](A,B,C){Ta,Tb,Tc}
 \tkzDefTriangleCenter[mittenpunkt](A,B,C)
 \tkzGetPoint{Mi}
 \tkzDrawPoints(Ma,Mb,Mc,Ja,Jb,Jc)
 \tkzClipBB
 \tkzDrawPolygon[blue](A,B,C)
 \tkzDrawLines[add=0 and 1](Ja,Ma
              Jb,Mb Jc,Mc)
 \tkzDrawLines[add=1 and 1](A,B A,C B,C)
 \tkzDrawCircles[gray](Ja,Ta Jb,Tb Jc,Tc)
 \tkzDrawPoints[blue](B,C,A)
 \tkzDrawPoints[red](Mi)
 \tkzLabelPoints[red](Mi)
 \tkzLabelPoints[left](Mb)
 \tkzLabelPoints(Ma,Mc,Jb,Jc)
 \tkzLabelPoints[above left](Ja,Jc)
 \tkzShowBB
\end{tikzpicture}
```

7 Draw a point

7.0.1 Drawing points \tkzDrawPoint

`\tkzDrawPoint[⟨local options⟩](⟨name⟩)`

arguments	default	definition
name of point	no default	Only one point name is accepted

The argument is required. The disc takes the color of the circle, but lighter. It is possible to change everything. The point is a node and therefore it is invariant if the drawing is modified by scaling.

options	default	definition
shape	circle	Possible **cross** or **cross out**
size	6	6× **\pgflinewidth**
color	black	the default color can be changed

We can create other forms such as **cross**

7.0.2 Example of point drawings

Note that **scale** does not affect the shape of the dots. Which is normal. Most of the time, we are satisfied with a single point shape that we can define from the beginning, either with a macro or by modifying a configuration file.

```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoint(1,3){A}
 \tkzDefPoint(4,1){B}
 \tkzDefPoint(0,0){O}
 \tkzDrawPoint[color=red](A)
 \tkzDrawPoint[fill=blue!20,draw=blue](B)
 \tkzDrawPoint[color=green](O)
\end{tikzpicture}
```

It is possible to draw several points at once but this macro is a little slower than the previous one. Moreover, we have to make do with the same options for all the points.

`\tkzDrawPoints[⟨local options⟩](⟨liste⟩)`

arguments	default	definition
points list	no default	example `\tkzDrawPoints(A,B,C)`

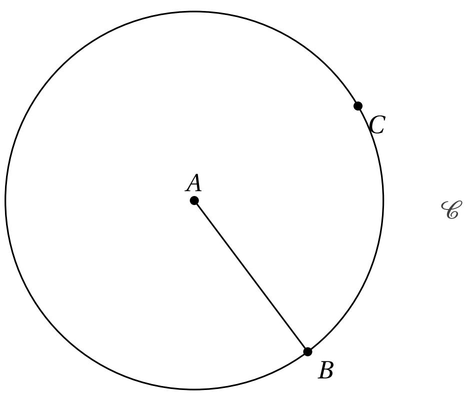
options	default	definition
shape	circle	Possible **cross** or **cross out**
size	6	$6\times$ `\pgflinewidth`
color	black	the default color can be changed

Beware of the final "s", an oversight leads to cascading errors if you try to draw multiple points. The options are the same as for the previous macro.

7.0.3 First example

```
\begin{tikzpicture}
  \tkzDefPoint(1,3){A}
  \tkzDefPoint(4,1){B}
  \tkzDefPoint(0,0){C}
  \tkzDrawPoints[size=6,color=red,
                 fill=red!50](A,B,C)
\end{tikzpicture}
```

7.0.4 Second example




```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoint(2,3){A}  \tkzDefPoint(5,-1){B}
 \tkzDefPoint[label=below:$\mathcal{C}$,
              shift={(2,3)}](-30:5.5){E}
 \begin{scope}[shift=(A)]
    \tkzDefPoint(30:5){C}
 \end{scope}
 \tkzCalcLength[cm](A,B)\tkzGetLength{rAB}
 \tkzDrawCircle[R](A,\rAB cm)
 \tkzDrawSegment(A,B)
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints(B,C)
 \tkzLabelPoints[above](A)
\end{tikzpicture}
```

8 Point on line or circle

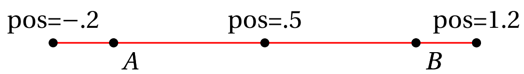
8.1 Point on a line

\tkzDefPointOnLine[⟨local options⟩](⟨A,B⟩)

arguments	default	definition
pt1,pt2	no default	Two points to define a line

options	default	definition
pos=nb		nb is a decimal

8.1.1 Use of option pos

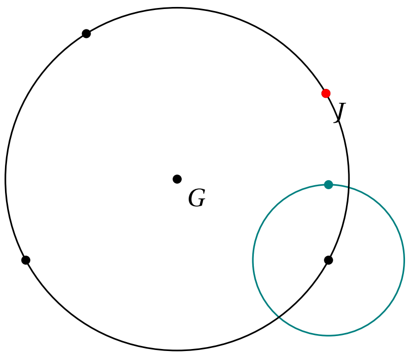



```
\begin{tikzpicture}
\tkzDefPoints{0/0/A,4/0/B}
\tkzDrawLine[red](A,B)
\tkzDefPointOnLine[pos=1.2](A,B)
\tkzGetPoint{P}
\tkzDefPointOnLine[pos=-0.2](A,B)
\tkzGetPoint{R}
\tkzDefPointOnLine[pos=0.5](A,B)
\tkzGetPoint{S}
\tkzDrawPoints(A,B,P)
\tkzLabelPoints(A,B)
\tkzLabelPoint[above](P){pos=$1.2$}
\tkzLabelPoint[above](R){pos=$-.2$}
\tkzLabelPoint[above](S){pos=$.5$}
\tkzDrawPoints(A,B,P,R,S)
\tkzLabelPoints(A,B)
\end{tikzpicture}
```

8.2 Point on a circle

\tkzDefPointOnCircle[⟨local options⟩]

options	default	definition
angle	0	angle formed with the abscissa axis
center	tkzPointResult	circle center required
radius	\tkzLengthResult	radius circle




```
\begin{tikzpicture}
 \tkzDefPoints{0/0/A,4/0/B,0.8/3/C}
 \tkzDefPointOnCircle[angle=90,center=B,radius=1 cm]
 \tkzGetPoint{I}
 \tkzDefCircle[circum](A,B,C)
 \tkzGetPoint{G} \tkzGetLength{rG}
 \tkzDefPointOnCircle[angle=30,center=G,radius=\rG pt]
 \tkzGetPoint{J}
 \tkzDrawCircle[R,teal](B,1cm)
 \tkzDrawPoint[teal](I)
 \tkzDrawPoints(A,B,C)
 \tkzDrawCircle(G,J)
 \tkzDrawPoints(G,J)
 \tkzDrawPoint[red](J)
 \tkzLabelPoints(G,J)
\end{tikzpicture}
```

9 Definition of points by transformation; \tkzDefPointBy

These transformations are:

- translation;
- homothety;
- orthogonal reflection or symmetry;
- central symmetry;
- orthogonal projection;
- rotation (degrees or radians);
- inversion with respect to a circle.

The choice of transformations is made through the options. There are two macros, one for the transformation of a single point `\tkzDefPointBy` and the other for the transformation of a list of points `\tkzDefPointsBy`. By default the image of A is A'. For example, we'll write:

```
\tkzDefPointBy[translation= from A to A'](B)
```

The result is in `tkzPointResult`

`\tkzDefPointBy[⟨local options⟩](⟨pt⟩)`

The argument is a simple existing point and its image is stored in `tkzPointResult`. If you want to keep this point then the macro `\tkzGetPoint{M}` allows you to assign the name `M` to the point.

arguments	definition	examples
pt	existing point name	(A)

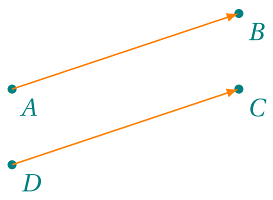
options		examples
translation	= from #1 to #2	[translation=from A to B](E)
homothety	= center #1 ratio #2	[homothety=center A ratio .5](E)
reflection	= over #1--#2	[reflection=over A--B](E)
symmetry	= center #1	[symmetry=center A](E)
projection	= onto #1--#2	[projection=onto A--B](E)
rotation	= center #1 angle #2	[rotation=center O angle 30](E)
rotation in rad	= center #1 angle #2	[rotation in rad=center O angle pi/3](E)
inversion	= center #1 through #2	[inversion =center O through A](E)

The image is only defined and not drawn.

9.1 Examples of transformations

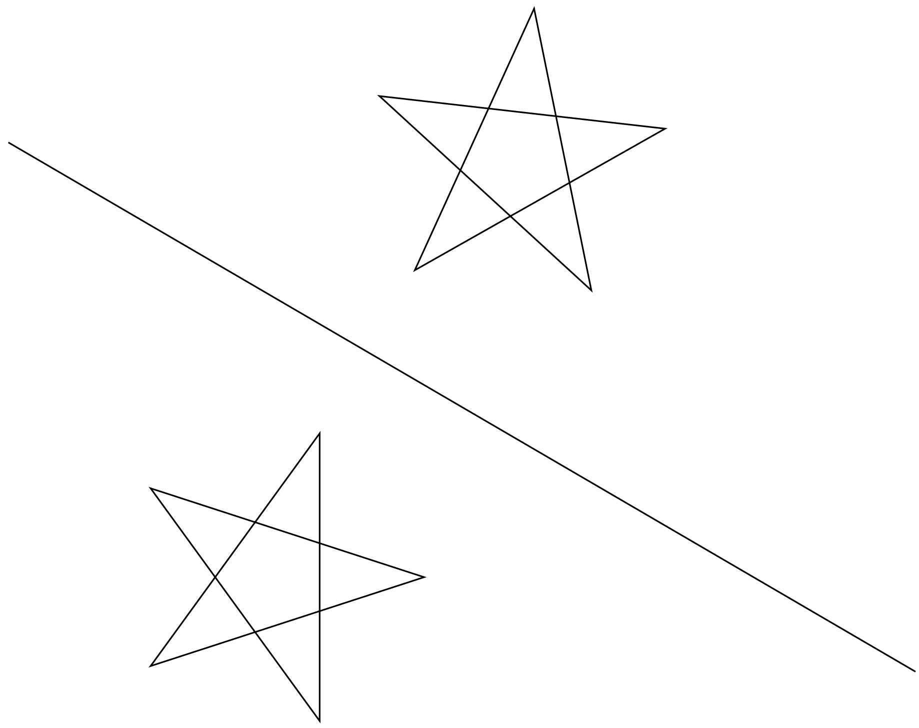
9.1.1 Example of translation

9.2 Example of translation



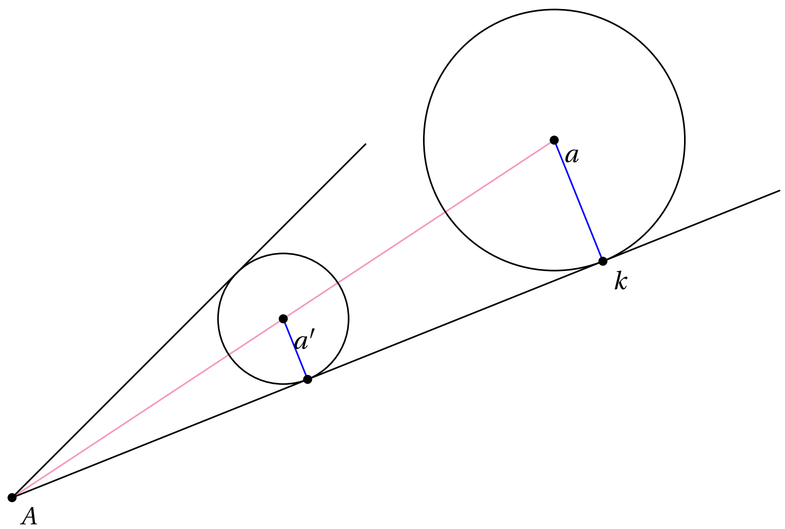

```
\begin{tikzpicture}[>=latex]
 \tkzDefPoint(0,0){A}  \tkzDefPoint(3,1){B}
 \tkzDefPoint(3,0){C}
 \tkzDefPointBy[translation= from B to A](C)
 \tkzGetPoint{D}
 \tkzDrawPoints[teal](A,B,C,D)
 \tkzLabelPoints[color=teal](A,B,C,D)
 \tkzDrawSegments[orange,->](A,B D,C)
\end{tikzpicture}
```

9.2.1 Example of reflection (orthogonal symmetry)



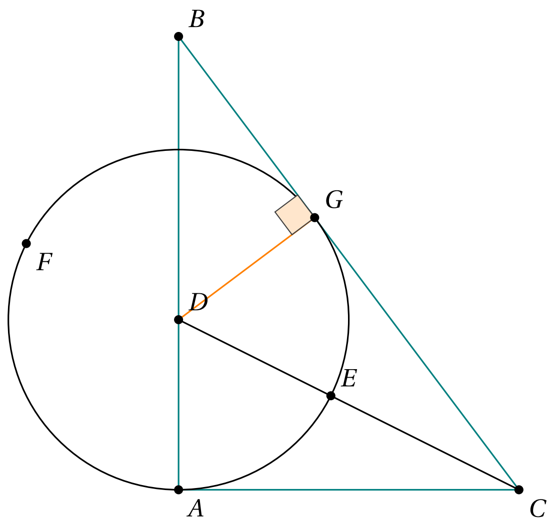
```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{1.5/-1.5/C,-4.5/2/D}
 \tkzDefPoint(-4,-2){O}
 \tkzDefPoint(-2,-2){A}
 \foreach \i in {0,1,...,4}{%
 \pgfmathparse{0+\i * 72}
 \tkzDefPointBy[rotation=%
 center O angle \pgfmathresult](A)
  \tkzGetPoint{A\i}
 \tkzDefPointBy[reflection = over C--D](A\i)
  \tkzGetPoint{A\i'}}
 \tkzDrawPolygon(A0, A2, A4, A1, A3)
 \tkzDrawPolygon(A0', A2', A4', A1', A3')
 \tkzDrawLine[add= .5 and .5](C,D)
\end{tikzpicture}
```

9.2.2 Example of homothety and projection



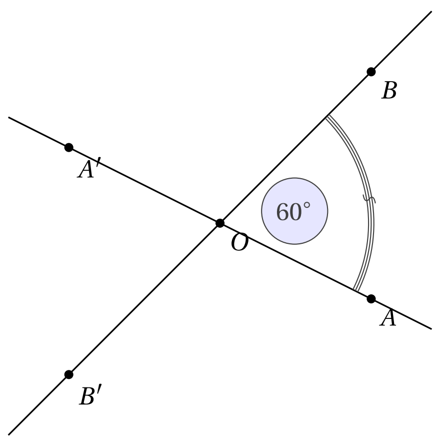

```
\begin{tikzpicture}[scale=1.2]
  \tkzDefPoint(0,1){A}   \tkzDefPoint(5,3){B}   \tkzDefPoint(3,4){C}
  \tkzDefLine[bisector](B,A,C)                      \tkzGetPoint{a}
  \tkzDrawLine[add=0 and 0,color=magenta!50 ](A,a)
  \tkzDefPointBy[homothety=center A ratio .5](a)    \tkzGetPoint{a'}
  \tkzDefPointBy[projection = onto A--B](a')        \tkzGetPoint{k'}
  \tkzDefPointBy[projection = onto A--B](a)        \tkzGetPoint{k}
  \tkzDrawLines[add= 0 and .3](A,k A,C)
  \tkzDrawSegments[blue](a',k' a,k)
  \tkzDrawPoints(a,a',k,k',A)
  \tkzDrawCircles(a',k' a,k)
  \tkzLabelPoints(a,a',k,A)
\end{tikzpicture}
```

9.2.3 Example of projection



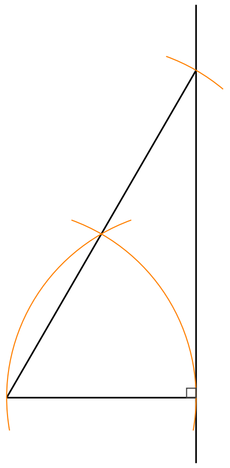

```
\begin{tikzpicture}[scale=1.5]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(0,4){B}
 \tkzDefTriangle[pythagore](B,A) \tkzGetPoint{C}
 \tkzDefLine[bisector](B,C,A) \tkzGetPoint{c}
 \tkzInterLL(C,c)(A,B)        \tkzGetPoint{D}
 \tkzDefPointBy[projection=onto B--C](D) \tkzGetPoint{G}
 \tkzInterLC(C,D)(D,A) \tkzGetPoints{E}{F}
 \tkzDrawPolygon[teal](A,B,C)
 \tkzDrawSegment(C,D)
 \tkzDrawCircle(D,A)
 \tkzDrawSegment[orange](D,G)
 \tkzMarkRightAngle[fill=orange!20](D,G,B)
 \tkzDrawPoints(A,C,F) \tkzLabelPoints(A,C,F)
 \tkzDrawPoints(B,D,E,G)
 \tkzLabelPoints[above right](B,D,E,G)
 \end{tikzpicture}
```

9.2.4 Example of symmetry



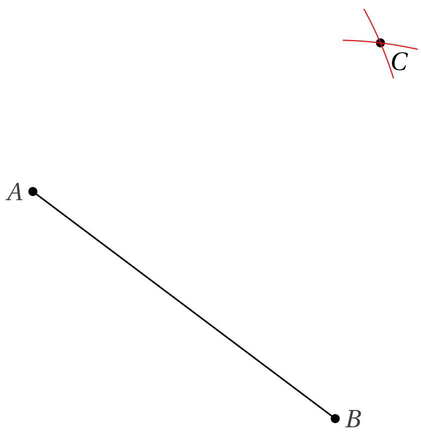
```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-1){A}
  \tkzDefPoint(2,2){B}
  \tkzDefPointsBy[symmetry=center O](B,A){}
  \tkzDrawLine(A,A')
  \tkzDrawLine(B,B')
  \tkzMarkAngle[mark=s,arc=lll,
      size=2 cm,mkcolor=red](A,O,B)
  \tkzLabelAngle[pos=1,circle,draw,
     fill=blue!10](A,O,B){$60^{\circ}$}
  \tkzDrawPoints(A,B,O,A',B')
  \tkzLabelPoints(A,B,O,A',B')
\end{tikzpicture}
```

9.2.5 Example of rotation



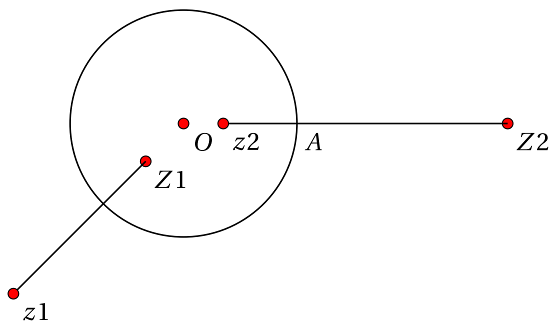
```
\begin{tikzpicture}[scale=0.5]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(5,0){B}
 \tkzDrawSegment(A,B)
 \tkzDefPointBy[rotation=center A angle 60](B)
 \tkzGetPoint{C}
 \tkzDefPointBy[symmetry=center C](A)
 \tkzGetPoint{D}
 \tkzDrawSegment(A,tkzPointResult)
 \tkzDrawLine(B,D)
 \tkzDrawArc[orange,delta=10](A,B)(C)
 \tkzDrawArc[orange,delta=10](B,C)(A)
 \tkzDrawArc[orange,delta=10](C,D)(D)
 \tkzMarkRightAngle(D,B,A)
\end{tikzpicture}
```

9.2.6 Example of rotation in radian



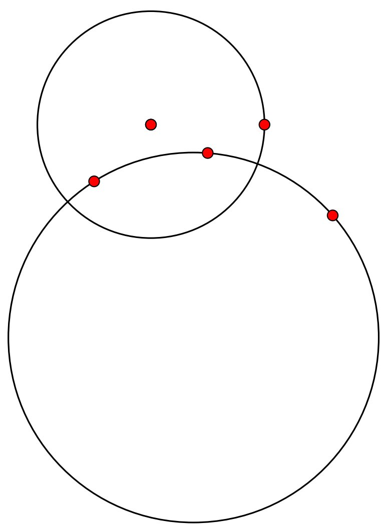

```
\begin{tikzpicture}
  \tkzDefPoint["$A$" left](1,5){A}
  \tkzDefPoint["$B$" right](5,2){B}
  \tkzDefPointBy[rotation in rad= center A angle pi/3](B)
  \tkzGetPoint{C}
  \tkzDrawSegment(A,B)
  \tkzDrawPoints(A,B,C)
  \tkzCompass[color=red](A,C)
  \tkzCompass[color=red](B,C)
  \tkzLabelPoints(C)
\end{tikzpicture}
```

9.2.7 Inversion of points




```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(1,0){A}
  \tkzDefPoint(-1.5,-1.5){z1}
  \tkzDefPoint(0.35,0){z2}
  \tkzDefPointBy[inversion =%
      center O through A](z1)
  \tkzGetPoint{Z1}
  \tkzDefPointBy[inversion =%
      center O through A](z2)
  \tkzGetPoint{Z2}
  \tkzDrawCircle(O,A)
  \tkzDrawPoints[color=black,
      fill=red,size=4](Z1,Z2)
  \tkzDrawSegments(z1,Z1 z2,Z2)
  \tkzDrawPoints[color=black,
      fill=red,size=4](O,z1,z2)
  \tkzLabelPoints(O,A,z1,z2,Z1,Z2)
\end{tikzpicture}
```

9.2.8 Point Inversion: Orthogonal Circles



```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(1,0){A}
  \tkzDrawCircle(O,A)
  \tkzDefPoint(0.5,-0.25){z1}
  \tkzDefPoint(-0.5,-0.5){z2}
  \tkzDefPointBy[inversion = %
     center O through A](z1)
  \tkzGetPoint{Z1}
  \tkzCircumCenter(z1,z2,Z1)
  \tkzGetPoint{c}
  \tkzDrawCircle(c,Z1)
  \tkzDrawPoints[color=black,
     fill=red,size=4](O,z1,z2,Z1,O,A)
\end{tikzpicture}
```

9.3 Transformation of multiple points; \tkzDefPointsBy

Variant of the previous macro for defining multiple images. You must give the names of the images as arguments, or indicate that the names of the images are formed from the names of the antecedents, leaving the argument empty.

```
\tkzDefPointsBy[translation= from A to A'](B,C){}
```

The images are B' and C'.

```
\tkzDefPointsBy[translation= from A to A'](B,C){D,E}
```

The images are D and E.

```
\tkzDefPointsBy[translation= from A to A'](B)
```

The image is B'.

```
\tkzDefPointsBy[⟨local options⟩](⟨list of points⟩){⟨list of points⟩}
```

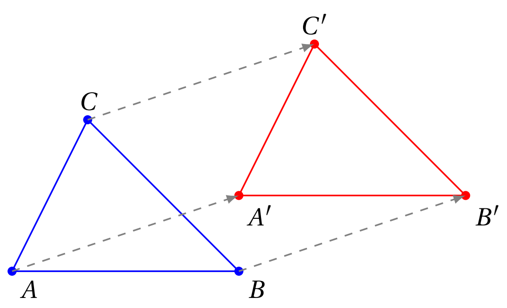
arguments	examples	
`(⟨list of points⟩){⟨list of pts⟩}`	`(A,B){E,F}`	E is the image of A and F is the image of B.

If the list of images is empty then the name of the image is the name of the antecedent to which " ' " is added.

options	examples
`translation = from #1 to #2`	`[translation=from A to B](E){}`
`homothety = center #1 ratio #2`	`[homothety=center A ratio .5](E){F}`
`reflection = over #1--#2`	`[reflection=over A--B](E){F}`
`symmetry = center #1`	`[symmetry=center A](E){F}`
`projection = onto #1--#2`	`[projection=onto A--B](E){F}`
`rotation = center #1 angle #2`	`[rotation=center angle 30](E){F}`
`rotation in rad = center #1 angle #2`	`for instance angle pi/3`

The points are only defined and not drawn.

9.3.1 Example of translation




```
\begin{tikzpicture}[>=latex]
 \tkzDefPoint(0,0){A}  \tkzDefPoint(3,1){A'}
 \tkzDefPoint(3,0){B}  \tkzDefPoint(1,2){C}
 \tkzDefPointsBy[translation= from A to A'](B,C){}
 \tkzDrawPolygon[color=blue](A,B,C)
 \tkzDrawPolygon[color=red](A',B',C')
 \tkzDrawPoints[color=blue](A,B,C)
 \tkzDrawPoints[color=red](A',B',C')
 \tkzLabelPoints(A,B,A',B')
 \tkzLabelPoints[above](C,C')
 \tkzDrawSegments[color = gray,->,
            style=dashed](A,A' B,B' C,C')
\end{tikzpicture}
```

10 Defining points using a vector

10.1 \tkzDefPointWith

There are several possibilities to create points that meet certain vector conditions. This can be done with `\tkzDefPointWith`. The general principle is as follows, two points are passed as arguments, i.e. a vector. The different options allow to obtain a new point forming with the first point (with some exceptions) a collinear vector or a vector orthogonal to the first vector. Then the length is either proportional to that of the first one, or proportional to the unit. Since this point is only used temporarily, it does not have to be named immediately. The result is in `tkzPointResult`. The macro `\tkzGetPoint` allows you to retrieve the point and name it differently.

There are options to define the distance between the given point and the obtained point. In the general case this distance is the distance between the 2 points given as arguments if the option is of the "normed" type then the distance between the given point and the obtained point is 1 cm. Then the K option allows to obtain multiples.

`\tkzDefPointWith(⟨pt1,pt2⟩)`

It is in fact the definition of a point meeting vectorial conditions.

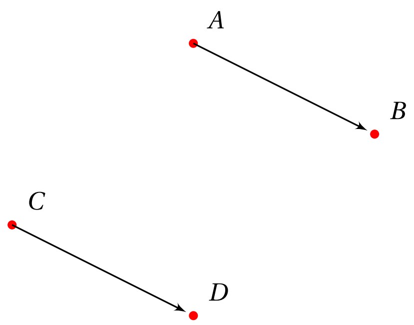
arguments	definition	explication
(pt1,pt2)	point couple	the result is a point in **tkzPointResult**

In what follows, it is assumed that the point is recovered by `\tkzGetPoint{C}`

options	example	explication
orthogonal	[orthogonal](A,B)	$AC = AB$ and $\overrightarrow{AC} \perp \overrightarrow{AB}$
orthogonal normed	[orthogonal normed](A,B)	$AC = 1$ and $\overrightarrow{AC} \perp \overrightarrow{AB}$
linear	[linear](A,B)	$\overrightarrow{AC} = K \times \overrightarrow{AB}$
linear normed	[linear normed](A,B)	$AC = K$ and $\overrightarrow{AC} = k \times \overrightarrow{AB}$
colinear= at #1	[colinear= at C](A,B)	$\overrightarrow{CD} = \overrightarrow{AB}$
colinear normed= at #1	[colinear normed= at C](A,B)	$\overrightarrow{CD} = \overrightarrow{AB}$
K	[linear](A,B),K=2	$\overrightarrow{AC} = 2 \times \overrightarrow{AB}$

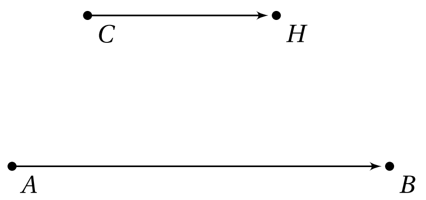
10.1.1 Option colinear at

$(\overrightarrow{AB} = \overrightarrow{CD})$



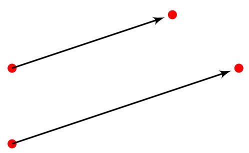

```
\begin{tikzpicture}[scale=1.2,
   vect/.style={->,shorten >=3pt,>=latex'}]
  \tkzDefPoint(2,3){A}   \tkzDefPoint(4,2){B}
  \tkzDefPoint(0,1){C}
  \tkzDefPointWith[colinear=at C](A,B)
  \tkzGetPoint{D}
  \tkzDrawPoints[color=red](A,B,C,D)
  \tkzLabelPoints[above right=3pt](A,B,C,D)
  \tkzDrawSegments[vect](A,B C,D)
\end{tikzpicture}
```

10.1.2 Option colinear at with K




```
\begin{tikzpicture}[vect/.style={->,
               shorten >=3pt,>=latex'}]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,0){B}
  \tkzDefPoint(1,2){C}
  \tkzDefPointWith[colinear=at C](A,B)
  \tkzGetPoint{G}
  \tkzDefPointWith[colinear=at C,K=0.5](A,B)
  \tkzGetPoint{H}
  \tkzLabelPoints(A,B,C,G,H)
  \tkzDrawPoints(A,B,C,G,H)
\tkzDrawSegments[vect](A,B C,H)
\end{tikzpicture}
```

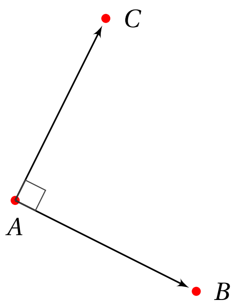
10.1.3 Option colinear at with $K = \frac{\sqrt{2}}{2}$



```
\begin{tikzpicture}[vect/.style={->,
          shorten >=3pt,>=latex'}]
 \tkzDefPoint(1,1){A}
 \tkzDefPoint(4,2){B}
 \tkzDefPoint(2,2){CU}
 \tkzDefPointWith[colinear=at C,K=sqrt(2)/2](A,B)
 \tkzGetPoint{D}
 \tkzDrawPoints[color=red](A,B,C,D)
 \tkzDrawSegments[vect](A,B C,D)
\end{tikzpicture}
```

10.1.4 Option orthogonal

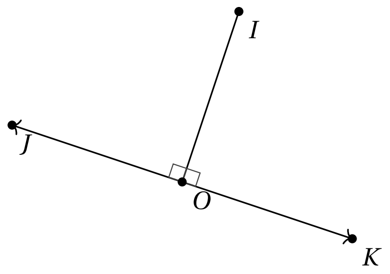
AB=AC since $K = 1$.




```
\begin{tikzpicture}[scale=1.2,
  vect/.style={->,shorten >=3pt,>=latex'}]
   \tkzDefPoint(2,3){A}
   \tkzDefPoint(4,2){B}
   \tkzDefPointWith[orthogonal,K=1](A,B)
     \tkzGetPoint{C}
   \tkzDrawPoints[color=red](A,B,C)
   \tkzLabelPoints[right=3pt](B,C)
   \tkzLabelPoints[below=3pt](A)
   \tkzDrawSegments[vect](A,B A,C)
   \tkzMarkRightAngle(B,A,C)
\end{tikzpicture}
```

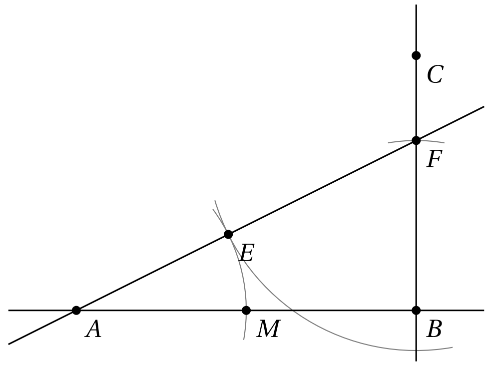
10.1.5 Option orthogonal with $K = -1$

OK=OI since $|K| = 1$ then OI=OJ=OK.



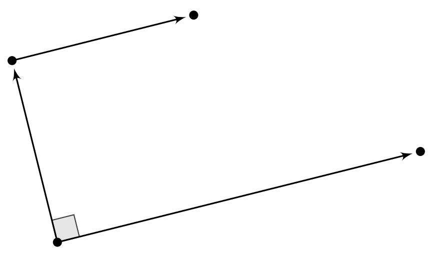

```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(1,2){O}
  \tkzDefPoint(2,5){I}
  \tkzDefPointWith[orthogonal](O,I)
  \tkzGetPoint{J}
  \tkzDefPointWith[orthogonal,K=-1](O,I)
  \tkzGetPoint{K}
  \tkzDrawSegment(O,I)
  \tkzDrawSegments[->](O,J O,K)
  \tkzMarkRightAngles(I,O,J I,O,K)
  \tkzDrawPoints(O,I,J,K)
  \tkzLabelPoints(O,I,J,K)
\end{tikzpicture}
```

10.1.6 Option orthogonal more complicated example




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoints{0/0/A,6/0/B}
  \tkzDefMidPoint(A,B)
  \tkzGetPoint{I}
  \tkzDefPointWith[orthogonal,K=-.75](B,A)
  \tkzGetPoint{C}
  \tkzInterLC(B,C)(B,I)
   \tkzGetPoints{D}{F}
  \tkzDuplicateSegment(B,F)(A,F)
  \tkzGetPoint{E}
  \tkzDrawArc[delta=10](F,E)(B)
  \tkzInterLC(A,B)(A,E)
  \tkzGetPoints{N}{M}
  \tkzDrawArc[delta=10](A,M)(E)
  \tkzDrawLines(A,B B,C A,F)
  \tkzCompass(B,F)
  \tkzDrawPoints(A,B,C,F,M,E)
  \tkzLabelPoints(A,B,C,F,M,E)
\end{tikzpicture}
```

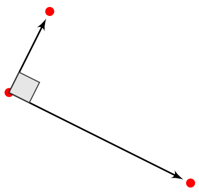
10.1.7 Options colinear and orthogonal



```
\begin{tikzpicture}[scale=1.2,
  vect/.style={->,shorten >=3pt,>=latex'}]
   \tkzDefPoint(2,1){A}
   \tkzDefPoint(6,2){B}
   \tkzDefPointWith[orthogonal,K=.5](A,B)
   \tkzGetPoint{C}
   \tkzDefPointWith[colinear=at C,K=.5](A,B)
   \tkzGetPoint{D}
   \tkzMarkRightAngle[fill=gray!20](B,A,C)
   \tkzDrawSegments[vect](A,B A,C C,D)
   \tkzDrawPoints(A,...,D)
\end{tikzpicture}
```

10.1.8 Option orthogonal normed, $K = 1$

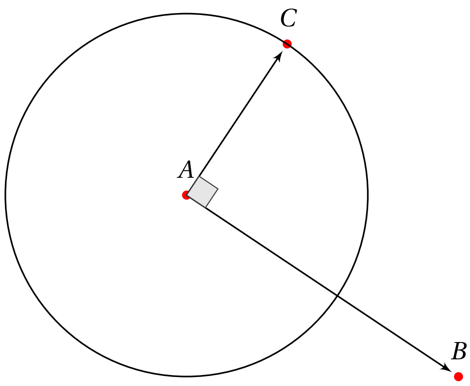
$AC = 1$.



```
\begin{tikzpicture}[scale=1.2,
  vect/.style={->,shorten >=3pt,>=latex'}]
  \tkzDefPoint(2,3){A}    \tkzDefPoint(4,2){B}
  \tkzDefPointWith[orthogonal normed](A,B)
  \tkzGetPoint{C}
  \tkzDrawPoints[color=red](A,B,C)
  \tkzDrawSegments[vect](A,B A,C)
  \tkzMarkRightAngle[fill=gray!20](B,A,C)
\end{tikzpicture}
```

10.1.9 Option orthogonal normed and $K = 2$

$K = 2$ therefore $AC = 2$.

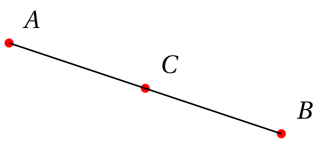



```
\begin{tikzpicture}[scale=1.2,
   vect/.style={->,shorten >=3pt,>=latex'}]
   \tkzDefPoint(2,3){A}    \tkzDefPoint(5,1){B}
   \tkzDefPointWith[orthogonal normed,K=2](A,B)
   \tkzGetPoint{C}
   \tkzDrawPoints[color=red](A,B,C)
   \tkzDrawCircle[R](A,2cm)
   \tkzDrawSegments[vect](A,B A,C)
   \tkzMarkRightAngle[fill=gray!20](B,A,C)
   \tkzLabelPoints[above=3pt](A,B,C)
\end{tikzpicture}
```

10.1.10 Option linear

Here $K = 0.5$.

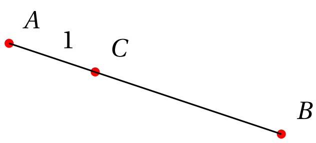
This amounts to applying a homothety or a multiplication of a vector by a real. Here is the middle of $[AB]$.




```
\begin{tikzpicture}[scale=1.2]
   \tkzDefPoint(1,3){A}    \tkzDefPoint(4,2){B}
   \tkzDefPointWith[linear,K=0.5](A,B)
   \tkzGetPoint{C}
   \tkzDrawPoints[color=red](A,B,C)
   \tkzDrawSegment(A,B)
   \tkzLabelPoints[above right=3pt](A,B,C)
\end{tikzpicture}
```

10.1.11 Option linear normed

In the following example $AC = 1$ and C belongs to (AB).




```
\begin{tikzpicture}[scale=1.2]
 \tkzDefPoint(1,3){A}    \tkzDefPoint(4,2){B}
 \tkzDefPointWith[linear normed](A,B)
 \tkzGetPoint{C}
 \tkzDrawPoints[color=red](A,B,C)
 \tkzDrawSegment(A,B)
 \tkzLabelSegment(A,C){$1$}
 \tkzLabelPoints[above right=3pt](A,B,C)
\end{tikzpicture}
```

10.2 \tkzGetVectxy

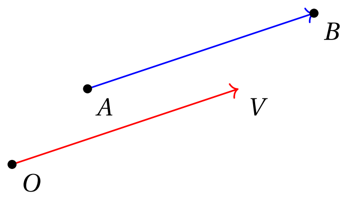
Retrieving the coordinates of a vector.

`\tkzGetVectxy(⟨A,B⟩){⟨text⟩}`

Allows to obtain the coordinates of a vector.

arguments	example	explication
(point){name of macro}	\tkzGetVectxy(A,B){V}	\Vx,\Vy: coordinates of $\overrightarrow{AB}$

10.2.1 Coordinate transfer with \tkzGetVectxy




```
\begin{tikzpicture}
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(1,1){A}
 \tkzDefPoint(4,2){B}
 \tkzGetVectxy(A,B){v}
 \tkzDefPoint(\vx,\vy){V}
 \tkzDrawSegment[->,color=red](O,V)
 \tkzDrawSegment[->,color=blue](A,B)
 \tkzDrawPoints(A,B,O)
 \tkzLabelPoints(A,B,O,V)
\end{tikzpicture}
```

11 Random point definition

At the moment there are four possibilities:

1. point in a rectangle;
2. on a segment;
3. on a straight line;
4. on a circle.

11.1 Obtaining random points

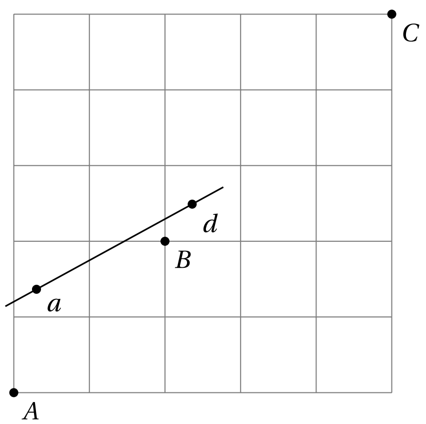
This is the new version that replaces `\tkzGetRandPointOn`.

`\tkzDefRandPointOn[⟨local options⟩]`

The result is a point with a random position that can be named with the macro `\tkzGetPoint`. It is possible to use `tkzPointResult` if it is not necessary to retain the results.

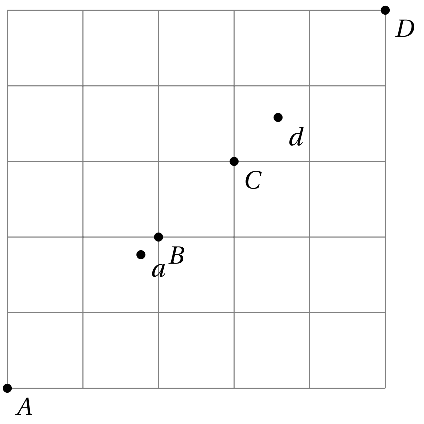
options	default	definition
`rectangle=pt1 and pt2`		`[rectangle=A and B]`
`segment= pt1--pt2`		`[segment=A--B]`
`line=pt1--pt2`		`[line=A--B]`
`circle =center pt1 radius dim`		`[circle = center A radius 2 cm]`
`circle through=center pt1 through pt2`		`[circle through= center A through B]`
`disk through=center pt1 through pt2`		`[disk through=center A through B]`

11.2 Random point in a rectangle



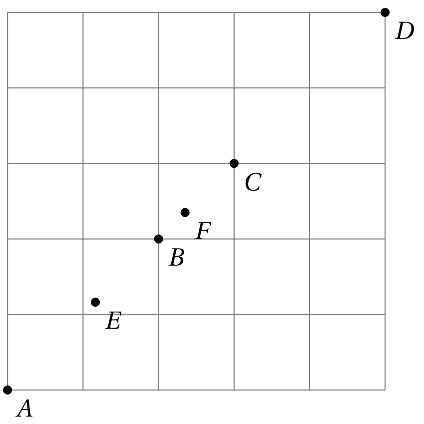

```
\begin{tikzpicture}
  \tkzInit[xmax=5,ymax=5]\tkzGrid
  \tkzDefPoints{0/0/A,2/2/B,5/5/C}
  \tkzDefRandPointOn[rectangle = A and B]
  \tkzGetPoint{a}
  \tkzDefRandPointOn[rectangle = B and C]
  \tkzGetPoint{d}
  \tkzDrawLine(a,d)
  \tkzDrawPoints(A,B,C,a,d)
  \tkzLabelPoints(A,B,C,a,d)
\end{tikzpicture}
```

11.3 Random point on a segment



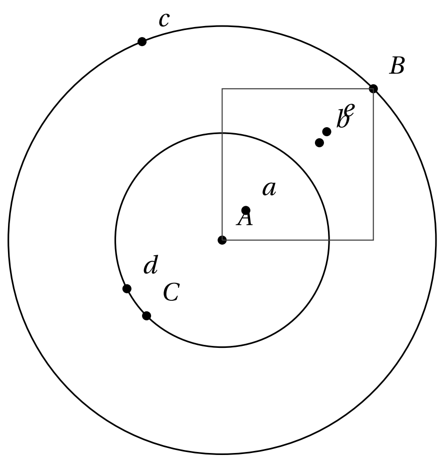

```
\begin{tikzpicture}
  \tkzInit[xmax=5,ymax=5] \tkzGrid
  \tkzDefPoints{0/0/A,2/2/B,3/3/C,5/5/D}
  \tkzDefRandPointOn[segment = A--B]\tkzGetPoint{a}
  \tkzDefRandPointOn[segment = C--D]\tkzGetPoint{d}
  \tkzDrawPoints(A,B,C,D,a,d)
  \tkzLabelPoints(A,B,C,D,a,d)
\end{tikzpicture}
```

11.4 Random point on a straight line



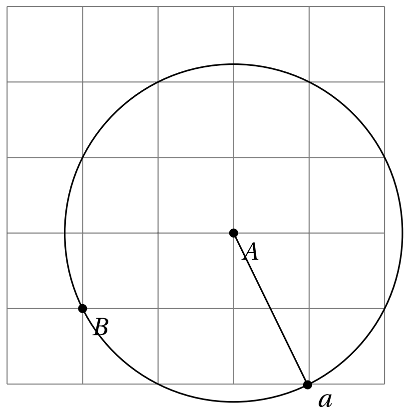

```
\begin{tikzpicture}
  \tkzInit[xmax=5,ymax=5] \tkzGrid
  \tkzDefPoints{0/0/A,2/2/B,3/3/C,5/5/D}
  \tkzDefRandPointOn[line = A--B]\tkzGetPoint{E}
  \tkzDefRandPointOn[line = C--D]\tkzGetPoint{F}
  \tkzDrawPoints(A,...,F)
  \tkzLabelPoints(A,...,F)
\end{tikzpicture}
```

11.4.1 Example of random points



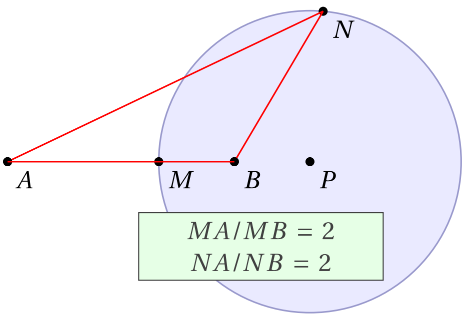

```
\begin{tikzpicture}
 \tkzDefPoints{0/0/A,2/2/B,-1/-1/C}
 \tkzDefCircle[through=](A,C)
 \tkzGetLength{rAC}
 \tkzDrawCircle(A,C)
 \tkzDrawCircle(A,B)
 \tkzDefRandPointOn[rectangle=A and B]
 \tkzGetPoint{a}
 \tkzDefRandPointOn[segment=A--B]
 \tkzGetPoint{b}
 \tkzDefRandPointOn[circle=center A radius \rAC pt]
    \tkzGetPoint{d}
 \tkzDefRandPointOn[circle through= center A through B]
     \tkzGetPoint{c}
 \tkzDefRandPointOn[disk through=center A through B]
     \tkzGetPoint{e}
 \tkzLabelPoints[above right=3pt](A,B,C,a,b,...,e)
 \tkzDrawPoints[](A,B,C,a,b,...,e)
 \tkzDrawRectangle(A,B)
\end{tikzpicture}
```

11.5 Random point on a circle




```
\begin{tikzpicture}
  \tkzInit[xmax=5,ymax=5]  \tkzGrid
  \tkzDefPoints{3/2/A,1/1/B}
  \tkzCalcLength[cm](A,B) \tkzGetLength{rAB}
  \tkzDrawCircle[R](A,\rAB cm)
  \tkzDefRandPointOn[circle = center A radius
   \rAB cm]\tkzGetPoint{a}
  \tkzDrawSegment(A,a)
  \tkzDrawPoints(A,B,a)
  \tkzLabelPoints(A,B,a)
\end{tikzpicture}
```

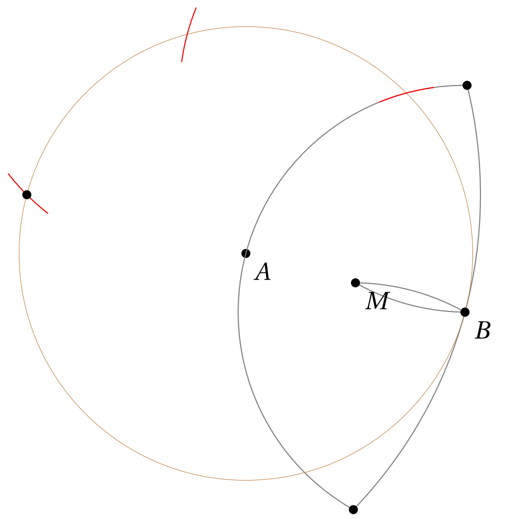
11.5.1 Random example and circle of Apollonius




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/A,3/0/B}
 \def\coeffK{2}
 \tkzApolloniusCenter[K=\coeffK](A,B)
 \tkzGetPoint{P}
 \tkzDefApolloniusPoint[K=\coeffK](A,B)
 \tkzGetPoint{M}
 \tkzDefApolloniusRadius[K=\coeffK](A,B)
 \tkzDrawCircle[R,color = blue!50!black,
     fill=blue!20,
     opacity=.4](tkzPointResult,\tkzLengthResult pt)
 \tkzDefRandPointOn[circle through= center P through M]
 \tkzGetPoint{N}
 \tkzDrawPoints(A,B,P,M,N)
 \tkzLabelPoints(A,B,P,M,N)
 \tkzDrawSegments[red](N,A N,B)
 \tkzDrawPoints(A,B)
 \tkzDrawSegments[red](A,B)
 \tkzLabelCircle[R,draw,fill=green!10,%
     text width=3cm,%
     text centered](P,\tkzLengthResult pt-20pt)(-
120)%
  { $MA/MB=\coeffK$\\$NA/NB=\coeffK$}
\end{tikzpicture}
```

11.6 Middle of a compass segment

To conclude this section, here is a more complex example. It involves determining the middle of a segment, using only a compass.




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){A}
  \tkzDefRandPointOn[circle= center A radius 4cm]
  \tkzGetPoint{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](B,E)(D)
  \tkzDrawCircle[color=brown,line width=.2pt](A,B)
  \tkzDrawArc[arc](D,B)(M)
  \tkzDrawArc[arc](E,M)(B)
  \tkzCompasss[color=red,style=solid](B,I I,J J,C)
  \tkzDrawPoints(B,C,D,E,M)
  \tkzLabelPoints(A,B,M)
 \end{tikzpicture}
```

12 The straight lines

It is of course essential to draw straight lines, but before this can be done, it is necessary to be able to define certain particular lines such as mediators, bisectors, parallels or even perpendiculars. The principle is to determine two points on the straight line.

12.1 Definition of straight lines

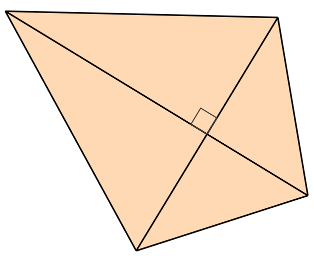
```
\tkzDefLine[⟨local options⟩](⟨pt1,pt2⟩) or (⟨pt1,pt2,pt3⟩)
```

The argument is a list of two or three points. Depending on the case, the macro defines one or two points necessary to obtain the line sought. Either the macro `\tkzGetPoint` or the macro `\tkzGetPoints` must be used.

arguments	example	explication
(⟨pt1,pt2⟩)	(⟨A,B⟩)	[mediator](A,B)
(⟨pt1,pt2,pt3⟩)	(⟨A,B,C⟩)	[bisector](B,A,C)

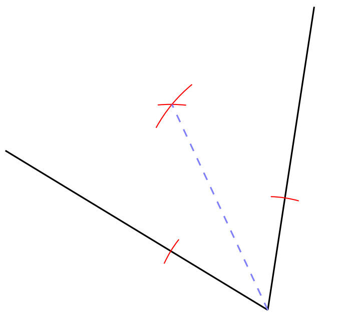
options	default	definition
mediator		two points are defined
perpendicular=through...	mediator	perpendicular to a straight line passing through a point
orthogonal=through...	mediator	see above
parallel=through...	mediator	parallel to a straight line passing through a point
bisector	mediator	bisector of an angle defined by three points
bisector out	mediator	Exterior Angle Bisector
K	1	coefficient for the perpendicular line
normed	false	normalizes the created segment

12.1.1 Example with mediator



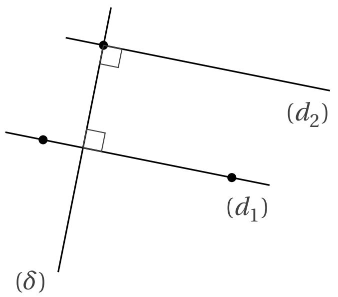
```
\begin{tikzpicture}[rotate=25]
 \tkzDefPoints{-2/0/A,1/2/B}
 \tkzDefLine[mediator](A,B)            \tkzGetPoints{C}{D}
 \tkzDefPointWith[linear,K=.75](C,D) \tkzGetPoint{D}
 \tkzDefMidPoint(A,B)                  \tkzGetPoint{I}
 \tkzFillPolygon[color=orange!30](A,C,B,D)
 \tkzDrawSegments(A,B C,D)
 \tkzMarkRightAngle(B,I,C)
 \tkzDrawSegments(D,B D,A)
 \tkzDrawSegments(C,B C,A)
\end{tikzpicture}
```

12.1.2 Example with bisector and normed



```
\begin{tikzpicture}[rotate=25,scale=.75]
 \tkzDefPoints{0/0/C, 2/-3/A, 4/0/B}
 \tkzDefLine[bisector,normed](B,A,C) \tkzGetPoint{a}
 \tkzDrawLines[add= 0 and .5](A,B A,C)
 \tkzShowLine[bisector,gap=4,size=2,color=red](B,A,C)
 \tkzDrawLines[blue!50,dashed,add= 0 and 3](A,a)
\end{tikzpicture}
```

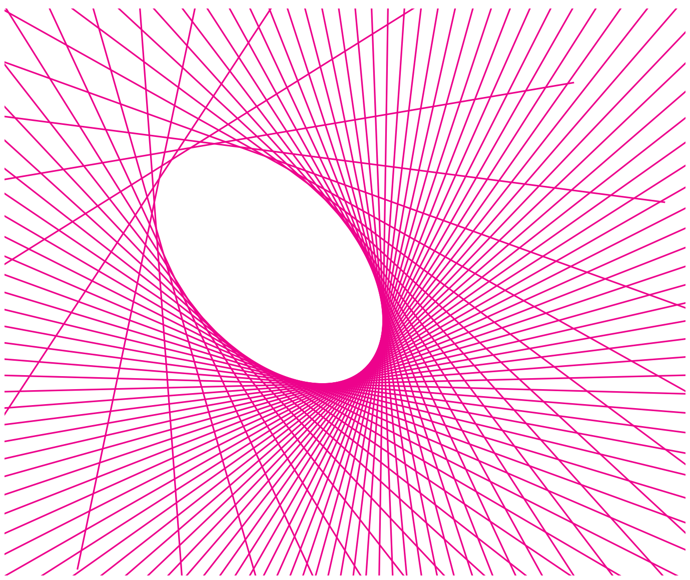
12.1.3 Example with orthogonal and parallel




```
\begin{tikzpicture}
   \tkzDefPoints{-1.5/-0.25/A,1/-0.75/B,-0.7/1/C}
   \tkzDrawLine(A,B)
   \tkzLabelLine[pos=1.25,below left](A,B){$(d_1)$}
   \tkzDrawPoints(A,B,C)
   \tkzDefLine[orthogonal=through C](B,A) \tkzGetPoint{c}
   \tkzDrawLine(C,c)
   \tkzLabelLine[pos=1.25,left](C,c){$(\delta)$}
   \tkzInterLL(A,B)(C,c) \tkzGetPoint{I}
   \tkzMarkRightAngle(C,I,B)
   \tkzDefLine[parallel=through C](A,B) \tkzGetPoint{c'}
   \tkzDrawLine(C,c')
   \tkzLabelLine[pos=1.25,below left](C,c'){$(d_2)$}
   \tkzMarkRightAngle(I,C,c')
\end{tikzpicture}
```

12.1.4 An envelope

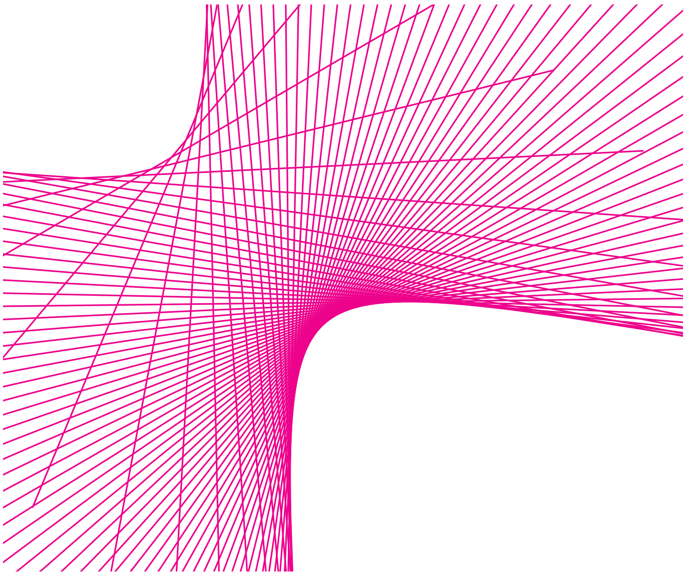
Based on a figure from O. Reboux with pst-eucl by D Rodriguez.



```
\begin{tikzpicture}[scale=.75]
 \tkzInit[xmin=-6,ymin=-4,xmax=6,ymax=6] % necessary
 \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=magenta,add= 3 and 3](tkzFirstPointResult,tkzSecondPointResult)}
\end{tikzpicture}
```

12.1.5 A parabola

Based on a figure from O. Reboux with pst-eucl by D Rodriguez. It is not necessary to name the two points that define the mediator.



```
\begin{tikzpicture}[scale=.75]
 \tkzInit[xmin=-6,ymin=-4,xmax=6,ymax=6]
 \tkzClip
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(132:5){A}
 \tkzDefPoint(4,0){B}
 \foreach \ang in {5,10,...,360}{%
  \tkzDefPoint(\ang:4){M}
  \tkzDefLine[mediator](A,M)
  \tkzDrawLine[color=magenta,add= 3 and 3](tkzFirstPointResult,tkzSecondPointResult)}
\end{tikzpicture}
```

12.2 Specific lines: Tangent to a circle

Two constructions are proposed. The first one is the construction of a tangent to a circle at a given point of this circle and the second one is the construction of a tangent to a circle passing through a given point outside a disc.

\tkzDefTangent[⟨local options⟩](⟨pt1,pt2⟩) or (⟨pt1,dim⟩)

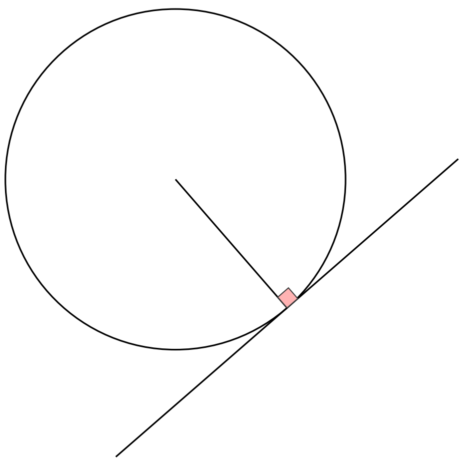
The parameter in brackets is the center of the circle or the center of the circle and a point on the circle or the center and the radius. This macro replaces the old one: **\tkzTangent**.

arguments	example	explication
(⟨pt1,pt2 or (⟨pt1,dim⟩)⟩)	(⟨A,B⟩) or (⟨A,2cm⟩)	$[AB]$ is radius A is the center

options	default	definition
at=pt	at	tangent to a point on the circle
from=pt	at	tangent to a circle passing through a point
from with R=pt	at	idem, but the circle is defined by center = radius

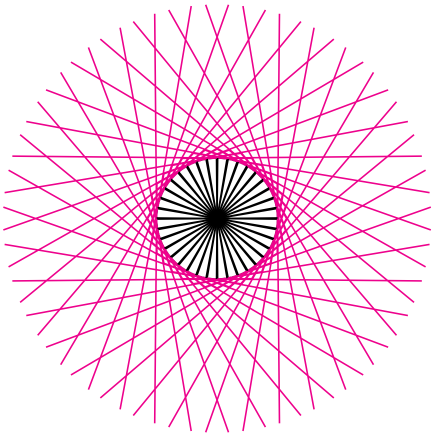
The tangent is not drawn. A second point of the tangent is given by **tkzPointResult**.

12.2.1 Example of a tangent passing through a point on the circle



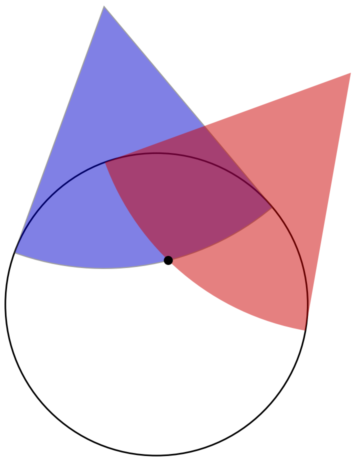
```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(6,6){E}
  \tkzDefRandPointOn[circle=center O radius 3cm]
  \tkzGetPoint{A}
  \tkzDrawSegment(O,A)
  \tkzDrawCircle(O,A)
  \tkzDefTangent[at=A](O)
  \tkzGetPoint{h}
  \tkzDrawLine[add = 4 and 3](A,h)
  \tkzMarkRightAngle[fill=red!30](O,A,h)
\end{tikzpicture}
```

12.2.2 Example of tangents passing through an external point



```
\begin{tikzpicture}[scale=.8]
  \tkzDefPoint(3,3){c}
  \tkzDefPoint(6,3){a0}
  \tkzRadius=1 cm
  \tkzDrawCircle[R](c,\tkzRadius)
  \foreach \an in {0,10,...,350}{
     \tkzDefPointBy[rotation=center c angle \an](a0)
     \tkzGetPoint{a}
     \tkzDefTangent[from with R = a](c,\tkzRadius)
     \tkzGetPoints{e}{f}
     \tkzDrawLines[color=magenta](a,f a,e)
      \tkzDrawSegments(c,e c,f)
      }%
\end{tikzpicture}
```

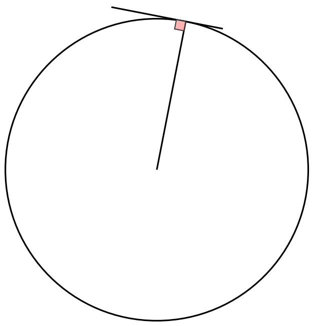
12.2.3 Example of Andrew Mertz



```
\begin{tikzpicture}[scale=.5]
\tkzDefPoint(100:8){A}\tkzDefPoint(50:8){B}
\tkzDefPoint(0,0){C} \tkzDefPoint(0,4){R}
\tkzDrawCircle(C,R)
\tkzDefTangent[from = A](C,R)  \tkzGetPoints{D}{E}
\tkzDefTangent[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}
```

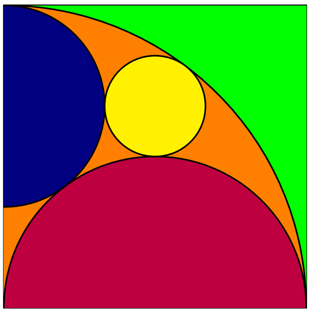
http://www.texample.net/tikz/examples/

12.2.4 Drawing a tangent option from with R and at



```
\begin{tikzpicture}[scale=.5]
\tkzDefPoint(0,0){O}
\tkzDefRandPointOn[circle=center O radius 4cm]
\tkzGetPoint{A}
\tkzDefTangent[at=A](O)
\tkzGetPoint{h}
\tkzDrawSegments(O,A)
\tkzDrawCircle(O,A)
\tkzDrawLine[add = 1 and 1](A,h)
\tkzMarkRightAngle[fill=red!30](O,A,h)
\end{tikzpicture}
```

12.2.5 Drawing a tangent option from



```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoint(0,0){B}
 \tkzDefPoint(0,8){A}
 \tkzDefSquare(A,B)
 \tkzGetPoints{C}{D}
 \tkzDrawSquare(A,B)
 \tkzClipPolygon(A,B,C,D)
 \tkzDefPoint(4,8){F}
 \tkzDefPoint(4,0){E}
 \tkzDefPoint(4,4){Q}
 \tkzFillPolygon[color = green](A,B,C,D)
 \tkzDrawCircle[fill = orange](B,A)
 \tkzDrawCircle[fill = purple](E,B)
 \tkzDefTangent[from=B](F,A)
 \tkzInterLL(F,tkzFirstPointResult)(C,D)
 \tkzInterLL(A,tkzPointResult)(F,E)
 \tkzDrawCircle[fill = yellow](tkzPointResult,Q)
 \tkzDefPointBy[projection= onto B--A](tkzPointResult)
 \tkzDrawCircle[fill = blue!50!black](tkzPointResult,A)
\end{tikzpicture}
```

13 Drawing, naming the lines

The following macros are simply used to draw, name lines.

13.1 Draw a straight line

To draw a normal straight line, just give a couple of points. You can use the **add** option to extend the line (This option is due to **Mark Wibrow**, see the code below).

```
  \tikzset{%
    add/.style args={#1 and #2}{
        to path={%
 ($(\tikztostart)!-#1!(\tikztotarget)$)--($(\tikztotarget)!-#2!(\tikztostart)$)%
  \tikztonodes}}}
```

In the special case of lines defined in a triangle, the number of arguments is a list of three points (the vertices of the triangle). The second point is where the line will come from. The first and last points determine the target segment. The old method has therefore been slightly modified. So for **\tkzDrawMedian**, instead of $(A, B)(C)$ you have to write (B, C, A) where C is the point that will be linked to the middle of the segment $[A, B]$.

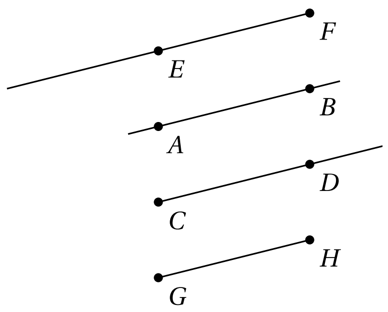
\tkzDrawLine[⟨local options⟩](⟨pt1,pt2⟩) or (⟨pt1,pt2,pt3⟩)

The arguments are a list of two points or three points.

options	default	definition
median	none	[median](A,B,C) median from B
altitude	none	[altitude](C,A,B) altitude from A
bisector	none	[bisector](B,C,A) bisector from C
none	none	draw the straight line (AB)
add= nb1 and nb2	.2 and .2	extends the segment

add defines the length of the line passing through the points pt1 and pt2. Both numbers are percentages. The styles of TikZ are accessible for plots.

13.1.1 Examples with add



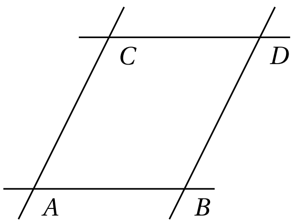

```
\begin{tikzpicture}
 \tkzInit[xmin=-2,xmax=3,ymin=-2.25,ymax=2.25]
 \tkzClip[space=.25]
 \tkzDefPoint(0,0){A} \tkzDefPoint(2,0.5){B}
 \tkzDefPoint(0,-1){C}\tkzDefPoint(2,-0.5){D}
 \tkzDefPoint(0,1){E} \tkzDefPoint(2,1.5){F}
 \tkzDefPoint(0,-2){G} \tkzDefPoint(2,-1.5){H}
 \tkzDrawLine(A,B)    \tkzDrawLine[add = 0 and .5](C,D)
 \tkzDrawLine[add = 1 and 0](E,F)
 \tkzDrawLine[add = 0 and 0](G,H)
 \tkzDrawPoints(A,B,C,D,E,F,G,H)
 \tkzLabelPoints(A,B,C,D,E,F,G,H)
\end{tikzpicture}
```

It is possible to draw several lines, but with the same options.

`\tkzDrawLines[⟨local options⟩](⟨pt1,pt2 pt3,pt4 ...⟩)`

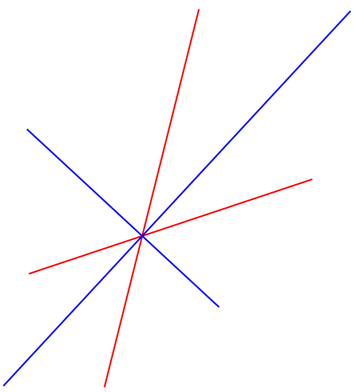
Arguments are a list of pairs of points separated by spaces. The styles of Ti*k*Z are available for the draws.

13.1.2 Example with \tkzDrawLines



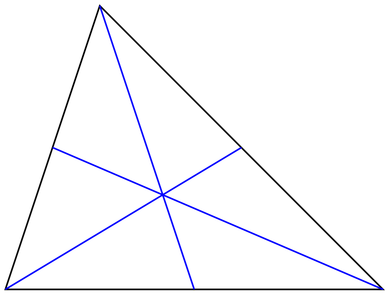

```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,0){B}
  \tkzDefPoint(1,2){C}
  \tkzDefPoint(3,2){D}
  \tkzDrawLines(A,B C,D A,C B,D)
  \tkzLabelPoints(A,B,C,D)
\end{tikzpicture}
```

13.1.3 Example with the option add



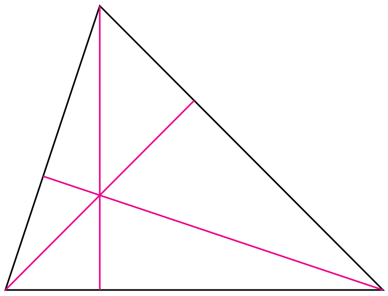
```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(3,1){I}
 \tkzDefPoint(1,4){J}
 \tkzDefLine[bisector](I,O,J)
   \tkzGetPoint{i}
 \tkzDefLine[bisector out](I,O,J)
   \tkzGetPoint{j}
 \tkzDrawLines[add = 1 and .5,color=red](O,I O,J)
 \tkzDrawLines[add = 1 and .5,color=blue](O,i O,j)
\end{tikzpicture}
```

13.1.4 Medians in a triangle



```
\begin{tikzpicture}[scale=1.25]
  \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
  \tkzDefPoint(1,3){C} \tkzDrawPolygon(A,B,C)
  \tkzSetUpLine[color=blue]
  \tkzDrawLine[median](B,C,A)
  \tkzDrawLine[median](C,A,B)
  \tkzDrawLine[median](A,B,C)
\end{tikzpicture}
```

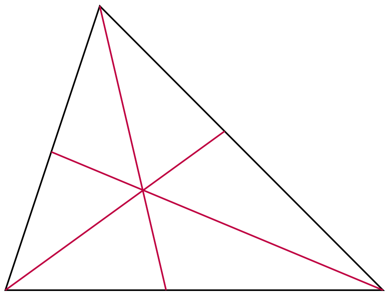
13.1.5 Altitudes in a triangle



```
\begin{tikzpicture}[scale=1.25]
 \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
 \tkzDefPoint(1,3){C} \tkzDrawPolygon(A,B,C)
 \tkzSetUpLine[color=magenta]
 \tkzDrawLine[altitude](B,C,A)
 \tkzDrawLine[altitude](C,A,B)
 \tkzDrawLine[altitude](A,B,C)
\end{tikzpicture}
```

13.1.6 Bisectors in a triangle

You have to give the angles in a straight line.



```
\begin{tikzpicture}[scale=1.25]
 \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
 \tkzDefPoint(1,3){C} \tkzDrawPolygon(A,B,C)
 \tkzSetUpLine[color=purple]
 \tkzDrawLine[bisector](B,C,A)
 \tkzDrawLine[bisector](C,A,B)
 \tkzDrawLine[bisector](A,B,C)
\end{tikzpicture}
```

13.2 Add labels on a straight line \tkzLabelLine

`\tkzLabelLine[⟨local options⟩](⟨pt1,pt2⟩){⟨label⟩}`

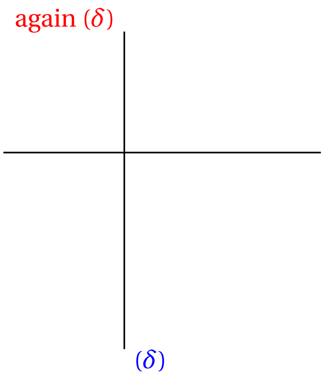
arguments	default	definition
label		`\tkzLabelLine(A,B){$\Delta$}`

options	default	definition
pos	.5	`pos` is an option for Ti*k*Z, but essential in this case…

As an option, and in addition to the `pos`, you can use all styles of Ti*k*Z, especially the placement with `above`, `right`, …

13.2.1 Example with \tkzLabelLine

An important option is pos, it's the one that allows you to place the label along the right. The value of pos can be greater than 1 or negative.




```
\begin{tikzpicture}
   \tkzDefPoints{0/0/A,3/0/B,1/1/C}
   \tkzDefLine[perpendicular=through C,K=-1](A,B)
   \tkzGetPoint{c}
   \tkzDrawLines(A,B C,c)
   \tkzLabelLine[pos=1.25,blue,right](C,c){$(\delta)$}
   \tkzLabelLine[pos=-0.25,red,left](C,c){again $(\delta)$}
\end{tikzpicture}
```

14 Draw, Mark segments

There is, of course, a macro to simply draw a segment (it would be possible, as for a half line, to create a style with \add).

14.1 Draw a segment \tkzDrawSegment

\tkzDrawSegment[⟨local options⟩](⟨pt1,pt2⟩)

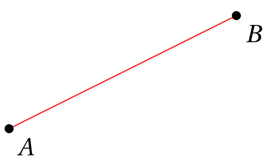
The arguments are a list of two points. The styles of TikZ are available for the drawings.

argument	example	definition
(pt1,pt2)	(A,B)	draw the segment $[A,B]$

options	example	definition
TikZ options		all TikZ options are valid.
add	0 and 0	add = kl and kr, …
…	…	allows the segment to be extended to the left and right.
dim	no default	dim = {label,dim,option}, …
…	…	allows you to add dimensions to a figure.

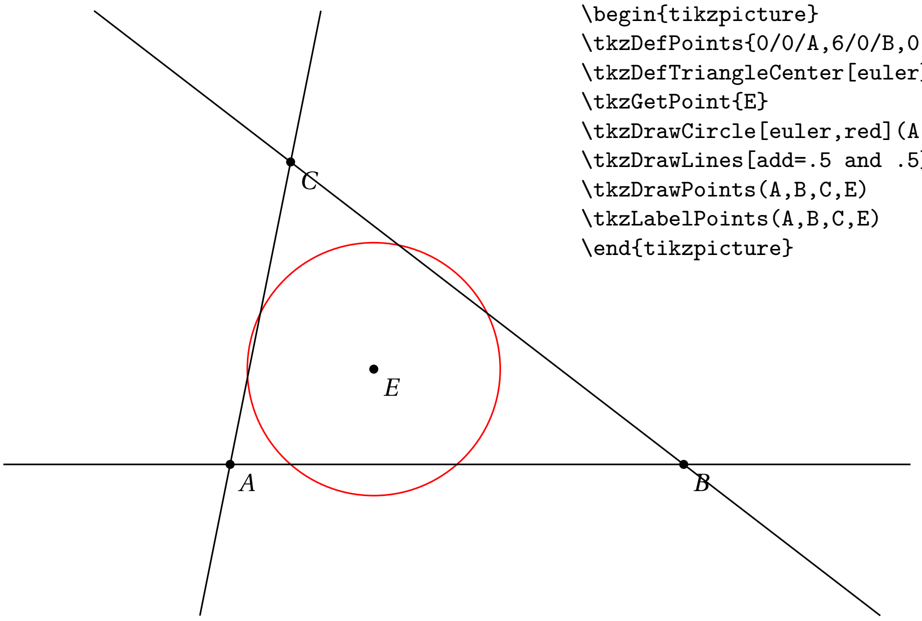
This is of course equivalent to \draw (A)--(B);

14.1.1 Example with point references



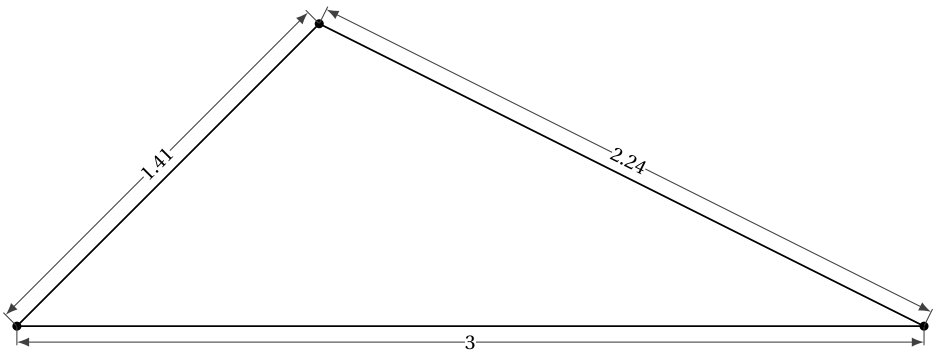

```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,1){B}
  \tkzDrawSegment[color=red,thin](A,B)
  \tkzDrawPoints(A,B)
  \tkzLabelPoints(A,B)
\end{tikzpicture}
```

14.1.2 Example of extending an segment with option add




```
\begin{tikzpicture}
\tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
\tkzDefTriangleCenter[euler](A,B,C)
\tkzGetPoint{E}
\tkzDrawCircle[euler,red](A,B,C)
\tkzDrawLines[add=.5 and .5](A,B A,C B,C)
\tkzDrawPoints(A,B,C,E)
\tkzLabelPoints(A,B,C,E)
\end{tikzpicture}
```

14.1.3 Example of adding dimensions with option dim



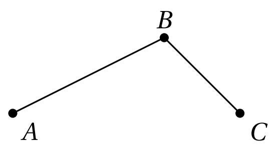

```
\begin{tikzpicture}[scale=4]
 \pgfkeys{/pgf/number format/.cd,fixed,precision=2}
 % Define the first two points
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(3,0){B}
 \tkzDefPoint(1,1){C}
 % Draw the triangle and the points
 \tkzDrawPolygon(A,B,C)
 \tkzDrawPoints(A,B,C)
 % Label the sides
 \tkzCalcLength[cm](A,B)\tkzGetLength{ABl}
 \tkzCalcLength[cm](B,C)\tkzGetLength{BCl}
 \tkzCalcLength[cm](A,C)\tkzGetLength{ACl}
 % add dim
 \tkzDrawSegment[dim={\pgfmathprintnumber\BCl,6pt,transform shape}](C,B)
 \tkzDrawSegment[dim={\pgfmathprintnumber\ACl,6pt,transform shape}](A,C)
 \tkzDrawSegment[dim={\pgfmathprintnumber\ABl,-6pt,transform shape}](A,B)
\end{tikzpicture}
```

14.2 Drawing segments \tkzDrawSegments

If the options are the same we can plot several segments with the same macro.

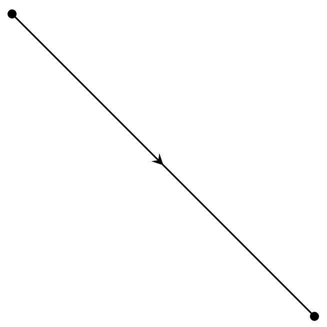
`\tkzDrawSegments[⟨local options⟩](⟨pt1,pt2 pt3,pt4 ...⟩)`

The arguments are a two-point couple list. The styles of TikZ are available for the plots.




```
\begin{tikzpicture}
  \tkzInit[xmin=-1,xmax=3,ymin=-1,ymax=2]
  \tkzClip[space=1]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,1){B}
  \tkzDefPoint(3,0){C}
  \tkzDrawSegments(A,B B,C)
  \tkzDrawPoints(A,B,C)
  \tkzLabelPoints(A,C)
  \tkzLabelPoints[above](B)
\end{tikzpicture}
```

14.2.1 Place an arrow on segment



```
\begin{tikzpicture}
  \tikzset{
    arr/.style={postaction=decorate,
    decoration={markings,
    mark=at position .5 with {\arrow[thick]{#1}}
      }}}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(4,-4){B}
  \tkzDrawSegments[arr=stealth](A,B)
  \tkzDrawPoints(A,B)
\end{tikzpicture}
```

14.3 Mark a segment \tkzMarkSegment

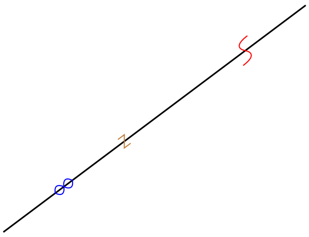
`\tkzMarkSegment[⟨local options⟩](⟨pt1,pt2⟩)`

The macro allows you to place a mark on a segment.

options	default	definition
pos	.5	position of the mark
color	black	color of the mark
mark	none	choice of the mark
size	4pt	size of the mark

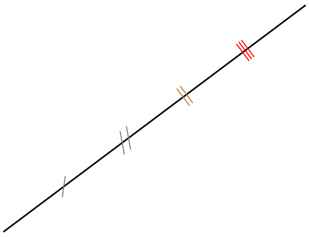
Possible marks are those provided by TikZ, but other marks have been created based on an idea by Yves Combe.

14.3.1 Several marks



```
\begin{tikzpicture}
  \tkzDefPoint(2,1){A}
  \tkzDefPoint(6,4){B}
  \tkzDrawSegment(A,B)
  \tkzMarkSegment[color=brown,size=2pt,pos=0.4, mark=z](A,B)
  \tkzMarkSegment[color=blue,pos=0.2, mark=oo](A,B)
  \tkzMarkSegment[pos=0.8,mark=s,color=red](A,B)
\end{tikzpicture}
```

14.3.2 Use of mark



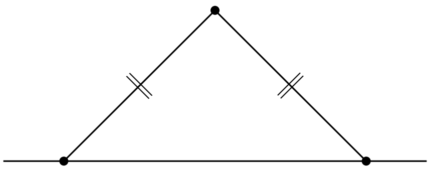
```
\begin{tikzpicture}
  \tkzDefPoint(2,1){A}
  \tkzDefPoint(6,4){B}
  \tkzDrawSegment(A,B)
  \tkzMarkSegment[color=gray,pos=0.2,mark=s|](A,B)
  \tkzMarkSegment[color=gray,pos=0.4,mark=s||](A,B)
  \tkzMarkSegment[color=brown,pos=0.6,mark=||](A,B)
  \tkzMarkSegment[color=red,pos=0.8,mark=|||](A,B)
\end{tikzpicture}
```

14.4 Marking segments \tkzMarkSegments

`\tkzMarkSegments[⟨local options⟩](⟨pt1,pt2 pt3,pt4 ...⟩)`

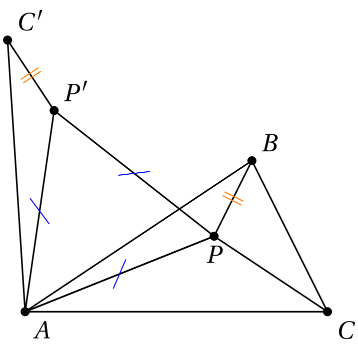
Arguments are a list of pairs of points separated by spaces. The styles of Ti*k*Z are available for plots.

14.4.1 Marks for an isosceles triangle



```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/O,2/2/A,4/0/B,6/2/C}
 \tkzDrawSegments(O,A A,B)
 \tkzDrawPoints(O,A,B)
 \tkzDrawLine(O,B)
 \tkzMarkSegments[mark=||,size=6pt](O,A A,B)
\end{tikzpicture}
```

14.5 Another marking




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoint(0,0){A}\tkzDefPoint(3,2){B}
 \tkzDefPoint(4,0){C}\tkzDefPoint(2.5,1){P}
 \tkzDrawPolygon(A,B,C)
 \tkzDefEquilateral(A,P) \tkzGetPoint{P'}
 \tkzDefPointsBy[rotation=center A angle 60](P,B){P',C'}
 \tkzDrawPolygon(A,P,P')
 \tkzDrawPolySeg(P',C',A,P,B)
 \tkzDrawSegment(C,P)
 \tkzDrawPoints(A,B,C,C',P,P')
 \tkzMarkSegments[mark=s|,size=6pt,
 color=blue](A,P P,P' P',A)
 \tkzMarkSegments[mark=||,color=orange](B,P P',C')
 \tkzLabelPoints(A,C) \tkzLabelPoints[below](P)
 \tkzLabelPoints[above right](P',C',B)
\end{tikzpicture}
```

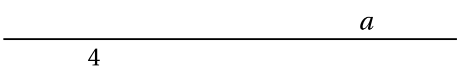
\tkzLabelSegment[⟨local options⟩](⟨pt1,pt2⟩){⟨label⟩}

This macro allows you to place a label along a segment or a line. The options are those of Ti*k*Z for example `pos`.

argument	example	definition
label	`\tkzLabelSegment(A,B){5}`	label text
(pt1,pt2)	(A,B)	label along $[AB]$

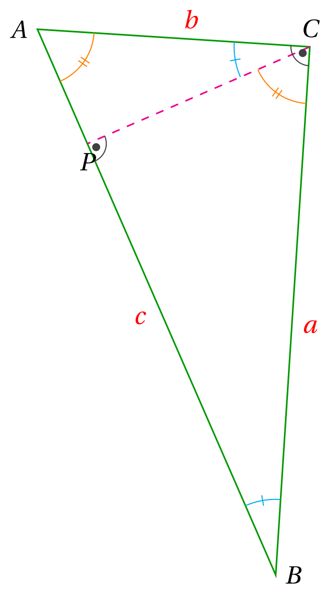
options	default	definition
pos	.5	label's position

14.5.1 Multiple labels




```
\begin{tikzpicture}
\tkzInit
\tkzDefPoint(0,0){A}
\tkzDefPoint(6,0){B}
\tkzDrawSegment(A,B)
\tkzLabelSegment[above,pos=.8](A,B){$a$}
\tkzLabelSegment[below,pos=.2](A,B){$4$}
\end{tikzpicture}
```

14.5.2 Labels and right-angled triangle

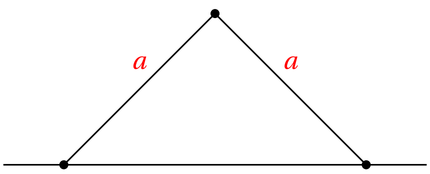



```
\begin{tikzpicture}[rotate=-60]
\tikzset{label seg style/.append style = {%
        color      = red,
        }}
\tkzDefPoint(0,1){A}
\tkzDefPoint(2,4){C}
\tkzDefPointWith[orthogonal normed,K=7](C,A)
\tkzGetPoint{B}
\tkzDrawPolygon[green!60!black](A,B,C)
\tkzDrawLine[altitude,dashed,color=magenta](B,C,A)
\tkzGetPoint{P}
\tkzLabelPoint[left](A){$A$}
\tkzLabelPoint[right](B){$B$}
\tkzLabelPoint[above](C){$C$}
\tkzLabelPoint[below](P){$P$}
\tkzLabelSegment[](B,A){$c$}
\tkzLabelSegment[swap](B,C){$a$}
\tkzLabelSegment[swap](C,A){$b$}
\tkzMarkAngles[size=1cm,
     color=cyan,mark=|](C,B,A A,C,P)
\tkzMarkAngle[size=0.75cm,
     color=orange,mark=||](P,C,B)
\tkzMarkAngle[size=0.75cm,
      color=orange,mark=||](B,A,C)
\tkzMarkRightAngles[german](A,C,B B,P,C)
\end{tikzpicture}
```

`\tkzLabelSegments[⟨local options⟩](⟨pt1,pt2 pt3,pt4 ...⟩)`

The arguments are a two-point couple list. The styles of TikZ are available for plotting.

14.5.3 Labels for an isosceles triangle




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/O,2/2/A,4/0/B,6/2/C}
 \tkzDrawSegments(O,A A,B)
 \tkzDrawPoints(O,A,B)
 \tkzDrawLine(O,B)
 \tkzLabelSegments[color=red,above=4pt](O,A A,B){$a$}
\end{tikzpicture}
```

15 Triangles

15.1 Definition of triangles \tkzDefTriangle

The following macros will allow you to define or construct a triangle from `at least` two points.

At the moment, it is possible to define the following triangles:

- `two angles` determines a triangle with two angles;
- `equilateral` determines an equilateral triangle;
- `half` determines a right-angled triangle such that the ratio of the measurements of the two adjacent sides to the right angle is equal to 2;
- `pythagore` determines a right-angled triangle whose side measurements are proportional to 3, 4 and 5;
- `school` determines a right-angled triangle whose angles are 30, 60 and 90 degrees;
- `golden` determines a right-angled triangle such that the ratio of the measurements on the two adjacent sides to the right angle is equal to $\Phi = 1.618034$, I chose "golden triangle" as the denomination because it comes from the golden rectangle and I kept the denomination "gold triangle" or "Euclid's triangle" for the isosceles triangle whose angles at the base are 72 degrees;
- `euclide` or `gold` for the gold triangle;
- `cheops` determines a third point such that the triangle is isosceles with side measurements proportional to 2, Φ and Φ.

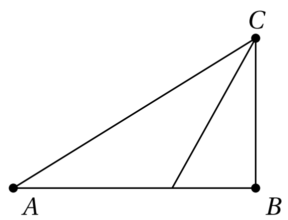
`\tkzDefTriangle[⟨local options⟩](⟨A,B⟩)`

The points are ordered because the triangle is constructed following the direct direction of the trigonometric circle. This macro is either used in partnership with `\tkzGetPoint` or by using `tkzPointResult` if it is not necessary to keep the name.

options	default	definition
two angles= #1 and #2	no defaut	triangle knowing two angles
equilateral	no defaut	equilateral triangle
pythagore	no defaut	proportional to the pythagorean triangle 3-4-5
school	no defaut	angles of 30, 60 and 90 degrees
gold	no defaut	angles of 72, 72 and 36 degrees, A is the apex
euclide	no defaut	same as above but $[AB]$ is the base
golden	no defaut	B rectangle and $AB/AC = \Phi$
cheops	no defaut	AC=BC, AC and BC are proportional to 2 and Φ.

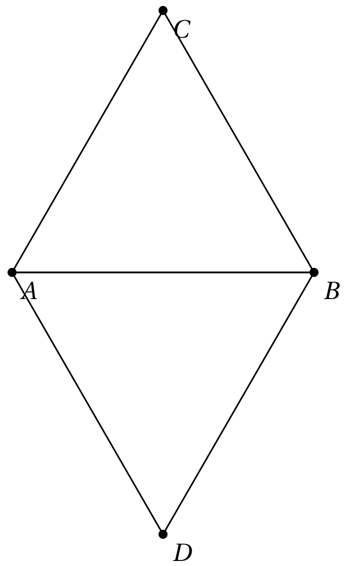
`\tkzGetPoint` allows you to store the point otherwise `tkzPointResult` allows for immediate use.

15.1.1 Option golden



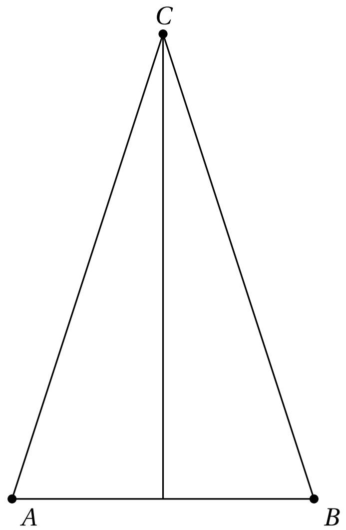

```
\begin{tikzpicture}[scale=.8]
\tkzInit[xmax=5,ymax=3] \tkzClip[space=.5]
  \tkzDefPoint(0,0){A}      \tkzDefPoint(4,0){B}
  \tkzDefTriangle[golden](A,B)\tkzGetPoint{C}
  \tkzDrawPolygon(A,B,C) \tkzDrawPoints(A,B,C)
  \tkzLabelPoints(A,B) \tkzDrawBisector(A,C,B)
  \tkzLabelPoints[above](C)
\end{tikzpicture}
```

15.1.2 Option equilateral




```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(4,0){B}
  \tkzDefTriangle[equilateral](A,B)
  \tkzGetPoint{C}
  \tkzDrawPolygon(A,B,C)
  \tkzDefTriangle[equilateral](B,A)
  \tkzGetPoint{D}
  \tkzDrawPolygon(B,A,D)
  \tkzDrawPoints(A,B,C,D)
  \tkzLabelPoints(A,B,C,D)
\end{tikzpicture}
```

15.1.3 Option gold or euclide




```
\begin{tikzpicture}
 \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
 \tkzDefTriangle[euclide](A,B)\tkzGetPoint{C}
 \tkzDrawPolygon(A,B,C)
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints(A,B)
 \tkzLabelPoints[above](C)
 \tkzDrawBisector(A,C,B)
\end{tikzpicture}
```

15.2 Drawing of triangles

`\tkzDrawTriangle[⟨local options⟩](⟨A,B⟩)`

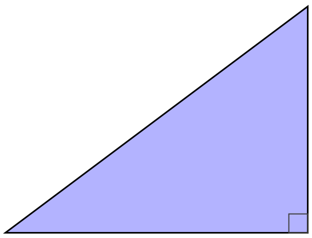
Macro similar to the previous macro but the sides are drawn.

options	default	definition
two angles= #1 and #2	equilateral	triangle knowing two angles
equilateral	equilateral	equilateral triangle
pythagore	equilateral	proportional to the pythagorean triangle 3-4-5
school	equilateral	the angles are 30, 60 and 90 degrees
gold	equilateral	the angles are 72, 72 and 36 degrees, A is the vertex
euclide	equilateral	identical to the previous one but $[AB]$ is the base
golden	equilateral	B rectangle and $AB/AC = \Phi$
cheops	equilateral	isosceles in C and $AC/AB = \frac{\Phi}{2}$

In all its definitions, the dimensions of the triangle depend on the two starting points.

15.2.1 Option pythagore

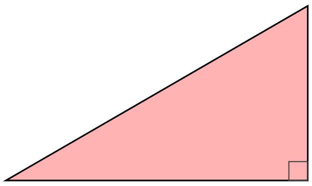
This triangle has sides whose lengths are proportional to 3, 4 and 5.



```
\begin{tikzpicture}
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(4,0){B}
 \tkzDrawTriangle[pythagore,fill=blue!30](A,B)
 \tkzMarkRightAngles(A,B,tkzPointResult)
\end{tikzpicture}
```

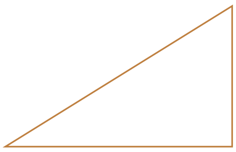
15.2.2 Option school

The angles are 30, 60 and 90 degrees.



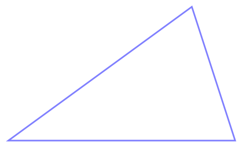
```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
  \tkzDrawTriangle[school,fill=red!30](A,B)
  \tkzMarkRightAngles(tkzPointResult,B,A)
\end{tikzpicture}
```

15.2.3 Option golden



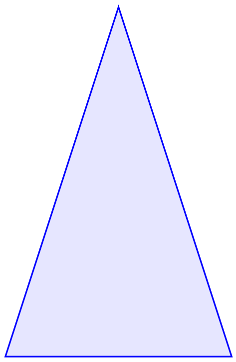
```
\begin{tikzpicture}[scale=1]
\tkzDefPoint(0,-10){M}
\tkzDefPoint(3,-10){N}
\tkzDrawTriangle[golden,color=brown](M,N)
\end{tikzpicture}
```

15.2.4 Option gold



```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(5,-5){I}
  \tkzDefPoint(8,-5){J}
  \tkzDrawTriangle[gold,color=blue!50](I,J)
\end{tikzpicture}
```

15.2.5 Option euclide



```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(10,-5){K}
  \tkzDefPoint(13,-5){L}
  \tkzDrawTriangle[euclide,color=blue,fill=blue!10](K,L)
\end{tikzpicture}
```

16 Specific triangles with \tkzDefSpcTriangle

The centers of some triangles have been defined in the "points" section, here it is a question of determining the three vertices of specific triangles.

`\tkzDefSpcTriangle[⟨local options⟩](⟨A,B,C⟩)`

The order of the points is important!

options	default	definition
in or incentral	centroid	two-angled triangle
ex or excentral	centroid	equilateral triangle
extouch	centroid	proportional to the pythagorean triangle 3-4-5
intouch or contact	centroid	30, 60 and 90 degree angles
centroid or medial	centroid	angles of 72, 72 and 36 degrees, A is the vertex
orthic	centroid	same as above but $[AB]$ is the base
feuerbach	centroid	B rectangle and $AB/AC = \Phi$
euler	centroid	AC=BC, AC and BC are proportional to 2 and Φ.
tangential	centroid	AC=BC, AC and BC are proportional to 2 and Φ.
name	no defaut	AC=BC, AC and BC are proportional to 2 and Φ.

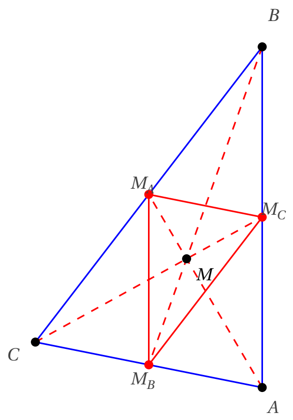
`\tkzGetPoint` allows you to store the point otherwise `tkzPointResult` allows for immediate use.

16.0.1 Option medial or centroid

The geometric centroid of the polygon vertices of a triangle is the point G (sometimes also denoted M) which is also the intersection of the triangle's three triangle medians. The point is therefore sometimes called the median

point. The centroid is always in the interior of the triangle.
Weisstein, Eric W. "Centroid triangle" From MathWorld–A Wolfram Web Resource.

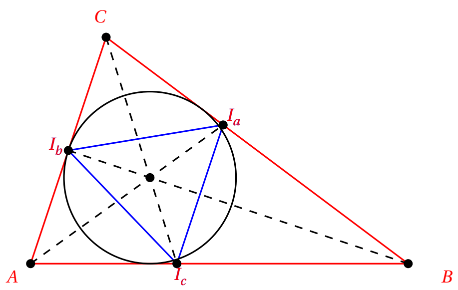
In the following example, we obtain the Euler circle which passes through the previously defined points.




```
\begin{tikzpicture}[rotate=90,scale=.75]
 \tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
 \tkzDefTriangleCenter[centroid](A,B,C)
        \tkzGetPoint{M}
 \tkzDefSpcTriangle[medial,name=M](A,B,C){_A,_B,_C}
 \tkzDrawPolygon[color=blue](A,B,C)
 \tkzDrawSegments[dashed,red](A,M_A B,M_B C,M_C)
 \tkzDrawPolygon[color=red](M_A,M_B,M_C)
 \tkzDrawPoints(A,B,C,M)
 \tkzDrawPoints[red](M_A,M_B,M_C)
\tkzAutoLabelPoints[center=M,font=\scriptsize]%
(A,B,C,M_A,M_B,M_C)
 \tkzLabelPoints[font=\scriptsize](M)
\end{tikzpicture}
```

16.0.2 Option in or incentral

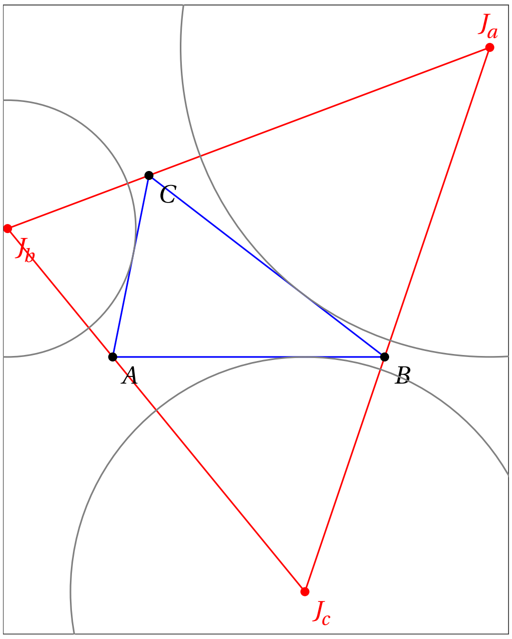
The incentral triangle is the triangle whose vertices are determined by the intersections of the reference triangle's angle bisectors with the respective opposite sides.
Weisstein, Eric W. "Incentral triangle" From MathWorld–A Wolfram Web Resource.




```
\begin{tikzpicture}[scale=1]
  \tkzDefPoints{ 0/0/A,5/0/B,1/3/C}
  \tkzDefSpcTriangle[in,name=I](A,B,C){_a,_b,_c}
  \tkzInCenter(A,B,C)\tkzGetPoint{I}
  \tkzDrawPolygon[red](A,B,C)
  \tkzDrawPolygon[blue](I_a,I_b,I_c)
  \tkzDrawPoints(A,B,C,I,I_a,I_b,I_c)
  \tkzDrawCircle[in](A,B,C)
  \tkzDrawSegments[dashed](A,I_a B,I_b C,I_c)
 \tkzAutoLabelPoints[center=I,
  blue,font=\scriptsize](I_a,I_b,I_c)
 \tkzAutoLabelPoints[center=I,red,
  font=\scriptsize](A,B,C,I_a,I_b,I_c)
\end{tikzpicture}
```

16.0.3 Option ex or excentral

The excentral triangle of a triangle ABC is the triangle $J_aJ_bJ_c$ with vertices corresponding to the excenters of ABC.

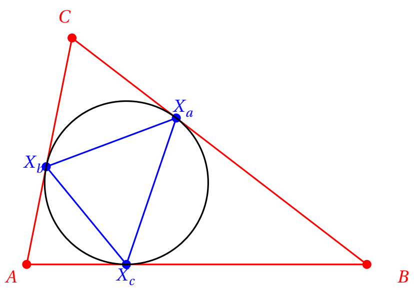



```
\begin{tikzpicture}[scale=.6]
 \tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
 \tkzDefSpcTriangle[excentral,name=J](A,B,C){_a,_b,_c}
 \tkzDefSpcTriangle[extouch,name=T](A,B,C){_a,_b,_c}
 \tkzDrawPolygon[blue](A,B,C)
 \tkzDrawPolygon[red](J_a,J_b,J_c)
 \tkzDrawPoints(A,B,C)
 \tkzDrawPoints[red](J_a,J_b,J_c)
 \tkzLabelPoints(A,B,C)
 \tkzLabelPoints[red](J_b,J_c)
 \tkzLabelPoints[red,above](J_a)
 \tkzClipBB \tkzShowBB
 \tkzDrawCircles[gray](J_a,T_a J_b,T_b J_c,T_c)
\end{tikzpicture}
```

16.0.4 Option intouch

The contact triangle of a triangle ABC, also called the intouch triangle, is the triangle formed by the points of tangency of the incircle of ABC with ABC.
Weisstein, Eric W. "Contact triangle" From MathWorld–A Wolfram Web Resource.

We obtain the intersections of the bisectors with the sides.

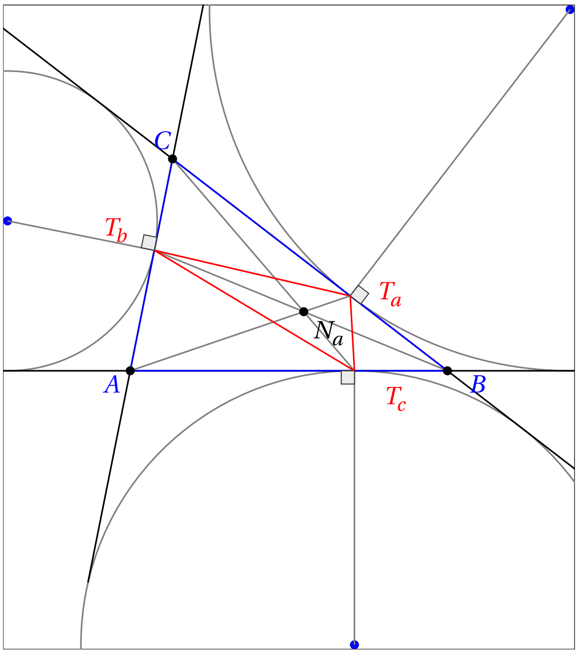



```
\begin{tikzpicture}[scale=.75]
 \tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
 \tkzDefSpcTriangle[intouch,name=X](A,B,C){_a,_b,_c}
 \tkzInCenter(A,B,C)\tkzGetPoint{I}
 \tkzDrawPolygon[red](A,B,C)
 \tkzDrawPolygon[blue](X_a,X_b,X_c)
 \tkzDrawPoints[red](A,B,C)
 \tkzDrawPoints[blue](X_a,X_b,X_c)
 \tkzDrawCircle[in](A,B,C)
 \tkzAutoLabelPoints[center=I,blue,font=\scriptsize]%
(X_a,X_b,X_c)
 \tkzAutoLabelPoints[center=I,red,font=\scriptsize]%
(A,B,C)
\end{tikzpicture}
```

16.0.5 Option extouch

The extouch triangle $T_aT_bT_c$ is the triangle formed by the points of tangency of a triangle ABC with its excircles J_a, J_b, and J_c. The points T_a, T_b, and T_c can also be constructed as the points which bisect the perimeter of $A_1A_2A_3$ starting at A, B, and C.
Weisstein, Eric W. "Extouch triangle" From MathWorld–A Wolfram Web Resource.

We obtain the points of contact of the exinscribed circles as well as the triangle formed by the centres of the exinscribed circles.



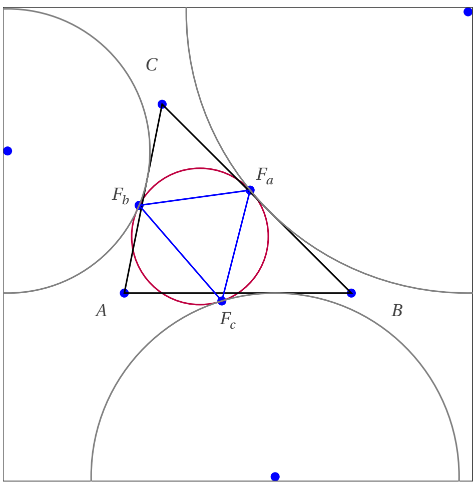

```
\begin{tikzpicture}[scale=.7]
\tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
\tkzDefSpcTriangle[excentral,
                  name=J](A,B,C){_a,_b,_c}
\tkzDefSpcTriangle[extouch,
                   name=T](A,B,C){_a,_b,_c}
\tkzDefTriangleCenter[nagel](A,B,C)
\tkzGetPoint{N_a}
\tkzDefTriangleCenter[centroid](A,B,C)
\tkzGetPoint{G}
\tkzDrawPoints[blue](J_a,J_b,J_c)
\tkzClipBB \tkzShowBB
\tkzDrawCircles[gray](J_a,T_a J_b,T_b J_c,T_c)
\tkzDrawLines[add=1 and 1](A,B B,C C,A)
\tkzDrawSegments[gray](A,T_a B,T_b C,T_c)
\tkzDrawSegments[gray](J_a,T_a J_b,T_b J_c,T_c)
\tkzDrawPolygon[blue](A,B,C)
\tkzDrawPolygon[red](T_a,T_b,T_c)
\tkzDrawPoints(A,B,C,N_a)
\tkzLabelPoints(N_a)
\tkzAutoLabelPoints[center=Na,blue](A,B,C)
\tkzAutoLabelPoints[center=G,red,
                          dist=.4](T_a,T_b,T_c)
\tkzMarkRightAngles[fill=gray!15](J_a,T_a,B
 J_b,T_b,C J_c,T_c,A)
\end{tikzpicture}
```

16.0.6 Option feuerbach

The Feuerbach triangle is the triangle formed by the three points of tangency of the nine-point circle with the excircles.

Weisstein, Eric W. "Feuerbach triangle" From MathWorld–A Wolfram Web Resource.

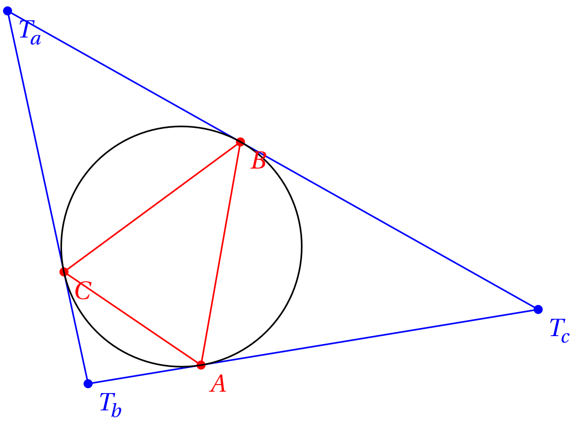
The points of tangency define the Feuerbach triangle.




```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(3,0){B}
  \tkzDefPoint(0.5,2.5){C}
  \tkzDefCircle[euler](A,B,C) \tkzGetPoint{N}
  \tkzDefSpcTriangle[feuerbach,
                      name=F](A,B,C){_a,_b,_c}
  \tkzDefSpcTriangle[excentral,
                      name=J](A,B,C){_a,_b,_c}
  \tkzDefSpcTriangle[extouch,
                       name=T](A,B,C){_a,_b,_c}
  \tkzDrawPoints[blue](J_a,J_b,J_c,F_a,F_b,F_c,A,B,C)
  \tkzClipBB \tkzShowBB
  \tkzDrawCircle[purple](N,F_a)
  \tkzDrawPolygon(A,B,C)
  \tkzDrawPolygon[blue](F_a,F_b,F_c)
  \tkzDrawCircles[gray](J_a,F_a J_b,F_b J_c,F_c)
  \tkzAutoLabelPoints[center=N,dist=.3,
   font=\scriptsize](A,B,C,F_a,F_b,F_c,J_a,J_b,J_c)
\end{tikzpicture}
```

16.0.7 Option tangential

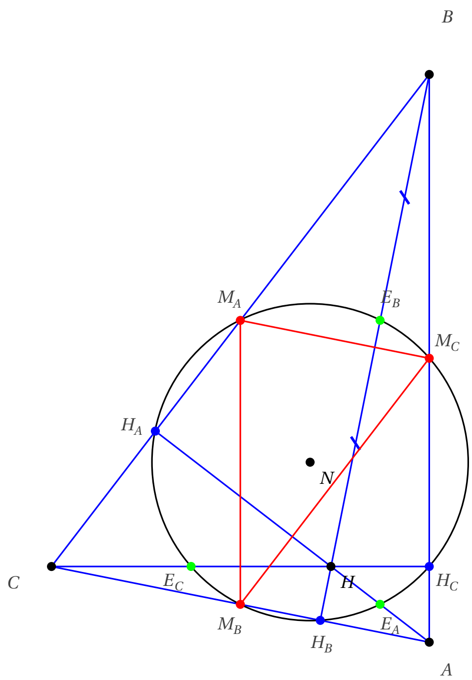
The tangential triangle is the triangle $T_aT_bT_c$ formed by the lines tangent to the circumcircle of a given triangle ABC at its vertices. It is therefore antipedal triangle of ABC with respect to the circumcenter O.
Weisstein, Eric W. "Tangential Triangle." From MathWorld–A Wolfram Web Resource.




```
\begin{tikzpicture}[scale=.5,rotate=80]
  \tkzDefPoints{0/0/A,6/0/B,1.8/4/C}
  \tkzDefSpcTriangle[tangential,
    name=T](A,B,C){_a,_b,_c}
  \tkzDrawPolygon[red](A,B,C)
  \tkzDrawPolygon[blue](T_a,T_b,T_c)
  \tkzDrawPoints[red](A,B,C)
  \tkzDrawPoints[blue](T_a,T_b,T_c)
  \tkzDefCircle[circum](A,B,C)
  \tkzGetPoint{O}
  \tkzDrawCircle(O,A)
  \tkzLabelPoints[red](A,B,C)
  \tkzLabelPoints[blue](T_a,T_b,T_c)
\end{tikzpicture}
```

16.0.8 Option euler

The Euler triangle of a triangle ABC is the triangle $E_AE_BE_C$ whose vertices are the midpoints of the segments joining the orthocenter H with the respective vertices. The vertices of the triangle are known as the Euler points, and lie on the nine-point circle.




```
\begin{tikzpicture}[rotate=90,scale=1.25]
 \tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
 \tkzDefSpcTriangle[medial,
     name=M](A,B,C){_A,_B,_C}
 \tkzDefTriangleCenter[euler](A,B,C)
     \tkzGetPoint{N} % I= N nine points
 \tkzDefTriangleCenter[ortho](A,B,C)
        \tkzGetPoint{H}
 \tkzDefMidPoint(A,H) \tkzGetPoint{E_A}
 \tkzDefMidPoint(C,H) \tkzGetPoint{E_C}
 \tkzDefMidPoint(B,H) \tkzGetPoint{E_B}
 \tkzDefSpcTriangle[ortho,name=H](A,B,C){_A,_B,_C}
 \tkzDrawPolygon[color=blue](A,B,C)
 \tkzDrawCircle(N,E_A)
 \tkzDrawSegments[blue](A,H_A B,H_B C,H_C)
 \tkzDrawPoints(A,B,C,N,H)
 \tkzDrawPoints[red](M_A,M_B,M_C)
 \tkzDrawPoints[blue]( H_A,H_B,H_C)
 \tkzDrawPoints[green](E_A,E_B,E_C)
 \tkzAutoLabelPoints[center=N,font=\scriptsize]%
(A,B,C,M_A,M_B,M_C,H_A,H_B,H_C,E_A,E_B,E_C)
\tkzLabelPoints[font=\scriptsize](H,N)
\tkzMarkSegments[mark=s|,size=3pt,
  color=blue,line width=1pt](B,E_B E_B,H)
   \tkzDrawPolygon[color=red](M_A,M_B,M_C)
\end{tikzpicture}
```

17 Definition of polygons

17.1 Defining the points of a square

We have seen the definitions of some triangles. Let us look at the definitions of some quadrilaterals and regular polygons.

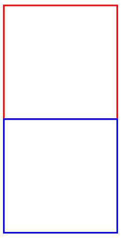
`\tkzDefSquare(⟨pt1,pt2⟩)`

The square is defined in the forward direction. From two points, two more points are obtained such that the four taken in order form a square. The square is defined in the forward direction. The results are in **tkzFirstPointResult** and **tkzSecondPointResult**.
We can rename them with **\tkzGetPoints**.

Arguments	example	explication
(⟨pt1,pt2⟩)	\tkzDefSquare(⟨A,B⟩)	The square is defined in the direct direction.

17.1.1 Using \tkzDefSquare with two points

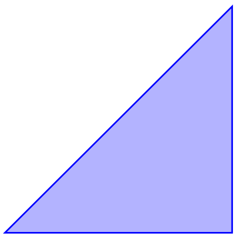
Note the inversion of the first two points and the result.



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint(0,0){A} \tkzDefPoint(3,0){B}
  \tkzDefSquare(A,B)
  \tkzDrawPolygon[color=red](A,B,tkzFirstPointResult,%
              tkzSecondPointResult)
  \tkzDefSquare(B,A)
  \tkzDrawPolygon[color=blue](B,A,tkzFirstPointResult,%
              tkzSecondPointResult)
\end{tikzpicture}
```

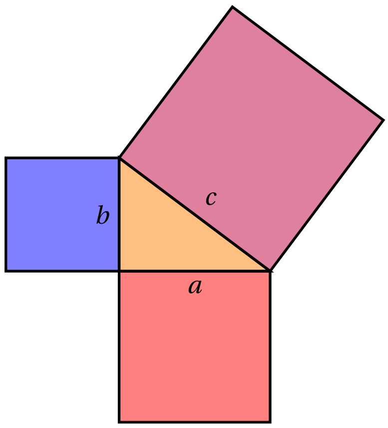
We may only need one point to draw an isosceles right-angled triangle so we use **\tkzGetFirstPoint** or **\tkzGetSecondPoint**.

17.1.2 Use of \tkzDefSquare to obtain an isosceles right-angled triangle



```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(3,0){B}
  \tkzDefSquare(A,B) \tkzGetFirstPoint{C}
  \tkzDrawPolygon[color=blue,fill=blue!30](A,B,C)
\end{tikzpicture}
```

17.1.3 Pythagorean Theorem and \tkzDefSquare




```
\begin{tikzpicture}[scale=.5]
\tkzInit
\tkzDefPoint(0,0){C}
\tkzDefPoint(4,0){A}
\tkzDefPoint(0,3){B}
\tkzDefSquare(B,A)\tkzGetPoints{E}{F}
\tkzDefSquare(A,C)\tkzGetPoints{G}{H}
\tkzDefSquare(C,B)\tkzGetPoints{I}{J}
\tkzFillPolygon[fill = red!50 ](A,C,G,H)
\tkzFillPolygon[fill = blue!50 ](C,B,I,J)
\tkzFillPolygon[fill = purple!50](B,A,E,F)
\tkzFillPolygon[fill = orange,opacity=.5](A,B,C)
\tkzDrawPolygon[line width = 1pt](A,B,C)
\tkzDrawPolygon[line width = 1pt](A,C,G,H)
\tkzDrawPolygon[line width = 1pt](C,B,I,J)
\tkzDrawPolygon[line width = 1pt](B,A,E,F)
\tkzLabelSegment[](A,C){$a$}
\tkzLabelSegment[](C,B){$b$}
\tkzLabelSegment[swap](A,B){$c$}
\end{tikzpicture}
```

17.2 Definition of parallelogram

17.3 Defining the points of a parallelogram

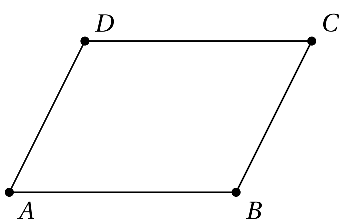
It is a matter of completing three points in order to obtain a parallelogram.

\tkzDefParallelogram(⟨pt1,pt2,pt3⟩)

From three points, another point is obtained such that the four taken in order form a parallelogram. The result is in `tkzPointResult`.
We can rename it with the name `\tkzGetPoint`...

arguments	default	definition
(⟨pt1,pt2,pt3⟩)	no default	Three points are necessary

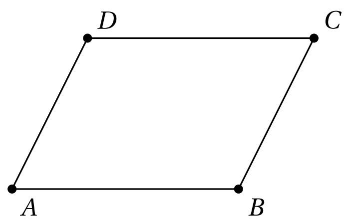
17.3.1 Example of a parallelogram definition




```
\begin{tikzpicture}[scale=1]
 \tkzDefPoints{0/0/A,3/0/B,4/2/C}
 \tkzDefParallelogram(A,B,C)
 \tkzGetPoint{D}
 \tkzDrawPolygon(A,B,C,D)
 \tkzLabelPoints(A,B)
 \tkzLabelPoints[above right](C,D)
 \tkzDrawPoints(A,...,D)
\end{tikzpicture}
```

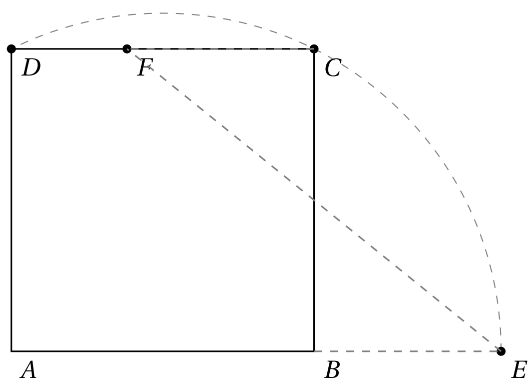
17.3.2 Simple example

Explanation of the definition of a parallelogram




```
\begin{tikzpicture}[scale=1]
  \tkzDefPoints{0/0/A,3/0/B,4/2/C}
  \tkzDefPointWith[colinear= at C](B,A)
  \tkzGetPoint{D}
  \tkzDrawPolygon(A,B,C,D)
  \tkzLabelPoints(A,B)
  \tkzLabelPoints[above right](C,D)
  \tkzDrawPoints(A,...,D)
\end{tikzpicture}
```

17.3.3 Construction of the golden rectangle




```
\begin{tikzpicture}[scale=.5]
  \tkzInit[xmax=14,ymax=10]
  \tkzClip[space=1]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(8,0){B}
  \tkzDefMidPoint(A,B)\tkzGetPoint{I}
  \tkzDefSquare(A,B)\tkzGetPoints{C}{D}
  \tkzDrawSquare(A,B)
  \tkzInterLC(A,B)(I,C)\tkzGetPoints{G}{E}
  \tkzDrawArc[style=dashed,color=gray](I,E)(D)
  \tkzDefPointWith[colinear= at C](E,B)
  \tkzGetPoint{F}
  \tkzDrawPoints(C,D,E,F)
  \tkzLabelPoints(A,B,C,D,E,F)
  \tkzDrawSegments[style=dashed,color=gray]%
(E,F C,F B,E)
\end{tikzpicture}
```

17.4 Drawing a square

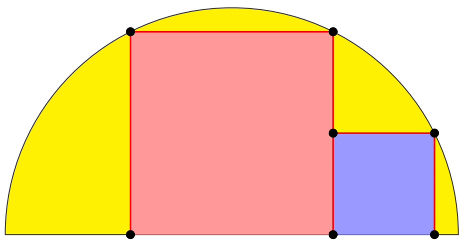
`\tkzDrawSquare[⟨local options⟩](⟨pt1,pt2⟩)`

The macro draws a square but not the vertices. It is possible to color the inside. The order of the points is that of the direct direction of the trigonometric circle.

arguments	example	explication
(⟨pt1,pt2⟩)	`\tkzDrawSquare(⟨A,B⟩)`	`\tkzGetPoints{C}{D}`

options	example	explication
Options TikZ	`red,line width=1pt`	

17.4.1 The idea is to inscribe two squares in a semi-circle.



```
\begin{tikzpicture}[scale=.75]
   \tkzInit[ymax=8,xmax=8]
 \tkzClip[space=.25]    \tkzDefPoint(0,0){A}
 \tkzDefPoint(8,0){B}  \tkzDefPoint(4,0){I}
 \tkzDefSquare(A,B)    \tkzGetPoints{C}{D}
 \tkzInterLC(I,C)(I,B) \tkzGetPoints{E'}{E}
 \tkzInterLC(I,D)(I,B) \tkzGetPoints{F'}{F}
 \tkzDefPointsBy[projection=onto A--B](E,F){H,G}
 \tkzDefPointsBy[symmetry   = center H](I){J}
 \tkzDefSquare(H,J)    \tkzGetPoints{K}{L}
 \tkzDrawSector[fill=yellow](I,B)(A)
 \tkzFillPolygon[color=red!40](H,E,F,G)
 \tkzFillPolygon[color=blue!40](H,J,K,L)
 \tkzDrawPolySeg[color=red](H,E,F,G)
 \tkzDrawPolySeg[color=red](J,K,L)
 \tkzDrawPoints(E,G,H,F,J,K,L)
\end{tikzpicture}
```

17.5 The golden rectangle

`\tkzDefGoldRectangle(⟨point,point⟩)`

The macro determines a rectangle whose size ratio is the number Φ. The created points are in **tkzFirstPointResult** and **tkzSecondPointResult**. They can be obtained with the macro **\tkzGetPoints**. The following macro is used to draw the rectangle.

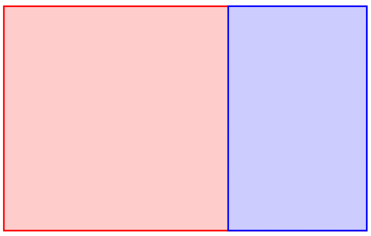
arguments	example	explication
(⟨pt1,pt2⟩)	(⟨A,B⟩)	If C and D are created then $AB/BC = \Phi$.

`\tkzDrawGoldRectangle[⟨local options⟩](⟨point,point⟩)`

arguments	example	explication
(⟨pt1,pt2⟩)	(⟨A,B⟩)	Draws the golden rectangle based on the segment $[AB]$

options	example	explication
Options TikZ	red,line width=1pt	

17.5.1 Golden Rectangles



```
\begin{tikzpicture}[scale=.6]
 \tkzDefPoint(0,0){A}      \tkzDefPoint(8,0){B}
 \tkzDefGoldRectangle(A,B) \tkzGetPoints{C}{D}
 \tkzDefGoldRectangle(B,C) \tkzGetPoints{E}{F}
 \tkzDrawPolygon[color=red,fill=red!20](A,B,C,D)
 \tkzDrawPolygon[color=blue,fill=blue!20](B,C,E,F)
\end{tikzpicture}
```

17.6 Drawing a polygon

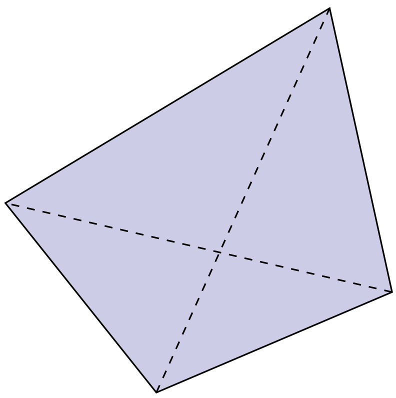
`\tkzDrawPolygon[⟨local options⟩](⟨points list⟩)`

Just give a list of points and the macro plots the polygon using the Ti*k*Z options present. You can replace (A,B,C,D,E) by $(A,...,E)$ and (P_1,P_2,P_3,P_4,P_5) by $(P_1,P...,P_5)$

arguments	example	explication
(⟨pt1,pt2,pt3,...⟩)	\tkzDrawPolygon[gray,dashed](A,B,C)	Drawing a triangle

options	default	example
Options TikZ	...	\tkzDrawPolygon[red,line width=2pt](A,B,C)

17.6.1 \tkzDrawPolygon



```
\begin{tikzpicture} [rotate=18,scale=1.5]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(2.25,0.2){B}
 \tkzDefPoint(2.5,2.75){C}
 \tkzDefPoint(-0.75,2){D}
 \tkzDrawPolygon[fill=black!50!blue!20!](A,B,C,D)
 \tkzDrawSegments[style=dashed](A,C B,D)
\end{tikzpicture}
```

17.7 Drawing a polygonal chain

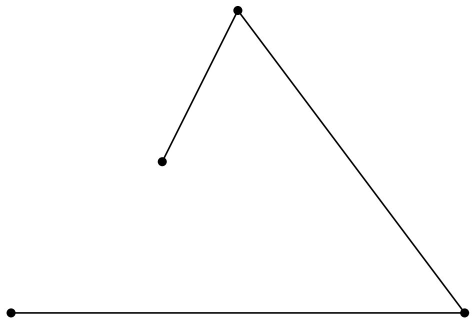
`\tkzDrawPolySeg[⟨local options⟩](⟨points list⟩)`

Just give a list of points and the macro plots the polygonal chain using the Ti*k*Z options present.

arguments	example	explication
(⟨pt1,pt2,pt3,...⟩)	\tkzDrawPolySeg[gray,dashed](A,B,C)	Drawing a triangle

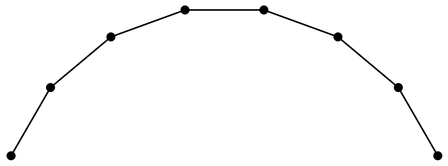
options	default	example
Options TikZ	...	\tkzDrawPolySeg[red,line width=2pt](A,B,C)

17.7.1 Polygonal chain



```
\begin{tikzpicture}
 \tkzDefPoints{0/0/A,6/0/B,3/4/C,2/2/D}
 \tkzDrawPolySeg(A,...,D)
 \tkzDrawPoints(A,...,D)
\end{tikzpicture}
```

17.7.2 Polygonal chain: index notation



```
\begin{tikzpicture}
\foreach \pt in {1,2,...,8} {%
\tkzDefPoint(\pt*20:3){P_\pt}}
\tkzDrawPolySeg(P_1,P_...,P_8)
\tkzDrawPoints(P_1,P_...,P_8)
\end{tikzpicture}
```

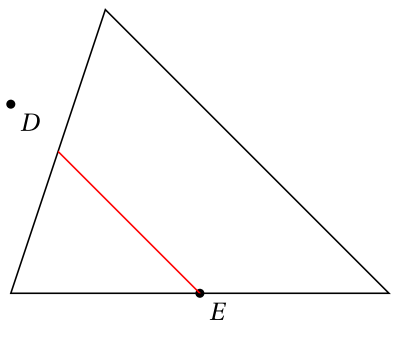
17.8 Clip a polygon

\tkzClipPolygon[⟨local options⟩](⟨points list⟩)

This macro makes it possible to contain the different plots in the designated polygon.

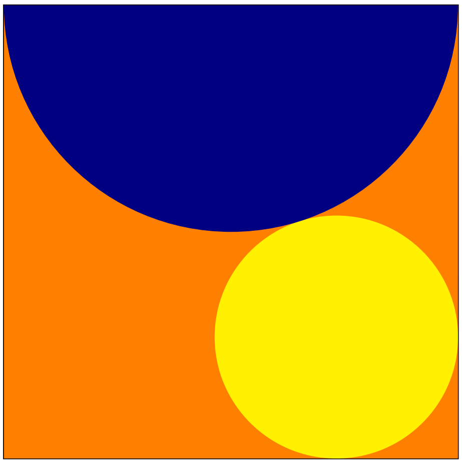
arguments	example	explication
(⟨pt1,pt2⟩)	(⟨A,B⟩)	

17.8.1 \tkzClipPolygon




```
\begin{tikzpicture}[scale=1.25]
 \tkzInit[xmin=0,xmax=4,ymin=0,ymax=3]
 \tkzClip[space=.5]
 \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
 \tkzDefPoint(1,3){C} \tkzDrawPolygon(A,B,C)
 \tkzDefPoint(0,2){D}  \tkzDefPoint(2,0){E}
 \tkzDrawPoints(D,E) \tkzLabelPoints(D,E)
 \tkzClipPolygon(A,B,C)
 \tkzDrawLine[color=red](D,E)
\end{tikzpicture}
```

17.8.2 Example: use of "Clip" for Sangaku in a square



```
\begin{tikzpicture}[scale=.75]
 \tkzDefPoint(0,0){A} \tkzDefPoint(8,0){B}
 \tkzDefSquare(A,B) \tkzGetPoints{C}{D}
 \tkzDrawPolygon(B,C,D,A)
 \tkzClipPolygon(B,C,D,A)
 \tkzDefPoint(4,8){F}
 \tkzDefTriangle[equilateral](C,D)
 \tkzGetPoint{I}
 \tkzDrawPoint(I)
 \tkzDefPointBy[projection=onto B--C](I)
 \tkzGetPoint{J}
 \tkzInterLL(D,B)(I,J)  \tkzGetPoint{K}
 \tkzDefPointBy[symmetry=center K](B)
 \tkzGetPoint{M}
 \tkzDrawCircle(M,I)
 \tkzCalcLength(M,I)   \tkzGetLength{dMI}
 \tkzFillPolygon[color = orange](A,B,C,D)
 \tkzFillCircle[R,color = yellow](M,\dMI pt)
 \tkzFillCircle[R,color = blue!50!black](F,4 cm)%
\end{tikzpicture}
```

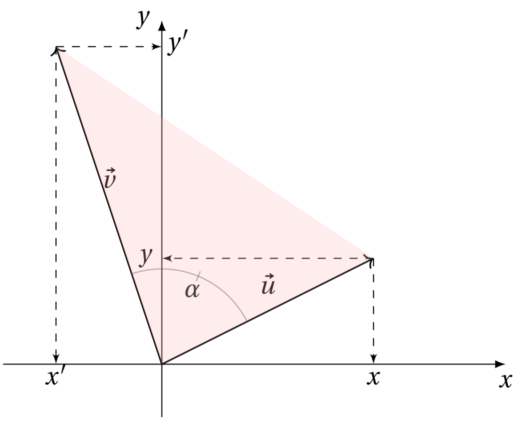
17.9 Color a polygon

\tkzFillPolygon[⟨local options⟩](⟨points list⟩)

You can color by drawing the polygon, but in this case you color the inside of the polygon without drawing it.

arguments	example	explication
(⟨pt1,pt2,…⟩)	(⟨A,B,…⟩)	

17.9.1 \tkzFillPolygon




```
\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)
\tkzPointShowCoord[xlabel=$x'$,ylabel=$y'$,%
                 ystyle={right=2pt}](B)
\tkzDrawSegments[->](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}
```

17.10 Regular polygon

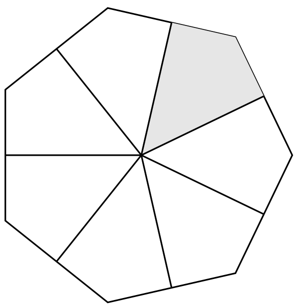
`\tkzDefRegPolygon[⟨local options⟩](⟨pt1,pt2⟩)`

From the number of sides, depending on the options, this macro determines a regular polygon according to its center or one side.

arguments	example	explication
(⟨pt1,pt2⟩)	(⟨O,A⟩)	with option "center", O is the center of the polygon.
(⟨pt1,pt2⟩)	(⟨A,B⟩)	with option "side", $[AB]$ is a side.

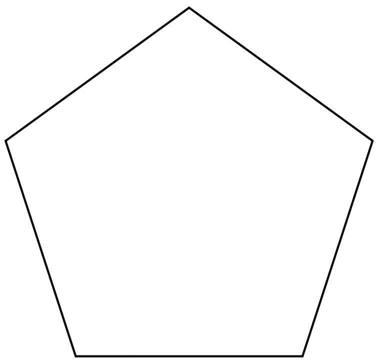
options	default	example
name	P	The vertices are named $P1,P2,\ldots$
sides	5	number of sides.
center	center	The first point is the center.
side	center	The two points are vertices.
Options TikZ	...	

17.10.1 Option center



```
\begin{tikzpicture}
\tkzDefPoints{0/0/P0,0/0/Q0,2/0/P1}
\tkzDefMidPoint(P0,P1) \tkzGetPoint{Q1}
  \tkzDefRegPolygon[center,sides=7](P0,P1)
\tkzDefMidPoint(P1,P2) \tkzGetPoint{Q1}
  \tkzDefRegPolygon[center,sides=7,name=Q](P0,Q1)
\tkzDrawPolygon(P1,P...,P7)
\tkzFillPolygon[gray!20](Q0,Q1,P2,Q2)
\foreach \j in {1,...,7} {\tkzDrawSegment[black](P0,Q\j)}
\end{tikzpicture}
```

17.10.2 Option side



```
\begin{tikzpicture}[scale=1]
    \tkzDefPoints{-4/0/A, -1/0/B}
    \tkzDefRegPolygon[side,sides=5,name=P](A,B)
    \tkzDrawPolygon[thick](P1,P...,P5)
\end{tikzpicture}
```

18 The Circles

Among the following macros, one will allow you to draw a circle, which is not a real feat. To do this, you will need to know the center of the circle and either the radius of the circle or a point on the circumference. It seemed to me that the most frequent use was to draw a circle with a given centre passing through a given point. This will be the default method, otherwise you will have to use the `R` option. There are a large number of special circles, for example the circle circumscribed by a triangle.

- I have created a first macro `\tkzDefCircle` which allows, according to a particular circle, to retrieve its center and the measurement of the radius in cm. This recovery is done with the macros `\tkzGetPoint` and `\tkzGetLength`;
- then a macro `\tkzDrawCircle`;
- then a macro that allows you to color in a disc, but without drawing the circle `\tkzFillCircle`;
- sometimes, it is necessary for a drawing to be contained in a disk, this is the role assigned to `\tkzClipCircle`;
- it finally remains to be able to give a label to designate a circle and if several possibilities are offered, we will see here `\tkzLabelCircle`.

18.1 Characteristics of a circle: \tkzDefCircle

This macro allows you to retrieve the characteristics (center and radius) of certain circles.

`\tkzDefCircle[⟨local options⟩](⟨A,B⟩) or (⟨A,B,C⟩)`

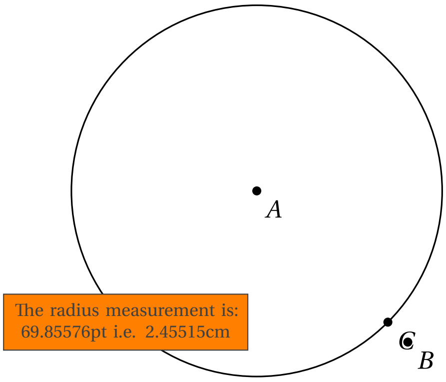
Attention the arguments are lists of two or three points. This macro is either used in partnership with `\tkzGetPoint` and/or `\tkzGetLength` to obtain the center and the radius of the circle, or by using `tkzPointResult` and `tkzLengthResult` if it is not necessary to keep the results.

arguments	example	explication
(⟨pt1,pt2⟩) or (⟨pt1,pt2,pt3⟩)	(⟨A,B⟩)	$[AB]$ is radius A is the center

options	default	definition
through	through	circle characterized by two points defining a radius
diameter	through	circle characterized by two points defining a diameter
circum	through	circle circumscribed of a triangle
in	through	incircle a triangle
ex	through	excircle of a triangle
euler or nine	through	Euler's Circle
spieker	through	Spieker Circle
apollonius	through	circle of Apollonius
orthogonal	through	circle of given centre orthogonal to another circle
orthogonal through	through	circle orthogonal circle passing through 2 points
K	1	coefficient used for a circle of Apollonius

In the following examples, I draw the circles with a macro not yet presented, but this is not necessary. In some cases you may only need the center or the radius.

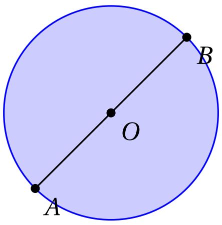
18.1.1 Example with a random point and option through




```
\begin{tikzpicture}[scale=1]
\tkzDefPoint(0,4){A}
\tkzDefPoint(2,2){B}
\tkzDefMidPoint(A,B) \tkzGetPoint{I}
\tkzDefRandPointOn[segment = I--B]
 \tkzGetPoint{C}
\tkzDefCircle[through](A,C)
\tkzGetLength{rACpt}
\tkzpttocm(\rACpt){rACcm}
\tkzDrawCircle(A,C)
\tkzDrawPoints(A,B,C)
\tkzLabelPoints(A,B,C)
\tkzLabelCircle[draw,fill=orange,
         text width=3cm,text centered,
         font=\scriptsize](A,C)(-90)%
{The radius measurement is:
 \rACpt pt i.e. \rACcm cm}
\end{tikzpicture}
```

18.1.2 Example with option diameter

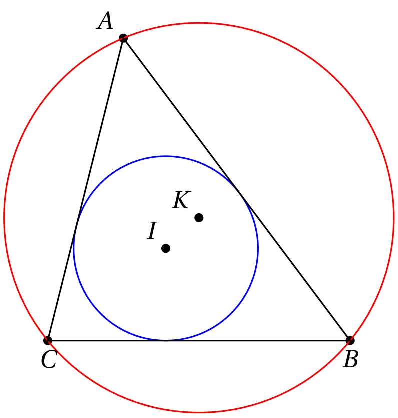
It is simpler here to search directly for the middle of $[AB]$.




```
\begin{tikzpicture}[scale=1]
   \tkzDefPoint(0,0){A}
   \tkzDefPoint(2,2){B}
   \tkzDefCircle[diameter](A,B)
   \tkzGetPoint{O}
   \tkzDrawCircle[blue,fill=blue!20](O,B)
   \tkzDrawSegment(A,B)
   \tkzDrawPoints(A,B,O)
   \tkzLabelPoints(A,B,O)
\end{tikzpicture}
```

18.1.3 Circles inscribed and circumscribed for a given triangle

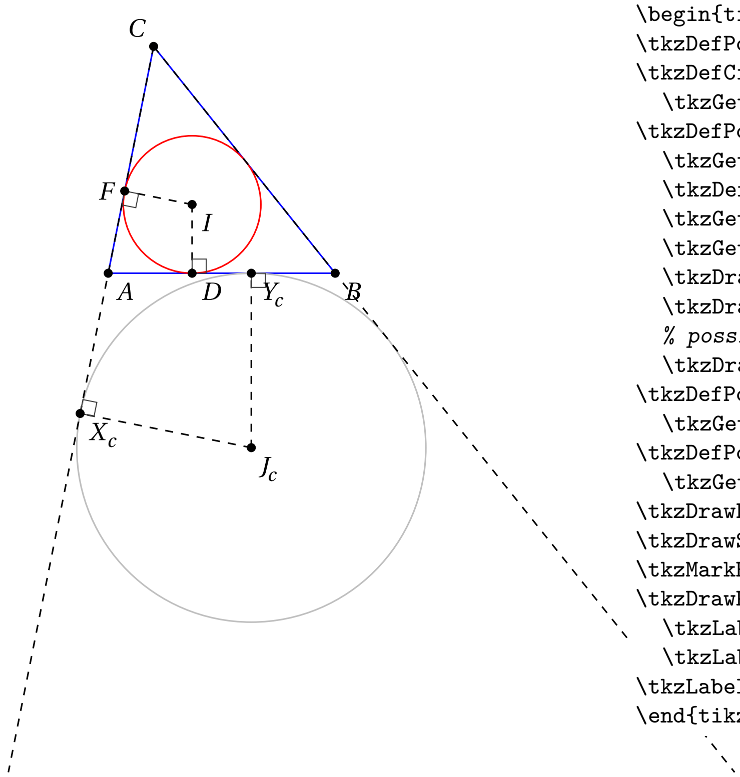
You can also obtain the center of the inscribed circle and its projection on one side of the triangle with **\tkzGetFirstPointI** and **\tkzGetSecondPointIb**.




```
\begin{tikzpicture}[scale=1]
   \tkzDefPoint(2,2){A}
   \tkzDefPoint(5,-2){B}
   \tkzDefPoint(1,-2){C}
   \tkzDefCircle[in](A,B,C)
   \tkzGetPoint{I}    \tkzGetLength{rIN}
   \tkzDefCircle[circum](A,B,C)
   \tkzGetPoint{K}   \tkzGetLength{rCI}
   \tkzDrawPoints(A,B,C,I,K)
   \tkzDrawCircle[R,blue](I,\rIN pt)
   \tkzDrawCircle[R,red](K,\rCI pt)
   \tkzLabelPoints[below](B,C)
   \tkzLabelPoints[above left](A,I,K)
   \tkzDrawPolygon(A,B,C)
\end{tikzpicture}
```

18.1.4 Example with option ex

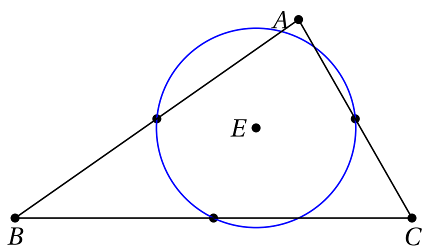
We want to define an excircle of a triangle relatively to point C




```
\begin{tikzpicture}[scale=.75]
\tkzDefPoints{ 0/0/A,4/0/B,0.8/4/C}
\tkzDefCircle[ex](B,C,A)
  \tkzGetPoint{J_c} \tkzGetLength{rc}
\tkzDefPointBy[projection=onto A--C ](J_c)
  \tkzGetPoint{X_c}
  \tkzDefPointBy[projection=onto A--B ](J_c)
  \tkzGetPoint{Y_c}
  \tkzGetPoint{I}
  \tkzDrawPolygon[color=blue](A,B,C)
  \tkzDrawCircle[R,color=lightgray](J_c,\rc pt)
  % possible  \tkzDrawCircle[ex](A,B,C)
  \tkzDrawCircle[in,color=red](A,B,C)    \tkzGetPoint{I}
\tkzDefPointBy[projection=onto A--C ](I)
  \tkzGetPoint{F}
\tkzDefPointBy[projection=onto A--B ](I)
  \tkzGetPoint{D}
\tkzDrawLines[add=0 and 2.2,dashed](C,A C,B)
\tkzDrawSegments[dashed](J_c,X_c I,D  I,F J_c,Y_c)
\tkzMarkRightAngles(A,F,I B,D,I J_c,X_c,A J_c,Y_c,B)
\tkzDrawPoints(B,C,A,I,D,F,X_c,J_c,Y_c)
  \tkzLabelPoints(B,A,J_c,I,D,X_c,Y_c)
  \tkzLabelPoints[above left](C)
\tkzLabelPoints[left](F)
\end{tikzpicture}
```

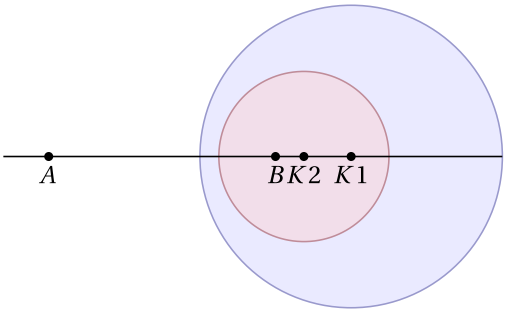
18.1.5 Euler's circle for a given triangle with option euler

We verify that this circle passes through the middle of each side.




```
\begin{tikzpicture}[scale=.75]
   \tkzDefPoint(5,3.5){A}
   \tkzDefPoint(0,0){B} \tkzDefPoint(7,0){C}
   \tkzDefCircle[euler](A,B,C)
   \tkzGetPoint{E}  \tkzGetLength{rEuler}
   \tkzDefSpcTriangle[medial](A,B,C){M_a,M_b,M_c}
   \tkzDrawPoints(A,B,C,E,M_a,M_b,M_c)
   \tkzDrawCircle[R,blue](E,\rEuler pt)
   \tkzDrawPolygon(A,B,C)
   \tkzLabelPoints[below](B,C)
   \tkzLabelPoints[left](A,E)
\end{tikzpicture}
```

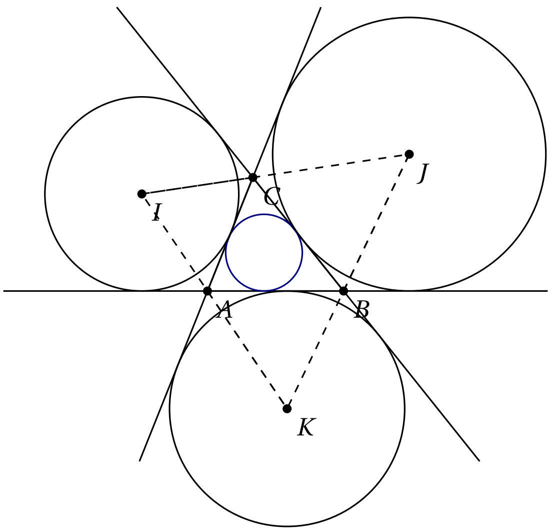
18.1.6 Apollonius circles for a given segment option apollonius




```
\begin{tikzpicture}[scale=0.75]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(4,0){B}
  \tkzDefCircle[apollonius,K=2](A,B)
  \tkzGetPoint{K1}
  \tkzGetLength{rAp}
  \tkzDrawCircle[R,color = blue!50!black,
      fill=blue!20,opacity=.4](K1,\rAp pt)
  \tkzDefCircle[apollonius,K=3](A,B)
  \tkzGetPoint{K2}   \tkzGetLength{rAp}
  \tkzDrawCircle[R,color=red!50!black,
   fill=red!20,opacity=.4](K2,\rAp pt)
  \tkzLabelPoints[below](A,B,K1,K2)
  \tkzDrawPoints(A,B,K1,K2)
  \tkzDrawLine[add=.2 and 1](A,B)
\end{tikzpicture}
```

18.1.7 Circles exinscribed to a given triangle option ex

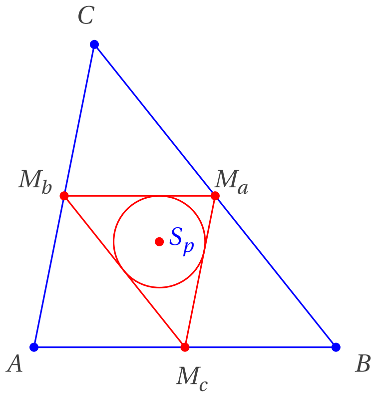
You can also get the center and the projection of it on one side of the triangle.
with `\tkzGetFirstPoint{Jb}` and `\tkzGetSecondPoint{Tb}`.




```
\begin{tikzpicture}[scale=.6]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(3,0){B}
  \tkzDefPoint(1,2.5){C}
  \tkzDefCircle[ex](A,B,C) \tkzGetPoint{I}
    \tkzGetLength{rI}
  \tkzDefCircle[ex](C,A,B) \tkzGetPoint{J}
    \tkzGetLength{rJ}
  \tkzDefCircle[ex](B,C,A) \tkzGetPoint{K}
    \tkzGetLength{rK}
   \tkzDefCircle[in](B,C,A) \tkzGetPoint{O}
     \tkzGetLength{rO}
  \tkzDrawLines[add=1.5 and 1.5](A,B A,C B,C)
  \tkzDrawPoints(I,J,K)
  \tkzDrawPolygon(A,B,C)
  \tkzDrawPolygon[dashed](I,J,K)
  \tkzDrawCircle[R,blue!50!black](O,\rO)
  \tkzDrawSegments[dashed](A,K B,J C,I)
  \tkzDrawPoints(A,B,C)
  \tkzDrawCircles[R](J,{\rJ} I,{\rI} K,{\rK})
  \tkzLabelPoints(A,B,C,I,J,K)
\end{tikzpicture}
```

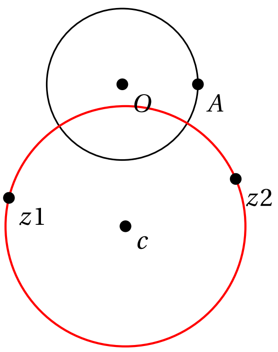
18.1.8 Spieker circle with option spieker

The incircle of the medial triangle $M_aM_bM_c$ is the Spieker circle:



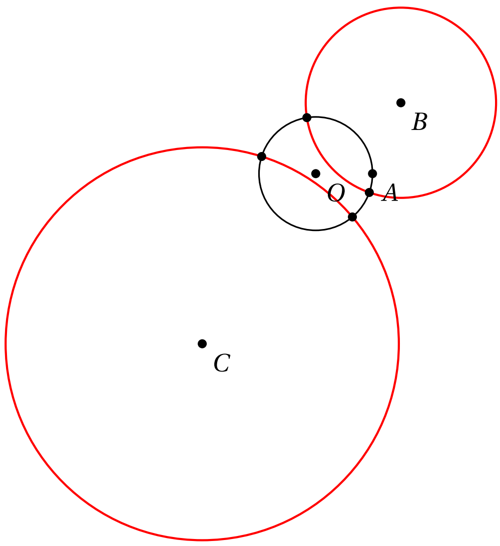

```
\begin{tikzpicture}[scale=1]
  \tkzDefPoints{ 0/0/A,4/0/B,0.8/4/C}
   \tkzDefSpcTriangle[medial](A,B,C){M_a,M_b,M_c}
   \tkzDefTriangleCenter[spieker](A,B,C)
   \tkzGetPoint{S_p}
   \tkzDrawPolygon[blue](A,B,C)
   \tkzDrawPolygon[red](M_a,M_b,M_c)
   \tkzDrawPoints[blue](B,C,A)
   \tkzDrawPoints[red](M_a,M_b,M_c,S_p)
   \tkzDrawCircle[in,red](M_a,M_b,M_c)
   \tkzAutoLabelPoints[center=S_p,dist=.3](M_a,M_b,M_c)
   \tkzLabelPoints[blue,right](S_p)
   \tkzAutoLabelPoints[center=S_p](A,B,C)
\end{tikzpicture}
```

18.1.9 Orthogonal circle passing through two given points, option orthogonal through




```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(1,0){A}
  \tkzDrawCircle(O,A)
  \tkzDefPoint(-1.5,-1.5){z1}
  \tkzDefPoint(1.5,-1.25){z2}
  \tkzDefCircle[orthogonal through=z1 and z2](O,A)
   \tkzGetPoint{c}
  \tkzDrawCircle[thick,color=red](tkzPointResult,z1)
  \tkzDrawPoints[fill=red,color=black,
  size=4](O,A,z1,z2,c)
  \tkzLabelPoints(O,A,z1,z2,c)
\end{tikzpicture}
```

18.1.10 Orthogonal circle of given center




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoints{0/0/O,1/0/A}
  \tkzDefPoints{1.5/1.25/B,-2/-3/C}
  \tkzDefCircle[orthogonal from=B](O,A)
  \tkzGetPoints{z1}{z2}
  \tkzDefCircle[orthogonal from=C](O,A)
  \tkzGetPoints{t1}{t2}
  \tkzDrawCircle(O,A)
  \tkzDrawCircle[thick,color=red](B,z1)
  \tkzDrawCircle[thick,color=red](C,t1)
  \tkzDrawPoints(t1,t2,C)
  \tkzDrawPoints(z1,z2,O,A,B)
  \tkzLabelPoints(O,A,B,C)
\end{tikzpicture}
```

19 Draw, Label the Circles

– I created a first macro `\tkzDrawCircle`,

- then a macro that allows you to color a disc, but without drawing the circle. `\tkzFillCircle`,
- sometimes, it is necessary for a drawing to be contained in a disc,this is the role assigned to `\tkzClipCircle`,
- It finally remains to be able to give a label to designate a circle and if several possibilities are offered, we will see here `\tkzLabelCircle`.

19.1 Draw a circle

`\tkzDrawCircle[⟨local options⟩](⟨A,B⟩)`

Attention you need only two points to define a radius or a diameter. An additional option **R** is available to give a measure directly.

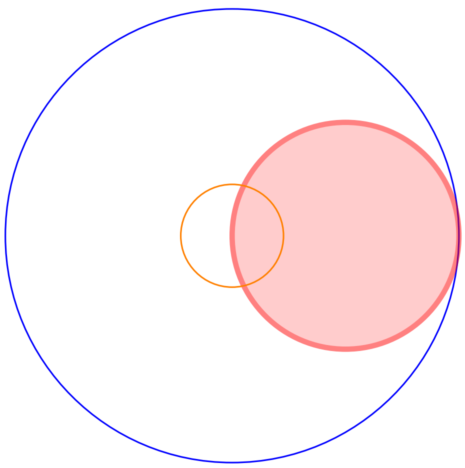
arguments	example	explication
(⟨pt1,pt2⟩)	(⟨A,B⟩)	two points to define a radius or a diameter

options	default	definition
through	through	circle with two points defining a radius
diameter	through	circle with two points defining a diameter
R	through	circle characterized by a point and the measurement of a radius

Of course, you have to add all the styles of Ti*k*Z for the tracings...

19.1.1 Circles and styles, draw a circle and color the disc

We'll see that it's possible to colour in a disc while tracing the circle.



```
\begin{tikzpicture}
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(3,0){A}
 % circle with centre O and passing through A
  \tkzDrawCircle[color=blue](O,A)
 % diameter circle $[OA]$
  \tkzDrawCircle[diameter,color=red,%
                 line width=2pt,fill=red!40,%
                 opacity=.5](O,A)
 % circle with centre O and radius = exp(1) cm
  \edef\rayon{\fpeval{0.25*exp(1)}}
  \tkzDrawCircle[R,color=orange](O,\rayon cm)
\end{tikzpicture}
```

19.2 Drawing circles

`\tkzDrawCircles[⟨local options⟩](⟨A,B C,D⟩)`

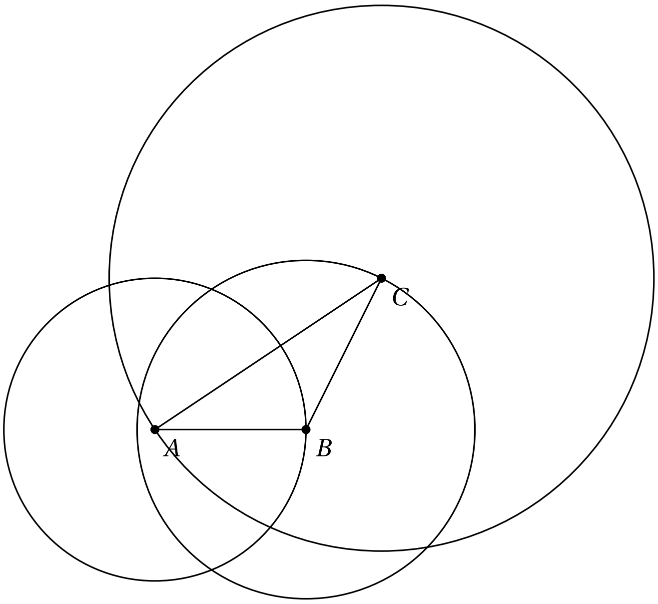
Attention, the arguments are lists of two points. The circles that can be drawn are the same as in the previous macro. An additional option **R** is available to give a measure directly.

arguments	example	explication
(⟨pt1,pt2 pt3,pt4 ...⟩)	(⟨A,B C,D⟩)	List of two points

options	default	definition
through	through	circle with two points defining a radius
diameter	through	circle with two points defining a diameter
R	through	circle characterized by a point and the measurement of a radius

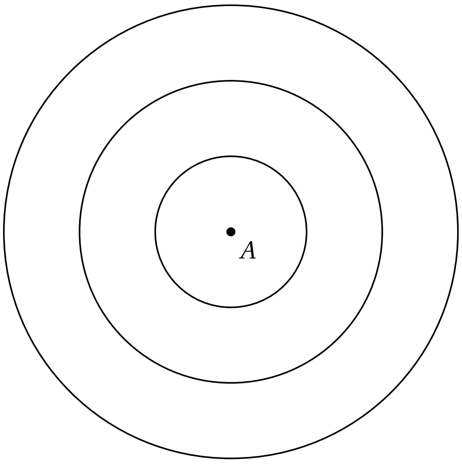
Of course, you have to add all the styles of TikZ for the tracings...

19.2.1 Circles defined by a triangle.



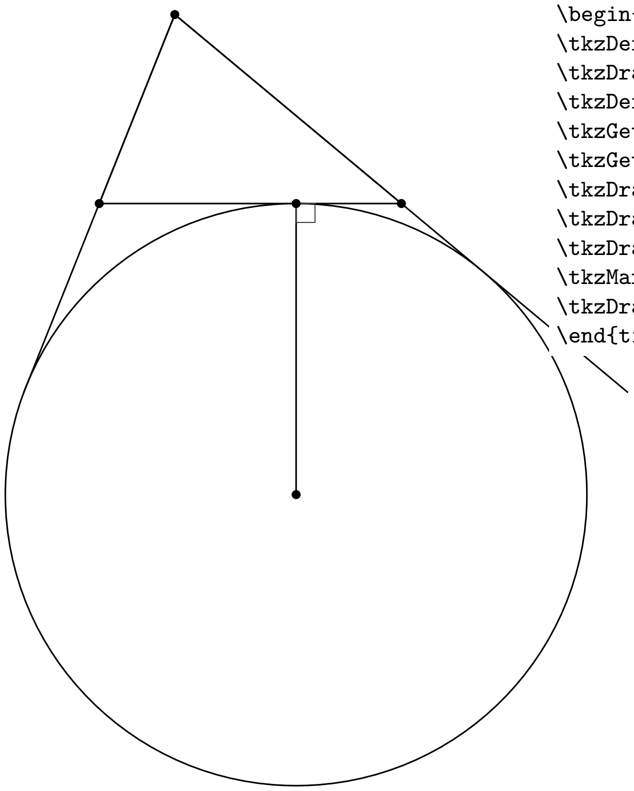

```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,0){B}
  \tkzDefPoint(3,2){C}
  \tkzDrawPolygon(A,B,C)
  \tkzDrawCircles(A,B B,C C,A)
  \tkzDrawPoints(A,B,C)
  \tkzLabelPoints(A,B,C)
\end{tikzpicture}
```

19.2.2 Concentric circles.




```
\begin{tikzpicture}
   \tkzDefPoint(0,0){A}
   \tkzDrawCircles[R](A,1cm A,2cm A,3cm)
   \tkzDrawPoint(A)
   \tkzLabelPoints(A)
\end{tikzpicture}
```

19.2.3 Exinscribed circles.

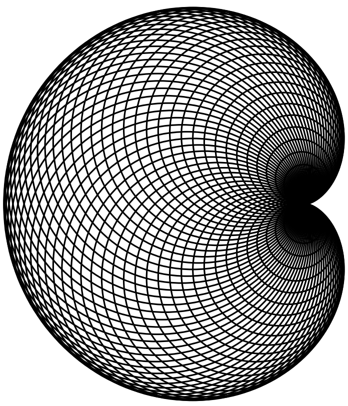


```
\begin{tikzpicture}[scale=1]
\tkzDefPoints{0/0/A,4/0/B,1/2.5/C}
\tkzDrawPolygon(A,B,C)
\tkzDefCircle[ex](B,C,A)
\tkzGetPoint{J_c} \tkzGetSecondPoint{T_c}
\tkzGetLength{rJc}
\tkzDrawCircle[R](J_c,{\rJc pt})
\tkzDrawLines[add=0 and 1](C,A C,B)
\tkzDrawSegment(J_c,T_c)
\tkzMarkRightAngle(J_c,T_c,B)
\tkzDrawPoints(A,B,C,J_c,T_c)
\end{tikzpicture}
```

19.2.4 Cardioid

Based on an idea by O. Reboux made with pst-eucl (Pstricks module) by D. Rodriguez.

Its name comes from the Greek *kardia (heart)*, in reference to its shape, and was given to it by Johan Castillon (Wikipedia).



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,0){A}
  \foreach \ang in {5,10,...,360}{%
     \tkzDefPoint(\ang:2){M}
     \tkzDrawCircle(M,A)
   }
\end{tikzpicture}
```

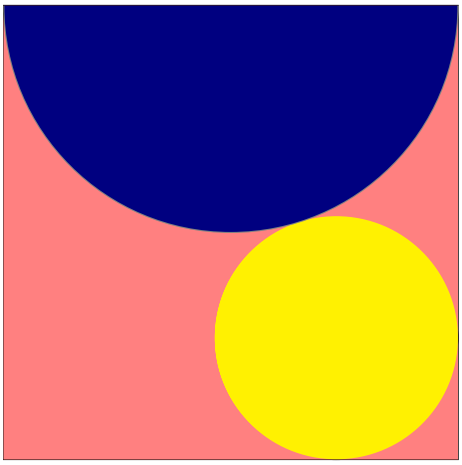
19.3 Draw a semicircle

`\tkzDrawSemiCircle[⟨local options⟩](⟨A,B⟩)`

arguments	example	explication
(⟨pt1,pt2⟩)	(⟨O,A⟩) or(⟨A,B⟩)	radius or diameter

options	default	definition
through	through	circle characterized by two points defining a radius
diameter	through	circle characterized by two points defining a diameter

19.3.1 Use of \tkzDrawSemiCircle



```
\begin{tikzpicture}
   \tkzDefPoint(0,0){A} \tkzDefPoint(6,0){B}
   \tkzDefSquare(A,B) \tkzGetPoints{C}{D}
   \tkzDrawPolygon(B,C,D,A)
   \tkzDefPoint(3,6){F}
   \tkzDefTriangle[equilateral](C,D) \tkzGetPoint{I}
   \tkzDefPointBy[projection=onto B--C](I) \tkzGetPoint{J}
   \tkzInterLL(D,B)(I,J)  \tkzGetPoint{K}
   \tkzDefPointBy[symmetry=center K](B) \tkzGetPoint{M}
   \tkzDrawCircle(M,I)
   \tkzCalcLength(M,I)   \tkzGetLength{dMI}
   \tkzFillPolygon[color = red!50](A,B,C,D)
   \tkzFillCircle[R,color = yellow](M,\dMI pt)
   \tkzDrawSemiCircle[fill = blue!50!black](F,D)%
\end{tikzpicture}
```

19.4 Colouring a disc

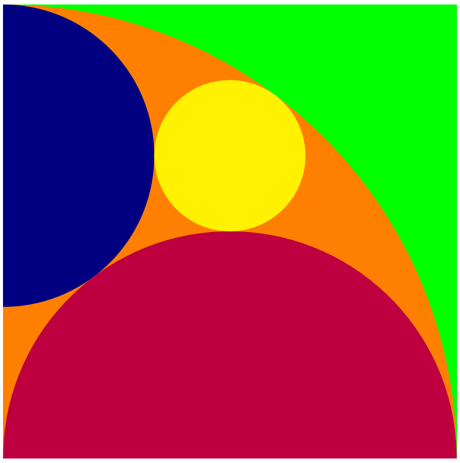
This was possible with the previous macro, but disk tracing was mandatory, this is no longer the case.

`\tkzFillCircle[⟨local options⟩](⟨A,B⟩)`

options	default	definition
radius	radius	two points define a radius
R	radius	a point and the measurement of a radius

You don't need to put **radius** because that's the default option. Of course, you have to add all the styles of Ti*k*Z for the plots.

19.4.1 Example from a sangaku



```
\begin{tikzpicture}
   \tkzInit[xmin=0,xmax = 6,ymin=0,ymax=6]
   \tkzDefPoint(0,0){B}  \tkzDefPoint(6,0){C}%
   \tkzDefSquare(B,C)    \tkzGetPoints{D}{A}
   \tkzClipPolygon(B,C,D,A)
   \tkzDefMidPoint(A,D)  \tkzGetPoint{F}
   \tkzDefMidPoint(B,C)  \tkzGetPoint{E}
   \tkzDefMidPoint(B,D)  \tkzGetPoint{Q}
   \tkzDefTangent[from = B](F,A) \tkzGetPoints{G}{H}
   \tkzInterLL(F,G)(C,D) \tkzGetPoint{J}
   \tkzInterLL(A,J)(F,E) \tkzGetPoint{K}
   \tkzDefPointBy[projection=onto B--A](K)
 \tkzGetPoint{M}
   \tkzFillPolygon[color = green](A,B,C,D)
   \tkzFillCircle[color = orange](B,A)
   \tkzFillCircle[color = blue!50!black](M,A)
   \tkzFillCircle[color = purple](E,B)
   \tkzFillCircle[color = yellow](K,Q)
\end{tikzpicture}
```

19.5 Clipping a disc

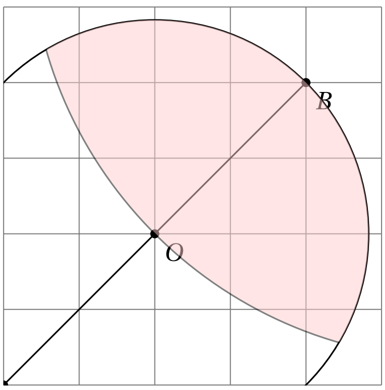
`\tkzClipCircle[⟨local options⟩](⟨A,B⟩) or (⟨A,r⟩)`

arguments	example	explication
(⟨A,B⟩) or (⟨A,r⟩)	(⟨A,B⟩) or (⟨A,2cm⟩)	AB radius or diameter

options	default	definition
radius	radius	circle characterized by two points defining a radius
R	radius	circle characterized by a point and the measurement of a radius

It is not necessary to put **radius** because that is the default option.

19.5.1 Example




```
  \begin{tikzpicture}
  \tkzInit[xmax=5,ymax=5]
  \tkzGrid \tkzClip
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,2){O}
  \tkzDefPoint(4,4){B}
  \tkzDefPoint(6,6){C}
  \tkzDrawPoints(O,A,B,C)
  \tkzLabelPoints(O,A,B,C)
  \tkzDrawCircle(O,A)
  \tkzClipCircle(O,A)
  \tkzDrawLine(A,C)
  \tkzDrawCircle[fill=red!20,opacity=.5](C,O)
\end{tikzpicture}
```

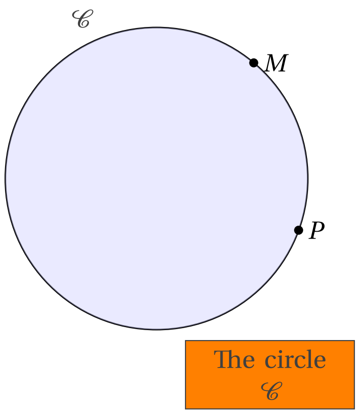
19.6 Giving a label to a circle

`\tkzLabelCircle[⟨local options⟩](⟨A,B⟩)(⟨angle⟩){⟨label⟩}`

options	default	definition
radius	radius	circle characterized by two points defining a radius
R	radius	circle characterized by a point and the measurement of a radius

You don't need to put **radius** because that's the default option. We can use the styles from Ti*k*Z. The label is created and therefore "passed" between braces.

19.6.1 Example




```
\begin{tikzpicture}
 \tkzDefPoint(0,0){O} \tkzDefPoint(2,0){N}
 \tkzDefPointBy[rotation=center O angle 50](N)
     \tkzGetPoint{M}
 \tkzDefPointBy[rotation=center O angle -20](N)
      \tkzGetPoint{P}
 \tkzDefPointBy[rotation=center O angle 125](N)
      \tkzGetPoint{P'}
 \tkzLabelCircle[above=4pt](O,N)(120){$\mathcal{C}$}
 \tkzDrawCircle(O,M)
 \tkzFillCircle[color=blue!20,opacity=.4](O,M)
 \tkzLabelCircle[R,draw,fill=orange,%
       text width=2cm,text centered](O,3 cm)(-60)%
          {The circle\\ $\mathcal{C}$}
 \tkzDrawPoints(M,P)\tkzLabelPoints[right](M,P)
\end{tikzpicture}
```

20 Intersections

It is possible to determine the coordinates of the points of intersection between two straight lines, a straight line and a circle, and two circles.

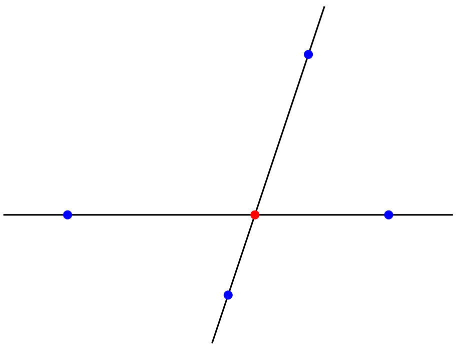
The associated commands have no optional arguments and the user must determine the existence of the intersection points himself.

20.1 Intersection of two straight lines

`\tkzInterLL(⟨A,B⟩)(⟨C,D⟩)`

Defines the intersection point **tkzPointResult** of the two lines (AB) and (CD). The known points are given in pairs (two per line) in brackets, and the resulting point can be retrieved with the macro `\tkzDefPoint`.

20.1.1 Example of intersection between two straight lines



```
\begin{tikzpicture}[rotate=-45,scale=.75]
  \tkzDefPoint(2,1){A}
     \tkzDefPoint(6,5){B}
  \tkzDefPoint(3,6){C}
     \tkzDefPoint(5,2){D}
  \tkzDrawLines(A,B C,D)
  \tkzInterLL(A,B)(C,D)
     \tkzGetPoint{I}
  \tkzDrawPoints[color=blue](A,B,C,D)
   \tkzDrawPoint[color=red](I)
\end{tikzpicture}
```

20.2 Intersection of a straight line and a circle

As before, the line is defined by a couple of points. The circle is also defined by a couple:

- (O,C) which is a pair of points, the first is the centre and the second is any point on the circle.
- (O,r) The r measure is the radius measure. The unit can be the *cm* or *pt*.

`\tkzInterLC[⟨options⟩](⟨A,B⟩)(⟨O,C⟩) or (⟨O,r⟩) or (⟨O,C,D⟩)`

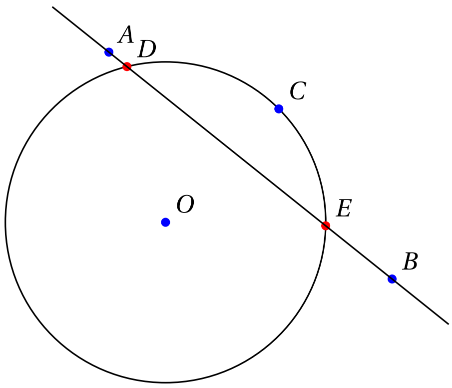
So the arguments are two couples.

options	default	definition
N	N	(O,C) determines the circle
R	N	(O, 1 cm) or (O, 120 pt)
with nodes	N	(O,C,D) CD is a radius

The macro defines the intersection points I and J of the line (AB) and the center circle O with radius r if they exist; otherwise, an error will be reported in the `.log` file.

20.2.1 Simple example of a line-circle intersection

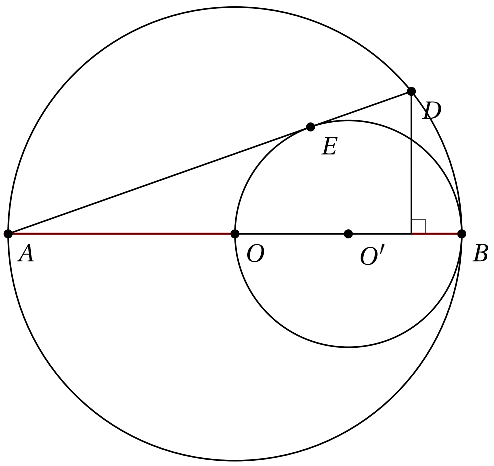
In the following example, the drawing of the circle uses two points and the intersection of the straight line and the circle uses two pairs of points:




```
\begin{tikzpicture}[scale=.75]
 \tkzInit[xmax=5,ymax=4]
 \tkzDefPoint(1,1){O}
 \tkzDefPoint(0,4){A}
 \tkzDefPoint(5,0){B}
 \tkzDefPoint(3,3){C}
 \tkzInterLC(A,B)(O,C)  \tkzGetPoints{D}{E}
 \tkzDrawCircle(O,C)
 \tkzDrawPoints[color=blue](O,A,B,C)
 \tkzDrawPoints[color=red](D,E)
 \tkzDrawLine(A,B)
 \tkzLabelPoints[above right](O,A,B,C,D,E)
\end{tikzpicture}
```

20.2.2 More complex example of a line-circle intersection

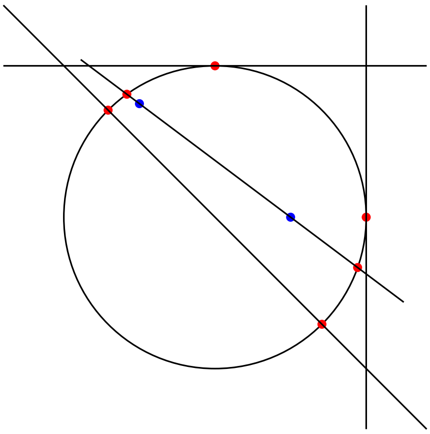
Figure from http://gogeometry.com/problem/p190_tangent_circle




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(8,0){B}
  \tkzDefMidPoint(A,B)
  \tkzGetPoint{O}
  \tkzDrawCircle(O,B)
  \tkzDefMidPoint(O,B)
  \tkzGetPoint{O'}
  \tkzDrawCircle(O',B)
  \tkzDefTangent[from=A](O',B)
  \tkzGetSecondPoint{E}
  \tkzInterLC(A,E)(O,B)
  \tkzGetSecondPoint{D}
  \tkzDefPointBy[projection=onto A--B](D)
   \tkzGetPoint{F}
  \tkzMarkRightAngle(D,F,B)
  \tkzDrawSegments(A,D A,B D,F)
  \tkzDrawSegments[color=red,line width=1pt,
      opacity=.4](A,O F,B)
  \tkzDrawPoints(A,B,O,O',E,D)
  \tkzLabelPoints(A,B,O,O',E,D)
\end{tikzpicture}
```

20.2.3 Circle defined by a center and a measure, and special cases

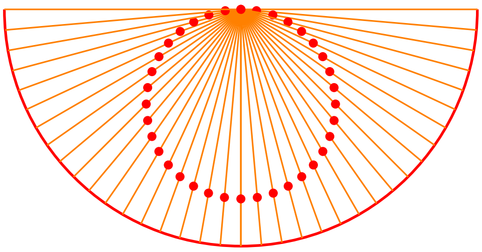
Let’s look at some special cases like straight lines tangent to the circle.



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint(0,8){A}  \tkzDefPoint(8,0){B}
  \tkzDefPoint(8,8){C}  \tkzDefPoint(4,4){I}
  \tkzDefPoint(2,7){E}  \tkzDefPoint(6,4){F}
  \tkzDrawCircle[R](I,4 cm)
  \tkzInterLC[R](A,C)(I,4 cm)  \tkzGetPoints{I1}{I2}
  \tkzInterLC[R](B,C)(I,4 cm)  \tkzGetPoints{J1}{J2}
  \tkzInterLC[R](A,B)(I,4 cm)  \tkzGetPoints{K1}{K2}
  \tkzDrawPoints[color=red](I1,J1,K1,K2)
  \tkzDrawLines(A,B B,C A,C)
  \tkzInterLC[R](E,F)(I,4 cm)  \tkzGetPoints{I2}{J2}
  \tkzDrawPoints[color=blue](E,F)
  \tkzDrawPoints[color=red](I2,J2)
  \tkzDrawLine(I2,J2)
\end{tikzpicture}
```

20.2.4 More complex example

Be careful with the syntax. First of all, calculations for the points can be done during the passage of the arguments, but the syntax of **xfp** must be respected. You can see that I use the term **pi** because **xfp** can work with radians. You can also work with degrees but in this case, you need to use specific commands like `sind` or `cosd`. Furthermore, when calculations require the use of parentheses, they must be inserted in a group... TEX{ ...}.



```
\begin{tikzpicture}[scale=1.25]
  \tkzDefPoint(0,1){J}
  \tkzDefPoint(0,0){O}
  \tkzDrawArc[R,line width=1pt,color=red](J,2.5 cm)(180,0)
  \foreach \i in {0,-5,-10,...,-85,-90}{
    \tkzDefPoint({2.5*cosd(\i)},{1+2.5*sind(\i)}){P}
     \tkzDrawSegment[color=orange](J,P)
     \tkzInterLC[R](P,J)(O,1 cm)
     \tkzGetPoints{M}{N}
     \tkzDrawPoints[red](N)
     }
  \foreach \i in {-90,-95,...,-175,-180}{
     \tkzDefPoint({2.5*cosd(\i)},{1+2.5*sind(\i)}){P}
     \tkzDrawSegment[color=orange](J,P)
     \tkzInterLC[R](P,J)(O,1 cm)
     \tkzGetPoints{M}{N}
     \tkzDrawPoints[red](M)
     }
\end{tikzpicture}
```

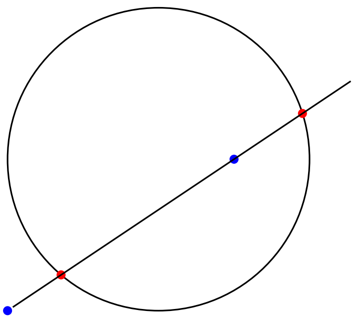
20.2.5 Calculation of radius example 1

With **pgfmath** and **\pgfmathsetmacro**

The radius measurement may be the result of a calculation that is not done within the intersection macro, but before. A length can be calculated in several ways. It is possible of course, to use the module **pgfmath** and the macro **\pgfmathsetmacro**. In some cases, the results obtained are not precise enough, so the following calculation $0.0002 \div 0.0001$ gives 1.98 with pgfmath while xfp will give 2.

20.2.6 Calculation of radius example 2

With **xfp** and **\fpeval**:

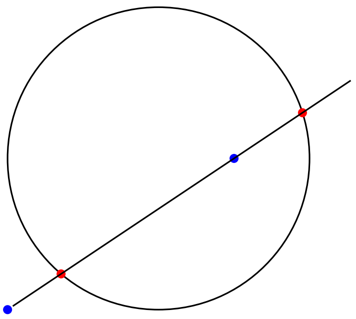


```
  \begin{tikzpicture}
  \tkzDefPoint(2,2){A}
  \tkzDefPoint(5,4){B}
  \tkzDefPoint(4,4){O}
  \edef\tkzLen{\fpeval{0.0002/0.0001}}
  \tkzDrawCircle[R](O,\tkzLen cm)
  \tkzInterLC[R](A,B)(O, \tkzLen cm)
  \tkzGetPoints{I}{J}
  \tkzDrawPoints[color=blue](A,B)
  \tkzDrawPoints[color=red](I,J)
  \tkzDrawLine(I,J)
\end{tikzpicture}
```

20.2.7 Calculation of radius example 3

With TEX and `\tkzLength`.

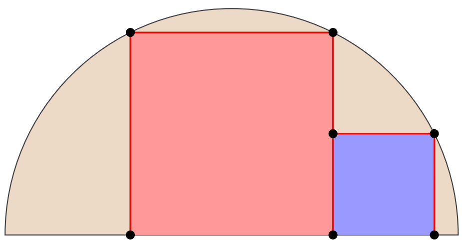
This dimension was created with `\newdimen`. 2 cm has been transformed into points. It is of course possible to use TEX to calculate.



```
\begin{tikzpicture}
\tkzDefPoints{2/2/A,5/4/B,4/4/O}
  \tkzLength=2cm
  \tkzDrawCircle[R](O,\tkzLength)
  \tkzInterLC[R](A,B)(O,\tkzLength)
  \tkzGetPoints{I}{J}
  \tkzDrawPoints[color=blue](A,B)
  \tkzDrawPoints[color=red](I,J)
  \tkzDrawLine(I,J)
\end{tikzpicture}
```

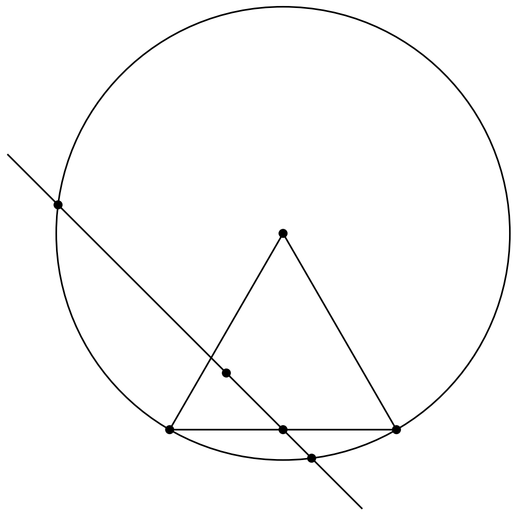
20.2.8 Squares in half a disc

A Sangaku look! It is a question of proving that one can inscribe in a half-disc, two squares, and to determine the length of their respective sides according to the radius.



```
\begin{tikzpicture}[scale=.75]
 \tkzDefPoints{0/0/A,8/0/B,4/0/I}
 \tkzDefSquare(A,B) \tkzGetPoints{C}{D}
 \tkzInterLC(I,C)(I,B)\tkzGetPoints{E'}{E}
 \tkzInterLC(I,D)(I,B)\tkzGetPoints{F'}{F}
 \tkzDefPointsBy[projection = onto A--B](E,F){H,G}
 \tkzDefPointsBy[symmetry   = center H](I){J}
 \tkzDefSquare(H,J)\tkzGetPoints{K}{L}
 \tkzDrawSector[fill=brown!30](I,B)(A)
 \tkzFillPolygon[color=red!40](H,E,F,G)
 \tkzFillPolygon[color=blue!40](H,J,K,L)
 \tkzDrawPolySeg[color=red](H,E,F,G)
 \tkzDrawPolySeg[color=red](J,K,L)
 \tkzDrawPoints(E,G,H,F,J,K,L)
\end{tikzpicture}
```

20.2.9 Option "with nodes"



```
\begin{tikzpicture}[scale=.75]
\tkzDefPoints{0/0/A,4/0/B,1/1/D,2/0/E}
\tkzDefTriangle[equilateral](A,B)
\tkzGetPoint{C}
\tkzDrawCircle(C,A)
\tkzInterLC[with nodes](D,E)(C,A,B)
\tkzGetPoints{F}{G}
\tkzDrawPolygon(A,B,C)
\tkzDrawPoints(A,...,G)
\tkzDrawLine(F,G)
\end{tikzpicture}
```

20.3 Intersection of two circles

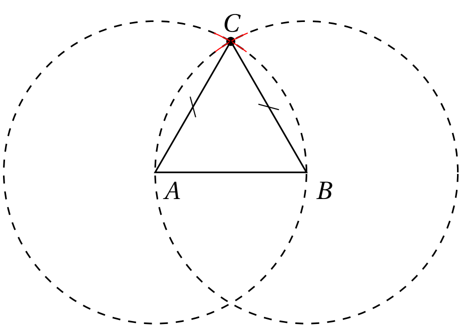
The most frequent case is that of two circles defined by their center and a point, but as before the option `R` allows to use the radius measurements.

`\tkzInterCC[⟨options⟩](⟨O,A⟩)(⟨O',A'⟩) or (⟨O,r⟩)(⟨O',r'⟩) or (⟨O,A,B⟩) (⟨O',C,D⟩)`

options	default	definition
N	N	OA and $O'A'$ are radii, O and O' are the centres
R	N	r and r' are dimensions and measure the radii
with nodes	N	in (A,A,C)(C,B,F) AC and BF give the radii.

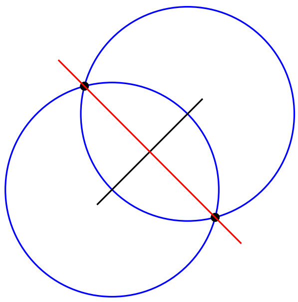
This macro defines the intersection point(s) I and J of the two center circles O and O'. If the two circles do not have a common point then the macro ends with an error that is not handled.
It is also possible to use directly `\tkzInterCCN` and `\tkzInterCCR`.

20.3.1 Construction of an equilateral triangle



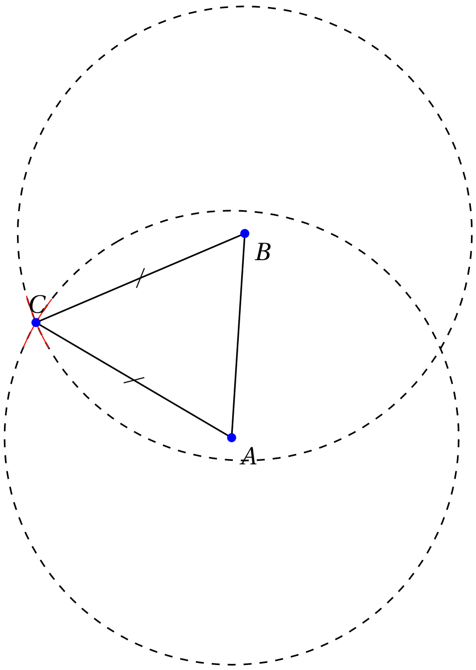

```
\begin{tikzpicture}[trim left=-1cm,scale=.5]
 \tkzDefPoint(1,1){A}
 \tkzDefPoint(5,1){B}
 \tkzInterCC(A,B)(B,A)\tkzGetPoints{C}{D}
 \tkzDrawPoint[color=black](C)
 \tkzDrawCircle[dashed](A,B)
 \tkzDrawCircle[dashed](B,A)
 \tkzCompass[color=red](A,C)
 \tkzCompass[color=red](B,C)
 \tkzDrawPolygon(A,B,C)
 \tkzMarkSegments[mark=s|](A,C B,C)
 \tkzLabelPoints[](A,B)
 \tkzLabelPoint[above](C){$C$}
\end{tikzpicture}
```

20.3.2 Example a mediator



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(2,2){B}
  \tkzDrawCircle[color=blue](B,A)
  \tkzDrawCircle[color=blue](A,B)
  \tkzInterCC(B,A)(A,B)\tkzGetPoints{M}{N}
  \tkzDrawLine(A,B)
  \tkzDrawPoints(M,N)
  \tkzDrawLine[color=red](M,N)
\end{tikzpicture}
```

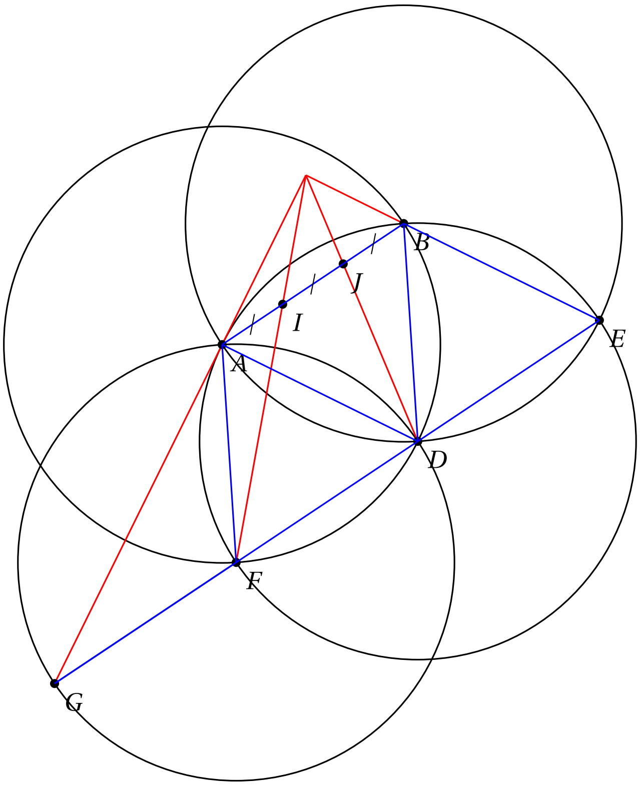
20.3.3 An isosceles triangle.




```
\begin{tikzpicture}[rotate=120,scale=.75]
 \tkzDefPoint(1,2){A}
 \tkzDefPoint(4,0){B}
 \tkzInterCC[R](A,4cm)(B,4cm)
 \tkzGetPoints{C}{D}
 \tkzDrawCircle[R,dashed](A,4 cm)
 \tkzDrawCircle[R,dashed](B,4 cm)
 \tkzCompass[color=red](A,C)
 \tkzCompass[color=red](B,C)
 \tkzDrawPolygon(A,B,C)
 \tkzDrawPoints[color=blue](A,B,C)
 \tkzMarkSegments[mark=s|](A,C B,C)
 \tkzLabelPoints[](A,B)
 \tkzLabelPoint[above](C){$C$}
\end{tikzpicture}
```

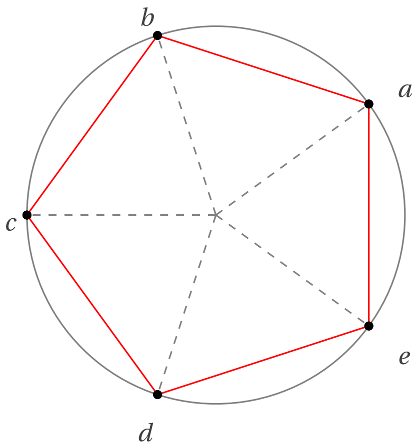
20.3.4 Segment trisection

The idea here is to divide a segment with a ruler and a compass into three segments of equal length.




```
\begin{tikzpicture}[scale=.8]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(3,2){B}
 \tkzInterCC(A,B)(B,A)
 \tkzGetPoints{C}{D}
 \tkzInterCC(D,B)(B,A)
 \tkzGetPoints{A}{E}
 \tkzInterCC(D,B)(A,B)
 \tkzGetPoints{F}{B}
 \tkzInterLC(E,F)(F,A)
 \tkzGetPoints{D}{G}
 \tkzInterLL(A,G)(B,E)
 \tkzGetPoint{O}
 \tkzInterLL(O,D)(A,B)
 \tkzGetPoint{J}
 \tkzInterLL(O,F)(A,B)
 \tkzGetPoint{I}
 \tkzDrawCircle(D,A)
 \tkzDrawCircle(A,B)
 \tkzDrawCircle(B,A)
 \tkzDrawCircle(F,A)
 \tkzDrawSegments[color=red](O,G
  O,B O,D O,F)
 \tkzDrawPoints(A,B,D,E,F,G,I,J)
 \tkzLabelPoints(A,B,D,E,F,G,I,J)
 \tkzDrawSegments[blue](A,B B,D A,D%
  A,F F,G E,G B,E)
 \tkzMarkSegments[mark=s|](A,I I,J J,B)
\end{tikzpicture}
```

20.3.5 With the option with nodes




```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoints{0/0/a,0/5/B,5/0/C}
 \tkzDefPoint(54:5){F}
 \tkzDrawCircle[color=gray](A,C)
 \tkzInterCC[with nodes](A,A,C)(C,B,F)
 \tkzGetPoints{a}{e}
 \tkzInterCC(A,C)(a,e) \tkzGetFirstPoint{b}
 \tkzInterCC(A,C)(b,a) \tkzGetFirstPoint{c}
 \tkzInterCC(A,C)(c,b) \tkzGetFirstPoint{d}
 \tkzDrawPoints(a,b,c,d,e)
 \tkzDrawPolygon[color=red](a,b,c,d,e)
 \foreach \vertex/\num in {a/36,b/108,c/180,
                           d/252,e/324}{%
 \tkzDrawPoint(\vertex)
 \tkzLabelPoint[label=\num:$\vertex$](\vertex){}
 \tkzDrawSegment[color=gray,style=dashed](A,\vertex)
 }
\end{tikzpicture}
```

21 The angles

21.1 Colour an angle: fill

The simplest operation

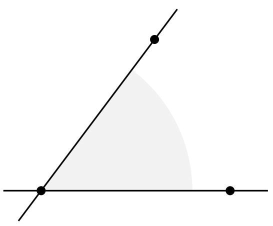
`\tkzFillAngle[⟨local options⟩](⟨A,O,B⟩)`

O is the vertex of the angle. OA and OB are the sides. Attention the angle is determined by the order of the points.

options	default	definition
size	1 cm	this option determines the radius of the coloured angular sector.

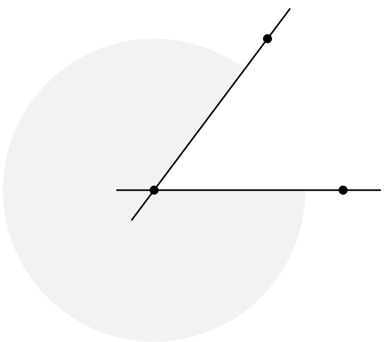
Of course, you have to add all the styles of Ti*k*Z, like the use of fill and shade...

21.1.1 Example with size

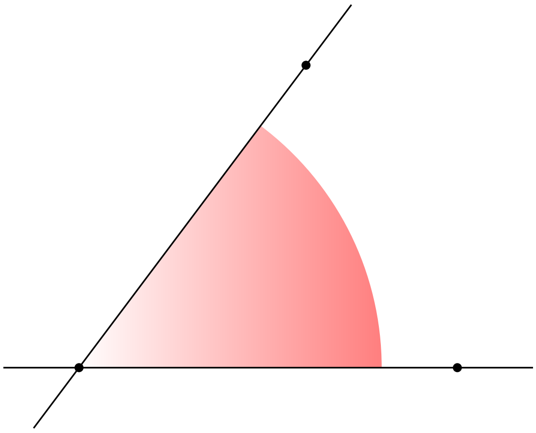


```
\begin{tikzpicture}
   \tkzInit
   \tkzDefPoints{0/0/O,2.5/0/A,1.5/2/B}
   \tkzFillAngle[size=2cm, fill=gray!10](A,O,B)
   \tkzDrawLines(O,A O,B)
   \tkzDrawPoints(O,A,B)
\end{tikzpicture}
```

21.1.2 Changing the order of items



```
\begin{tikzpicture}
   \tkzInit
   \tkzDefPoints{0/0/O,2.5/0/A,1.5/2/B}
   \tkzFillAngle[size=2cm,fill=gray!10](B,O,A)
   \tkzDrawLines(O,A O,B)
   \tkzDrawPoints(O,A,B)
\end{tikzpicture}
```

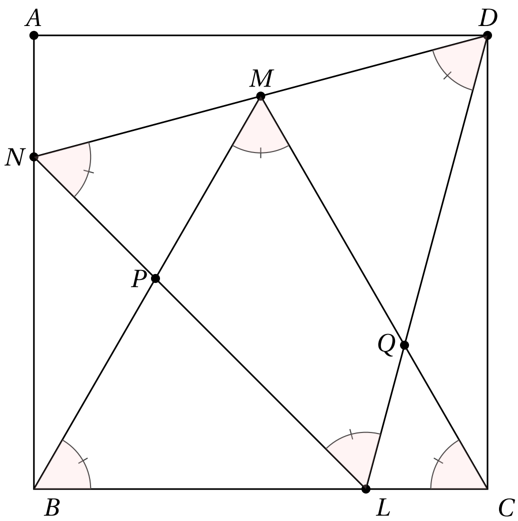


```
\begin{tikzpicture}
   \tkzInit
   \tkzDefPoints{0/0/O,5/0/A,3/4/B}
   % Don't forget {} to get, () to use
   \tkzFillAngle[size=4cm,left color=white,
                 right color=red!50](A,O,B)
   \tkzDrawLines(O,A O,B)
   \tkzDrawPoints(O,A,B)
\end{tikzpicture}
```

\tkzFillAngles[⟨local options⟩](⟨A,O,B⟩)(⟨A',O',B'⟩)etc.

With common options, there is a macro for multiple angles.

21.1.3 Multiples angles




```
\begin{tikzpicture}[scale=0.75]
  \tkzDefPoint(0,0){B}
  \tkzDefPoint(8,0){C}
  \tkzDefPoint(0,8){A}
  \tkzDefPoint(8,8){D}
  \tkzDrawPolygon(B,C,D,A)
  \tkzDefTriangle[equilateral](B,C)
  \tkzGetPoint{M}
  \tkzInterLL(D,M)(A,B) \tkzGetPoint{N}
  \tkzDefPointBy[rotation=center N angle -60](D)
  \tkzGetPoint{L}
  \tkzInterLL(N,L)(M,B)     \tkzGetPoint{P}
  \tkzInterLL(M,C)(D,L)     \tkzGetPoint{Q}
  \tkzDrawSegments(D,N N,L L,D B,M M,C)
  \tkzDrawPoints(L,N,P,Q,M,A,D)
  \tkzLabelPoints[left](N,P,Q)
  \tkzLabelPoints[above](M,A,D)
  \tkzLabelPoints(L,B,C)
  \tkzMarkAngles(C,B,M B,M,C M,C,B%
                 D,L,N L,N,D N,D,L)
  \tkzFillAngles[fill=red!20,opacity=.2](C,B,M%
      B,M,C M,C,B D,L,N L,N,D N,D,L)
\end{tikzpicture}
```

21.2 Mark an angle mark

More delicate operation because there are many options. The symbols used for marking in addition to those of Ti*k*Z are defined in the file `tkz-lib-marks.tex` and designated by the following characters:

`|, ||,|||, z, s, x, o, oo`

Their definitions are as follows

```
\pgfdeclareplotmark{||}
  %double bar
{%
  \pgfpathmoveto{\pgfqpoint{2\pgflinewidth}{\pgfplotmarksize}}
  \pgfpathlineto{\pgfqpoint{2\pgflinewidth}{-\pgfplotmarksize}}
  \pgfpathmoveto{\pgfqpoint{-2\pgflinewidth}{\pgfplotmarksize}}
  \pgfpathlineto{\pgfqpoint{-2\pgflinewidth}{-\pgfplotmarksize}}
  \pgfusepathqstroke
}
```

```
  %triple bar
  \pgfdeclareplotmark{|||}
  {%
    \pgfpathmoveto{\pgfqpoint{0 pt}{\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{0 pt}{-\pgfplotmarksize}}
    \pgfpathmoveto{\pgfqpoint{-3\pgflinewidth}{\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{-3\pgflinewidth}{-\pgfplotmarksize}}
    \pgfpathmoveto{\pgfqpoint{3\pgflinewidth}{\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{3\pgflinewidth}{-\pgfplotmarksize}}
    \pgfusepathqstroke
  }
```

```
  % An bar slant
  \pgfdeclareplotmark{s|}
  {%
    \pgfpathmoveto{\pgfqpoint{-.70710678\pgfplotmarksize}%
                             {-.70710678\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{.70710678\pgfplotmarksize}%
                             {.70710678\pgfplotmarksize}}
    \pgfusepathqstroke
  }
```

```
  % An double bar slant
  \pgfdeclareplotmark{s||}
  {%
   \pgfpathmoveto{\pgfqpoint{-0.75\pgfplotmarksize}{-\pgfplotmarksize}}
   \pgfpathlineto{\pgfqpoint{0.25\pgfplotmarksize}{\pgfplotmarksize}}
   \pgfpathmoveto{\pgfqpoint{0\pgfplotmarksize}{-\pgfplotmarksize}}
   \pgfpathlineto{\pgfqpoint{1\pgfplotmarksize}{\pgfplotmarksize}}
   \pgfusepathqstroke
  }
```

```
  % z
  \pgfdeclareplotmark{z}
  {%
    \pgfpathmoveto{\pgfqpoint{0.75\pgfplotmarksize}{-\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{-0.75\pgfplotmarksize}{-\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{0.75\pgfplotmarksize}{\pgfplotmarksize}}
    \pgfpathlineto{\pgfqpoint{-0.75\pgfplotmarksize}{\pgfplotmarksize}}
    \pgfusepathqstroke
  }
```

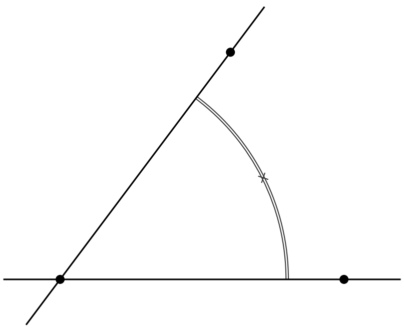
```
% s
\pgfdeclareplotmark{s}
{%
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
   \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{-\pgfplotmarksize}{\pgfplotmarksize}}
       {\pgfpoint{\pgfplotmarksize}{\pgfplotmarksize}}
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
    \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{\pgfplotmarksize}{-\pgfplotmarksize}}
       {\pgfpoint{-\pgfplotmarksize}{-\pgfplotmarksize}}
    \pgfusepathqstroke
}


% infinity
\pgfdeclareplotmark{oo}
{%
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
   \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{.5\pgfplotmarksize}{1\pgfplotmarksize}}
       {\pgfpoint{\pgfplotmarksize}{0pt}}
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
    \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{-.5\pgfplotmarksize}{1\pgfplotmarksize}}
       {\pgfpoint{-\pgfplotmarksize}{0pt}}
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
      \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{.5\pgfplotmarksize}{-1\pgfplotmarksize}}
       {\pgfpoint{\pgfplotmarksize}{0pt}}
   \pgfpathmoveto{\pgfqpoint{0pt}{0pt}}
    \pgfpathcurveto
       {\pgfpoint{0pt}{0pt}}
       {\pgfpoint{-.5\pgfplotmarksize}{-1\pgfplotmarksize}}
       {\pgfpoint{-\pgfplotmarksize}{0pt}}
    \pgfusepathqstroke
}
```

\tkzMarkAngle[⟨local options⟩](⟨A,O,B⟩)

O is the vertex. Attention the arguments vary according to the options. Several markings are possible. You can simply draw an arc or add a mark on this arc. The style of the arc is chosen with the option **arc**, the radius of the arc is given by **mksize**, the arc can, of course, be colored.

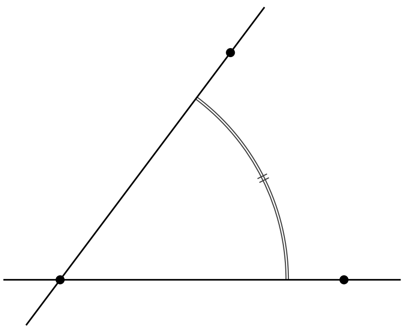
options	default	definition
arc	l	choice of l, ll and lll (single, double or triple).
size	1 cm	arc radius.
mark	none	choice of mark.
mksize	4pt	symbol size (mark).
mkcolor	black	symbol color (mark).
mkpos	0.5	position of the symbol on the arc.

21.2.1 Example with mark = x



```
\begin{tikzpicture}[scale=.75]
    \tkzDefPoints{0/0/O,5/0/A,3/4/B}
    \tkzMarkAngle[size = 4cm,mark = x,
                  arc=ll,mkcolor = red](A,O,B)
    \tkzDrawLines(O,A O,B)
    \tkzDrawPoints(O,A,B)
\end{tikzpicture}
```

21.2.2 Example with mark =||



```
\begin{tikzpicture}[scale=.75]
    \tkzDefPoints{0/0/O,5/0/A,3/4/B}
    \tkzMarkAngle[size = 4cm,mark = ||,
                arc=ll,mkcolor = red](A,O,B)
    \tkzDrawLines(O,A O,B)
    \tkzDrawPoints(O,A,B)
\end{tikzpicture}
```

`\tkzMarkAngles[⟨local options⟩](⟨A,O,B⟩)(⟨A',O',B'⟩)etc.`

With common options, there is a macro for multiple angles.

21.3 Label at an angle

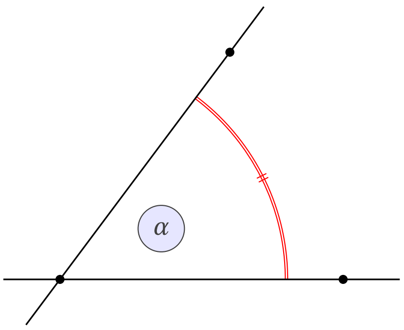
`\tkzLabelAngle[⟨local options⟩](⟨A,O,B⟩)`

There is only one option, dist (with or without unit), which can be replaced by the TikZ's pos option (without unit for the latter). By default, the value is in centimeters.

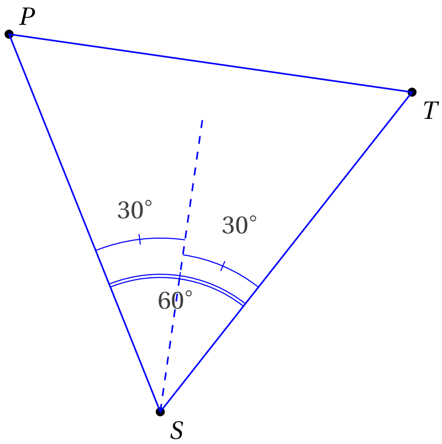
options	default	definition
pos	1	or dist, controls the distance from the top to the label.

It is possible to move the label with all TikZ options : rotate, shift, below, etc.

21.3.1 Example with pos




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoints{0/0/O,5/0/A,3/4/B}
  \tkzMarkAngle[size = 4cm,mark = ||,
      arc=ll,color = red](A,O,B)%
  \tkzDrawLines(O,A O,B)
  \tkzDrawPoints(O,A,B)
  \tkzLabelAngle[pos=2,draw,circle,
      fill=blue!10](A,O,B){$\alpha$}
\end{tikzpicture}
```




```
\begin{tikzpicture}[rotate=30]
  \tkzDefPoint(2,1){S}
  \tkzDefPoint(7,3){T}
  \tkzDefPointBy[rotation=center S angle 60](T)
  \tkzGetPoint{P}
  \tkzDefLine[bisector,normed](T,S,P)
  \tkzGetPoint{s}
  \tkzDrawPoints(S,T,P)
  \tkzDrawPolygon[color=blue](S,T,P)
  \tkzDrawLine[dashed,color=blue,add=0 and 3](S,s)
  \tkzLabelPoint[above right](P){$P$}
  \tkzLabelPoints(S,T)
  \tkzMarkAngle[size = 1.8cm,mark = |,arc=ll,
                color = blue](T,S,P)
  \tkzMarkAngle[size = 2.1cm,mark = |,arc=l,
                color = blue](T,S,s)
  \tkzMarkAngle[size = 2.3cm,mark = |,arc=l,
                color = blue](s,S,P)
 \tkzLabelAngle[pos = 1.5](T,S,P){$60^{\circ}$}%
 \tkzLabelAngles[pos = 2.7](T,S,s s,S,P){$30^{\circ}$}%
\end{tikzpicture}
```

`\tkzLabelAngles[⟨local options⟩](⟨A,O,B⟩)(⟨A',O',B'⟩)etc.`

With common options, there is a macro for multiple angles.

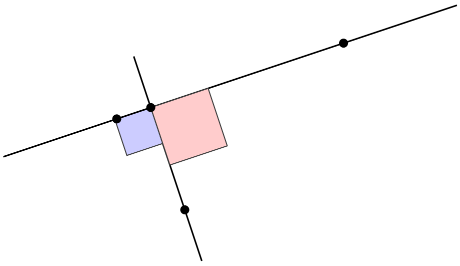
21.4 Marking a right angle

`\tkzMarkRightAngle[⟨local options⟩](⟨A,O,B⟩)`

The **german** option allows you to change the style of the drawing. The option **size** allows to change the size of the drawing.

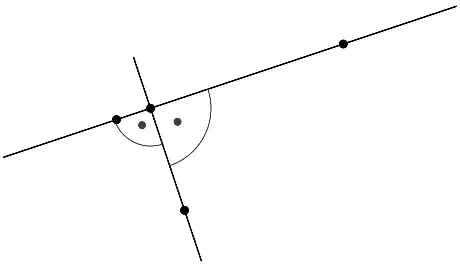
options	default	definition
german	normal	german arc with inner point.
size	0.2	side size.

21.4.1 Example of marking a right angle



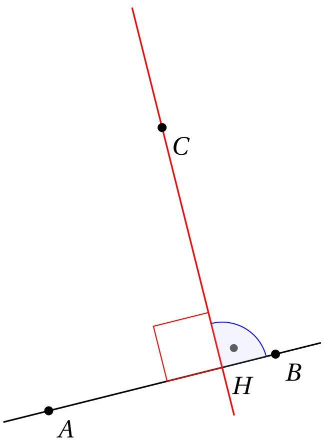
```
\begin{tikzpicture}
  \tkzDefPoints{0/0/A,3/1/B,0.9/-1.2/P}
  \tkzDefPointBy[projection = onto B--A](P)  \tkzGetPoint{H}
  \tkzDrawLines[add=.5 and .5](P,H)
  \tkzMarkRightAngle[fill=blue!20,size=.5,draw](A,H,P)
  \tkzDrawLines[add=.5 and .5](A,B)
  \tkzMarkRightAngle[fill=red!20,size=.8](B,H,P)
  \tkzDrawPoints[](A,B,P,H)
\end{tikzpicture}
```

21.4.2 Example of marking a right angle, german style



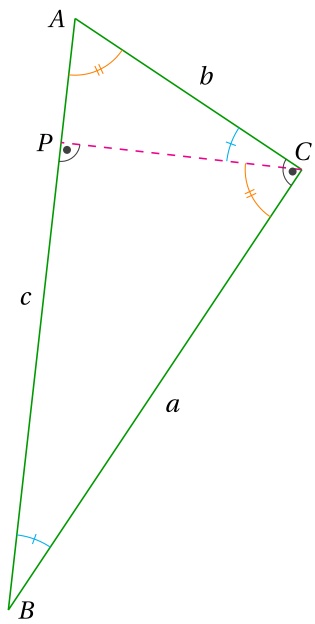
```
\begin{tikzpicture}
  \tkzDefPoints{0/0/A,3/1/B,0.9/-1.2/P}
  \tkzDefPointBy[projection = onto B--A](P)  \tkzGetPoint{H}
  \tkzDrawLines[add=.5 and .5](P,H)
  \tkzMarkRightAngle[german,size=.5,draw](A,H,P)
  \tkzDrawPoints[](A,B,P,H)
  \tkzDrawLines[add=.5 and .5,fill=blue!20](A,B)
  \tkzMarkRightAngle[german,size=.8](P,H,B)
\end{tikzpicture}
```

21.4.3 Mix of styles




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(4,1){B}
  \tkzDefPoint(2,5){C}
  \tkzDefPointBy[projection=onto B--A](C)
      \tkzGetPoint{H}
  \tkzDrawLine(A,B)
  \tkzDrawLine[add = .5 and .2,color=red](C,H)
  \tkzMarkRightAngle[,size=1,color=red](C,H,A)
  \tkzMarkRightAngle[german,size=.8,color=blue](B,H,C)
  \tkzFillAngle[opacity=.2,fill=blue!20,size=.8](B,H,C)
  \tkzLabelPoints(A,B,C,H)
  \tkzDrawPoints(A,B,C)
\end{tikzpicture}
```

21.4.4 Full example




```
\begin{tikzpicture}[rotate=-90]
\tkzDefPoint(0,1){A}
\tkzDefPoint(2,4){C}
\tkzDefPointWith[orthogonal normed,K=7](C,A)
\tkzGetPoint{B}
\tkzDrawSegment[green!60!black](A,C)
\tkzDrawSegment[green!60!black](C,B)
\tkzDrawSegment[green!60!black](B,A)
\tkzDrawLine[altitude,dashed,color=magenta](B,C,A)
\tkzGetPoint{P}
\tkzLabelPoint[left](A){$A$}
\tkzLabelPoint[right](B){$B$}
\tkzLabelPoint[above](C){$C$}
\tkzLabelPoint[left](P){$P$}
\tkzLabelSegment[auto](B,A){$c$}
\tkzLabelSegment[auto,swap](B,C){$a$}
\tkzLabelSegment[auto,swap](C,A){$b$}
\tkzMarkAngle[size=1cm,color=cyan,mark=|](C,B,A)
\tkzMarkAngle[size=1cm,color=cyan,mark=|](A,C,P)
\tkzMarkAngle[size=0.75cm,color=orange,mark=||](P,C,B)
\tkzMarkAngle[size=0.75cm,color=orange,mark=||](B,A,C)
\tkzMarkRightAngle[german](A,C,B)
\tkzMarkRightAngle[german](B,P,C)
\end{tikzpicture}
```

21.5 \tkzMarkRightAngles

`\tkzMarkRightAngles[⟨local options⟩](⟨A,O,B⟩)(⟨A',O',B'⟩)etc.`

With common options, there is a macro for multiple angles.

22 Angles tools

22.1 Recovering an angle \tkzGetAngle

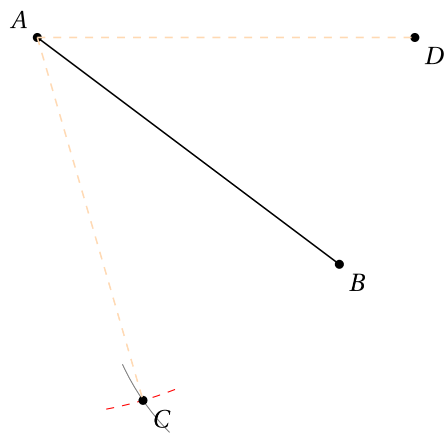
`\tkzGetAngle(⟨name of macro⟩)`

Assigns the value in degree of an angle to a macro. This macro retrieves `\tkzAngleResult` and stores the result in a new macro.

arguments	example	explication
name of macro	`\tkzGetAngle{ang}`	`\ang` contains the value of the angle.

22.2 Example of the use of \tkzGetAngle

The point here is that (AB) is the bisector of $\widehat{CAD}$, such that the AD slope is zero. We recover the slope of (AB) and then rotate twice.




```
\begin{tikzpicture}
  \tkzInit
  \tkzDefPoint(1,5){A} \tkzDefPoint(5,2){B}
  \tkzDrawSegment(A,B)
  \tkzFindSlopeAngle(A,B)\tkzGetAngle{tkzang}
  \tkzDefPointBy[rotation= center A angle \tkzang ](B)
   \tkzGetPoint{C}
  \tkzDefPointBy[rotation= center A angle -\tkzang ](B)
  \tkzGetPoint{D}
  \tkzCompass[length=1,dashed,color=red](A,C)
  \tkzCompass[delta=10,brown](B,C)
   \tkzDrawPoints(A,B,C,D)
  \tkzLabelPoints(B,C,D)
  \tkzLabelPoints[above left](A)
  \tkzDrawSegments[style=dashed,color=orange!30](A,C A,D)
\end{tikzpicture}
```

22.3 Angle formed by three points

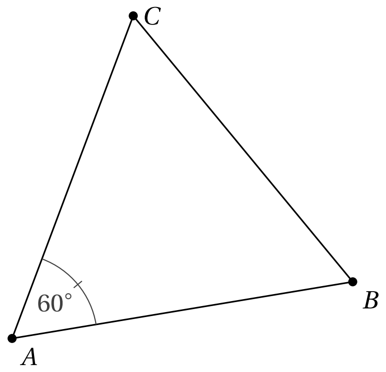
\tkzFindAngle(⟨pt1,pt2,pt3⟩)

The result is stored in a macro **\tkzAngleResult**.

arguments	example	explication
(pt1,pt2,pt3)	**\tkzFindAngle**(A,B,C)	**\tkzAngleResult** gives the angle $(\overrightarrow{BA},\overrightarrow{BC})$

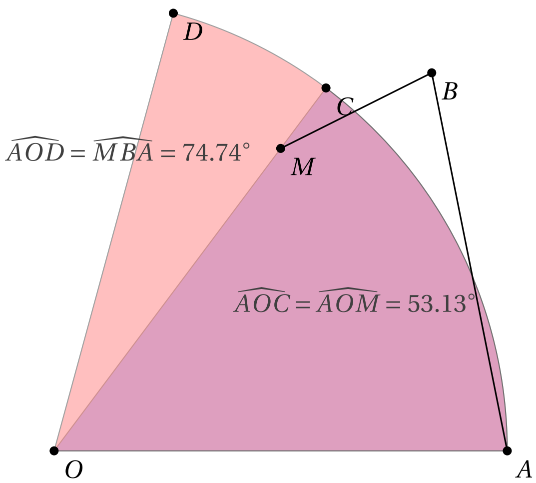
The result is between -180 degrees and +180 degrees. pt2 is the vertex and **\tkzGetAngle** can retrieve the angle.

22.3.1 Verification of angle measurement



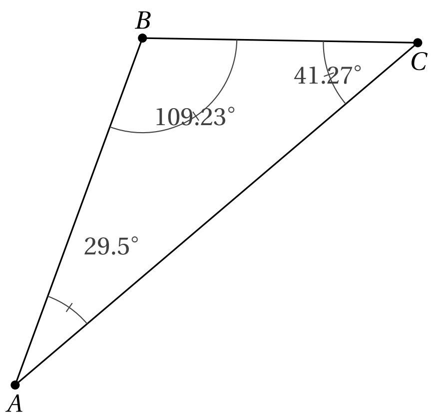

```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(-1,1){A}
  \tkzDefPoint(5,2){B}
  \tkzDefEquilateral(A,B)
  \tkzGetPoint{C}
  \tkzDrawPolygon(A,B,C)
  \tkzFindAngle(B,A,C)
  \tkzGetAngle{angleBAC}
  \edef\angleBAC{\fpeval{round(\angleBAC)}}
  \tkzDrawPoints(A,B,C)
  \tkzLabelPoints(A,B)
  \tkzLabelPoint[right](C){$C$}
  \tkzLabelAngle(B,A,C){\angleBAC$^\circ$}
  \tkzMarkAngle[size=1.5cm](B,A,C)
\end{tikzpicture}
```

22.4 Example of the use of \tkzFindAngle



```
\begin{tikzpicture}
   \tkzInit[xmin=-1,ymin=-1,xmax=7,ymax=7]
   \tkzClip
   \tkzDefPoint (0,0){O}  \tkzDefPoint (6,0){A}
   \tkzDefPoint (5,5){B}  \tkzDefPoint (3,4){M}
   \tkzFindAngle (A,O,M)  \tkzGetAngle{an}
   \tkzDefPointBy[rotation=center O angle \an](A)
   \tkzGetPoint{C}
   \tkzDrawSector[fill = blue!50,opacity=.5](O,A)(C)
   \tkzFindAngle(M,B,A)   \tkzGetAngle{am}
   \tkzDefPointBy[rotation = center O angle \am](A)
   \tkzGetPoint{D}
   \tkzDrawSector[fill = red!50,opacity = .5](O,A)(D)
   \tkzDrawPoints(O,A,B,M,C,D)
   \tkzLabelPoints(O,A,B,M,C,D)
\edef\an{\fpeval{round(\an,2)}}\edef\am{\fpeval{round(\am,2)}}
   \tkzDrawSegments(M,B B,A)
   \tkzText(4,2){$\widehat{AOC}=\widehat{AOM}=\an^{\circ}$}
   \tkzText(1,4){$\widehat{AOD}=\widehat{MBA}=\am^{\circ}$}
\end{tikzpicture}
```

22.4.1 Determination of the three angles of a triangle




```
\begin{tikzpicture}[scale=1.25,rotate=30]
\tkzDefPoints{0.5/1.5/A, 3.5/4/B, 6/2.5/C}
\tkzDrawPolygon(A,B,C)
\tkzDrawPoints(A,B,C)
\tkzLabelPoints[below](A,C)
\tkzLabelPoints[above](B)
\tkzMarkAngle[size=1cm](B,C,A)
\tkzFindAngle(B,C,A)
\tkzGetAngle{angleBCA}
\edef\angleBCA{\fpeval{round(\angleBCA,2)}}
\tkzLabelAngle[pos = 1](B,C,A){$\angleBCA^{\circ}$}
\tkzMarkAngle[size=1cm](C,A,B)
\tkzFindAngle(C,A,B)
\tkzGetAngle{angleBAC}
\edef\angleBAC{\fpeval{round(\angleBAC,2)}}
\tkzLabelAngle[pos = 1.8](C,A,B){%
          $\angleBAC^{\circ}$}
\tkzMarkAngle[size=1cm](A,B,C)
\tkzFindAngle(A,B,C)
\tkzGetAngle{angleABC}
\edef\angleABC{\fpeval{round(\angleABC,2)}}
\tkzLabelAngle[pos = 1](A,B,C){$\angleABC^{\circ}$}
\end{tikzpicture}
```

22.5 Determining a slope

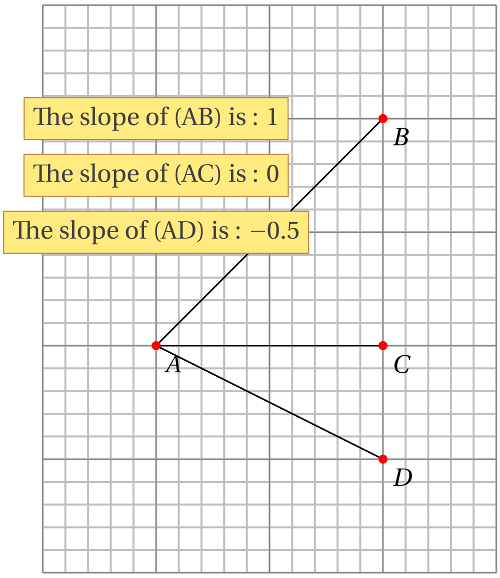
It is a question of determining whether it exists, the slope of a straight line defined by two points. No verification of the existence is made.

`\tkzFindSlope(⟨pt1,pt2⟩){⟨name of macro⟩}`

The result is stored in a macro.

arguments	example	explication
(pt1,pt2)pt3	`\tkzFindSlope(A,B){slope}`	`\slope` will give the result of $\frac{y_B-y_A}{x_B-x_A}$

Careful not to have $x_B = x_A$.




```
\begin{tikzpicture}[scale=1.5]
  \tkzInit[xmax=4,ymax=5]\tkzGrid[sub]
  \tkzDefPoint(1,2){A}    \tkzDefPoint(3,4){B}
  \tkzDefPoint(3,2){C}    \tkzDefPoint(3,1){D}
  \tkzDrawSegments(A,B A,C A,D)
  \tkzDrawPoints[color=red](A,B,C,D)
  \tkzLabelPoints(A,B,C,D)
  \tkzFindSlope(A,B){SAB} \tkzFindSlope(A,C){SAC}
  \tkzFindSlope(A,D){SAD}
  \pgfkeys{/pgf/number format/.cd,fixed,precision=2}
  \tkzText[fill=Gold!50,draw=brown](1,4)%
  {The slope of (AB) is : $\pgfmathprintnumber{\SAB}$}
  \tkzText[fill=Gold!50,draw=brown](1,3.5)%
  {The slope of (AC) is : $\pgfmathprintnumber{\SAC}$}
  \tkzText[fill=Gold!50,draw=brown](1,3)%
  {The slope of (AD) is : $\pgfmathprintnumber{\SAD}$}
\end{tikzpicture}
```

22.6 Angle formed by a straight line with the horizontal axis \tkzFindSlopeAngle

Much more interesting than the last one. The result is between -180 degrees and +180 degrees.

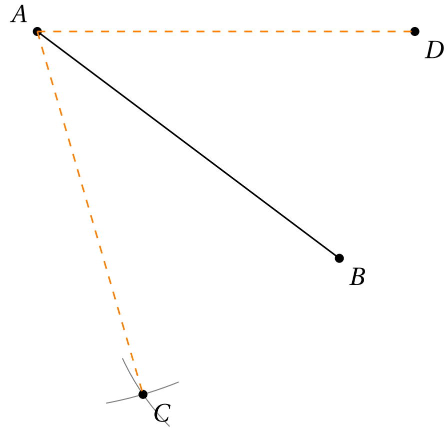
`\tkzFindSlopeAngle(⟨A,B⟩)`

Determines the slope of the straight line (AB). The result is stored in a macro `\tkzAngleResult`.

arguments	example	explication
(pt1,pt2)	`\tkzFindSlopeAngle(A,B)`	

`\tkzGetAngle` can retrieve the result. If retrieval is not necessary, you can use `\tkzAngleResult`.

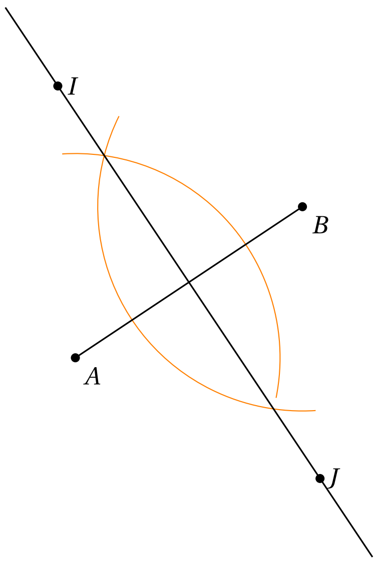
22.6.1 Folding




```
\begin{tikzpicture}
  \tkzDefPoint(1,5){A}
  \tkzDefPoint(5,2){B}
  \tkzDrawSegment(A,B)
  \tkzFindSlopeAngle(A,B)
  \tkzGetAngle{tkzang}
  \tkzDefPointBy[rotation= center A angle \tkzang ](B)
  \tkzGetPoint{C}
  \tkzDefPointBy[rotation= center A angle -\tkzang ](B)
  \tkzGetPoint{D}
  \tkzCompass[orange,length=1](A,C)
  \tkzCompass[orange,delta=10](B,C)
  \tkzDrawPoints(A,B,C,D)
  \tkzLabelPoints(B,C,D)
  \tkzLabelPoints[above left](A)
  \tkzDrawSegments[style=dashed,color=orange](A,C A,D)
\end{tikzpicture}
```

22.6.2 Example of the use of \tkzFindSlopeAngle

Here is another version of the construction of a mediator




```
\begin{tikzpicture}
 \tkzInit
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(3,2){B}
 \tkzDefLine[mediator](A,B)
 \tkzGetPoints{I}{J}
 \tkzCalcLength[cm](A,B)
 \tkzGetLength{dAB}
 \tkzFindSlopeAngle(A,B)
 \tkzGetAngle{tkzangle}
 \begin{scope}[rotate=\tkzangle]
   \tikzset{arc/.style={color=gray,delta=10}}
   \tkzDrawArc[orange,R,arc](B,3/4*\dAB)(120,240)
   \tkzDrawArc[orange,R,arc](A,3/4*\dAB)(-45,60)
   \tkzDrawLine(I,J)
   \tkzDrawSegment(A,B)
  \end{scope}
  \tkzDrawPoints(A,B,I,J)
  \tkzLabelPoints(A,B)
   \tkzLabelPoints[right](I,J)
\end{tikzpicture}
```

23 Sectors

23.1 \tkzDrawSector

Attention the arguments vary according to the options.

`\tkzDrawSector[⟨local options⟩](⟨O,...⟩)(⟨...⟩)`

options	default	definition
towards	towards	O is the center and the arc from A to (OB)
rotate	towards	the arc starts from A and the angle determines its length
R	towards	We give the radius and two angles
R with nodes	towards	We give the radius and two points

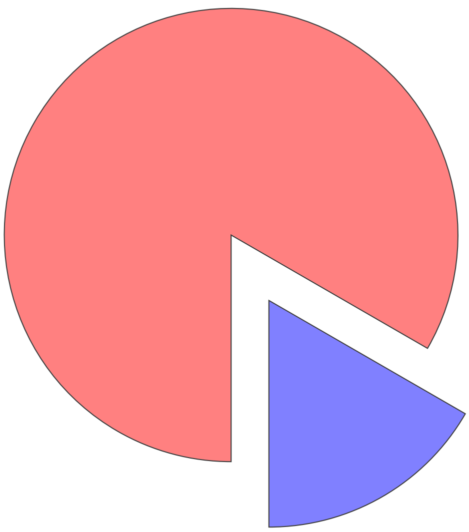
You have to add, of course, all the styles of TikZ for tracings...

options	arguments	example
towards	(⟨pt,pt⟩)(⟨pt⟩)	\tkzDrawSector(O,A)(B)
rotate	(⟨pt,pt⟩)(⟨an⟩)	\tkzDrawSector[rotate,color=red](O,A)(90)
R	(⟨pt,r⟩)(⟨an,an⟩)	\tkzDrawSector[R,color=blue](O,2 cm)(30,90)
R with nodes	(⟨pt,r⟩)(⟨pt,pt⟩)	\tkzDrawSector[R with nodes](O,2 cm)(A,B)

Here are a few examples:

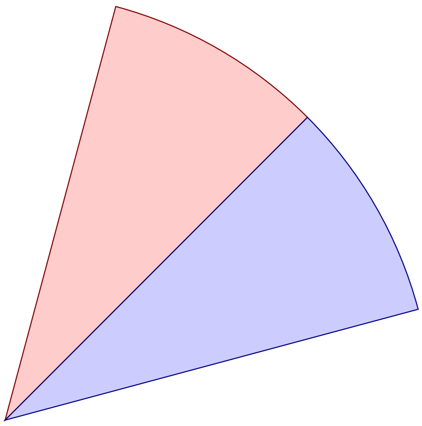
23.1.1 \tkzDrawSector and towards

There's no need to put **towards**. You can use **fill** as an option.



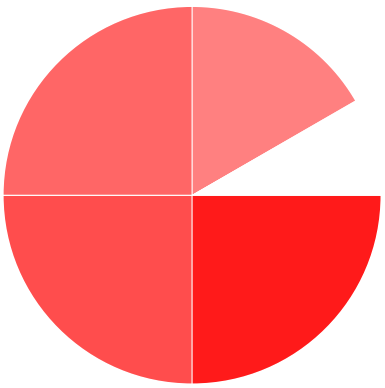
```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(-30:3){A}
  \tkzDefPointBy[rotation = center O angle -60](A)
  \tkzDrawSector[fill=red!50](O,A)(tkzPointResult)
 \begin{scope}[shift={(-60:1cm)}]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(-30:3){A}
  \tkzDefPointBy[rotation = center O angle -60](A)
  \tkzDrawSector[fill=blue!50](O,tkzPointResult)(A)
  \end{scope}
\end{tikzpicture}
```

23.1.2 \tkzDrawSector and rotate



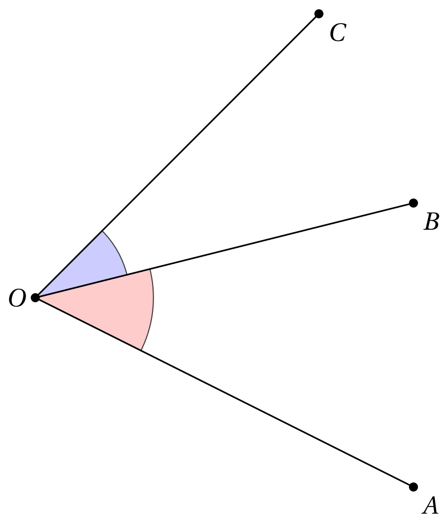
```
\begin{tikzpicture}[scale=2]
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(2,2){A}
 \tkzDrawSector[rotate,draw=red!50!black,%
 fill=red!20](O,A)(30)
 \tkzDrawSector[rotate,draw=blue!50!black,%
 fill=blue!20](O,A)(-30)
\end{tikzpicture}
```

23.1.3 \tkzDrawSector and R



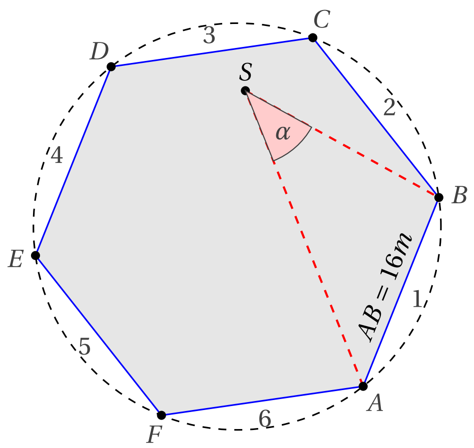
```
\begin{tikzpicture}[scale=1.25]
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(2,-1){A}
 \tkzDrawSector[R,draw=white,%
 fill=red!50](O,2cm)(30,90)
 \tkzDrawSector[R,draw=white,%
 fill=red!60](O,2cm)(90,180)
 \tkzDrawSector[R,draw=white,%
 fill=red!70](O,2cm)(180,270)
 \tkzDrawSector[R,draw=white,%
 fill=red!90](O,2cm)(270,360)
\end{tikzpicture}
```

23.1.4 \tkzDrawSector and R




```
\begin{tikzpicture}[scale=1.25]
 \tkzDefPoint(0,0){O}
 \tkzDefPoint(4,-2){A}
 \tkzDefPoint(4,1){B}
 \tkzDefPoint(3,3){C}
 \tkzDrawSector[R with nodes,%
               fill=blue!20](O,1 cm)(B,C)
 \tkzDrawSector[R with nodes,%
               fill=red!20](O,1.25 cm)(A,B)
\tkzDrawSegments(O,A O,B O,C)
\tkzDrawPoints(O,A,B,C)
\tkzLabelPoints(A,B,C)
\tkzLabelPoints[left](O)
\end{tikzpicture}
```

23.1.5 \tkzDrawSector and R with nodes




```
\begin{tikzpicture} [scale=.5]
 \tkzDefPoint(-1,-2){A}
 \tkzDefPoint(1,3){B}
 \tkzDefRegPolygon[side,sides=6](A,B)
 \tkzGetPoint{O}
 \tkzDrawPolygon[fill=black!10,
                draw=blue](P1,P...,P6)
 \tkzLabelRegPolygon[sep=1.05](O){A,...,F}
 \tkzDrawCircle[dashed](O,A)
 \tkzLabelSegment[above,sloped,
                 midway](A,B){\(A B = 16m\)}
 \foreach \i  [count=\xi from 1]  in {2,...,6,1}
   {%
     \tkzDefMidPoint(P\xi,P\i)
     \path (O) to [pos=1.1] node {\xi} (tkzPointResult) ;
     }
  \tkzDefRandPointOn[segment = P3--P5]
  \tkzGetPoint{S}
  \tkzDrawSegments[thick,dashed,red](A,S S,B)
  \tkzDrawPoints(P1,P...,P6,S)
  \tkzLabelPoint[left,above](S){$S$}
  \tkzDrawSector[R with nodes,fill=red!20](S,2 cm)(A,B)
  \tkzLabelAngle[pos=1.5](A,S,B){$\alpha$}
\end{tikzpicture}
```

23.2 \tkzFillSector

Attention the arguments vary according to the options.

`\tkzFillSector[⟨local options⟩](⟨O,...⟩)(⟨...⟩)`

options	default	definition
towards	towards	O is the center and the arc from A to (OB)
rotate	towards	the arc starts from A and the angle determines its length
R	towards	We give the radius and two angles
R with nodes	towards	We give the radius and two points

Of course, you have to add all the styles of Ti*k*Z for the tracings...

options	arguments	example
towards	(⟨pt,pt⟩)(⟨pt⟩)	`\tkzFillSector(O,A)(B)`
rotate	(⟨pt,pt⟩)(⟨an⟩)	`\tkzFillSector[rotate,color=red](O,A)(90)`
R	(⟨pt,r⟩)(⟨an,an⟩)	`\tkzFillSector[R,color=blue](O,2 cm)(30,90)`
R with nodes	(⟨pt,r⟩)(⟨pt,pt⟩)	`\tkzFillSector[R with nodes](O,2 cm)(A,B)`

23.2.1 \tkzFillSector and towards

It is useless to put **towards** and you will notice that the contours are not drawn, only the surface is colored.

```
\begin{tikzpicture}[scale=.6]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(-30:3){A}
  \tkzDefPointBy[rotation = center O angle -60](A)
  \tkzFillSector[fill=red!50](O,A)(tkzPointResult)
  \begin{scope}[shift={(-60:1cm)}]
   \tkzDefPoint(0,0){O}
   \tkzDefPoint(-30:3){A}
   \tkzDefPointBy[rotation = center O angle -60](A)
   \tkzFillSector[color=blue!50](O,tkzPointResult)(A)
  \end{scope}
\end{tikzpicture}
```

23.2.2 \tkzFillSector and rotate


```
\begin{tikzpicture}[scale=1.5]
 \tkzDefPoint(0,0){O} \tkzDefPoint(2,2){A}
 \tkzFillSector[rotate,color=red!20](O,A)(30)
 \tkzFillSector[rotate,color=blue!20](O,A)(-30)
\end{tikzpicture}
```

23.3 \tkzClipSector

Attention the arguments vary according to the options.

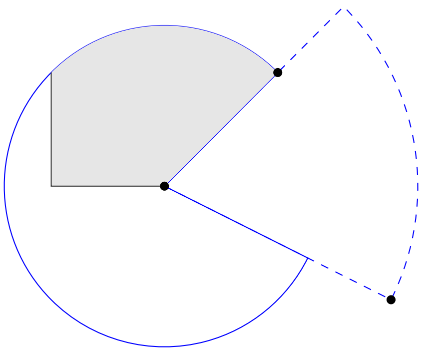
`\tkzClipSector[⟨local options⟩](⟨O,...⟩)(⟨...⟩)`

options	default	definition
towards	towards	O is the centre and the sector starts from A to (OB)
rotate	towards	The sector starts from A and the angle determines its amplitude.
R	towards	We give the radius and two angles

You have to add, of course, all the styles of TikZ for tracings...

options	arguments	example
towards	(⟨pt,pt⟩)(⟨pt⟩)	`\tkzClipSector(O,A)(B)`
rotate	(⟨pt,pt⟩)(⟨angle⟩)	`\tkzClipSector[rotate](O,A)(90)`
R	(⟨pt,r⟩)(⟨angle 1,angle 2⟩)	`\tkzClipSector[R](O,2 cm)(30,90)`

23.3.1 \tkzClipSector



```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-1){A}
  \tkzDefPoint(1,1){B}
  \tkzDrawSector[color=blue,dashed](O,A)(B)
  \tkzDrawSector[color=blue](O,B)(A)
  \tkzClipBB
  \begin{scope}
    \tkzClipSector(O,B)(A)
    \draw[fill=gray!20] (-1,0) rectangle (3,3);
  \end{scope}
  \tkzDrawPoints(A,B,O)
\end{tikzpicture}
```

24 The arcs

`\tkzDrawArc[⟨local options⟩](⟨O,...⟩)(⟨...⟩)`

This macro traces the arc of center O. Depending on the options, the arguments differ. It is a question of determining a starting point and an end point. Either the starting point is given, which is the simplest, or the radius of the arc is given. In the latter case, it is necessary to have two angles. Either the angles can be given directly, or nodes associated with the center can be given to determine them. The angles are in degrees.

options	default	definition
towards	towards	O is the center and the arc from A to (OB)
rotate	towards	the arc starts from A and the angle determines its length
R	towards	We give the radius and two angles
R with nodes	towards	We give the radius and two points
angles	towards	We give the radius and two points
delta	0	angle added on each side

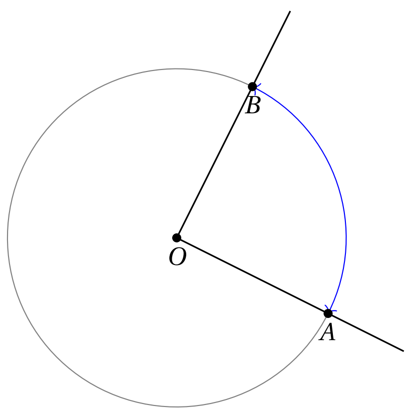
Of course, you have to add all the styles of TikZ for the tracings...

options	arguments	example
towards	(⟨pt,pt⟩)(⟨pt⟩)	`\tkzDrawArc[delta=10](O,A)(B)`
rotate	(⟨pt,pt⟩)(⟨an⟩)	`\tkzDrawArc[rotate,color=red](O,A)(90)`
R	(⟨pt,r⟩)(⟨an,an⟩)	`\tkzDrawArc[R](O,2 cm)(30,90)`
R with nodes	(⟨pt,r⟩)(⟨pt,pt⟩)	`\tkzDrawArc[R with nodes](O,2 cm)(A,B)`
angles	(⟨pt,pt⟩)(⟨an,an⟩)	`\tkzDrawArc[angles](O,A)(0,90)`

Here are a few examples:

24.1 Option towards

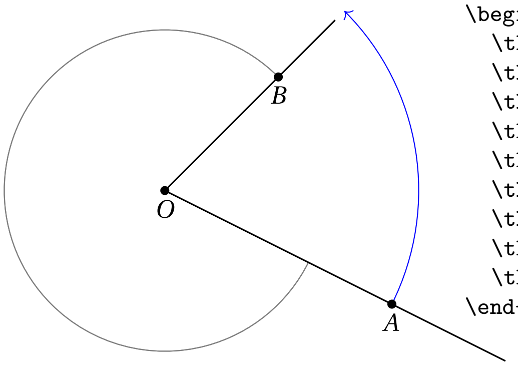
It's useless to put **towards**. In this first example the arc starts from A and goes to B. The arc going from B to A is different. The salient is obtained by going in the direct direction of the trigonometric circle.




```
\begin{tikzpicture}
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-1){A}
  \tkzDefPointBy[rotation= center O angle 90](A)
  \tkzGetPoint{B}
  \tkzDrawArc[color=blue,<->](O,A)(B)
  \tkzDrawArc(O,B)(A)
  \tkzDrawLines[add = 0 and .5](O,A O,B)
  \tkzDrawPoints(O,A,B)
  \tkzLabelPoints[below](O,A,B)
\end{tikzpicture}
```

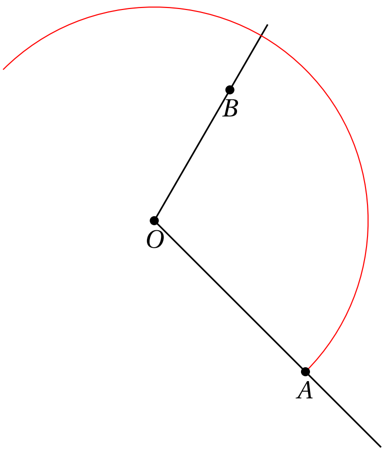
24.2 Option towards

In this one, the arc starts from A but stops on the right (OB).



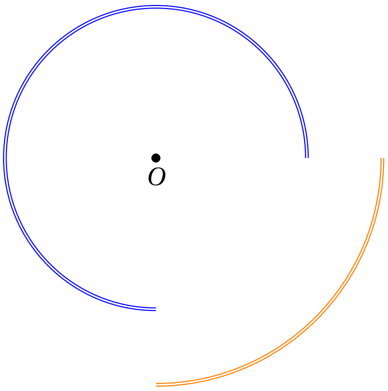

```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-1){A}
  \tkzDefPoint(1,1){B}
  \tkzDrawArc[color=blue,->](O,A)(B)
  \tkzDrawArc[color=gray](O,B)(A)
  \tkzDrawArc(O,B)(A)
  \tkzDrawLines[add = 0 and .5](O,A O,B)
  \tkzDrawPoints(O,A,B)
  \tkzLabelPoints[below](O,A,B)
\end{tikzpicture}
```

24.3 Option rotate



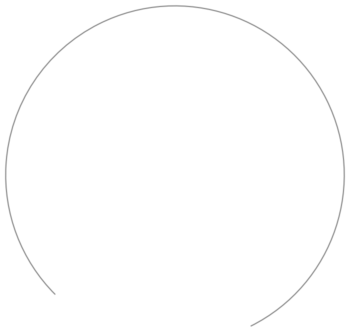

```
\begin{tikzpicture}
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-2){A}
  \tkzDefPoint(60:2){B}
  \tkzDrawLines[add = 0 and .5](O,A O,B)
  \tkzDrawArc[rotate,color=red](O,A)(180)
  \tkzDrawPoints(O,A,B)
  \tkzLabelPoints[below](O,A,B)
\end{tikzpicture}
```

24.4 Option R




```
\begin{tikzpicture}
  \tkzDefPoints{0/0/O}
  \tikzset{compass style/.append style={<->}}
  \tkzDrawArc[R,color=orange,double](O,3cm)(270,360)
  \tkzDrawArc[R,color=blue,double](O,2cm)(0,270)
  \tkzDrawPoint(O)
  \tkzLabelPoint[below](O){$O$}
\end{tikzpicture}
```

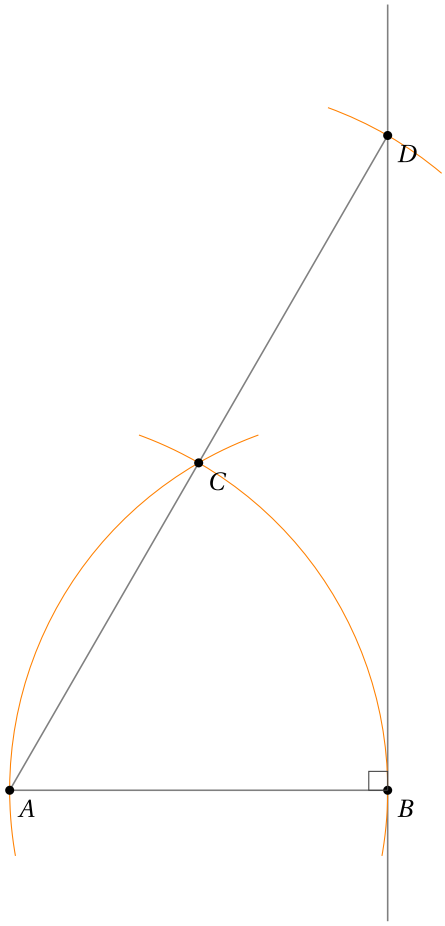
24.5 Option R with nodes



```
\begin{tikzpicture}
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2,-1){A}
  \tkzDefPoint(1,1){B}
  \tkzCalcLength(B,A)\tkzGetLength{radius}
  \tkzDrawArc[R with nodes](B,\radius pt)(A,O)
\end{tikzpicture}
```

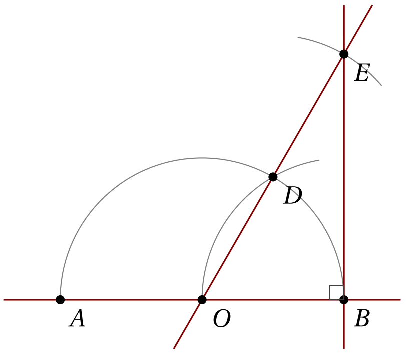
24.6 Option delta

This option allows a bit like `\tkzCompass` to place an arc and overflow on either side. delta is a measure in degrees.



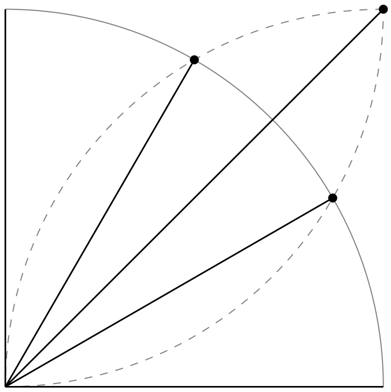

```
\begin{tikzpicture}
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(5,0){B}
 \tkzDefPointBy[rotation= center A angle 60](B)
 \tkzGetPoint{C}
 \tkzSetUpLine[color=gray]
 \tkzDefPointBy[symmetry= center C](A)
 \tkzGetPoint{D}
 \tkzDrawSegments(A,B A,D)
 \tkzDrawLine(B,D)
 \tkzSetUpCompass[color=orange]
 \tkzDrawArc[orange,delta=10](A,B)(C)
 \tkzDrawArc[orange,delta=10](B,C)(A)
 \tkzDrawArc[orange,delta=10](C,D)(D)
 \tkzDrawPoints(A,B,C,D)
 \tkzLabelPoints(A,B,C,D)
 \tkzMarkRightAngle(D,B,A)
\end{tikzpicture}
```

24.7 Option angles: example 1




```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,0){B}
  \tkzDefPoint(2.5,0){O}
  \tkzDefPointBy[rotation=center O angle 60](B)
  \tkzGetPoint{D}
  \tkzDefPointBy[symmetry=center D](O)
  \tkzGetPoint{E}
  \tkzSetUpLine[color=Maroon]
  \tkzDrawArc[angles](O,B)(0,180)
  \tkzDrawArc[angles,](B,O)(100,180)
  \tkzCompass[delta=20](D,E)
  \tkzDrawLines(A,B O,E B,E)
  \tkzDrawPoints(A,B,O,D,E)
  \tkzLabelPoints(A,B,O,D,E)
  \tkzMarkRightAngle(O,B,E)
\end{tikzpicture}
```

24.8 Option angles: example 2



```
  \begin{tikzpicture}
   \tkzDefPoint(0,0){O}
   \tkzDefPoint(5,0){I}
   \tkzDefPoint(0,5){J}
   \tkzInterCC(O,I)(I,O)\tkzGetPoints{B}{C}
   \tkzInterCC(O,I)(J,O)\tkzGetPoints{D}{A}
   \tkzInterCC(I,O)(J,O)\tkzGetPoints{L}{K}
   \tkzDrawArc[angles](O,I)(0,90)
   \tkzDrawArc[angles,color=gray,style=dashed](I,O)(90,180)
   \tkzDrawArc[angles,color=gray,style=dashed](J,O)(-
90,0)
   \tkzDrawPoints(A,B,K)
   \foreach \point in {I,A,B,J,K}{\tkzDrawSegment(O,\point)}
  \end{tikzpicture}
```

25 Miscellaneous tools

25.1 Duplicate a segment

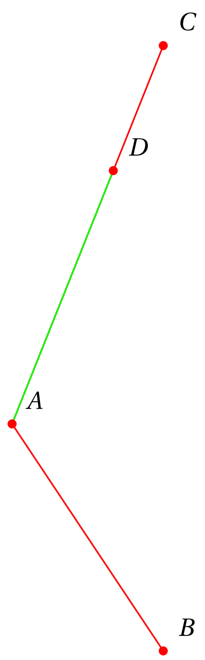
This involves constructing a segment on a given half-line of the same length as a given segment.

`\tkzDuplicateSegment(⟨pt1,pt2⟩)(⟨pt3,pt4⟩){⟨pt5⟩}`

This involves creating a segment on a given half-line of the same length as a given segment . It is in fact the definition of a point. `\tkzDuplicateSegment` is the new name of `\tkzDuplicateLen`.

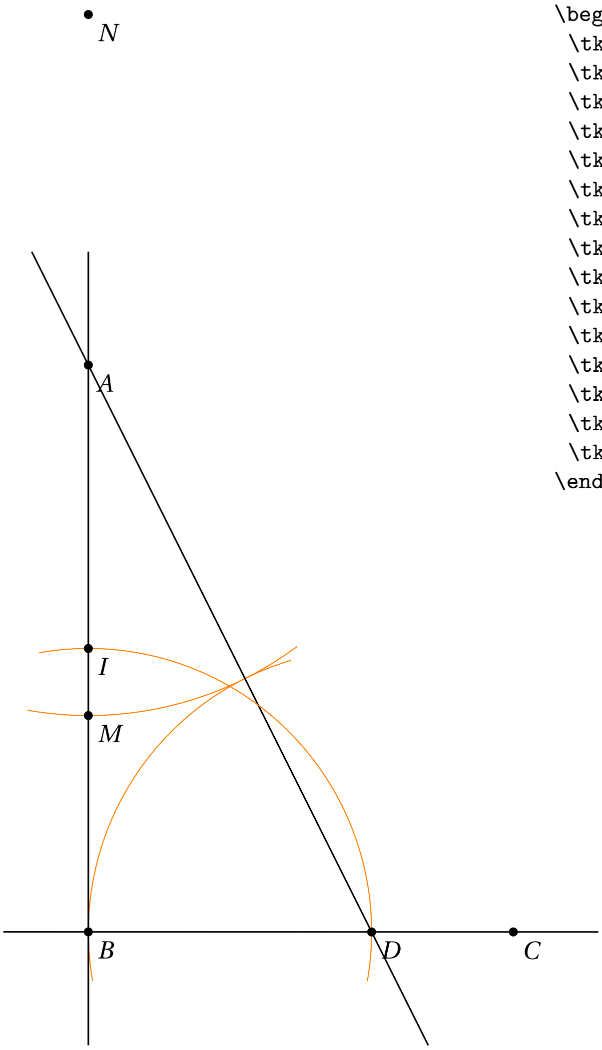
arguments	example
(pt1,pt2)(pt3,pt4){pt5}	\tkzDuplica

The macro `\tkzDuplicateLength` is identical to this one.




```
\begin{tikzpicture}
\tkzDefPoint(0,0){A}
\tkzDefPoint(2,-3){B}
\tkzDefPoint(2,5){C}
\tkzDrawSegments[red](A,B A,C)
\tkzDuplicateSegment(A,B)(A,C)
\tkzGetPoint{D}
\tkzDrawSegment[green](A,D)
\tkzDrawPoints[color=red](A,B,C,D)
\tkzLabelPoints[above right=3pt](A,B,C,D)
\end{tikzpicture}
```

25.1.1 Proportion of gold with \tkzDuplicateSegment




```
\begin{tikzpicture}[rotate=-90,scale=.75]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(10,0){B}
 \tkzDefMidPoint(A,B)
 \tkzGetPoint{I}
 \tkzDefPointWith[orthogonal,K=-.75](B,A)
 \tkzGetPoint{C}
 \tkzInterLC(B,C)(B,I)  \tkzGetSecondPoint{D}
 \tkzDuplicateSegment(B,D)(D,A) \tkzGetPoint{E}
 \tkzInterLC(A,B)(A,E)   \tkzGetPoints{N}{M}
 \tkzDrawArc[orange,delta=10](D,E)(B)
 \tkzDrawArc[orange,delta=10](A,M)(E)
 \tkzDrawLines(A,B B,C A,D)
 \tkzDrawArc[orange,delta=10](B,D)(I)
 \tkzDrawPoints(A,B,D,C,M,I,N)
 \tkzLabelPoints(A,B,D,C,M,I,N)
\end{tikzpicture}
```

25.2 Segment length \tkzCalcLength

There's an option in Ti*k*Z named **veclen**. This option is used to calculate AB if A and B are two points.

The only problem for me is that the version of Ti*k*Z is not accurate enough in some cases. My version uses the xfp package and is slower, but more accurate.

`\tkzCalcLength[⟨local options⟩](⟨pt1,pt2⟩){⟨name of macro⟩}`

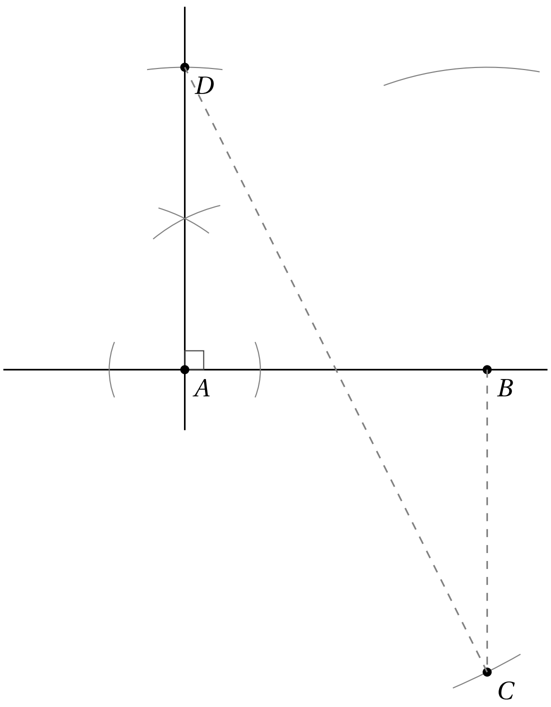
The result is stored in a macro.

arguments	example	explication
(pt1,pt2){name of macro}	\tkzCalcLength(A,B){dAB}	\dAB gives *AB* in pt

Only one option

options	default	example
cm	false	\tkzCalcLength[cm](A,B){dAB} \dAB gives *AB* in cm

25.2.1 Compass square construction




```
\begin{tikzpicture}[scale=1]
  \tkzDefPoint(0,0){A} \tkzDefPoint(4,0){B}
  \tkzDrawLine[add= .6 and .2](A,B)
  \tkzCalcLength[cm](A,B)\tkzGetLength{dAB}
  \tkzDefLine[perpendicular=through A](A,B)
  \tkzDrawLine(A,tkzPointResult) \tkzGetPoint{D}
  \tkzShowLine[orthogonal=through A,gap=2](A,B)
  \tkzMarkRightAngle(B,A,D)
  \tkzVecKOrth[-1](B,A)\tkzGetPoint{C}
  \tkzCompasss(A,D D,C)
  \tkzDrawArc[R](B,\dAB)(80,110)
  \tkzDrawPoints(A,B,C,D)
  \tkzDrawSegments[color=gray,style=dashed](B,C C,D)
  \tkzLabelPoints(A,B,C,D)
\end{tikzpicture}
```

25.3 Transformation from pt to cm

Not sure if this is necessary and it is only a division by 28.45274 and a multiplication by the same number. The macros are:

`\tkzpttocm(⟨nombre⟩){⟨name of macro⟩}`

arguments	example	explication
(number)name of macro	`\tkzpttocm(120){len}`	`\len` gives a number of `cm`

You'll have to use `\len` along with `cm`. The result is stored in a macro.

25.4 Transformation from cm to pt

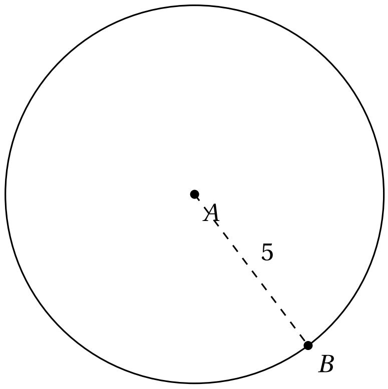
`\tkzcmtopt(⟨nombre⟩){⟨name of macro⟩}`

arguments	example	explication
(nombre){name of macro}	`\tkzcmtopt(5){len}`	`\len` length in `pt`

The result is stored in a macro. The result can be used with `\len` `pt`.

25.4.1 Example

The macro `\tkzDefCircle[radius](A,B)` defines the radius that we retrieve with `\tkzGetLength`, but this result is in `pt`.




```
\begin{tikzpicture}[scale=.5]
 \tkzDefPoint(0,0){A}
 \tkzDefPoint(3,-4){B}
 \tkzDefCircle[through](A,B)
 \tkzGetLength{rABpt}
 \tkzpttocm(\rABpt){rABcm}
 \tkzDrawCircle(A,B)
 \tkzDrawPoints(A,B)
 \tkzLabelPoints(A,B)
 \tkzDrawSegment[dashed](A,B)
 \tkzLabelSegment(A,B){$\pgfmathprintnumber{\rABcm}$}
\end{tikzpicture}
```

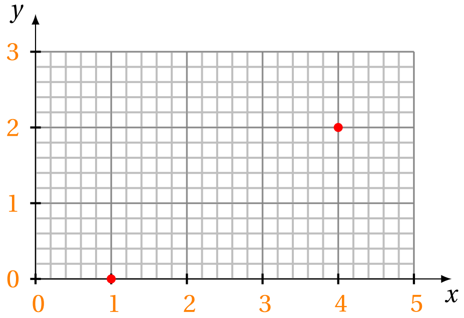
25.5 Get point coordinates

`\tkzGetPointCoord(⟨A⟩){⟨name of macro⟩}`

arguments	example	explication
(point){name of macro}	`\tkzGetPointCoord(A){A}`	`\Ax` and `\Ay` give coordinates for A

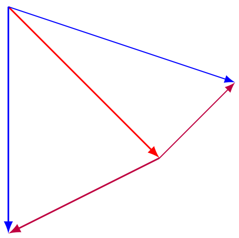
Stores in two macros the coordinates of a point. If the name of the macro is `p`, then `\px` and `\py` give the coordinates of the chosen point with the cm as unit.

25.5.1 Coordinate transfer with `\tkzGetPointCoord`




```
\begin{tikzpicture}
 \tkzInit[xmax=5,ymax=3]
 \tkzGrid[sub,orange]
 \tkzAxeXY
 \tkzDefPoint(1,0){A}
 \tkzDefPoint(4,2){B}
 \tkzGetPointCoord(A){a}
 \tkzGetPointCoord(B){b}
 \tkzDefPoint(\ax,\ay){C}
 \tkzDefPoint(\bx,\by){D}
 \tkzDrawPoints[color=red](C,D)
\end{tikzpicture}
```

25.5.2 Sum of vectors with \tkzGetPointCoord



```
\begin{tikzpicture}[>=latex]
  \tkzDefPoint(1,4){a}
  \tkzDefPoint(3,2){b}
  \tkzDefPoint(1,1){c}
  \tkzDrawSegment[->,red](a,b)
  \tkzGetPointCoord(c){c}
  \draw[color=blue,->](a) -- ([shift=(b)]\cx,\cy) ;
  \draw[color=purple,->](b) -- ([shift=(b)]\cx,\cy) ;
  \tkzDrawSegment[->,blue](a,c)
  \tkzDrawSegment[->,purple](b,c)
\end{tikzpicture}
```

26 Using the compass

26.1 Main macro \tkzCompass

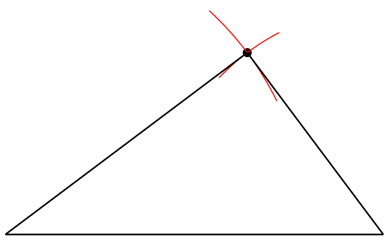
\tkzCompass[⟨local options⟩](⟨A,B⟩)

This macro allows you to leave a compass trace, i.e. an arc at a designated point. The center must be indicated. Several specific options will modify the appearance of the arc as well as TikZ options such as style, color, line thickness etc.

You can define the length of the arc with the option `length` or the option `delta`.

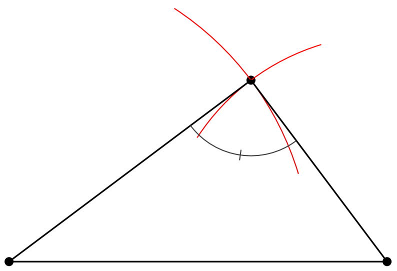
options	default	definition
delta	0 (deg)	Modifies the angle of the arc by increasing it symmetrically (in degrees)
length	1 (cm)	Changes the length (in cm)

26.1.1 Option length



```
\begin{tikzpicture}
  \tkzDefPoint(1,1){A}
  \tkzDefPoint(6,1){B}
  \tkzInterCC[R](A,4cm)(B,3cm)
  \tkzGetPoints{C}{D}
  \tkzDrawPoint(C)
  \tkzCompass[color=red,length=1.5](A,C)
  \tkzCompass[color=red](B,C)
  \tkzDrawSegments(A,B A,C B,C)
\end{tikzpicture}
```

26.1.2 Option delta



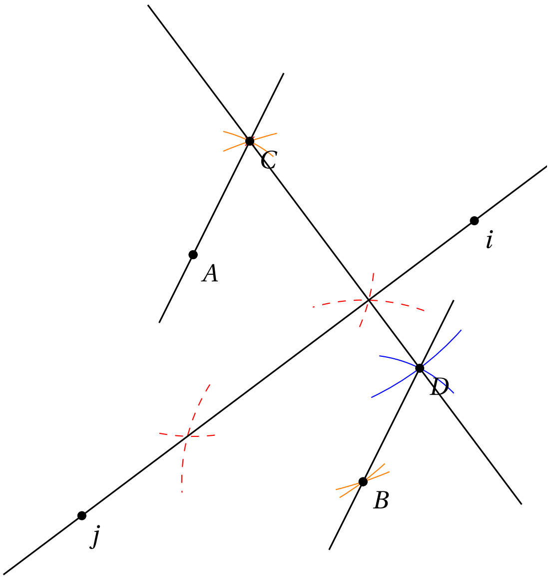
```
\begin{tikzpicture}
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(5,0){B}
  \tkzInterCC[R](A,4cm)(B,3cm)
  \tkzGetPoints{C}{D}
  \tkzDrawPoints(A,B,C)
  \tkzCompass[color=red,delta=20](A,C)
  \tkzCompass[color=red,delta=20](B,C)
  \tkzDrawPolygon(A,B,C)
  \tkzMarkAngle(A,C,B)
\end{tikzpicture}
```

26.2 Multiple constructions \tkzCompasss

\tkzCompasss[⟨local options⟩](⟨pt1,pt2 pt3,pt4,…⟩)

Attention the arguments are lists of two points. This saves a few lines of code.

options	default	definition
delta	0	Modifies the angle of the arc by increasing it symmetrically
length	1	Changes the length



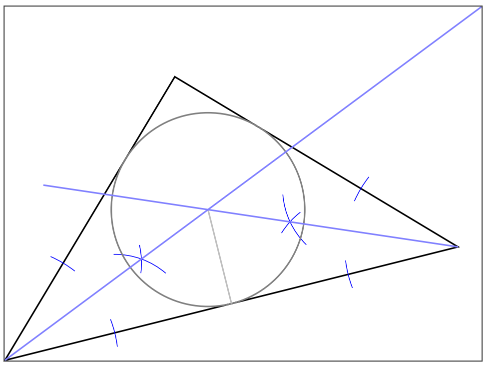

```
\begin{tikzpicture}[scale=.75]
 \tkzDefPoint(2,2){A}  \tkzDefPoint(5,-2){B}
 \tkzDefPoint(3,4){C}  \tkzDrawPoints(A,B)
 \tkzDrawPoint[color=red,shape=cross out](C)
 \tkzCompasss[color=orange](A,B A,C B,C C,B)
 \tkzShowLine[mediator,color=red,
                                dashed,length = 2](A,B)
 \tkzShowLine[parallel = through C,
                               color=blue,length=2](A,B)
 \tkzDefLine[mediator](A,B)  \tkzGetPoints{i}{j}
 \tkzDefLine[parallel=through C](A,B) \tkzGetPoint{D}
 \tkzDrawLines[add=.6 and .6](C,D A,C B,D)
 \tkzDrawLines(i,j) \tkzDrawPoints(A,B,C,i,j,D)
 \tkzLabelPoints(A,B,C,i,j,D)
\end{tikzpicture}
```

26.3 Configuration macro \tkzSetUpCompass

\tkzSetUpCompass[⟨local options⟩]

options	default	definition
line width	0.4pt	line thickness
color	black!50	line colour
style	solid	solid line style, dashed,dotted,...

26.3.1 Use of \tkzSetUpCompass



```
\begin{tikzpicture}[scale=.75,
      showbi/.style={bisector,size=2,gap=3}]
  \tkzSetUpCompass[color=blue,line width=.3 pt]
  \tkzDefPoints{0/1/A, 8/3/B, 3/6/C}
  \tkzDrawPolygon(A,B,C)
  \tkzDefLine[bisector](B,A,C)  \tkzGetPoint{a}
  \tkzDefLine[bisector](C,B,A)  \tkzGetPoint{b}
  \tkzShowLine[showbi](B,A,C)
  \tkzShowLine[showbi](C,B,A)
  \tkzInterLL(A,a)(B,b) \tkzGetPoint{I}
  \tkzDefPointBy[projection= onto A--B](I)
 \tkzGetPoint{H}
  \tkzDrawCircle[radius,color=gray](I,H)
  \tkzDrawSegments[color=gray!50](I,H)
  \tkzDrawLines[add=0 and -.2,color=blue!50 ](A,a B,b)
\tkzShowBB
\end{tikzpicture}
```

27 The Show

27.1 Show the constructions of some lines \tkzShowLine

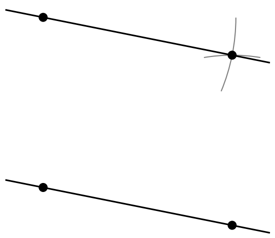
`\tkzShowLine[⟨local options⟩](⟨pt1,pt2⟩) or (⟨pt1,pt2,pt3⟩)`

These constructions concern mediatrices, perpendicular or parallel lines passing through a given point and bisectors. The arguments are therefore lists of two or three points. Several options allow the adjustment of the constructions. The idea of this macro comes from **Yves Combe**.

options	default	definition
mediator	mediator	displays the constructions of a mediator
perpendicular	mediator	constructions for a perpendicular
orthogonal	mediator	idem
bisector	mediator	constructions for a bisector
K	1	circle within a triangle
length	1	in cm, length of a arc
ratio	.5	arc length ratio
gap	2	placing the point of construction
size	1	radius of an arc (see bisector)

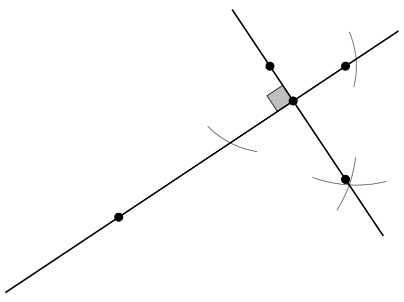
You have to add, of course, all the styles of Ti*k*Z for tracings…

27.1.1 Example of \tkzShowLine and parallel



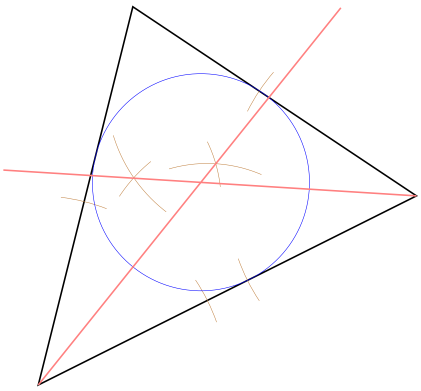
```
\begin{tikzpicture}
 \tkzDefPoints{-1.5/-0.25/A,1/-0.75/B,-1.5/2/C}
 \tkzDrawLine(A,B)
 \tkzDefLine[parallel=through C](A,B) \tkzGetPoint{c}
 \tkzShowLine[parallel=through C](A,B)
 \tkzDrawLine(C,c) \tkzDrawPoints(A,B,C,c)
\end{tikzpicture}
```

27.1.2 Example of \tkzShowLine and perpendicular



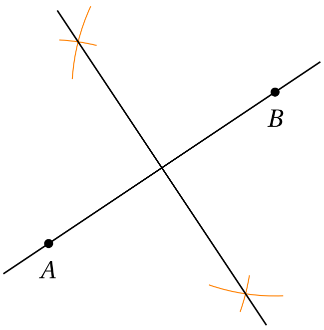
```
\begin{tikzpicture}
\tkzDefPoints{0/0/A, 3/2/B, 2/2/C}
\tkzDefLine[perpendicular=through C,K=-.5](A,B) \tkzGetPoint{c}
\tkzShowLine[perpendicular=through C,K=-.5,gap=3](A,B)
\tkzDefPointBy[projection=onto A--B](c)\tkzGetPoint{h}
\tkzMarkRightAngle[fill=lightgray](A,h,C)
\tkzDrawLines[add=.5 and .5](A,B C,c)
\tkzDrawPoints(A,B,C,h,c)
\end{tikzpicture}
```

27.1.3 Example of \tkzShowLine and bisector



```
\begin{tikzpicture}[scale=1.25]
 \tkzDefPoints{0/0/A, 4/2/B, 1/4/C}
 \tkzDrawPolygon(A,B,C)
 \tkzSetUpCompass[color=brown,line width=.1 pt]
 \tkzDefLine[bisector](B,A,C)  \tkzGetPoint{a}
 \tkzDefLine[bisector](C,B,A)  \tkzGetPoint{b}
 \tkzInterLL(A,a)(B,b) \tkzGetPoint{I}
 \tkzDefPointBy[projection = onto A--B](I)
   \tkzGetPoint{H}
 \tkzShowLine[bisector,size=2,gap=3,blue](B,A,C)
 \tkzShowLine[bisector,size=2,gap=3,blue](C,B,A)
 \tkzDrawCircle[radius,color=blue,%
 line width=.2pt](I,H)
 \tkzDrawSegments[color=red!50](I,tkzPointResult)
 \tkzDrawLines[add=0 and -0.3,color=red!50](A,a B,b)
\end{tikzpicture}
```

27.1.4 Example of \tkzShowLine and mediator




```
\begin{tikzpicture}
\tkzDefPoint(2,2){A}
\tkzDefPoint(5,4){B}
\tkzDrawPoints(A,B)
\tkzShowLine[mediator,color=orange,length=1](A,B)
\tkzGetPoints{i}{j}
\tkzDrawLines[add=-0.1 and -0.1](i,j)
\tkzDrawLines(A,B)
\tkzLabelPoints[below =3pt](A,B)
\end{tikzpicture}
```

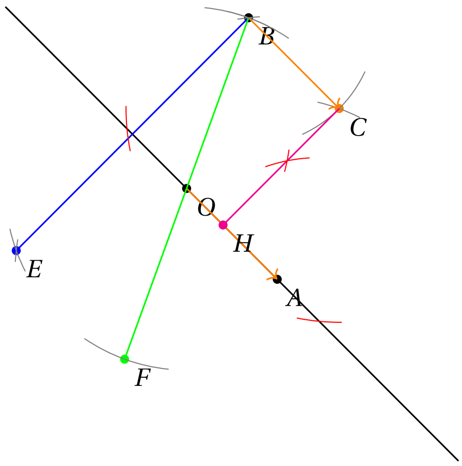
27.2 Constructions of certain transformations \tkzShowTransformation

`\tkzShowTransformation[⟨local options⟩](⟨pt1,pt2⟩) or (⟨pt1,pt2,pt3⟩)`

These constructions concern orthogonal symmetries, central symmetries, orthogonal projections and translations. Several options allow the adjustment of the constructions. The idea of this macro comes from **Yves Combe**.

options	default	definition
reflection= over pt1--pt2	reflection	constructions of orthogonal symmetry
symmetry=center pt	reflection	constructions of central symmetry
projection=onto pt1--pt2	reflection	constructions of a projection
translation=from pt1 to pt2	reflection	constructions of a translation
K	1	circle within a triangle
length	1	arc length
ratio	.5	arc length ratio
gap	2	placing the point of construction
size	1	radius of an arc (see bisector)

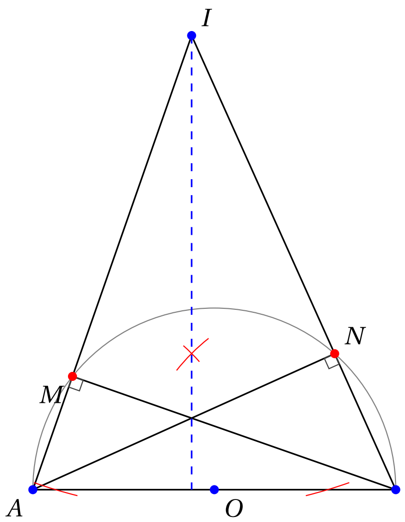
27.2.1 Example of the use of \tkzShowTransformation




```
\begin{tikzpicture}[scale=.6]
  \tkzDefPoint(0,0){O} \tkzDefPoint(2,-2){A}
  \tkzDefPoint(70:4){B} \tkzDrawPoints(A,O,B)
  \tkzLabelPoints(A,O,B)
  \tkzDrawLine[add= 2 and 2](O,A)
  \tkzDefPointBy[translation=from O to A](B)
  \tkzGetPoint{C}
  \tkzDrawPoint[color=orange](C)  \tkzLabelPoints(C)
  \tkzShowTransformation[translation=from O to A,%
             length=2](B)
  \tkzDrawSegments[->,color=orange](O,A B,C)
  \tkzDefPointBy[reflection=over O--A](B) \tkzGetPoint{E}
  \tkzDrawSegment[blue](B,E)
  \tkzDrawPoint[color=blue](E)\tkzLabelPoints(E)
  \tkzShowTransformation[reflection=over O--A,size=2](B)
  \tkzDefPointBy[symmetry=center O](B) \tkzGetPoint{F}
  \tkzDrawSegment[color=green](B,F)
  \tkzDrawPoint[color=green](F)\tkzLabelPoints(F)
  \tkzShowTransformation[symmetry=center O,%
                         length=2](B)
  \tkzDefPointBy[projection=onto O--A](C)
  \tkzGetPoint{H}
  \tkzDrawSegments[color=magenta](C,H)
  \tkzDrawPoint[color=magenta](H)\tkzLabelPoints(H)
  \tkzShowTransformation[projection=onto O--A,%
                            color=red,size=3,gap=-2](C)
\end{tikzpicture}
```

27.2.2 Another example of the use of \tkzShowTransformation

You'll find this figure again, but without the construction features.




```
\begin{tikzpicture}[scale=.6]
  \tkzDefPoints{0/0/A,8/0/B,3.5/10/I}
  \tkzDefMidPoint(A,B) \tkzGetPoint{O}
  \tkzDefPointBy[projection=onto A--B](I)
     \tkzGetPoint{J}
  \tkzInterLC(I,A)(O,A)  \tkzGetPoints{M'}{M}
  \tkzInterLC(I,B)(O,A)  \tkzGetPoints{N}{N'}
  \tkzDrawSemiCircle[diameter](A,B)
  \tkzDrawSegments(I,A I,B A,B B,M A,N)
  \tkzMarkRightAngles(A,M,B A,N,B)
  \tkzDrawSegment[style=dashed,color=blue](I,J)
  \tkzShowTransformation[projection=onto A--B,
                color=red,size=3,gap=-3](I)
  \tkzDrawPoints[color=red](M,N)
  \tkzDrawPoints[color=blue](O,A,B,I)
  \tkzLabelPoints(O)
  \tkzLabelPoints[above right](N,I)
  \tkzLabelPoints[below left](M,A)
\end{tikzpicture}
```

28 Different points

28.1 \tkzDefEquiPoints

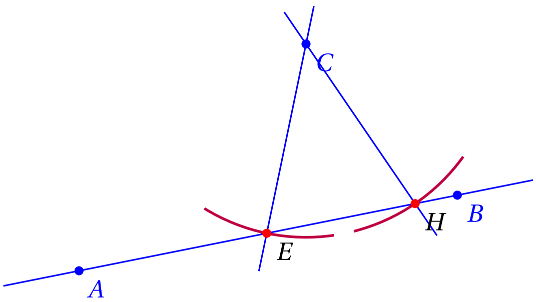
This macro makes it possible to obtain two points on a straight line equidistant from a given point.

\tkzDefEquiPoints[⟨local options⟩](⟨pt1,pt2⟩)

arguments	default	definition
(pt1,pt2)	no default	unordered list of two items

options	default	definition
dist	2 cm	half the distance between the two points
from=pt	no default	reference point
show	false	if true displays compass traces
/compass/delta	0	compass trace size

28.1.1 Using \tkzDefEquiPoints with options




```
\begin{tikzpicture}
  \tkzSetUpCompass[color=purple,line width=1pt]
  \tkzDefPoint(0,1){A}
  \tkzDefPoint(5,2){B}
  \tkzDefPoint(3,4){C}
  \tkzDefEquiPoints[from=C,dist=1,show,
      /tkzcompass/delta=20](A,B)
   \tkzGetPoints{E}{H}
   \tkzDrawLines[color=blue](C,E C,H A,B)
   \tkzDrawPoints[color=blue](A,B,C)
   \tkzDrawPoints[color=red](E,H)
   \tkzLabelPoints(E,H)
   \tkzLabelPoints[color=blue](A,B,C)
\end{tikzpicture}
```

29 Protractor

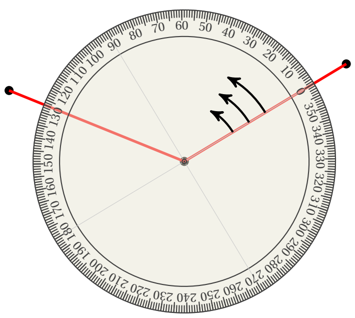
Based on an idea by Yves Combe, the following macro allows you to draw a protractor. The operating principle is even simpler. Just name a half-line (a ray). The protractor will be placed on the origin O, the direction of the half-line is given by A. The angle is measured in the direct direction of the trigonometric circle.

\tkzProtractor[⟨local options⟩](⟨O,A⟩)

options	default	definition
lw	0.4 pt	line thickness
scale	1	ratio: adjusts the size of the protractor
return	false	trigonometric circle indirect

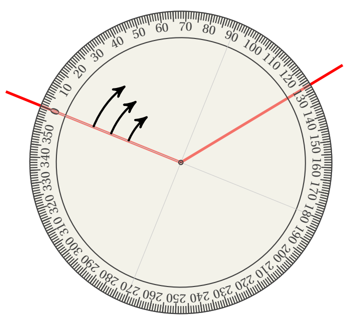
29.1 The circular protractor

Measuring in the forward direction



```
\begin{tikzpicture}[scale=.5]
\tkzDefPoint(2,0){A}\tkzDefPoint(0,0){O}
\tkzDefShiftPoint[A](31:5){B}
\tkzDefShiftPoint[A](158:5){C}
\tkzDrawPoints(A,B,C)
\tkzDrawSegments[color = red,
    line width = 1pt](A,B A,C)
  \tkzProtractor[scale = 1](A,B)
\end{tikzpicture}
```

29.2 The circular protractor, transparent and returned



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint(2,3){A}
  \tkzDefShiftPoint[A](31:5){B}
   \tkzDefShiftPoint[A](158:5){C}
  \tkzDrawSegments[color=red,line width=1pt](A,B A,C)
  \tkzProtractor[return](A,C)
\end{tikzpicture}
```

30 Some examples

30.1 Some interesting examples

30.1.1 Similar isosceles triangles

The following is from the excellent site **Descartes et les Mathématiques**. I did not modify the text and I am only the author of the programming of the figures.

http://debart.pagesperso-orange.fr/seconde/triangle.html

Bibliography:

- Géométrie au Bac - Tangente, special issue no. 8 - Exercise 11, page 11
- Elisabeth Busser and Gilles Cohen: 200 nouveaux problèmes du "Monde" - POLE 2007 (200 new problems of "Le Monde")
- Affaire de logique n° 364 - Le Monde February 17, 2004

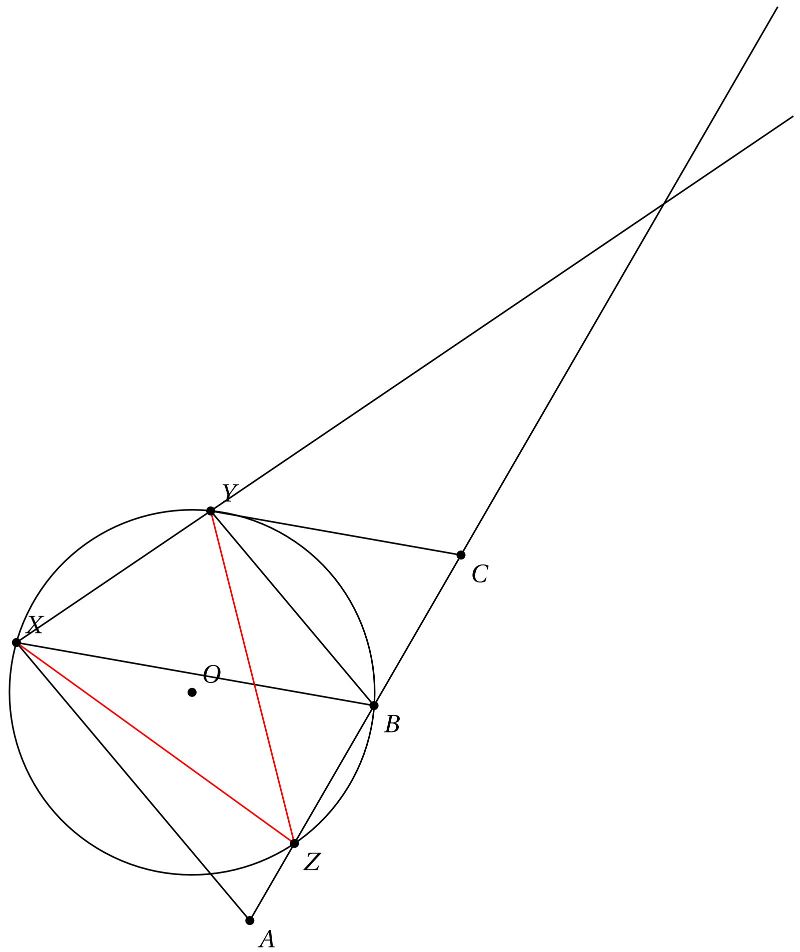
Two statements were proposed, one by the magazine *Tangente* and the other by *Le Monde*.

Editor of the magazine "Tangente": Two similar isosceles triangles AXB and BYC are constructed with main vertices X and Y, such that A, B and C are aligned and that these triangles are "indirect". Let α be the angle at vertex $\widehat{AXB} = \widehat{BYC}$. We then construct a third isosceles triangle XZY similar to the first two, with main vertex Z and "indirect". We ask to demonstrate that point Z belongs to the straight line (AC).

Editor of "Le Monde": We construct two similar isosceles triangles AXB and BYC with principal vertices X and Y, such that A, B and C are aligned and that these triangles are "indirect". Let α be the angle at vertex $\widehat{AXB} = \widehat{BYC}$. The point Z of the line segment $[AC]$ is equidistant from the two vertices X and Y.
At what angle does he see these two vertices?

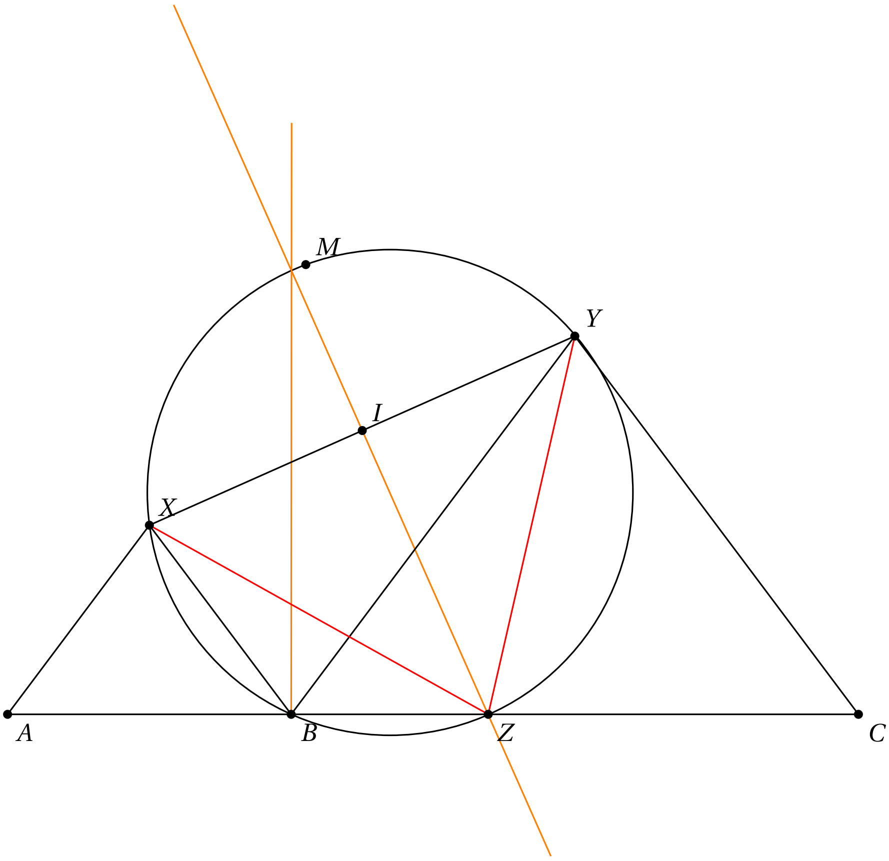
The constructions and their associated codes are on the next two pages, but you can search before looking. The programming respects (it seems to me ...) my reasoning in both cases.

30.1.2 Revised version of "Tangente"




```
\begin{tikzpicture}[scale=.8,rotate=60]
  \tkzDefPoint(6,0){X}   \tkzDefPoint(3,3){Y}
  \tkzDefShiftPoint[X](-110:6){A}    \tkzDefShiftPoint[X](-70:6){B}
  \tkzDefShiftPoint[Y](-110:4.2){A'} \tkzDefShiftPoint[Y](-70:4.2){B'}
  \tkzDefPointBy[translation= from A' to B ](Y) \tkzGetPoint{Y}
  \tkzDefPointBy[translation= from A' to B ](B') \tkzGetPoint{C}
  \tkzInterLL(A,B)(X,Y) \tkzGetPoint{O}
  \tkzDefMidPoint(X,Y) \tkzGetPoint{I}
  \tkzDefPointWith[orthogonal](I,Y)
  \tkzInterLL(I,tkzPointResult)(A,B) \tkzGetPoint{Z}
  \tkzDefCircle[circum](X,Y,B) \tkzGetPoint{O}
  \tkzDrawCircle(O,X)
  \tkzDrawLines[add = 0 and 1.5](A,C) \tkzDrawLines[add = 0 and 3](X,Y)
  \tkzDrawSegments(A,X B,X B,Y C,Y)   \tkzDrawSegments[color=red](X,Z Y,Z)
  \tkzDrawPoints(A,B,C,X,Y,O,Z)
  \tkzLabelPoints(A,B,C,Z)   \tkzLabelPoints[above right](X,Y,O)
\end{tikzpicture}
```

30.1.3 "Le Monde" version



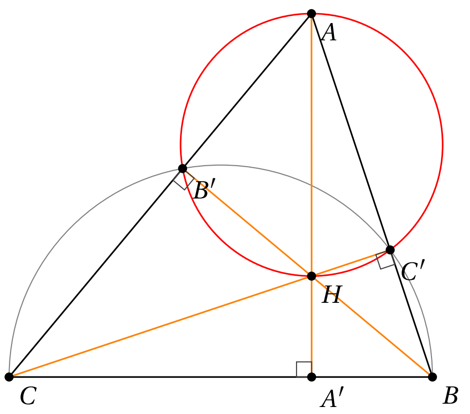

```
\begin{tikzpicture}[scale=1.25]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(3,0){B}
  \tkzDefPoint(9,0){C}
  \tkzDefPoint(1.5,2){X}
  \tkzDefPoint(6,4){Y}
  \tkzDefCircle[circum](X,Y,B) \tkzGetPoint{O}
  \tkzDefMidPoint(X,Y)              \tkzGetPoint{I}
  \tkzDefPointWith[orthogonal](I,Y)  \tkzGetPoint{i}
  \tkzDrawLines[add = 2 and 1,color=orange](I,i)
  \tkzInterLL(I,i)(A,B)              \tkzGetPoint{Z}
  \tkzInterLC(I,i)(O,B)              \tkzGetSecondPoint{M}
  \tkzDefPointWith[orthogonal](B,Z)  \tkzGetPoint{b}
  \tkzDrawCircle(O,B)
  \tkzDrawLines[add = 0 and 2,color=orange](B,b)
  \tkzDrawSegments(A,X B,X B,Y C,Y A,C X,Y)
  \tkzDrawSegments[color=red](X,Z Y,Z)
  \tkzDrawPoints(A,B,C,X,Y,Z,M,I)
  \tkzLabelPoints(A,B,C,Z)
  \tkzLabelPoints[above right](X,Y,M,I)
\end{tikzpicture}
```

30.1.4 Triangle altitudes

The following is again from the excellent site **Descartes et les Mathématiques** (Descartes and the Mathematics).

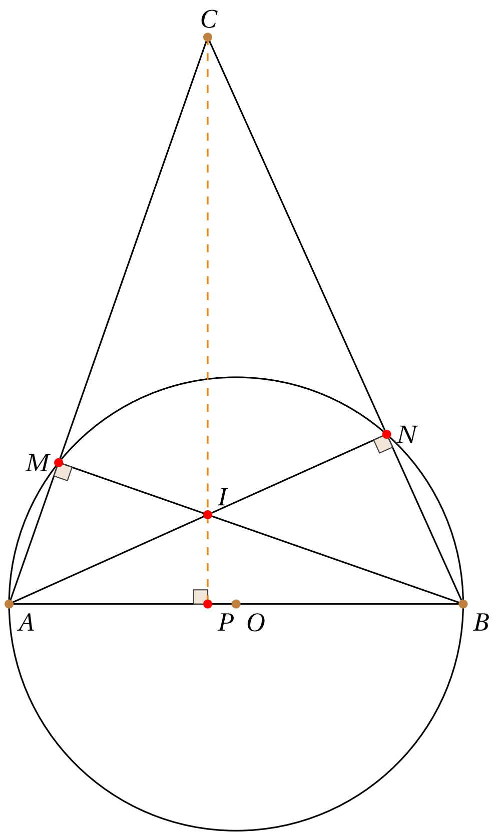
http://debart.pagesperso-orange.fr/geoplan/geometrie_triangle.html

The three altitudes of a triangle intersect at the same H-point.




```
\begin{tikzpicture}[scale=.8]
   \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'}
     \tkzDefCircle[circum](A,B',C')
    \tkzGetPoint{O}
   \tkzDrawCircle[color=red](O,A)
   \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}
```

30.1.5 Altitudes - other construction

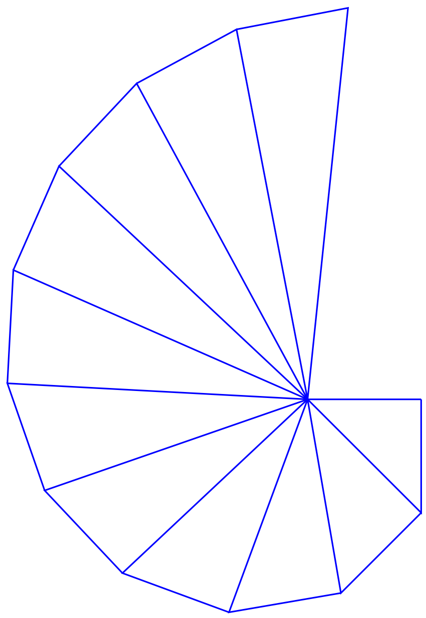



```
\begin{tikzpicture}[scale=.75]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(8,0){B}
  \tkzDefPoint(3.5,10){C}
  \tkzDefMidPoint(A,B)
  \tkzGetPoint{O}
  \tkzDefPointBy[projection=onto A--B](C)
  \tkzGetPoint{P}
  \tkzInterLC(C,A)(O,A)
  \tkzGetSecondPoint{M}
  \tkzInterLC(C,B)(O,A)
  \tkzGetFirstPoint{N}
  \tkzInterLL(B,M)(A,N)
  \tkzGetPoint{I}
  \tkzDrawCircle[diameter](A,B)
  \tkzDrawSegments(C,A C,B A,B B,M A,N)
  \tkzMarkRightAngles[fill=brown!20](A,M,B A,N,B A,P,C)
  \tkzDrawSegment[style=dashed,color=orange](C,P)
  \tkzLabelPoints(O,A,B,P)
  \tkzLabelPoint[left](M){$M$}
  \tkzLabelPoint[right](N){$N$}
  \tkzLabelPoint[above](C){$C$}
  \tkzLabelPoint[above right](I){$I$}
  \tkzDrawPoints[color=red](M,N,P,I)
  \tkzDrawPoints[color=brown](O,A,B,C)
\end{tikzpicture}
```

30.2 Different authors

30.2.1 Square root of the integers

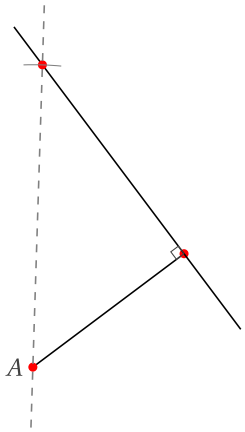
How to get 1, $\sqrt{2}$, $\sqrt{3}$ with a rule and a compass.



```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(1,0){a0}
   \tkzDrawSegment[blue](O,a0)
  \foreach \i [count=\j] in {0,...,10}{%
    \tkzDefPointWith[orthogonal normed](a\i,O)
    \tkzGetPoint{a\j}
    \tkzDrawPolySeg[color=blue](a\i,a\j,O)}
 \end{tikzpicture}
```

30.2.2 About right triangle

We have a segment $[AB]$ and we want to determine a point C such that $AC = 8$ cm and ABC is a right triangle in B.

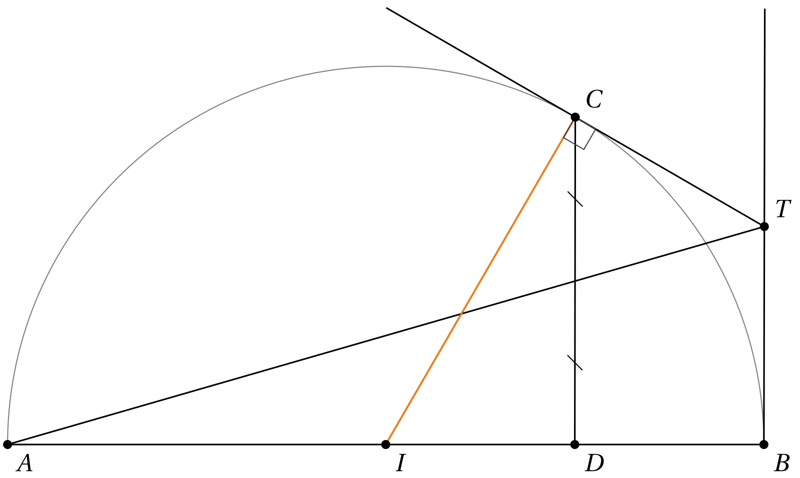



```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint["$A$" left](2,1){A}
  \tkzDefPoint(6,4){B}
  \tkzDrawSegment(A,B)
  \tkzDrawPoint[color=red](A)
  \tkzDrawPoint[color=red](B)
  \tkzDefPointWith[orthogonal,K=-1](B,A)
  \tkzDrawLine[add = .5 and .5](B,tkzPointResult)
  \tkzInterLC[R](B,tkzPointResult)(A,8 cm)
  \tkzGetPoints{C}{J}
  \tkzDrawPoint[color=red](C)
  \tkzCompass(A,C)
  \tkzMarkRightAngle(A,B,C)
  \tkzDrawLine[color=gray,style=dashed](A,C)
\end{tikzpicture}
```

30.2.3 Archimedes

This is an ancient problem proved by the great Greek mathematician Archimedes . The figure below shows a semicircle, with diameter AB. A tangent line is drawn and touches the semicircle at B. An other tangent line at a point, C, on the semicircle is drawn. We project the point C on the line segment $[AB]$ on a point D. The two tangent lines intersect at the point T.

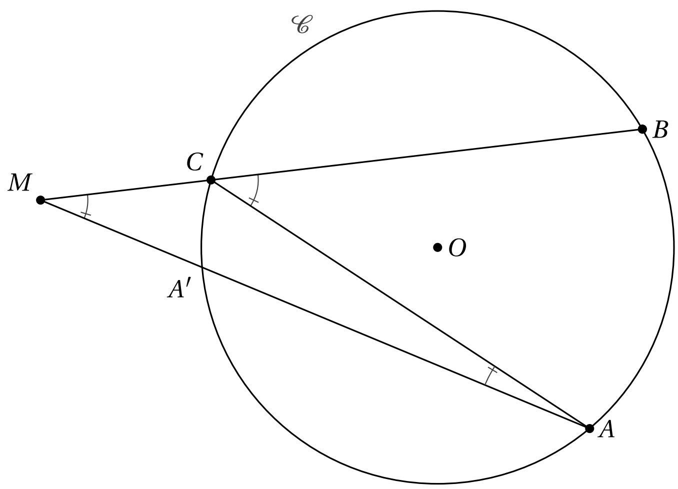
Prove that the line (AT) bisects (CD)




```
\begin{tikzpicture}[scale=1.25]
  \tkzDefPoint(0,0){A}\tkzDefPoint(6,0){D}
  \tkzDefPoint(8,0){B}\tkzDefPoint(4,0){I}
  \tkzDefLine[orthogonal=through D](A,D)
  \tkzInterLC[R](D,tkzPointResult)(I,4 cm) \tkzGetFirstPoint{C}
  \tkzDefLine[orthogonal=through C](I,C)    \tkzGetPoint{c}
  \tkzDefLine[orthogonal=through B](A,B)    \tkzGetPoint{b}
  \tkzInterLL(C,c)(B,b) \tkzGetPoint{T}
  \tkzInterLL(A,T)(C,D) \tkzGetPoint{P}
  \tkzDrawArc(I,B)(A)
  \tkzDrawSegments(A,B A,T C,D I,C) \tkzDrawSegment[color=orange](I,C)
  \tkzDrawLine[add = 1 and 0](C,T)   \tkzDrawLine[add = 0 and 1](B,T)
  \tkzMarkRightAngle(I,C,T)
  \tkzDrawPoints(A,B,I,D,C,T)
  \tkzLabelPoints(A,B,I,D)  \tkzLabelPoints[above right](C,T)
  \tkzMarkSegment[pos=.25,mark=s|](C,D) \tkzMarkSegment[pos=.75,mark=s|](C,D)
\end{tikzpicture}
```

30.2.4 Example: Dimitris Kapeta

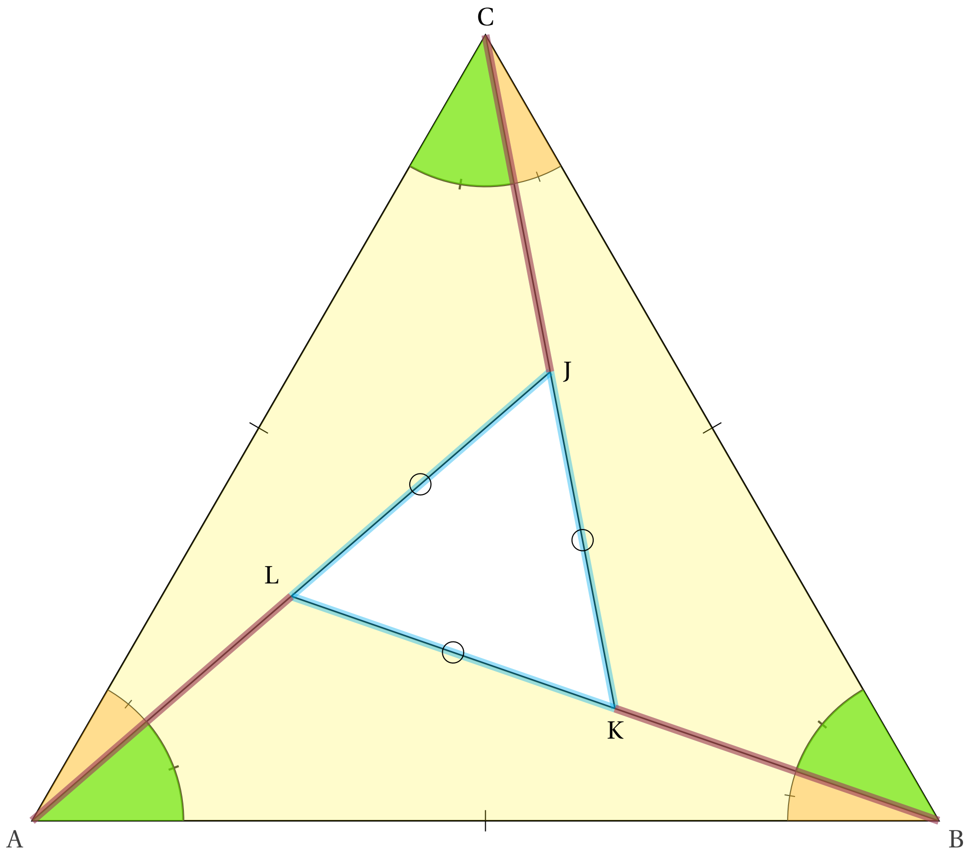
You need in this example to use `mkpos=.2` with `\tkzMarkAngle` because the measure of $\widehat{CAM}$ is too small. Another possiblity is to use `\tkzFillAngle`.



```
\begin{tikzpicture}[scale=1.25]
  \tkzDefPoint(0,0){O}
  \tkzDefPoint(2.5,0){N}
  \tkzDefPoint(-4.2,0.5){M}
  \tkzDefPointBy[rotation=center O angle 30](N)
  \tkzGetPoint{B}
  \tkzDefPointBy[rotation=center O angle -50](N)
  \tkzGetPoint{A}
  \tkzInterLC(M,B)(O,N) \tkzGetFirstPoint{C}
  \tkzInterLC(M,A)(O,N) \tkzGetSecondPoint{A'}
  \tkzMarkAngle[mkpos=.2, size=0.5](A,C,B)
  \tkzMarkAngle[mkpos=.2, size=0.5](A,M,C)
  \tkzDrawSegments(A,C M,A M,B)
  \tkzDrawCircle(O,N)
  \tkzLabelCircle[above left](O,N)(120){$\mathcal{C}$}
  \tkzMarkAngle[mkpos=.2, size=1.2](C,A,M)
  \tkzDrawPoints(O, A, B, M, B, C)
  \tkzLabelPoints[right](O,A,B)
  \tkzLabelPoints[above left](M,C)
  \tkzLabelPoint[below left](A'){$A'$}
\end{tikzpicture}
```

30.2.5 Example 1: John Kitzmiller

Prove that $\triangle LKJ$ is equilateral.

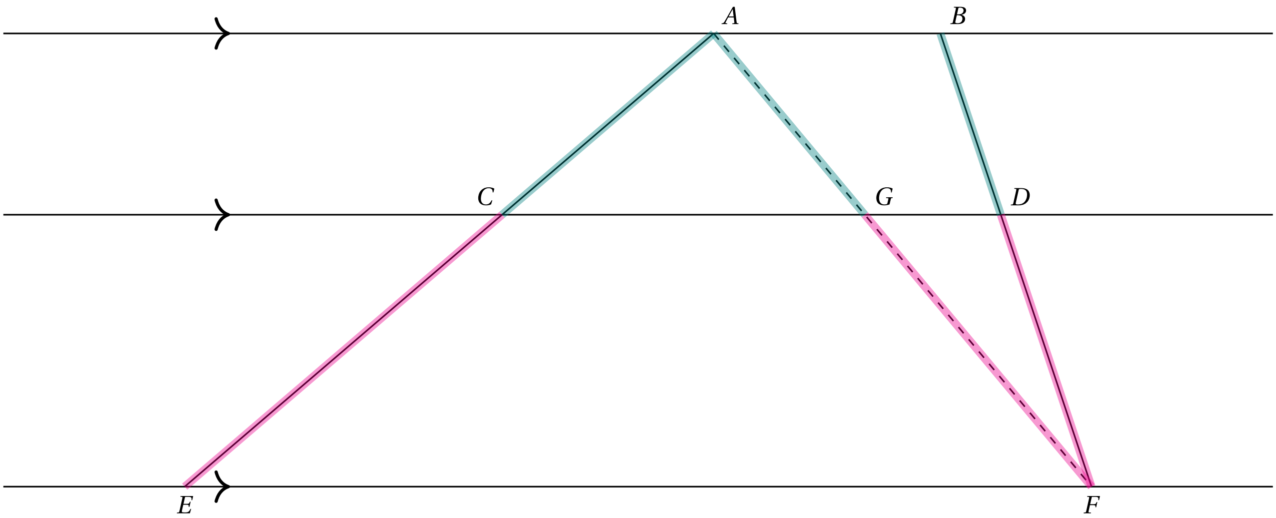


```
\begin{tikzpicture}[scale=2]
  \tkzDefPoint[label=below left:A](0,0){A}
  \tkzDefPoint[label=below right:B](6,0){B}
  \tkzDefTriangle[equilateral](A,B) \tkzGetPoint{C}
  \tkzMarkSegments[mark=|](A,B A,C B,C)
  \tkzDefBarycentricPoint(A=1,B=2) \tkzGetPoint{C'}
  \tkzDefBarycentricPoint(A=2,C=1) \tkzGetPoint{B'}
  \tkzDefBarycentricPoint(C=2,B=1) \tkzGetPoint{A'}
  \tkzInterLL(A,A')(C,C') \tkzGetPoint{J}
  \tkzInterLL(C,C')(B,B') \tkzGetPoint{K}
  \tkzInterLL(B,B')(A,A') \tkzGetPoint{L}
  \tkzLabelPoint[above](C){C}
  \tkzDrawPolygon(A,B,C) \tkzDrawSegments(A,J B,L C,K)
  \tkzMarkAngles[size=1 cm](J,A,C K,C,B L,B,A)
  \tkzMarkAngles[thick,size=1 cm](A,C,J C,B,K B,A,L)
  \tkzMarkAngles[opacity=.5](A,C,J C,B,K B,A,L)
  \tkzFillAngles[fill= orange,size=1 cm,opacity=.3](J,A,C K,C,B L,B,A)
  \tkzFillAngles[fill=orange, opacity=.3,thick,size=1,](A,C,J C,B,K B,A,L)
  \tkzFillAngles[fill=green, size=1, opacity=.5](A,C,J C,B,K B,A,L)
  \tkzFillPolygon[color=yellow, opacity=.2](J,A,C)
  \tkzFillPolygon[color=yellow, opacity=.2](K,B,C)
  \tkzFillPolygon[color=yellow, opacity=.2](L,A,B)
  \tkzDrawSegments[line width=3pt,color=cyan,opacity=0.4](A,J C,K B,L)
  \tkzDrawSegments[line width=3pt,color=red,opacity=0.4](A,L B,K C,J)
  \tkzMarkSegments[mark=o](J,K K,L L,J)
  \tkzLabelPoint[right](J){J}
  \tkzLabelPoint[below](K){K}
  \tkzLabelPoint[above left](L){L}
\end{tikzpicture}
```

30.2.6 Example 2: John Kitzmiller

Prove that $\dfrac{AC}{CE} = \dfrac{BD}{DF}$.

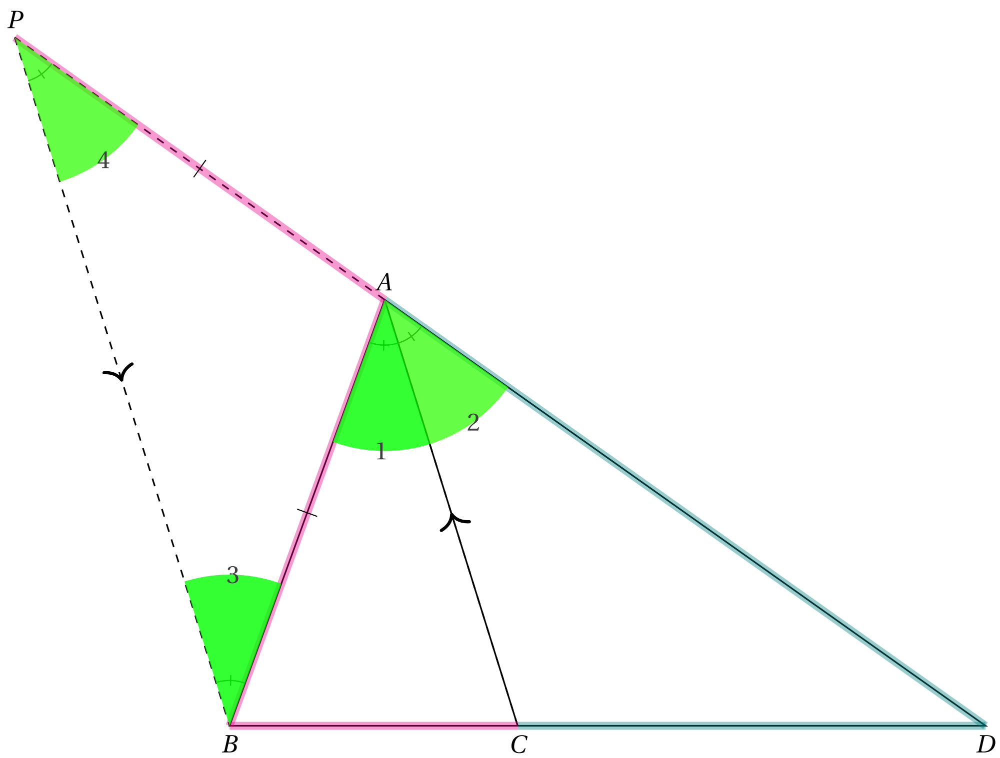
Another interesting example from John, you can see how to use some extra options like **decoration** and **postaction** from Ti*k*Z with **tkz-euclide**.



```
\begin{tikzpicture}[scale=2,decoration={markings,
  mark=at position 3cm with {\arrow[scale=2]{>}}}]
  \tkzDefPoints{0/0/E, 6/0/F, 0/1.8/P, 6/1.8/Q, 0/3/R, 6/3/S}
  \tkzDrawLines[postaction={decorate}](E,F P,Q R,S)
  \tkzDefPoints{3.5/3/A, 5/3/B}
  \tkzDrawSegments(E,A F,B)
  \tkzInterLL(E,A)(P,Q) \tkzGetPoint{C}
  \tkzInterLL(B,F)(P,Q) \tkzGetPoint{D}
  \tkzLabelPoints[above right](A,B)
  \tkzLabelPoints[below](E,F)
  \tkzLabelPoints[above left](C)
  \tkzDrawSegments[style=dashed](A,F)
  \tkzInterLL(A,F)(P,Q) \tkzGetPoint{G}
  \tkzLabelPoints[above right](D,G)
  \tkzDrawSegments[color=teal, line width=3pt, opacity=0.4](A,C A,G)
  \tkzDrawSegments[color=magenta, line width=3pt, opacity=0.4](C,E G,F)
  \tkzDrawSegments[color=teal, line width=3pt, opacity=0.4](B,D)
  \tkzDrawSegments[color=magenta, line width=3pt, opacity=0.4](D,F)
\end{tikzpicture}
```

30.2.7 Example 3: John Kitzmiller

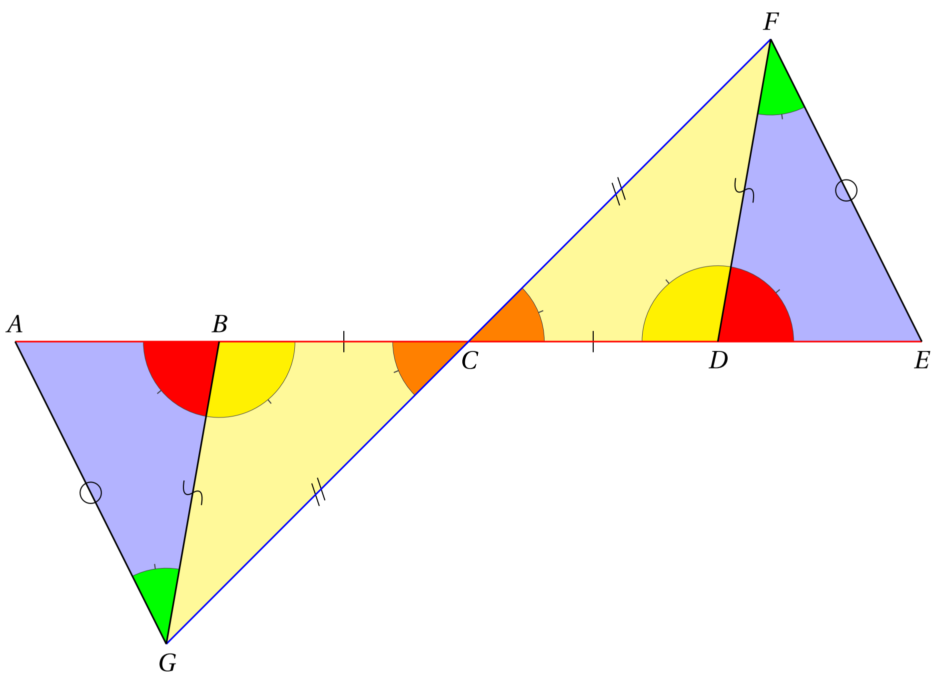
Prove that $\dfrac{BC}{CD} = \dfrac{AB}{AD}$ (Angle Bisector).



```
\begin{tikzpicture}[scale=2]
  \tkzDefPoints{0/0/B, 5/0/D}       \tkzDefPoint(70:3){A}
  \tkzDrawPolygon(B,D,A)
  \tkzDefLine[bisector](B,A,D)      \tkzGetPoint{a}
  \tkzInterLL(A,a)(B,D)           \tkzGetPoint{C}
  \tkzDefLine[parallel=through B](A,C) \tkzGetPoint{b}
  \tkzInterLL(A,D)(B,b)           \tkzGetPoint{P}
  \begin{scope}[decoration={markings,
   mark=at position .5 with {\arrow[scale=2]{>}}}]
   \tkzDrawSegments[postaction={decorate},dashed](C,A P,B)
  \end{scope}
  \tkzDrawSegment(A,C) \tkzDrawSegment[style=dashed](A,P)
  \tkzLabelPoints[below](B,C,D) \tkzLabelPoints[above](A,P)
  \tkzDrawSegments[color=magenta, line width=3pt, opacity=0.4](B,C P,A)
  \tkzDrawSegments[color=teal,    line width=3pt, opacity=0.4](C,D A,D)
  \tkzDrawSegments[color=magenta, line width=3pt, opacity=0.4](A,B)
  \tkzMarkAngles[size=3mm](B,A,C C,A,D)
  \tkzMarkAngles[size=3mm](B,A,C A,B,P)
  \tkzMarkAngles[size=3mm](B,P,A C,A,D)
  \tkzMarkAngles[size=3mm](B,A,C A,B,P B,P,A C,A,D)
  \tkzFillAngles[fill=green,  opacity=0.5](B,A,C A,B,P)
  \tkzFillAngles[fill=yellow, opacity=0.3](B,P,A C,A,D)
  \tkzFillAngles[fill=green,  opacity=0.6](B,A,C A,B,P B,P,A C,A,D)
  \tkzLabelAngle[pos=1](B,A,C){1}   \tkzLabelAngle[pos=1](C,A,D){2}
  \tkzLabelAngle[pos=1](A,B,P){3}    \tkzLabelAngle[pos=1](B,P,A){4}
  \tkzMarkSegments[mark=|](A,B A,P)
\end{tikzpicture}
```

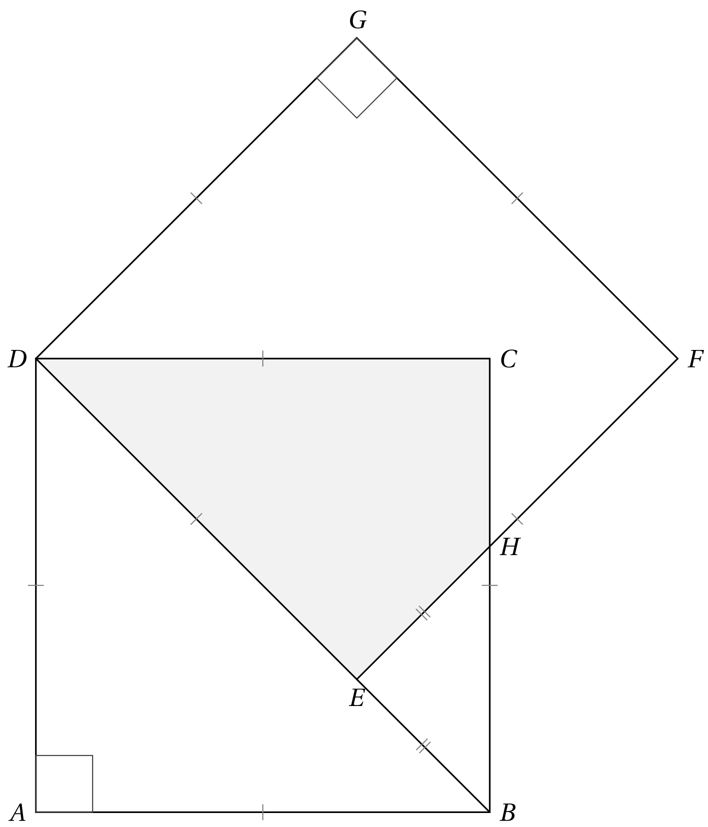
30.2.8 Example 4: author John Kitzmiller

Prove that $\overline{AG} \cong \overline{EF}$ (Detour).



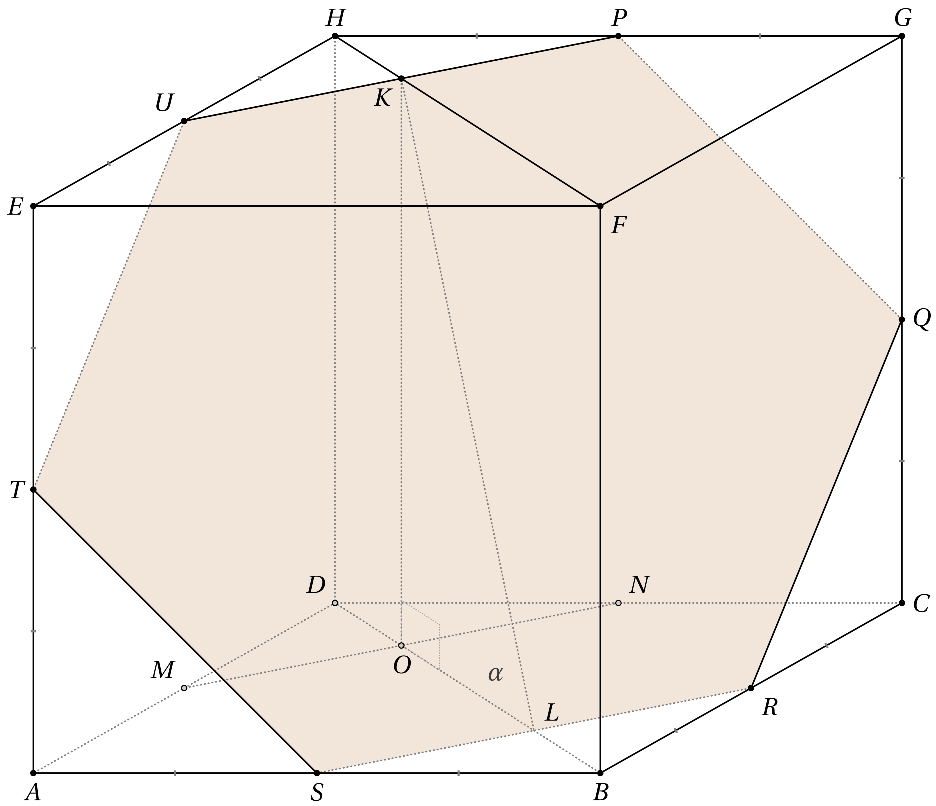
```
\begin{tikzpicture}[scale=2]
  \tkzDefPoint(0,3){A}    \tkzDefPoint(6,3){E}  \tkzDefPoint(1.35,3){B}
  \tkzDefPoint(4.65,3){D} \tkzDefPoint(1,1){G}  \tkzDefPoint(5,5){F}
  \tkzDefMidPoint(A,E)    \tkzGetPoint{C}
  \tkzFillPolygon[yellow, opacity=0.4](B,G,C)
  \tkzFillPolygon[yellow, opacity=0.4](D,F,C)
  \tkzFillPolygon[blue, opacity=0.3](A,B,G)
  \tkzFillPolygon[blue, opacity=0.3](E,D,F)
  \tkzMarkAngles[size=0.5 cm](B,G,A D,F,E)
  \tkzMarkAngles[size=0.5 cm](B,C,G D,C,F)
  \tkzMarkAngles[size=0.5 cm](G,B,C F,D,C)
  \tkzMarkAngles[size=0.5 cm](A,B,G E,D,F)
  \tkzFillAngles[size=0.5 cm,fill=green](B,G,A D,F,E)
  \tkzFillAngles[size=0.5 cm,fill=orange](B,C,G D,C,F)
  \tkzFillAngles[size=0.5 cm,fill=yellow](G,B,C F,D,C)
  \tkzFillAngles[size=0.5 cm,fill=red](A,B,G E,D,F)
  \tkzMarkSegments[mark=|](B,C D,C)  \tkzMarkSegments[mark=s||](G,C F,C)
  \tkzMarkSegments[mark=o](A,G E,F)  \tkzMarkSegments[mark=s](B,G D,F)
  \tkzDrawSegment[color=red](A,E)
  \tkzDrawSegment[color=blue](F,G)
  \tkzDrawSegments(A,G G,B E,F F,D)
  \tkzLabelPoints[below](C,D,E,G)  \tkzLabelPoints[above](A,B,F)
\end{tikzpicture}
```

30.2.9 Example 1: from Indonesia



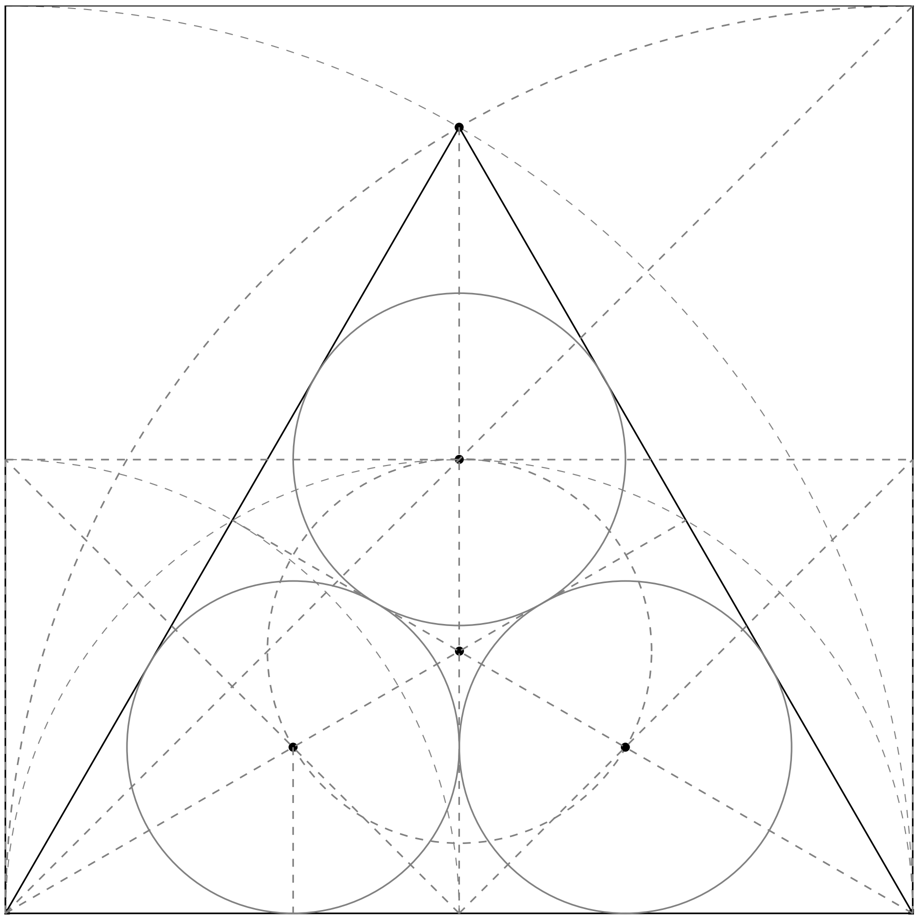
```
\begin{tikzpicture}[scale=3]
   \tkzDefPoints{0/0/A,2/0/B}
   \tkzDefSquare(A,B) \tkzGetPoints{C}{D}
   \tkzDefPointBy[rotation=center D angle 45](C)\tkzGetPoint{G}
   \tkzDefSquare(G,D)\tkzGetPoints{E}{F}
   \tkzInterLL(B,C)(E,F)\tkzGetPoint{H}
   \tkzFillPolygon[gray!10](D,E,H,C,D)
   \tkzDrawPolygon(A,...,D)\tkzDrawPolygon(D,...,G)
   \tkzDrawSegment(B,E)
   \tkzMarkSegments[mark=|,size=3pt,color=gray](A,B B,C C,D D,A E,F F,G G,D D,E)
   \tkzMarkSegments[mark=||,size=3pt,color=gray](B,E E,H)
   \tkzLabelPoints[left](A,D)
   \tkzLabelPoints[right](B,C,F,H)
   \tkzLabelPoints[above](G)\tkzLabelPoints[below](E)
   \tkzMarkRightAngles(D,A,B D,G,F)
\end{tikzpicture}
```

30.2.10 Example 2: from Indonesia



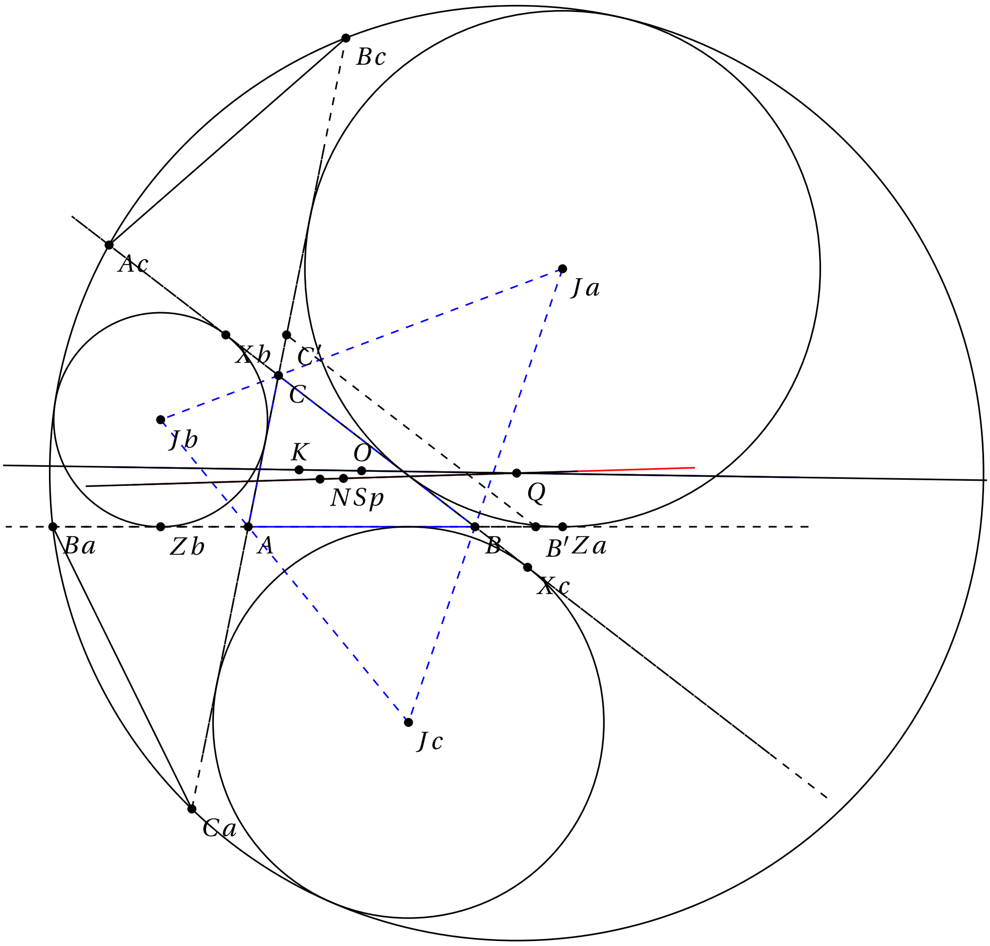
```
\begin{tikzpicture}[pol/.style={fill=brown!40,opacity=.5},
                    seg/.style={tkzdotted,color=gray},
                    hidden pt/.style={fill=gray!40},
                    mra/.style={color=gray!70,tkzdotted,/tkzrightangle/size=.2},
                    scale=3]
\tkzSetUpPoint[size=2]
\tkzDefPoints{0/0/A,2.5/0/B,1.33/0.75/D,0/2.5/E,2.5/2.5/F}
\tkzDefLine[parallel=through D](A,B) \tkzGetPoint{I1}
\tkzDefLine[parallel=through B](A,D) \tkzGetPoint{I2}
\tkzInterLL(D,I1)(B,I2) \tkzGetPoint{C}
\tkzDefLine[parallel=through E](A,D) \tkzGetPoint{I3}
\tkzDefLine[parallel=through D](A,E) \tkzGetPoint{I4}
\tkzInterLL(E,I3)(D,I4) \tkzGetPoint{H}
\tkzDefLine[parallel=through F](E,H) \tkzGetPoint{I5}
\tkzDefLine[parallel=through H](E,F) \tkzGetPoint{I6}
\tkzInterLL(F,I5)(H,I6) \tkzGetPoint{G}
\tkzDefMidPoint(G,H) \tkzGetPoint{P}
\tkzDefMidPoint(G,C) \tkzGetPoint{Q}
\tkzDefMidPoint(B,C) \tkzGetPoint{R}
\tkzDefMidPoint(A,B) \tkzGetPoint{S}
\tkzDefMidPoint(A,E) \tkzGetPoint{T}
\tkzDefMidPoint(E,H) \tkzGetPoint{U}
\tkzDefMidPoint(A,D) \tkzGetPoint{M}
\tkzDefMidPoint(D,C) \tkzGetPoint{N}
\tkzInterLL(B,D)(S,R) \tkzGetPoint{L}
\tkzInterLL(H,F)(U,P) \tkzGetPoint{K}
\tkzDefLine[parallel=through K](D,H) \tkzGetPoint{I7}
\tkzInterLL(K,I7)(B,D) \tkzGetPoint{O}

\tkzFillPolygon[pol](P,Q,R,S,T,U)
\tkzDrawSegments[seg](K,O K,L P,Q R,S T,U
                   C,D H,D A,D M,N B,D)
\tkzDrawSegments(E,H B,C G,F G,H G,C Q,R S,T U,P H,F)
\tkzDrawPolygon(A,B,F,E)
\tkzDrawPoints(A,B,C,E,F,G,H,P,Q,R,S,T,U,K)
\tkzDrawPoints[hidden pt](M,N,O,D)
\tkzMarkRightAngle[mra](L,O,K)
\tkzMarkSegments[mark=|,size=1pt,thick,color=gray](A,S B,S B,R C,R
                   Q,C Q,G G,P H,P
                   E,U H,U E,T A,T)

\tkzLabelAngle[pos=.3](K,L,O){$\alpha$}
\tkzLabelPoints[below](O,A,S,B)
\tkzLabelPoints[above](H,P,G)
\tkzLabelPoints[left](T,E)
\tkzLabelPoints[right](C,Q)
\tkzLabelPoints[above left](U,D,M)
\tkzLabelPoints[above right](L,N)
\tkzLabelPoints[below right](F,R)
\tkzLabelPoints[below left](K)
\end{tikzpicture}
```

30.2.11 Three circles



```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoints{0/0/A,8/0/B,0/4/a,8/4/b,8/8/c}
  \tkzDefTriangle[equilateral](A,B) \tkzGetPoint{C}
  \tkzDrawPolygon(A,B,C)
  \tkzDefSquare(A,B) \tkzGetPoints{D}{E}
  \tkzClipBB
  \tkzDefMidPoint(A,B) \tkzGetPoint{M}
  \tkzDefMidPoint(B,C) \tkzGetPoint{N}
  \tkzDefMidPoint(A,C) \tkzGetPoint{P}
  \tkzDrawSemiCircle[gray,dashed](M,B)
  \tkzDrawSemiCircle[gray,dashed](A,M)
  \tkzDrawSemiCircle[gray,dashed](A,B)
  \tkzDrawCircle[gray,dashed](B,A)
  \tkzInterLL(A,N)(M,a) \tkzGetPoint{Ia}
  \tkzDefPointBy[projection = onto A--B](Ia)
  \tkzGetPoint{ha}
  \tkzDrawCircle[gray](Ia,ha)
  \tkzInterLL(B,P)(M,b) \tkzGetPoint{Ib}
  \tkzDefPointBy[projection = onto A--B](Ib)
  \tkzGetPoint{hb}
  \tkzDrawCircle[gray](Ib,hb)
  \tkzInterLL(A,c)(M,C) \tkzGetPoint{Ic}
  \tkzDefPointBy[projection = onto A--C](Ic)
  \tkzGetPoint{hc}
  \tkzDrawCircle[gray](Ic,hc)
  \tkzInterLL(A,Ia)(B,Ib) \tkzGetPoint{G}
  \tkzDrawCircle[gray,dashed](G,Ia)
  \tkzDrawPolySeg(A,E,D,B)
  \tkzDrawPoints(A,B,C)
  \tkzDrawPoints(G,Ia,Ib,Ic)
  \tkzDrawSegments[gray,dashed](C,M A,N B,P M,a M,b A,a a,b b,B A,D Ia,ha)
\end{tikzpicture}
```

30.2.12 "The" Circle of APOLLONIUS



```
\begin{tikzpicture}[scale=.5]
\tkzDefPoints{0/0/A,6/0/B,0.8/4/C}
\tkzDefTriangleCenter[euler](A,B,C)        \tkzGetPoint{N}
\tkzDefTriangleCenter[circum](A,B,C)       \tkzGetPoint{O}
\tkzDefTriangleCenter[lemoine](A,B,C)      \tkzGetPoint{K}
\tkzDefTriangleCenter[spieker](A,B,C)      \tkzGetPoint{Sp}
\tkzDefExCircle(A,B,C)     \tkzGetPoint{Jb}
\tkzDefExCircle(C,A,B)     \tkzGetPoint{Ja}
\tkzDefExCircle(B,C,A)     \tkzGetPoint{Jc}
\tkzDefPointBy[projection=onto B--C ](Jc)   \tkzGetPoint{Xc}
\tkzDefPointBy[projection=onto B--C ](Jb)   \tkzGetPoint{Xb}
\tkzDefPointBy[projection=onto A--B ](Ja)   \tkzGetPoint{Za}
\tkzDefPointBy[projection=onto A--B ](Jb)   \tkzGetPoint{Zb}
\tkzDefLine[parallel=through Xc](A,C)       \tkzGetPoint{X'c}
\tkzDefLine[parallel=through Xb](A,B)       \tkzGetPoint{X'b}
\tkzDefLine[parallel=through Za](C,A)       \tkzGetPoint{Z'a}
\tkzDefLine[parallel=through Zb](C,B)       \tkzGetPoint{Z'b}
\tkzInterLL(Xc,X'c)(A,B)                    \tkzGetPoint{B'}
\tkzInterLL(Xb,X'b)(A,C)                    \tkzGetPoint{C'}
\tkzInterLL(Za,Z'a)(C,B)                    \tkzGetPoint{A''}
\tkzInterLL(Zb,Z'b)(C,A)                    \tkzGetPoint{B''}
\tkzDefPointBy[reflection= over Jc--Jb](B') \tkzGetPoint{Ca}
\tkzDefPointBy[reflection= over Jc--Jb](C') \tkzGetPoint{Ba}
\tkzDefPointBy[reflection= over Ja--Jb](A'')\tkzGetPoint{Bc}
\tkzDefPointBy[reflection= over Ja--Jb](B'')\tkzGetPoint{Ac}
\tkzDefCircle[circum](Ac,Ca,Ba)             \tkzGetPoint{Q}
\tkzDrawCircle[circum](Ac,Ca,Ba)
\tkzDefPointWith[linear,K=1.1](Q,Ac)        \tkzGetPoint{nAc}
\tkzClipCircle[through](Q,nAc)
\tkzDrawLines[add=1.5 and 1.5,dashed](A,B B,C A,C)
\tkzDrawPolygon[color=blue](A,B,C)
\tkzDrawPolygon[dashed,color=blue](Ja,Jb,Jc)
\tkzDrawCircles[ex](A,B,C B,C,A C,A,B)
\tkzDrawLines[add=0 and 0,dashed](Ca,Bc B,Za A,Ba B',C')
\tkzDrawLine[add=1 and 1,dashed](Xb,Xc)
\tkzDrawLine[add=7 and 3,blue](O,K)
\tkzDrawLine[add=8 and 15,red](N,Sp)
\tkzDrawLines[add=10 and 10](K,O N,Sp)
\tkzDrawSegments(Ba,Ca Bc,Ac)
\tkzDrawPoints(A,B,C,N,Ja,Jb,Jc,Xb,Xc,B',C',Za,Zb,Ba,Ca,Bc,Ac,Q,Sp,K,O)
\tkzLabelPoints(A,B,C,N,Ja,Jb,Jc,Xb,Xc,B',C',Za,Zb,Ba,Ca,Bc,Ac,Q,Sp)
\tkzLabelPoints[above](K,O)
\end{tikzpicture}
```

31 Customization

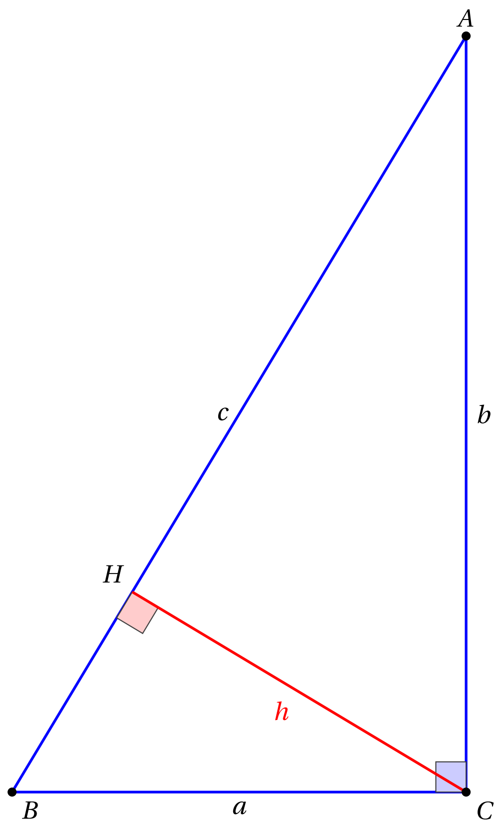
31.1 Use of \tkzSetUpLine

It is a macro that allows you to define the style of all the lines.

\tkzSetUpLine[⟨local options⟩]

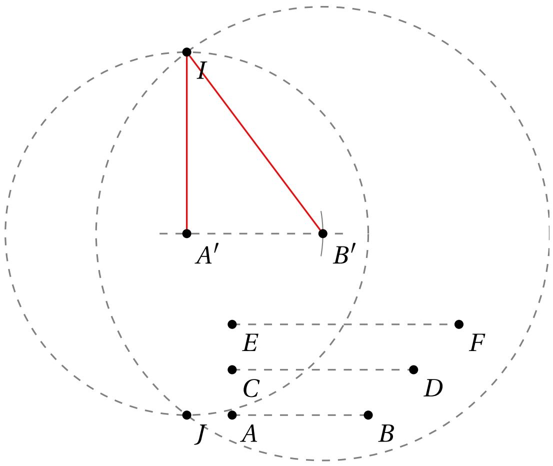
options	default	definition
color	black	colour of the construction lines
line width	0.4pt	thickness of the construction lines
style	solid	style of construction lines
add	.2 and .2	changing the length of a line segment

31.1.1 Example 1: change line width



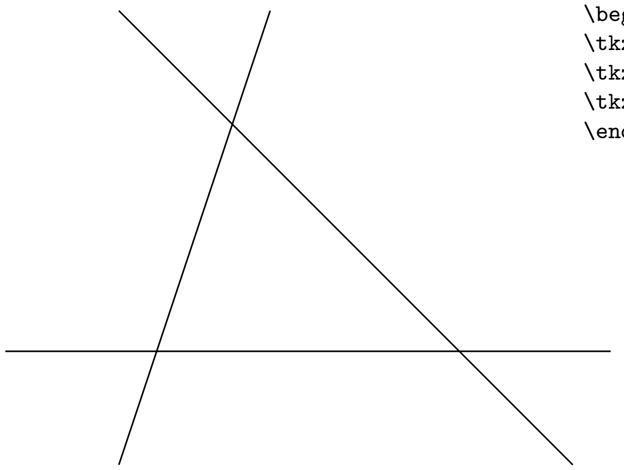

```
\begin{tikzpicture}
   \tkzSetUpLine[color=blue,line width=1pt]
\begin{scope}[rotate=-90]
    \tkzDefPoint(10,6){C}
    \tkzDefPoint( 0,6){A}
    \tkzDefPoint(10,0){B}
    \tkzDefPointBy[projection = onto B--A](C)
    \tkzGetPoint{H}
    \tkzDrawPolygon(A,B,C)
    \tkzMarkRightAngle[size=.4,fill=blue!20](B,C,A)
    \tkzMarkRightAngle[size=.4,fill=red!20](B,H,C)
    \tkzDrawSegment[color=red](C,H)
\end{scope}
 \tkzLabelSegment[below](C,B){$a$}
 \tkzLabelSegment[right](A,C){$b$}
 \tkzLabelSegment[left](A,B){$c$}
 \tkzLabelSegment[color=red](C,H){$h$}
 \tkzDrawPoints(A,B,C)
 \tkzLabelPoints[above left](H)
 \tkzLabelPoints(B,C)
 \tkzLabelPoints[above](A)
\end{tikzpicture}
```

31.1.2 Example 2: change style of line




```
\begin{tikzpicture}[scale=.6]
 \tkzDefPoint(1,0){A} \tkzDefPoint(4,0){B}
 \tkzDefPoint(1,1){C} \tkzDefPoint(5,1){D}
 \tkzDefPoint(1,2){E} \tkzDefPoint(6,2){F}
 \tkzDefPoint(0,4){A'}\tkzDefPoint(3,4){B'}
 \tkzCalcLength[cm](C,D)  \tkzGetLength{rCD}
 \tkzCalcLength[cm](E,F)  \tkzGetLength{rEF}
 \tkzInterCC[R](A',\rCD cm)(B',\rEF cm)
 \tkzGetPoints{I}{J}
 \tkzSetUpLine[style=dashed,color=gray]
 \tkzDrawLine(A',B')
 \tkzCompass(A',B')
 \tkzDrawSegments(A,B C,D E,F)
 \tkzDrawCircle[R](A',\rCD cm)
 \tkzDrawCircle[R](B',\rEF cm)
 \tkzSetUpLine[color=red]
 \tkzDrawSegments(A',I B',I)
 \tkzDrawPoints(A,B,C,D,E,F,A',B',I,J)
 \tkzLabelPoints(A,B,C,D,E,F,A',B',I,J)
\end{tikzpicture}
```

31.1.3 Example 3: extend lines



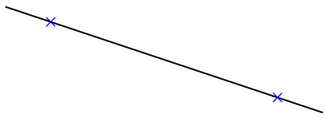
```
\begin{tikzpicture}
\tkzSetUpLine[add=.5 and .5]
\tkzDefPoints{0/0/A,4/0/B,1/3/C}
\tkzDrawLines(A,B B,C A,C)
\end{tikzpicture}
```

31.2 Points style

\tkzSetUpPoint[⟨local options⟩]

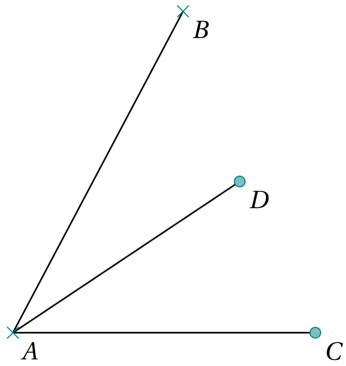
options	default	definition
color	black	point color
size	3pt	point size
fill	black!50	inside point color
shape	circle	point shape circle or cross

31.2.1 Use of \tkzSetUpPoint



```
\begin{tikzpicture}
  \tkzSetUpPoint[shape = cross out,color=blue]
  \tkzInit[xmax=100,xstep=20,ymax=.5]
  \tkzDefPoint(20,1){A}
  \tkzDefPoint(80,0){B}
  \tkzDrawLine(A,B)
  \tkzDrawPoints(A,B)
\end{tikzpicture}
```

31.2.2 Use of \tkzSetUpPoint inside a group



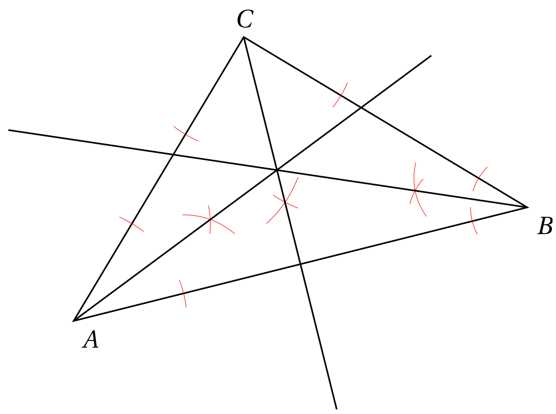

```
\begin{tikzpicture}
  \tkzInit[ymin=-0.5,ymax=3,xmin=-0.5,xmax=7]
  \tkzDefPoint(0,0){A}
  \tkzDefPoint(02.25,04.25){B}
  \tkzDefPoint(4,0){C}
  \tkzDefPoint(3,2){D}
  \tkzDrawSegments(A,B A,C A,D)
{\tkzSetUpPoint[shape=cross out,
            fill= teal!50,
            size=4,color=teal]
  \tkzDrawPoints(A,B)}
  \tkzSetUpPoint[fill= teal!50,size=4,
               color=teal]
   \tkzDrawPoints(C,D)
  \tkzLabelPoints(A,B,C,D)
\end{tikzpicture}
```

31.3 Use of \tkzSetUpCompass

\tkzSetUpCompass[⟨local options⟩]

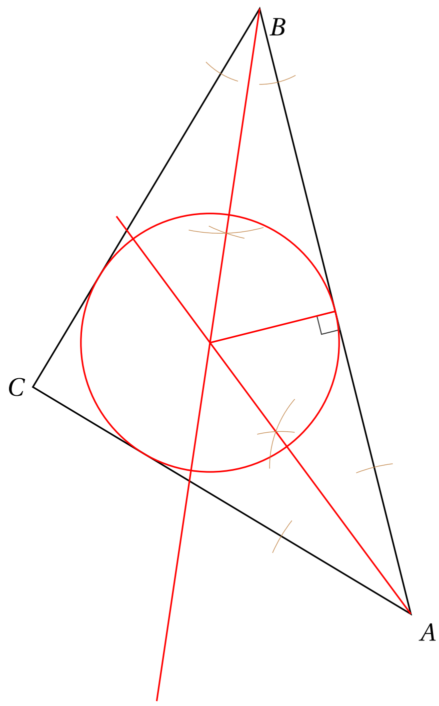
options	default	definition
color	black	color of construction arcs
line width	0.4pt	thickness of construction arcs
style	solid	style of the building arcs

31.3.1 Use of \tkzSetUpCompass with bisector




```
\begin{tikzpicture}[scale=0.75]
  \tkzDefPoints{0/1/A, 8/3/B, 3/6/C}
  \tkzDrawPolygon(A,B,C)
  \tkzSetUpCompass[color=red,line width=.2 pt]
  \tkzDefLine[bisector](A,C,B) \tkzGetPoint{c}
  \tkzDefLine[bisector](B,A,C) \tkzGetPoint{a}
  \tkzDefLine[bisector](C,B,A) \tkzGetPoint{b}
  \tkzShowLine[bisector,size=2,gap=3](A,C,B)
  \tkzShowLine[bisector,size=2,gap=3](B,A,C)
  \tkzShowLine[bisector,size=1,gap=2](C,B,A)
  \tkzDrawLines[add=0 and 0 ](B,b)
  \tkzDrawLines[add=0 and -.4 ](A,a  C,c)
  \tkzLabelPoints(A,B) \tkzLabelPoints[above](C)
\end{tikzpicture}
```

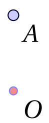
31.3.2 Another example of of\tkzSetUpCompass




```
\begin{tikzpicture}[scale=1,rotate=90]
  \tkzDefPoints{0/1/A, 8/3/B, 3/6/C}
  \tkzDrawPolygon(A,B,C)
  \tkzSetUpCompass[color=brown,
          line width=.3 pt,style=tkzdotted]
  \tkzDefLine[bisector](B,A,C)  \tkzGetPoint{a}
  \tkzDefLine[bisector](C,B,A)  \tkzGetPoint{b}
  \tkzInterLL(A,a)(B,b) \tkzGetPoint{I}
  \tkzDefPointBy[projection= onto A--B](I)
  \tkzGetPoint{H}
  \tkzMarkRightAngle(I,H,A)
  \tkzDrawCircle[radius,color=red](I,H)
  \tkzDrawSegments[color=red](I,H)
  \tkzDrawLines[add=0 and -.5,,color=red](A,a)
  \tkzDrawLines[add=0 and 0,color=red](B,b)
  \tkzShowLine[bisector,size=2,gap=3](B,A,C)
  \tkzShowLine[bisector,size=1,gap=3](C,B,A)
  \tkzLabelPoints(A,B)\tkzLabelPoints[left](C)
\end{tikzpicture}
```

31.4 Own style

You can set the normal style with tkzSetUpPoint and your own style




```
\tkzSetUpPoint[color=blue!50!white, fill=gray!20!red!50!white]
\tikzset{/tikz/mystyle/.style={color=blue!20!black,fill=blue!20}}
  \begin{tikzpicture}
    \tkzDefPoint(0,0){O}
    \tkzDefPoint(0,1){A}
    \tkzDrawPoints(O) % general style
    \tkzDrawPoints[mystyle,size=4](A) % my style
    \tkzLabelPoints(O,A)
  \end{tikzpicture}
```

32 Summary of tkz-base

32.1 Utility of tkz-base

First of all, you don't have to deal with TikZ the size of the bounding box. Early versions of tkz-euclide did not control the size of the bounding box, now the size of the bounding box is limited.

However, it is sometimes necessary to control the size of what will be displayed. To do this, you need to have prepared the bounding box you are going to work in, this is the role of tkz-base and its main macro **\tkzInit**. It is recommended to leave the graphic unit equal to 1 cm. For some drawings, it is interesting to fix the extreme values (xmin,xmax,ymin and ymax) and to "clip" the definition rectangle in order to control the size of the figure as well as possible.

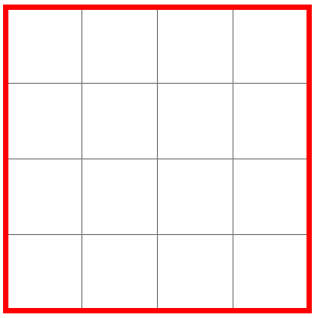
The two macros in tkz-base that are useful for tkz-euclide are:

- \tkzInit
- \tkzClip

To this, I added macros directly linked to the bounding box. You can now view it, backup it, restore it (see the documentation of tkz-base section Bounding Box).

32.2 \tkzInit and \tkzShowBB

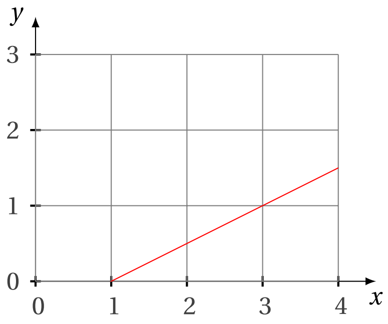
The rectangle around the figure shows you the bounding box.



```
\begin{tikzpicture}
 \tkzInit[xmin=-1,xmax=3,ymin=-1, ymax=3]
 \tkzGrid
 \tkzShowBB[red,line width=2pt]
\end{tikzpicture}
```

32.3 \tkzClip

The role of this macro is to "clip" the initial rectangle so that only the paths contained in this rectangle are drawn.



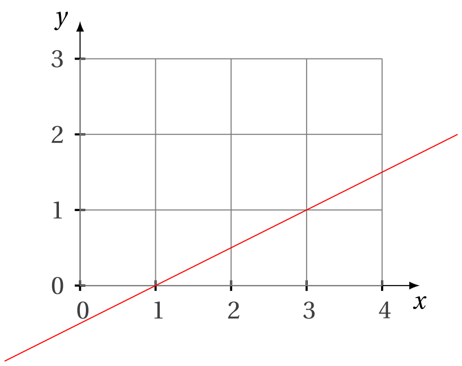

```
\begin{tikzpicture}
 \tkzInit[xmax=4, ymax=3]
 \tkzAxeXY
 \tkzGrid
 \tkzClip
 \draw[red] (-1,-1)--(5,2);
\end{tikzpicture}
```

It is possible to add a bit of space

```
\tkzClip[space=1]
```

32.4 \tkzClip and the option space

This option allows you to add some space around the "clipped" rectangle.




```
\begin{tikzpicture}
 \tkzInit[xmax=4, ymax=3]
 \tkzAxeXY
 \tkzGrid
 \tkzClip[space=1]
 \draw[red] (-1,-1)--(5,2);
\end{tikzpicture}
```

The dimensions of the "clipped" rectangle are `xmin-1`, `ymin-1`, `xmax+1` and `ymax+1`.

33 FAQ

33.1 Most common errors

For the moment, I'm basing myself on my own, because having changed syntax several times, I've made a number of mistakes. This section is going to be expanded.

- `\tkzDrawPoint(A,B)` when you need `\tkzDrawPoints`.

- `\tkzGetPoint(A)` When defining an object, use braces and not brackets, so write: `\tkzGetPoint{A}`.

- `\tkzGetPoint{A}` in place of `\tkzGetFirstPoint{A}`. When a macro gives two points as results, either we retrieve these points using `\tkzGetPoints{A}{B}`, or we retrieve only one of the two points, using `\tkzGetFirstPoint{A}` or `\tkzGetSecondPoint{A}`. These two points can be used with the reference `tkzFirstPointResult` or `tkzSecondPointResult`. It is possible that a third point is given as `tkzPointResult`.

- `\tkzDrawSegment(A,B A,C)` when you need `\tkzDrawSegments`. It is possible to use only the versions with an "s" but it is less efficient!

- Mixing options and arguments; all macros that use a circle need to know the radius of the circle. If the radius is given by a measure then the option includes a `R`.

- `\tkzDrawSegments[color = gray,style=dashed]{B,B' C,C'}` is a mistake. Only macros that define an object use braces.

- The angles are given in degrees, more rarely in radians.

- If an error occurs in a calculation when passing parameters, then it is better to make these calculations before calling the macro.

- Do not mix the syntax of `pgfmath` and `xfp`. I've often chosen `xfp` but if you prefer pgfmath then do your calculations before passing parameters.

- Use of `\tkzClip`: In order to get accurate results, I avoided using normalized vectors. The advantage of normalization is to control the dimension of the manipulated objects, the disadvantage is that with TeX, this implies inaccuracies. These inaccuracies are often small, in the order of a thousandth, but they lead to disasters if the drawing is enlarged. Not normalizing implies that some points are far away from the working area and `\tkzClip` allows you to reduce the size of the drawing.

- An error occurs if you use the macro `\tkzDrawAngle` with too small an angle. The error is produced by the `decoration` library when you want to place a mark on an arc. Even if the mark is absent, the error is still present. It is possible to get around this difficulty with the option `mkpos=.2` for example, which will place the mark before the arc. Another possibility is to use the macro `\tkzFillAngle`.

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