## Construction Rules

At any stage in the construction, you may do any of the following things to obtain additional points, lines or circles:

1. You may draw a straight line of any length through two existing points. (This means, of course, that the straight-edge is as long as you need it to be, so it is better than a real ruler in that sense.)
2. You may find a new point at the intersection of two lines, two circles, or of a line and a circle. When you are given a segment, of course, you are given the two points at its ends, so you can certainly use those.
3. You may construct a circle centered at any existing point having a radius equal to the distance between any two existing points. In other words, you can set the size of the compass from any two points $A$ and $B$, and then you can move the point of the compass to another point $C$ without changing the setting and draw a circle of radius $AB$ about the point $C$. We would call this $\odot C_{AB}$. (Of course this includes drawing a circle given its center, say $E$, and a point on the edge, say $F$ - you use the center and the edge to set the compass size, and then you re-use the center point as the center of the circle. We would call this $\odot E_F$.) As with the straightedge, there is no limit to the size of a circle that can be drawn, so the mathematical compass is better than any real one could be.
4. You may choose an arbitrary point on a line, circle, or on the plane. (And of course you can also choose a point not on a line or circle as in "pick any point not on $\overline{AB}$.")

## Recording Construction Steps

We record construction steps by listing equations which go along with the picture. We assume that any points on the right hand side of the equal sign already exist and that other objects (e.g. segments, rays, circles) can be easily created. Given the objects on the right hand side, new objects are listed on the left hand side. Sometimes the right hand side has the name of a *construction procedure*. For example, we may want to build the perpendicular bisector of a segment.

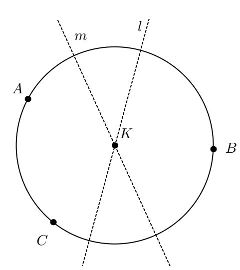
$\overleftrightarrow{CD}$ =`PerpBisector`$[A, B]$
is a construction procedure saying:
$C, D = \odot A_B \cap \odot B_A$
$\overleftrightarrow{CD}$

Although writing $\overleftrightarrow{CD}$ =`PerpBisector`$[A, B]$ may not save any space, it does a good job explaining what you are doing, not just your compass moves.

## Sample Construction Writeup

**Given:** Points $A$, $B$, and $C$
**Construct:** $\odot K_A$ such that the circle includes all three points.
**Game Plan:** $K$ is the intersection of the perpendicular bisectors of two sides of $\triangle ABC$. (Note $\triangle ABC$ is not needed for the construction.)
**Steps:**

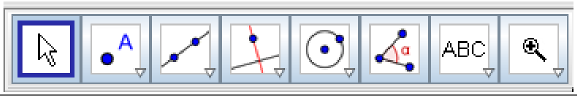
1. line $l$ = `PerpBisector`$[A, B]$
2. line $m$ = `PerpBisector`$[B, C]$
3. $K = l \cap m$
4. $\odot K_A$ QEF



**Why it Works:** A circle is the locus of all points some distance $r$ from the circle. The center of the desired circle is the point equidistant to $A$, $B$, and $C$. Any point on a perpendicular bisector is equidistant to the end points. Any point on $l$ is equidistant to $A$ and $B$. Similarly, any point on $k$ is equidistant to $B$ and $C$. So the intersection, $K$ is equidistant to all three points.

## GeoGebra Procedures and Tools

Here is a table of available GeoGebra tools which are found in this panel of icons.



| Description | Icon | Notes |
|---|---|---|
| select | | (also *esc* key) allows selection of an object |
| new point | | |
| `MidPoint`$[A, B]$ | | |
| `Line`$[A, B]$ | | |
| `Segment`$[A, B]$ | | |
| `Ray`$[A, B]$ | | |
| `PerpLine`$[C, \overleftrightarrow{AB}]$ | | |
| `PerpBisector`$[A, B]$ | | |
| `Parallel`$[A, \overline{CD}]$ | | |
| `AngleBisector`$[A, B, C]$ | | |
| `Circle`$[A, B]$ | | |
| `Circle`$[C, \overline{AB}]$ | | |
| `Arc`$[A, B, C]$ | | $\widehat{BC}$ in $\odot A_C$ |
| `Angle`$[A, B, C]$ | | $\angle ABC$ |