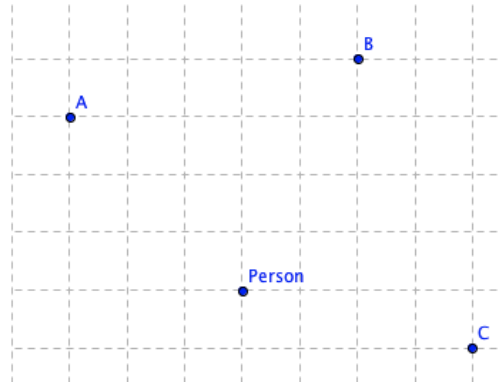


One interesting problem I've spent time trying to figure out where something/someone is located using readily available information.



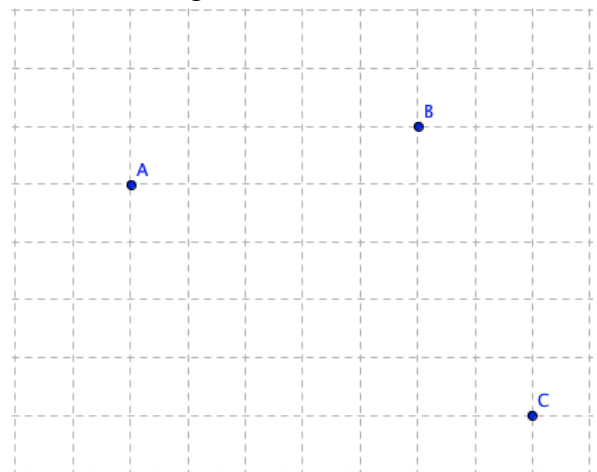
The situation above is one describes a person located relative to three different cell phone towers. If you knew the coordinates of each one, and the coordinates of the person, you could calculate the person's distance from each cell tower. You might organize the information like this:

Cell Tower	Distance to Person
A	4.24 km
B	4.47 km
C	4.12 km

This isn't very interesting. It's something you would be asked to do in a textbook problem on using the distance formula.

Let's spin this around then. Suppose you are instead given the following information for the scenario described above:

Cell Tower	Distance to Person
A	3.23 km
B	2.35 km
C	7.10 km



Most phones do have the ability to estimate their distance from a tower using internal clocks or signal strength, so this isn't out of the realm of possibility.

Where is the person located? How would you figure this out?

This is a very real world problem called **localization**, and is something that cell phones are often doing to help identify your location when GPS is not available.

Use the Geogebra applet to figure out the location for each of the following sets of distances:

Cell Tower	Distance to Person A	Distance to Person B	Distance to Person C	Distance to Person D	Distance to Person E
A	5.53 km	4.10 km	8.11 km	6.65 km	6.78 km
B	1.45 km	2.93 km	6.89 km	1.99 km	6.28 km
C	3.93 km	4.01 km	2.34 km	6.70 km	2.97 km

Coordinates of each person:

Person A: (,)	Person B: (,)	Person C: (,)	Person D: (,)	Person E: (,)
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Suppose one of the cell towers is not available. Can you figure out the possible locations in these cases?

Cell Tower	Distance to Person A	Distance to Person B	Distance to Person C
A	5.61 km	7.16 km	
B	1.37 km		4.28 km
C		3.95 km	1.11 km

Could you do this with only one cell tower?

Based on doing this on your own a few times, you want to try to figure out the following:

- What pattern do you follow to find the location from the given information?
- What steps, and in what order would you have a computer calculate and organize data?

You might find the following table of coordinates and the distances to the towers useful in thinking about how to solve this problem:

```
X = 5.62985819461, Y = 4.30764702618, Tower A = 7.155682, Tower B = 4.036076, Tower C = 1.359024
X = -0.691516433589, Y = 1.04238724442, Tower A = 5.965594, Tower B = 8.391585, Tower C = 6.971990
X = 2.84866416119, Y = 9.64823907077, Tower A = 4.671765, Tower B = 2.010539, Tower C = 7.357309
X = -1.26604051412, Y = 4.68062068082, Tower A = 2.334587, Tower B = 6.224907, Tower C = 7.457870
X = 4.28890975355, Y = 0.847250420825, Tower A = 8.113501, Tower B = 7.158582, Tower C = 2.749938
X = 1.80728323599, Y = 3.72101959207, Tower A = 4.316544, Tower B = 4.808085, Tower C = 4.254262
X = -1.60149771565, Y = 0.513905294336, Tower A = 6.513925, Tower B = 9.349780, Tower C = 7.997714
X = 0.348231905571, Y = 0.872648372259, Tower A = 6.273928, Tower B = 8.008405, Tower C = 6.038883
X = -1.24425368427, Y = 2.61615672942, Tower A = 4.390643, Tower B = 7.515848, Tower C = 7.254416
X = 2.14208598679, Y = 4.69726978312, Tower A = 3.895545, Tower B = 3.789442, Tower C = 4.214763
```