Space Jam Survey Merit Badge.

Print a Survey Merit Badge Workbook http://usscouts.org/mb/worksheets/surveying.pdf note it is the 2024 version so there will be a few updates as this badge was updated in 2025.

Got to: https://www.scouting.org/merit-badges/surveying/ this is the requirements. There is a link to click to download the Survey Merit Badge Pamphlet.

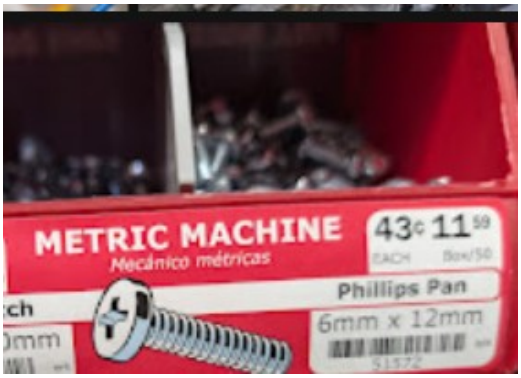
https://filestore.scouting.org/filestore/Merit_Badge_ReqandRes/Pamphlets/Surveying.pdf

Read and Study the Pamphlet. Fill out the Workbook as you read, and do the work below. 2, 3 and 4.

2. (a) Set an instrument over one of the corners of a five-sided lot laid out by your counselor.

For this we are going to use a baseball diamond, setting our instrument (a compass, on a tripod if possible OR cell phone with a compass app) up on Second Base (all angles and measurements will be from 2nd base). The five points are Home Plate, 1st Base, The Right Field Marker, 3rd Base and The Left Field Marker. (an alternative Soccer Field option for those that don't have access to a baseball field is provided in the appendix to this document).

We need to measure angles and record distances. You can download a compass app for your cell phone, or WALMART has a $14.86 Military-Style Compass that I recommend it. I mounted it on a camera tripod. Note that most cameras (all cameras and movie cameras ever made) use a ¼"-20 thread (or 3/8" for big ones). Not this compass, I had to get a 6mmx12mm 1.00 pitch phillips Pan Screw to mount the compass to my tripod.

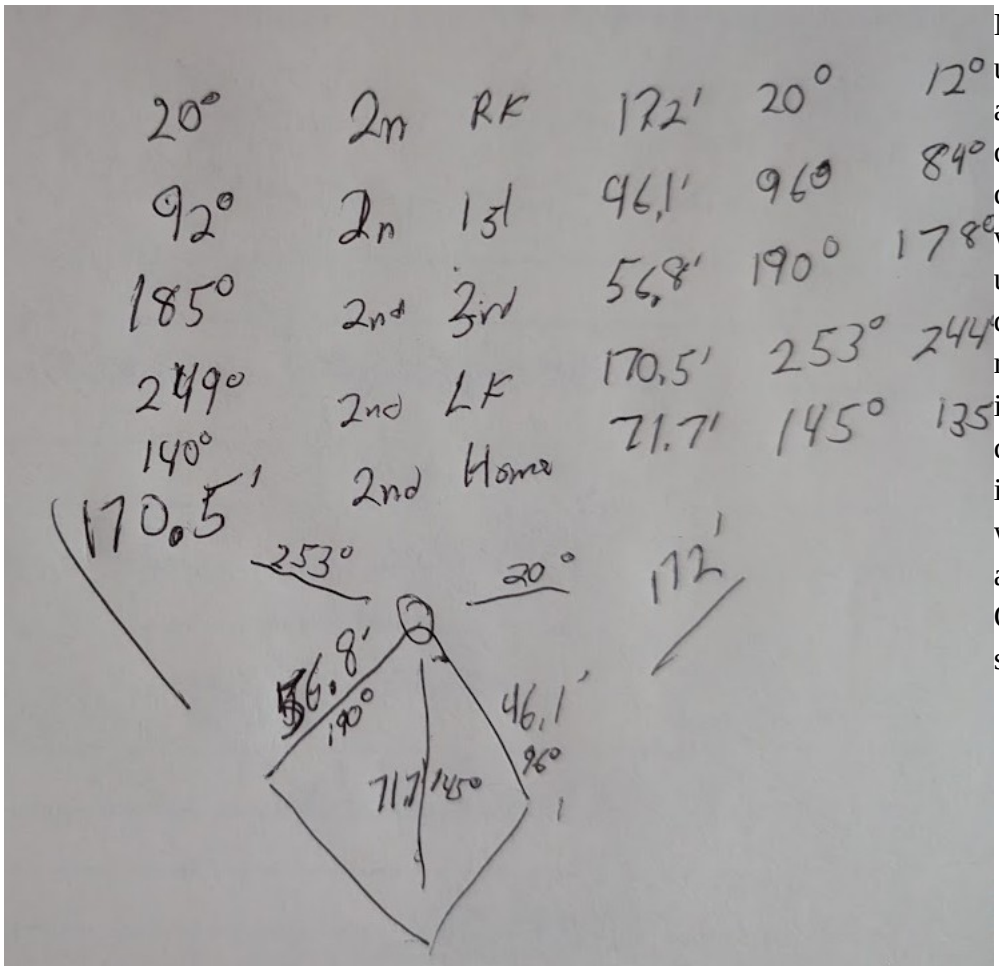


Next to make my distance measurements I recommend a 100’ Fiberglass tape measure. Walmart has it for $13.97, and it includes a stake to hold one end for you, you put it in the ground and the loop on the end goes on it.

Do you need one? Well you could use a 10’ tape measure, but that would be a hassle. If you have done the Orienteering Merit badge or do some research you can learn your pace, and step off your measurement and calculate the distance that way (my pace on level ground is about 3’ so 170’ would be 56 steps and about 2/3rds of a step. Just buy or borrow a 100’ measuring tape. Last I also bought a set of flags, the baseball park I surveyed didn’t have the bases, so we bought a 25 pack of survey flags (also from Walmart) $2.24.

Time to go out to the baseball field and set up. If you get the military style walmart compass you look through the black eye port, and fold out the sighting top. Now sight to home plate, you will see a number (degrees) on the bottom and another number on the top (the top number is behind you, the bottom number is in front, your sighting to home base. Write down a chart with all our points and add the info. After we get all the degrees, we will measure the distances. I used three different types of compasses and a professional surveyor Transit. So on my data I have the location, the distance (I used the Walmart 100’ measuring tape), and three different degree measurements, you will have only one. Here is my data, you will have totally different angles and your distances will be

different as my field had not been set up (we just put the bases where we thought they should go with our flags.

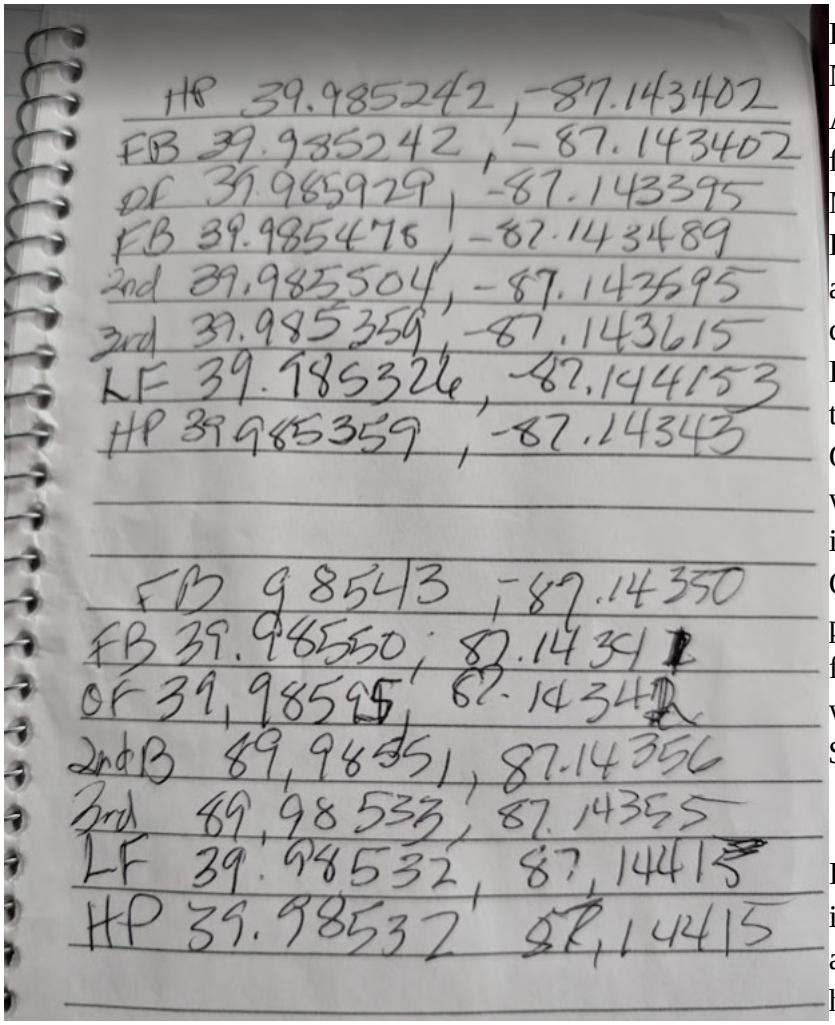


Now let me share a trick. I used AI to read my angles and distances and calculate X, Y coordinates. Put it did it wrong. Mathematicians use a system where 0 degrees is East (to the right) and degrees increase going counterclockwise. This isn't the way a compass works. North is 0 degrees and the degrees get bigger Clockwise. More on that soon.

Now you have your 2.(a), lets move on to 2.(b). Making the same measurements using GPS (Global Positioning System). So I want you to watch a video:

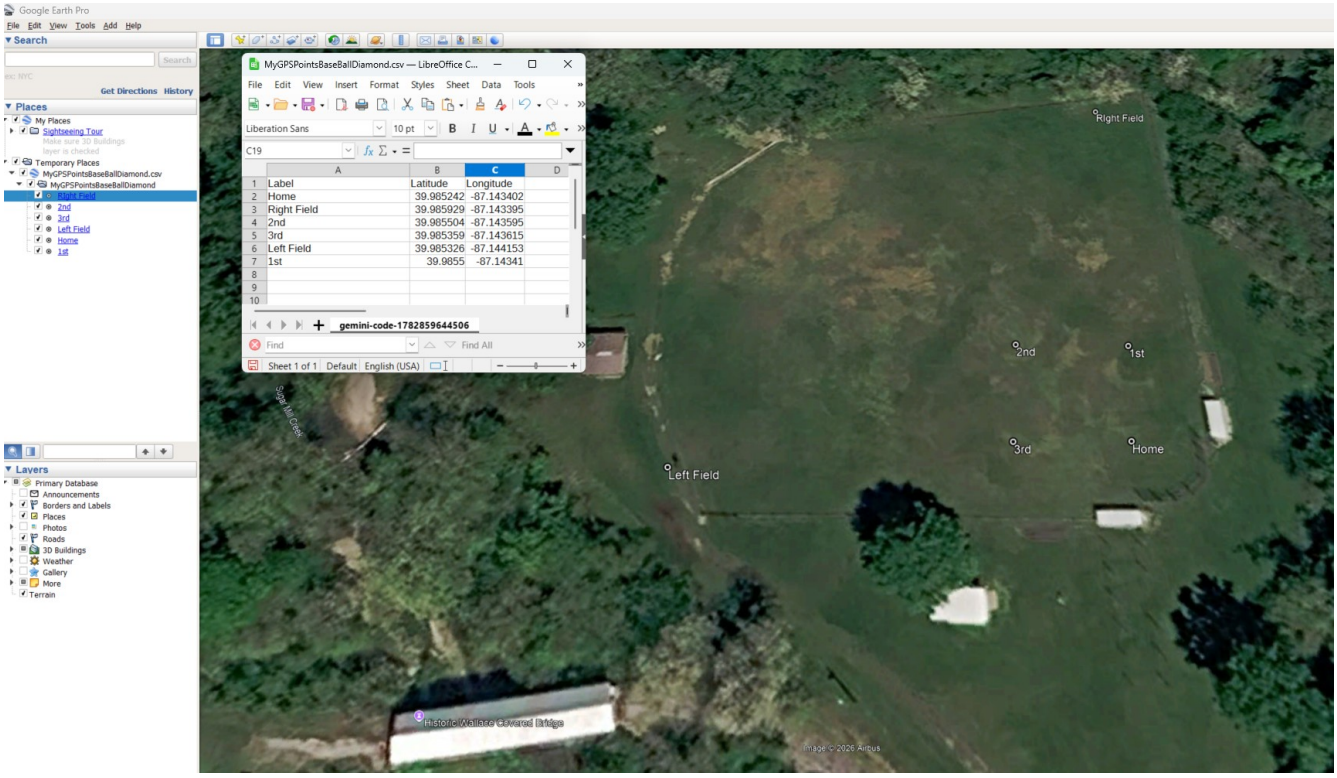
https://www.youtube.com/watch?v=WEv2Pi4WtPA the title is How to Find the Property Lines of Any Home (Version 4) by Mark Scheller he has some great stuff.

I was assisted by Ms. Susan, she has an iPhone and I have an Android, so we filled out our field notebook with measurements from both, some times we did it more than once as we felt something wasn't right (Latitude and Longitude wasn't different, didn't change… we messed up). Here is that data.



Hopefully you watched the video? Note the 6 degrees of freedom, Android, vs, 5 degrees of freedom for the iPhone? At least Google Maps, the app we used to get the Lat/Lon. So again using AI to look at the image, and take that data and creating a CSV (spreadsheet, I use Libre Office Calc, free open source tool). Next we downloaded Gooogle Earth on our PC (not the web Google Earth). And you can import your CSV file and we got a Google Earth map, we cherry picked the GPS data that made the field look right (a pro surveyor would just get it spot on with their $20,000 Total Station instrument).

If you zoom in you will see the data is very Spot On… We are getting ahead of ourselves here. We now have our Data, Landmark (base etc), our angle based on all measurements from 2nd base as our 0,0 xy point, and we have Lat/Lon for each. We are ready to move on the requirement 3. Below is the map with the GPS info on it, I added labels to my map too.



Here is my Google Gemini AI prompt to convert my data to X, Y for the charting, note I had done it before and had to hold the resulting map up over my head like a star chart LOL, AI isn't always right and you have to know what you are doing to take best advantage of it:

"This is data regarding a baseball diamond. I want to convert it to X,Y points. The data was all taken based on 2nd base being 0,0. Remember this uses a compass where 0 degrees is North and the degrees increase clockwise (as opposed to a mathematical East 0 degrees and counterclockwise increasing degrees). There are three different compasses used, so you will see one distance, but three columns of degrees. Just pick the most accurate compass."

I also pasted in a photo of my field notebook data.

Here is what I got back:

Based on the sketch drawn at the bottom of image.png, the column of bearings used to plot the field layout is the **fourth column** (containing $20°, $96°, $190°, $253°, and $145°).

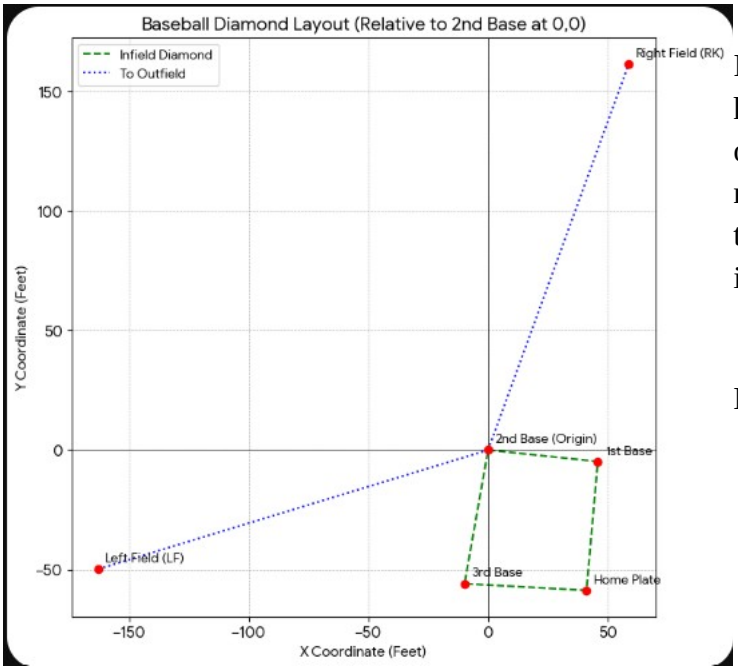
Since a compass bearing increases clockwise with 0° pointing due North (along the positive Y-axis), the formulas to convert these polar coordinates (distance d, angle θ) into Cartesian coordinates (X, Y) relative to 2nd Base (0,0) are:

$X = d * \sin(\theta)$ and $Y = d * \cos(\theta)$ (Me again, I downloaded a scientific calculator app to get the Cosine and Sine functions).

So cool, here is my data after Gemini AI did all the Sine Cosine work for me and created this chart;

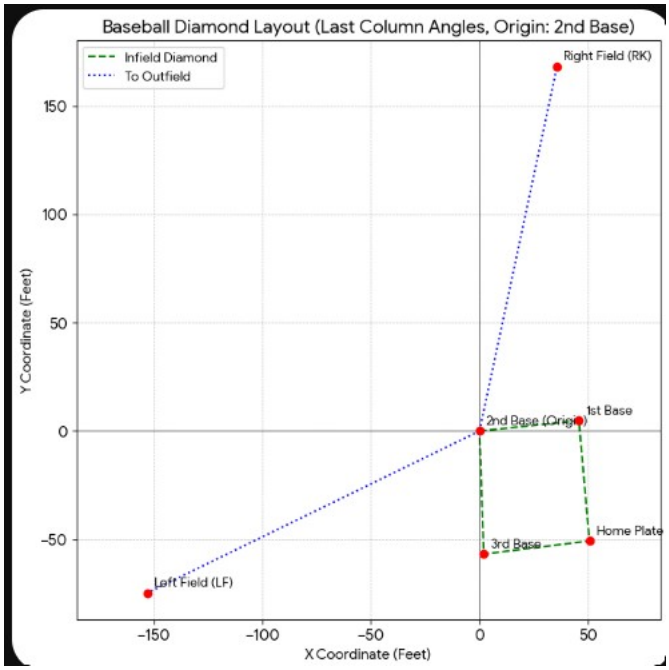
Location	Distance (d)	Bearing (θ)	X Coordinate	Y Coordinate
2nd Base (Origin)	0’	—	**0.00**	**0.00**
Right Field (RK)	172'	20	**58.83**	**161.63**
1st Base	46.1'	96	**45.85**	**-4.82**
Home Plate	71.7'	145	**41.13**	**-58.73**
3rd Base	56.8'	190	**-9.86**	**-55.94**
Left Field (LF)	170.5'	253	**-163.05**	**-49.85**

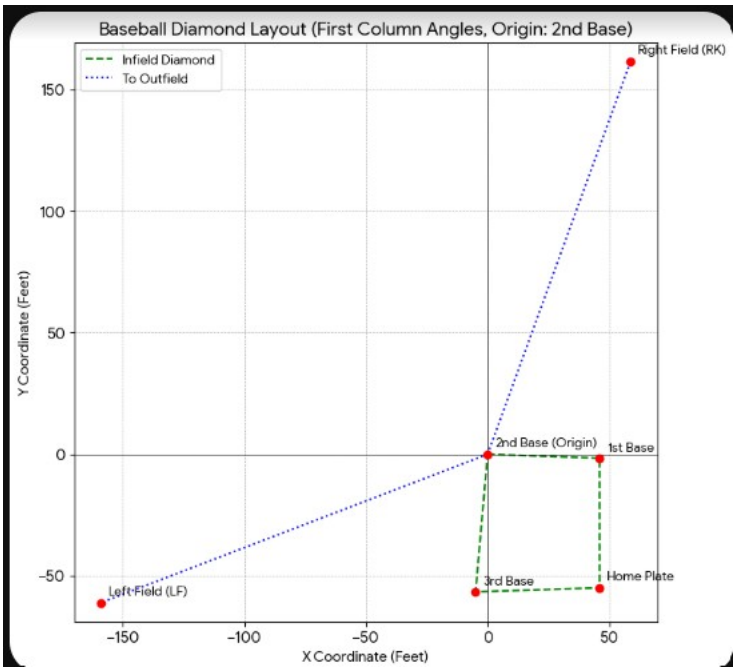
Next ask AI to chart it for me:



I told you the field I was measuring didn’t have any bases, so I kinda flagged it a bit off, or more likely I didn’t take my Angle measurements so will. I admit, I didn’t use the tripod (my compass wouldn’t mount on it till I got the 6MM screw LOL).

Here are the three sets of Angles plotted.


Baseball Diamond Layout (Last Column Angles, Origin: 2nd Base)
Infield Diamond
To Outfield
Right Field (RK)
1st Base
2nd Base (Origin)
3rd Base
Home Plate
Left Field (LF)
Y Coordinate (Feet)
X Coordinate (Feet)
150
100
50
0
-50
-150
-100
-50
0
50


Baseball Diamond Layout (First Column Angles, Origin: 2nd Base)
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Home Plate
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X Coordinate (Feet)
150
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50
0
-50
-150
-100
-50
0
50

We are now ready to move on to requirement 4. The requirements include a video of using a builders level (transit). So here are some photos of Ms. Susan and me doing that. Here is that video:

https://www.youtube.com/watch?v=UDuYrsxHmrA

So if you got the Military Style compass, it has a bubble level, you level it so the bubble is right in the middle, then get your tape measure and measure how far up your compass is from the ground. Then mark that spot on a stick. Next go to the spot you want to measure (is it higher or lower) sight down the compass and have your assistant put a finger on the spot (say up, up, down a tad). Now with your measuring tape what is the difference (up or down) record it in inches, it shouldn't be much on a baseball field.

A very inexpensive way to measure the difference in height between two points is a water level, here is a video on how that works: https://www.youtube.com/watch?v=9Y0cmgQ5CwY

starting at 3 minutes, how to build and use a long water level

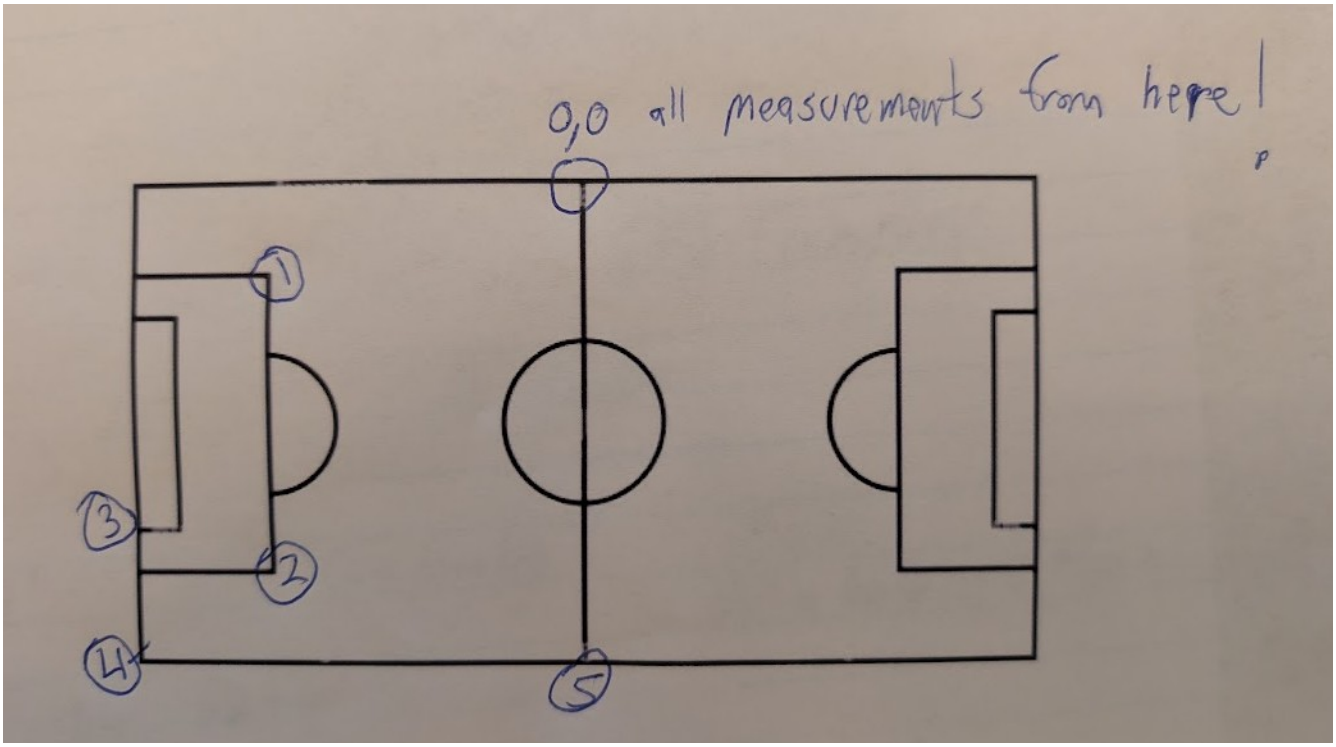
https://www.youtube.com/watch?v=BaA6PcqpPO8

And the most common way for shorter measurements is a laser level, check out this video:

https://www.youtube.com/watch?v=SouGepCR1R0

And last a $5 line level with a string check this out:

https://www.youtube.com/watch?v=Lub3i7__oro


0,0 all measurements from here!
1
2
3
4
5