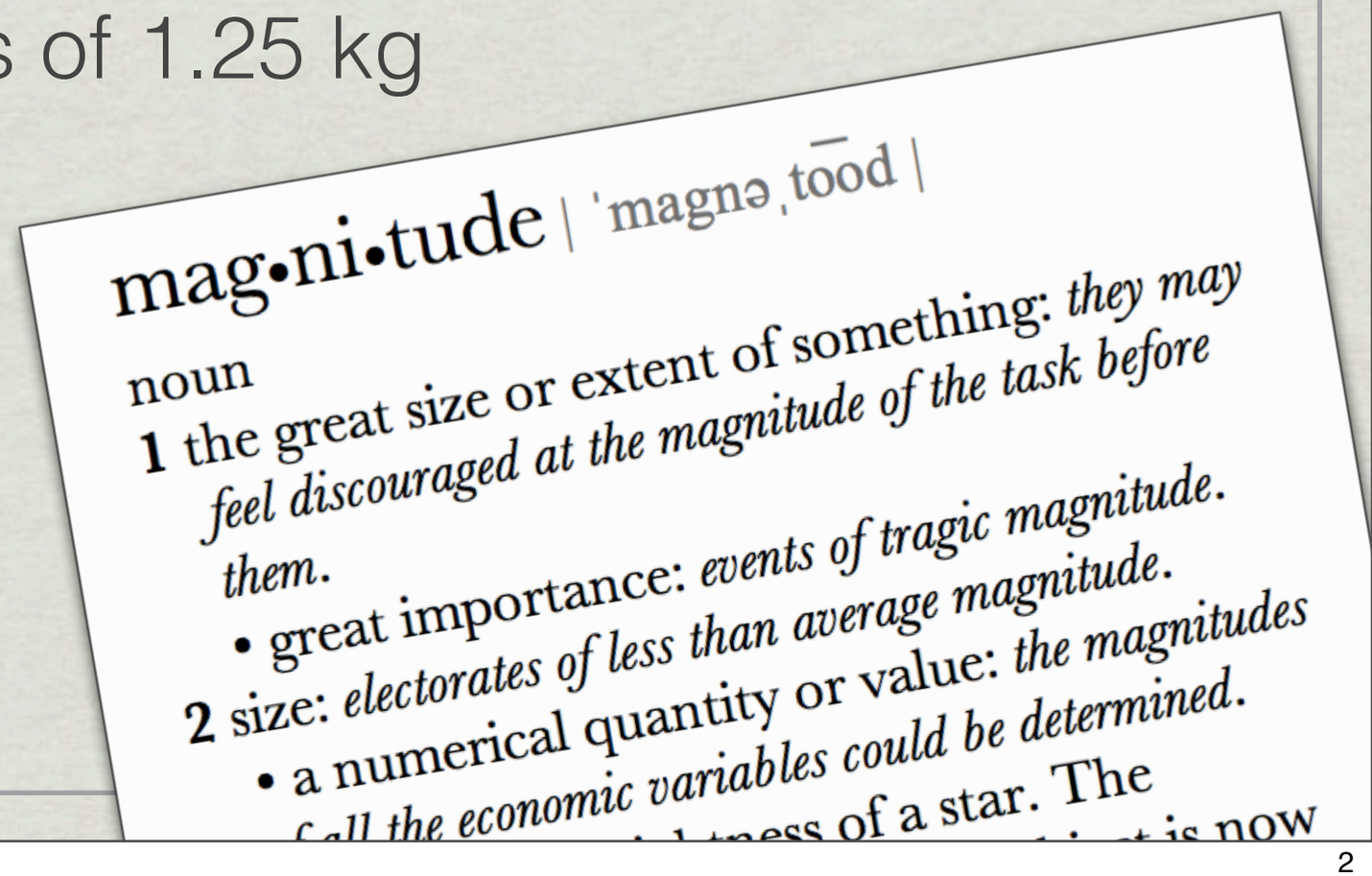
Vector Labs

San Diego , Walt Disney World, and Wissahickon High School

Scalars

- Numbers with magnitude and units only.
  - today's temperature is 84 °F
  - the car was driving for 4.3 s
  - the water has a mass of 1.25 kg


mag•ni•tude | ˈmagnəˌto͞od |

noun

1 the great size or extent of something: *they may feel discouraged at the magnitude of the task before them.*

• great importance: *events of tragic magnitude.*

2 size: *electorates of less than average magnitude.*

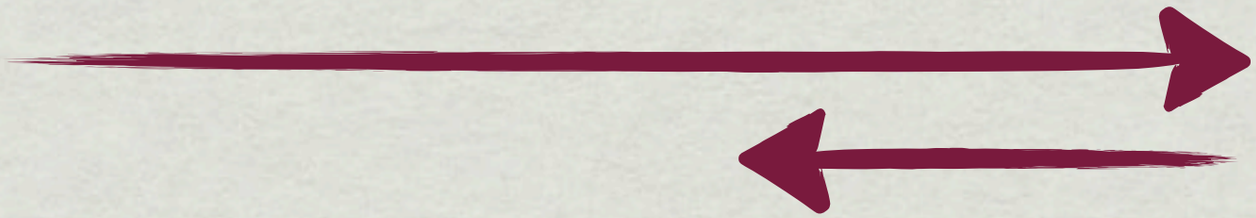
• a numerical quantity or value: *the magnitudes of all the economic variables could be determined.*

Vectors

- Numbers with magnitude and direction
- Scalar numbers have magnitude only
- Notation: $\bar{A}$ = 25m, at 174°
- Don’t use @ (this is NOT email)

Vectors can cause strange results

take 10 steps East and 4 steps West



"What is the total distance that you have travelled?"

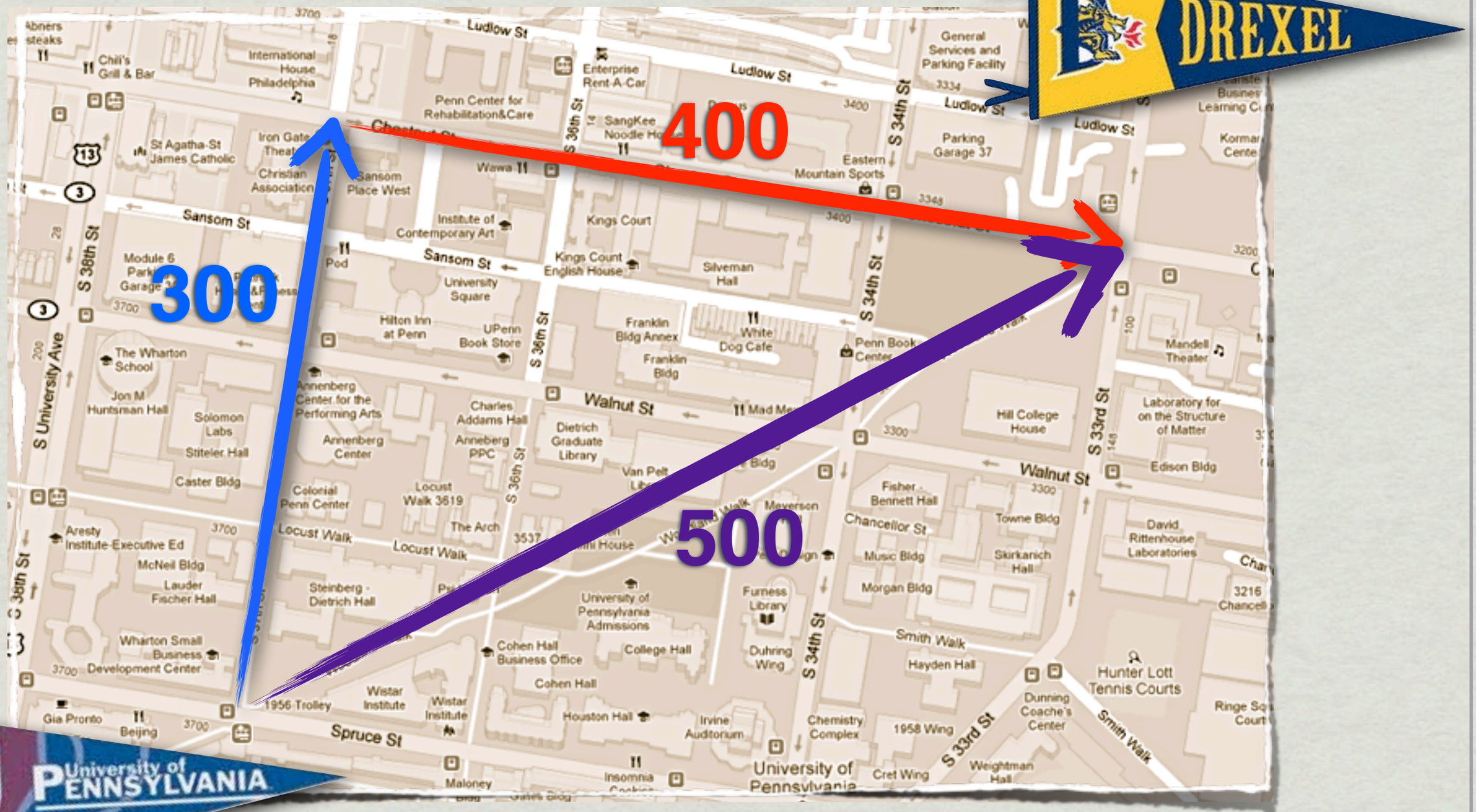
14 steps

"What is your *displacement* from where you started?"

6 steps East

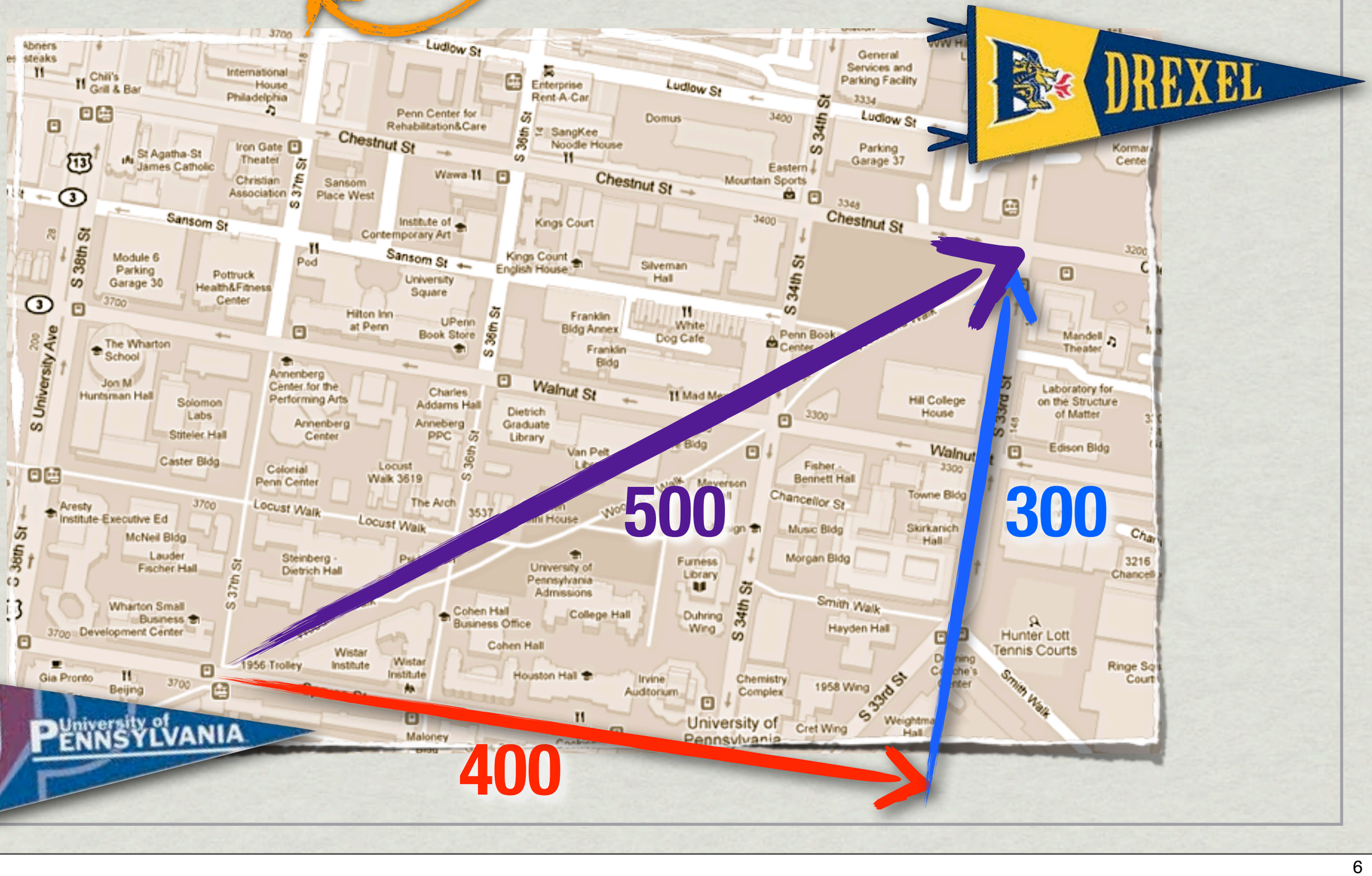
Two Directions Change the Math

Add: 300m, North and 400m, East

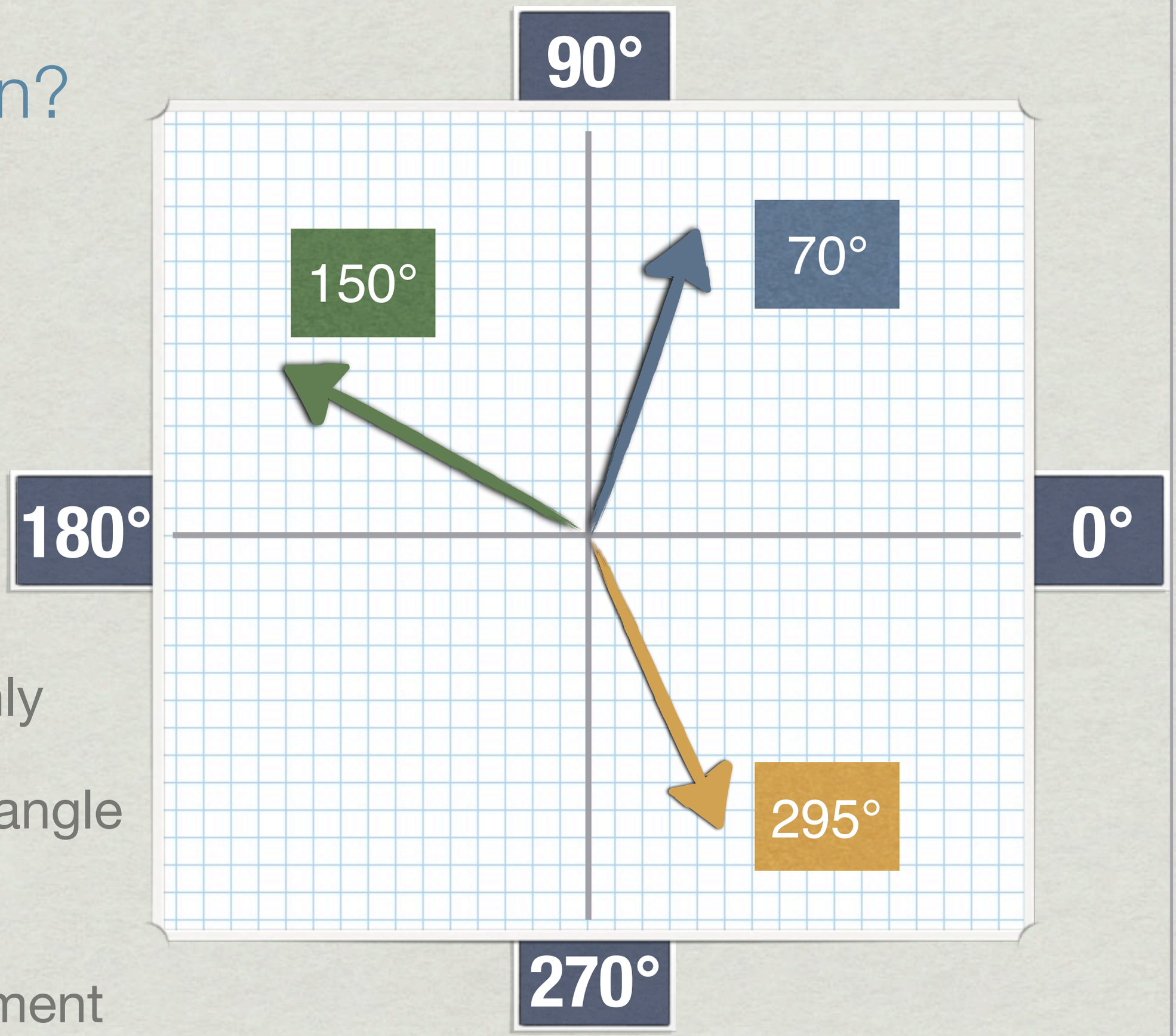


It’s the same thing…

Add: 400m, East and 300m, North

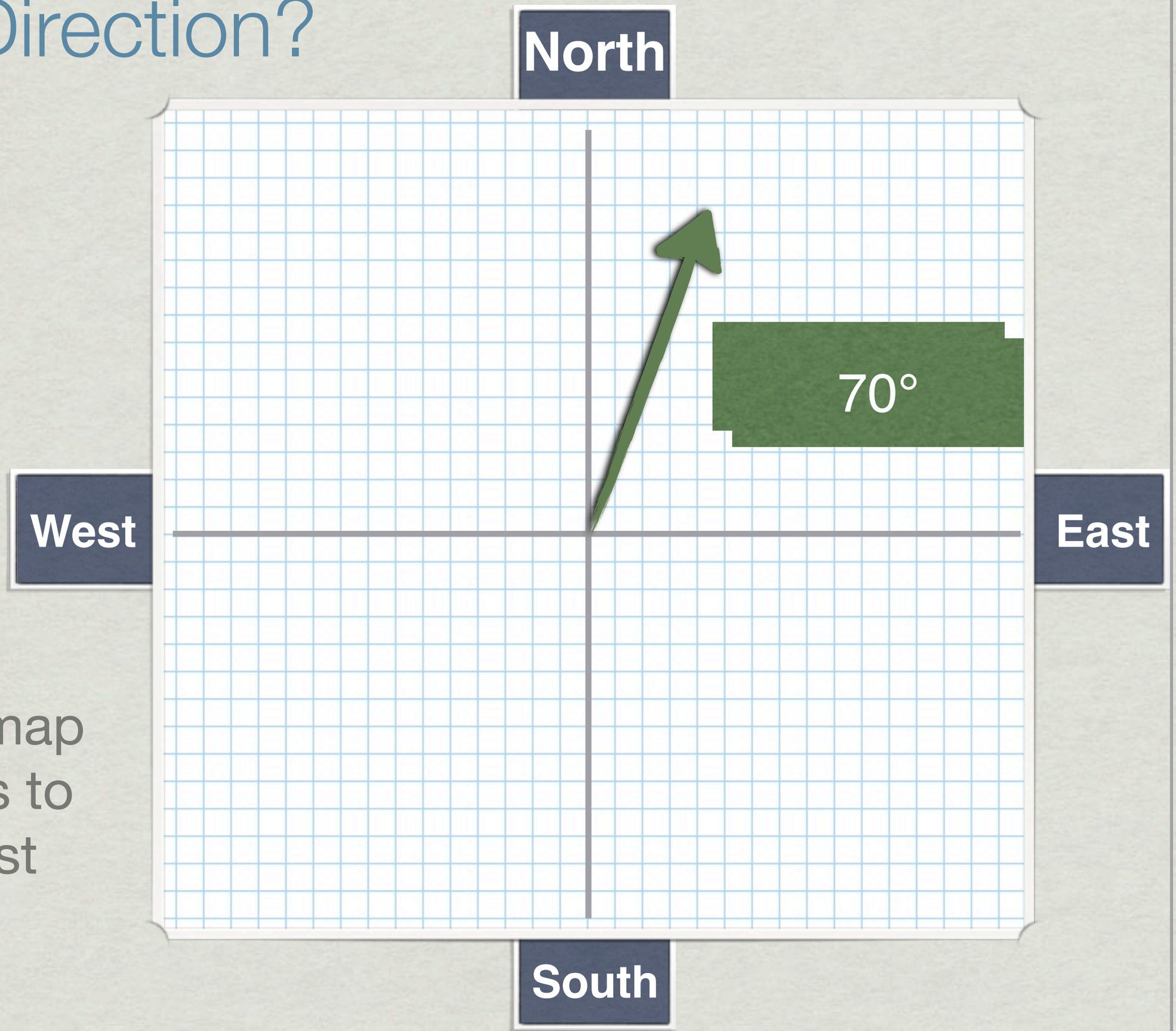


What Direction?



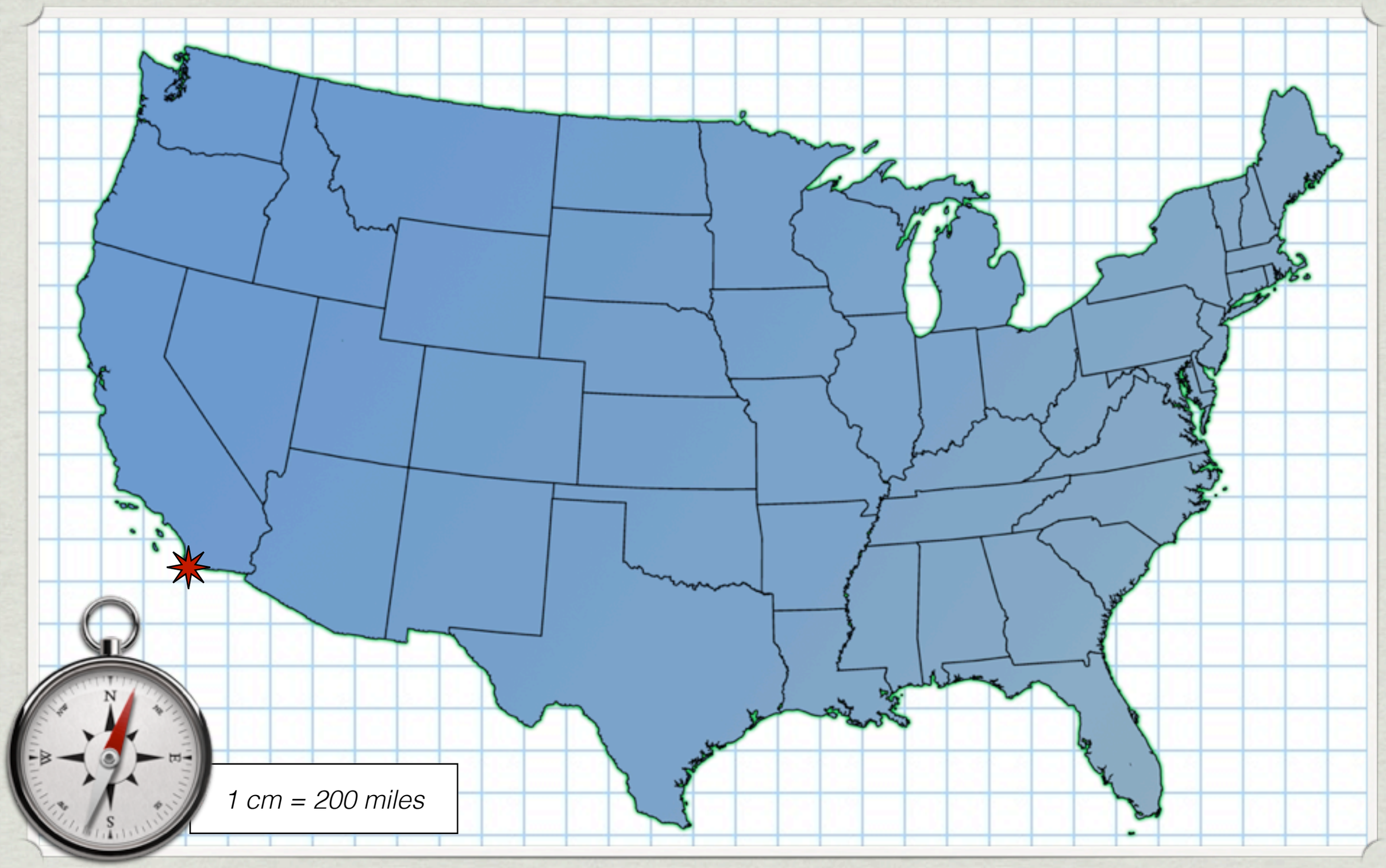
- Positive values only
- NOT the angle from a previous measurement

What Direction?

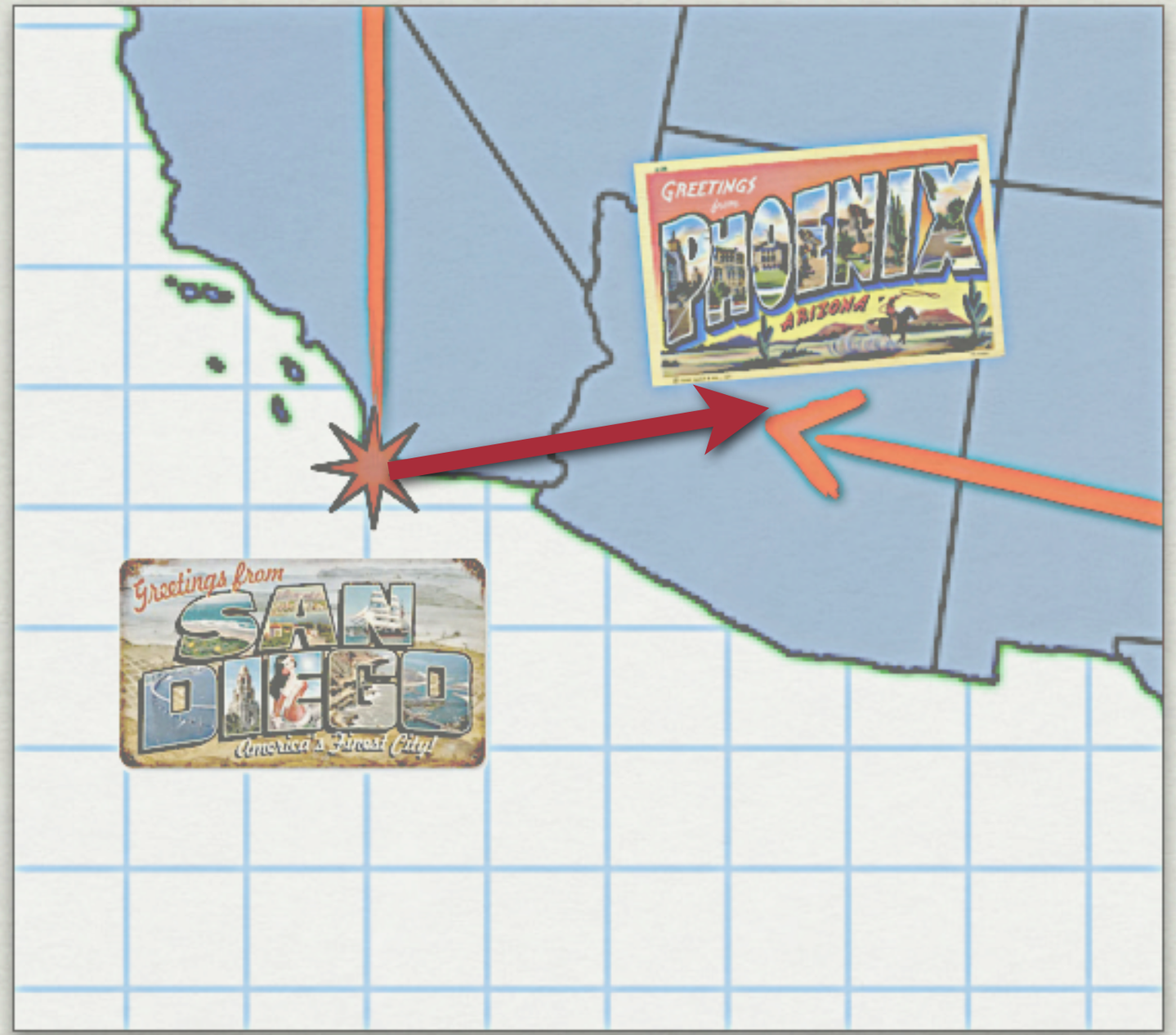


- Change map directions to angles first
- 70°

Why in the world, is my car in San Diego?



Equilibrant and Resultant



The Equilibrant vector would balance the vectors in one step. An equilibrant vector goes from the finish to the start.

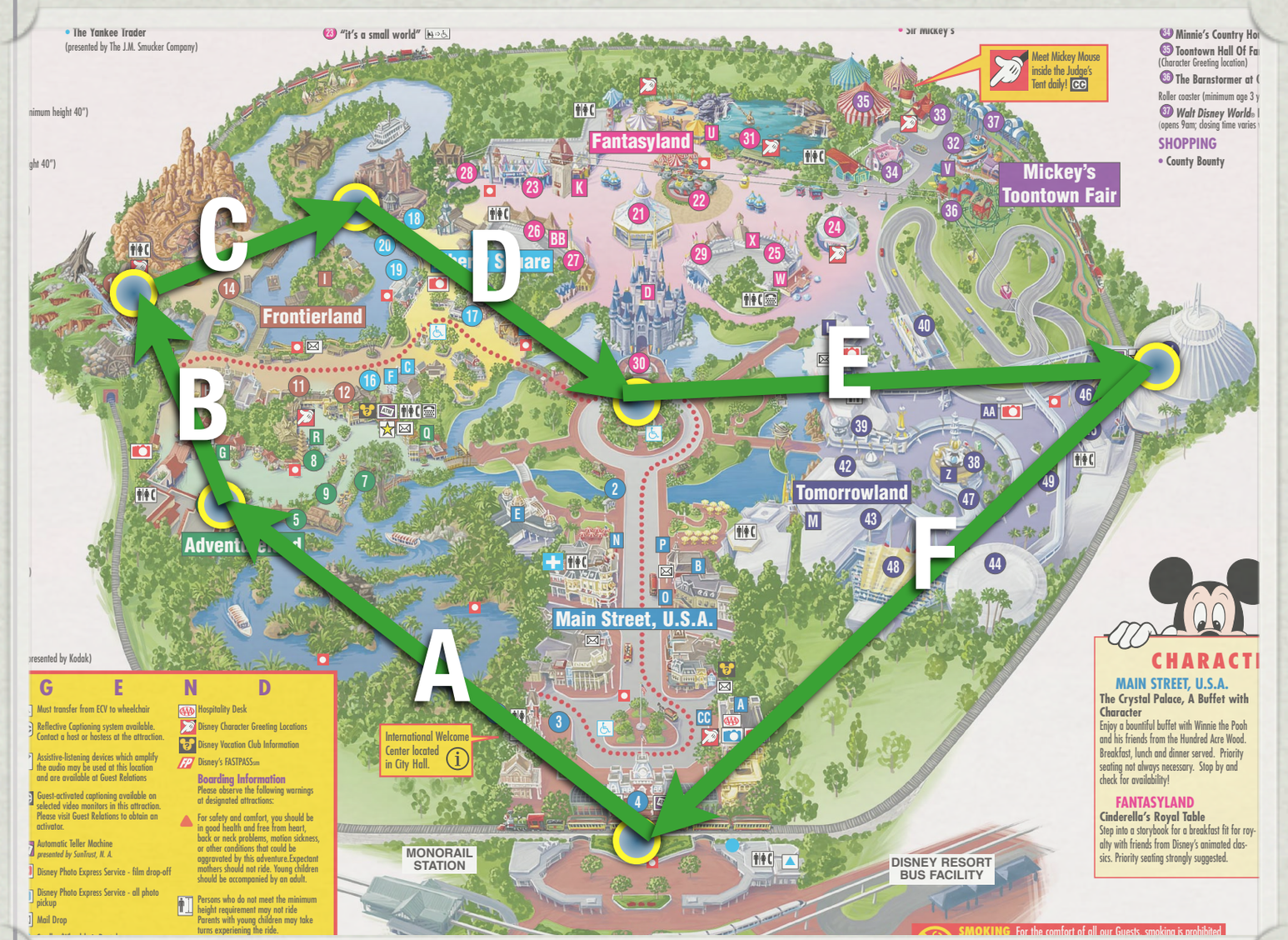
E = 360 miles, at 188°

The Resultant vector is the total of all vectors in one step. A displacement vector goes from the start to the finish.

R = 360 miles, at 8°

Where in Disney World will you go?

Step 4: Measure, Name, and Label Each Vector



A = 26.0cm, at 142°

B = 10.8cm, at 113°

C = 10.5cm, at 23°

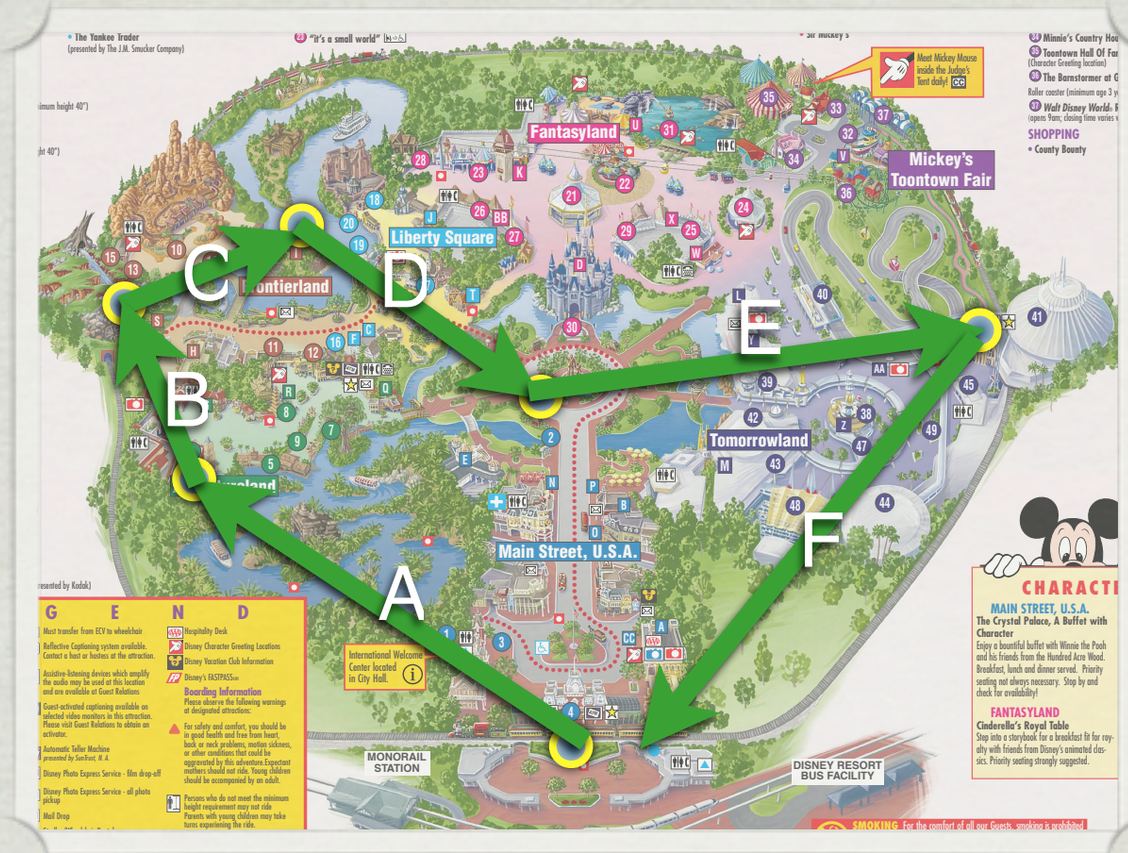
D = 16.1cm, at 325°

E = 25.4cm, at 3°

F = 32.5cm, at 223°

Step 5: Trace your steps by drawing the vectors to a ½ scale.

Don't cheat on the last step!!!



A = 26.0cm, at 142°

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D = 16.1cm, at 325°

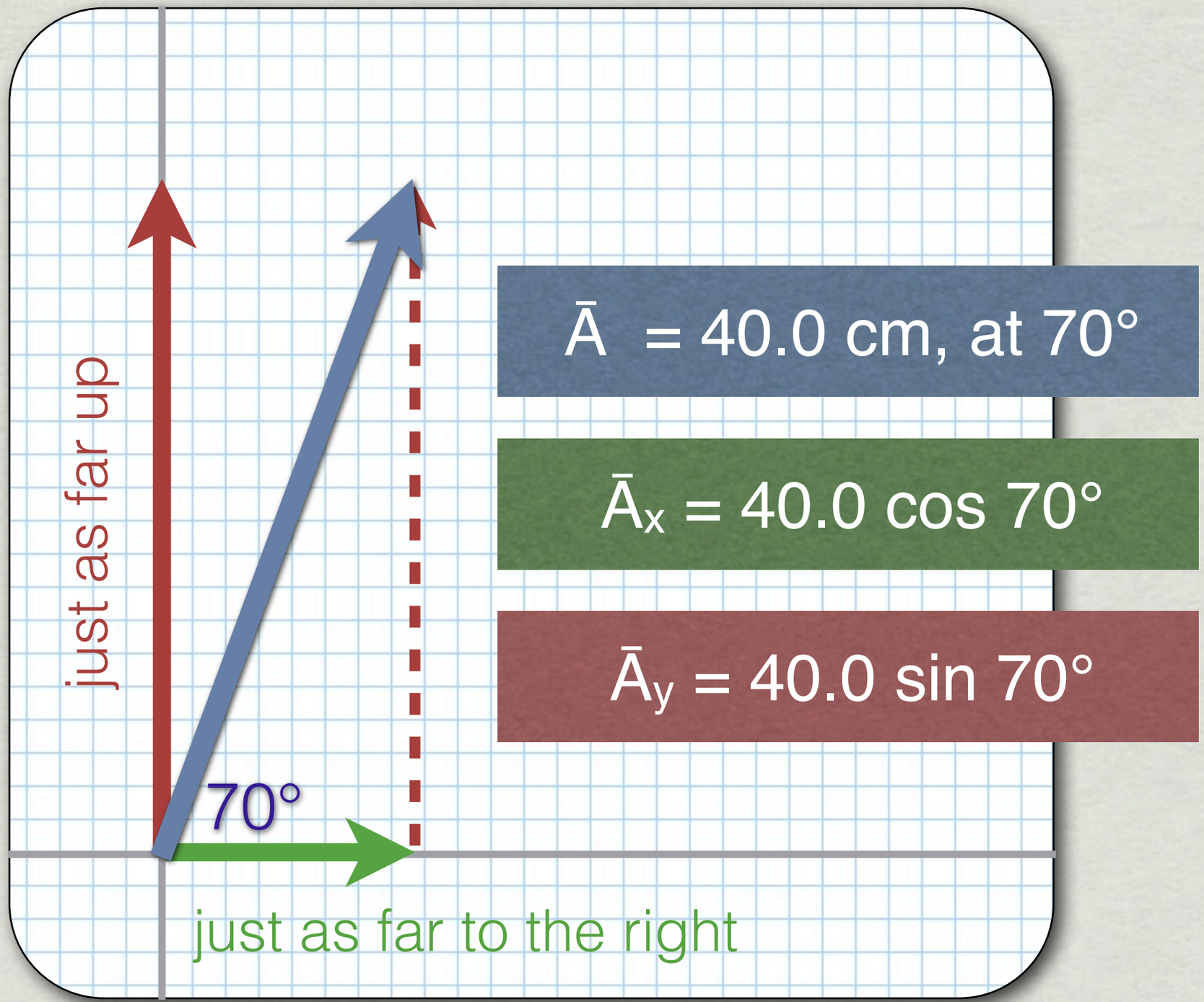
E = 25.4cm, at 3°

F = 32.5cm, at 223°

Graphical Addition

- Called the “Head to Tail” method
- One Vector starts where the previous vector stops
- Vector Sum is from the tail of the first to the head of the last

Component Method: Find the X and Y components



Break Down Your Vectors Into Components

Step 6. Find the horizontal and vertical components of each of the 6 vectors. Watch negatives!

X components **Y components**

_____ _____

_____ _____

_____ _____

_____ _____

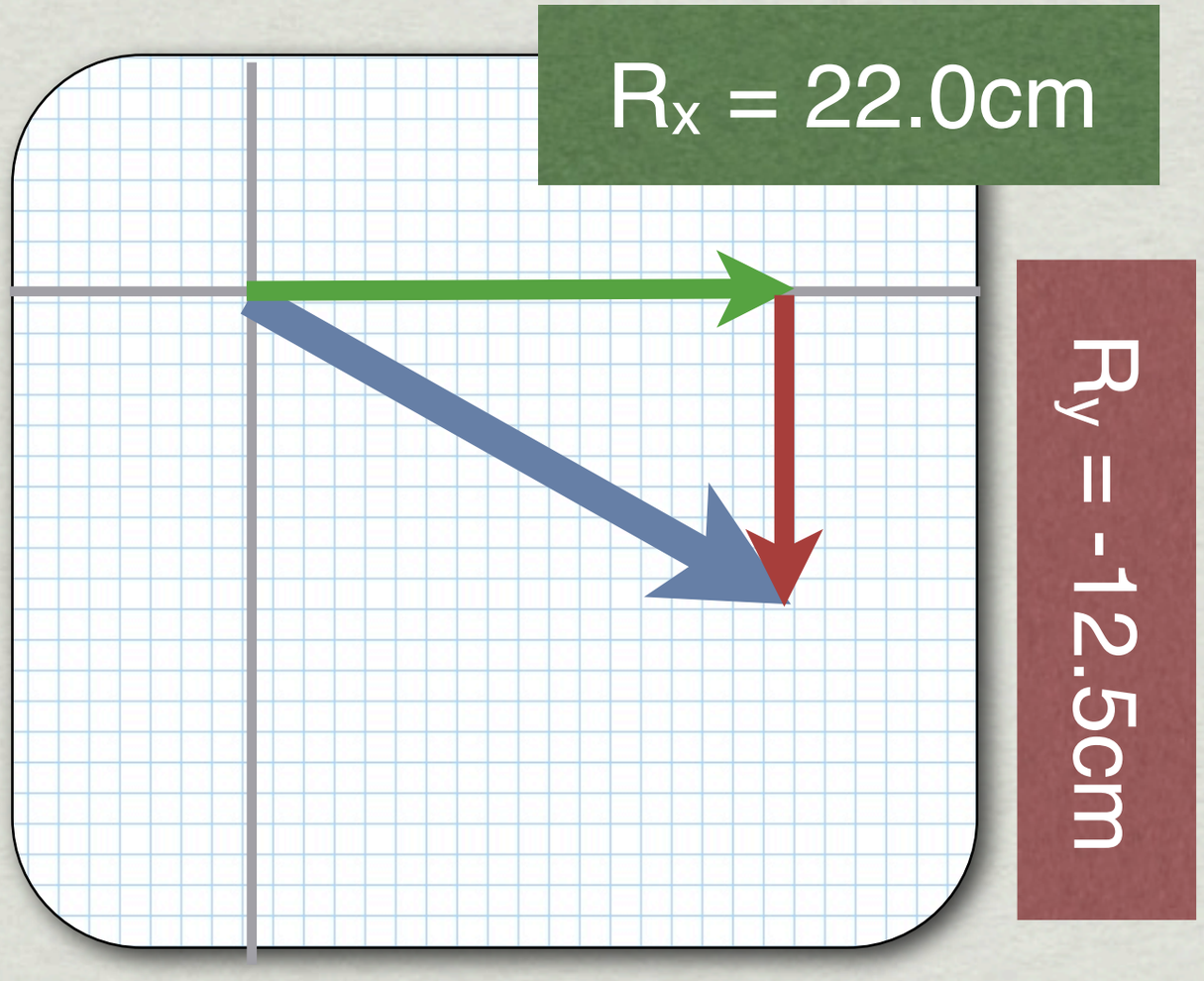
Step 7. Find the total x and total y of the resultant.

R_x _____ R_y _____

Component Method: Find the Resultant

$$R = \sqrt{R_X^2 + R_Y^2}\,, at(Tan^{-1}\frac{R_y}{R_x})$$

- Pythagorean to find Magnitude
- Trig to find Direction
- Careful with the angle



Almost Done

Step 8. Calculate the resultant and the equilibrant vectors.

R= _____

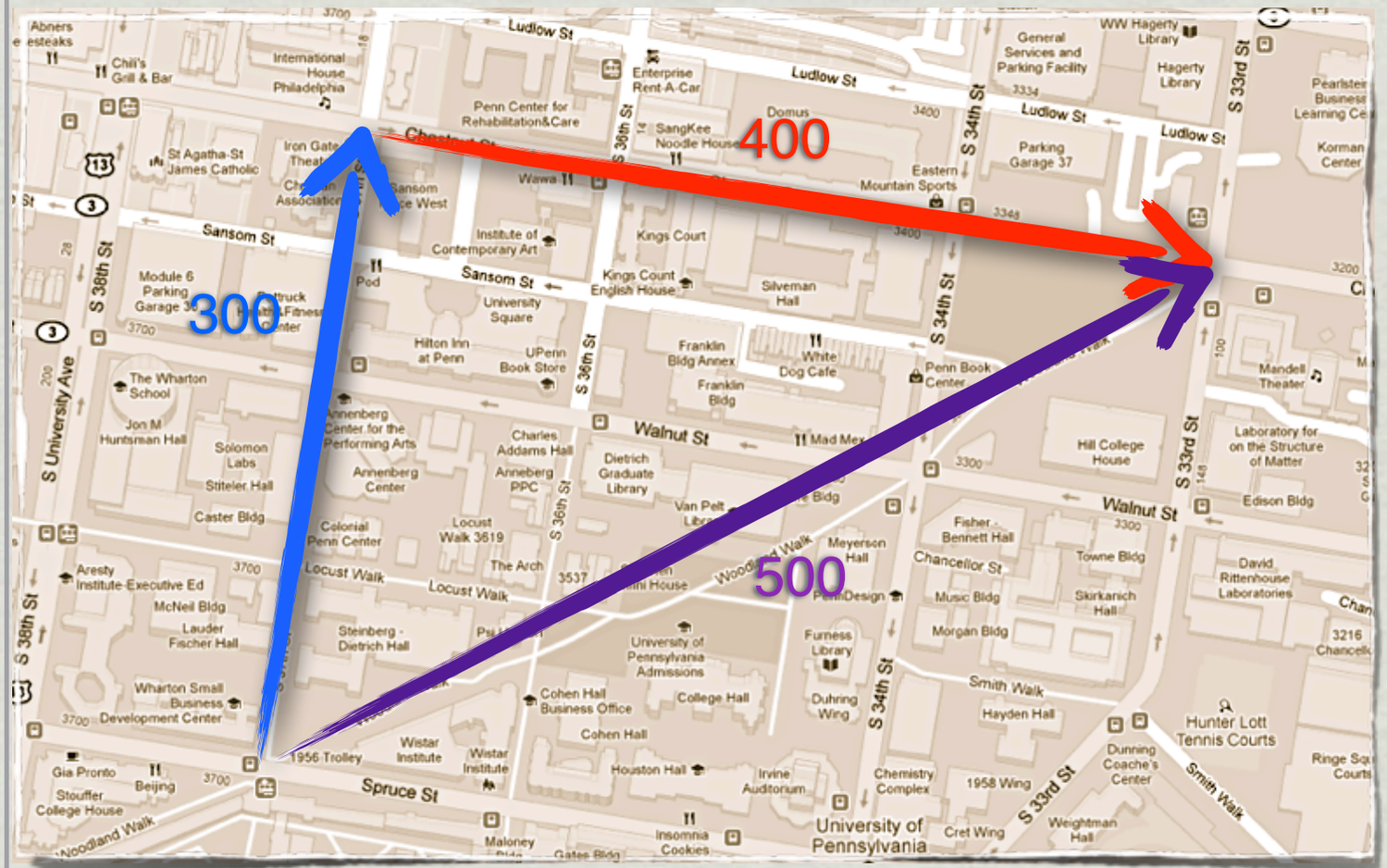
E= _____

Step 9. Conclusion

Compare and contrast the two methods of vector addition . Be sure to mention the simplicity and accuracy of each method.

We did this one before..

$$R = \sqrt{R_X^2 + R_Y^2}\,, at(Tan^{-1}\frac{R_y}{R_x})$$



- R = √(300² + 400²)
- R = 500 m
- θ = Tan^{-1} (300/400)7
- θ = 37°

What about your school?

Put the measurements together.
Find R_x and R_y and R (distance and direction).