Laws of Physics

Govern how matter interacts with other matter

What is an interaction?

When one object affects another (causes a change)

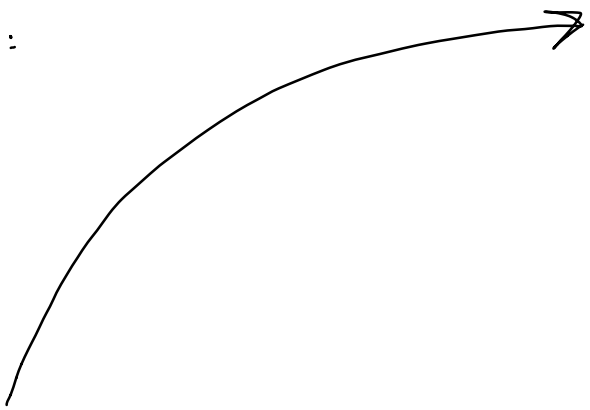
First thing to know:

How can we tell if an interaction has taken place?

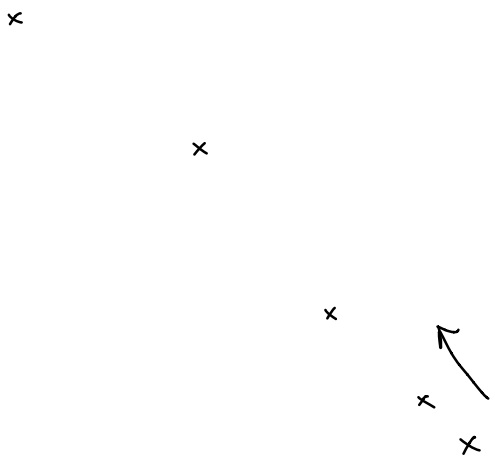
- An interaction will change an object's motion

Path of a proton:

Direction changing



Speeding up



Indicators of an interaction:

- Chg of direction
- Chg of speed

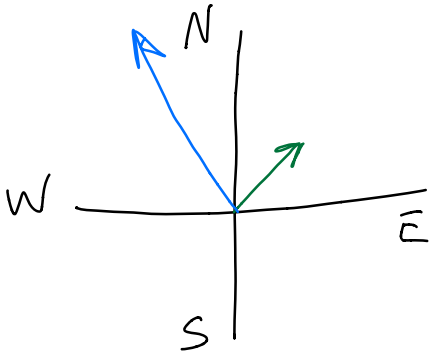
Combination of direction + speed is so important, we give it a special designation: velocity

- in everyday speech velocity = speed
  not in physics!

- "Airplane travelling @ 500 mph"
  Which direction?
  Speed, not velocity

- "Car driving NW at 15 knots"

- in diagrams, velocity is represented by an arrow



Change of direction, speed, or both = interaction

change of velocity = interaction

At all times, an object is either interacting or it isn't.

- the motion of an isolated rock

Default motion: uniform (constant velocity)

Newton's First Law

GOTO: Slides

Note: an object at rest still has constant velocity

Demo with ball or marker

- Drop
  Was there an interaction? How do we know? What with?
- Now hold. Is there an interaction now?

x
x
x
x
x
x

Sliding a book across a table: I'm applying a force? Why isn't the velocity changing?

Is a change of position evidence for interaction?

Let's return to velocity again
Velocity = speed AND direction

This concept comes up a lot in physics
Position = distance + direction

Some physical quantities are only represented by a size and a direction

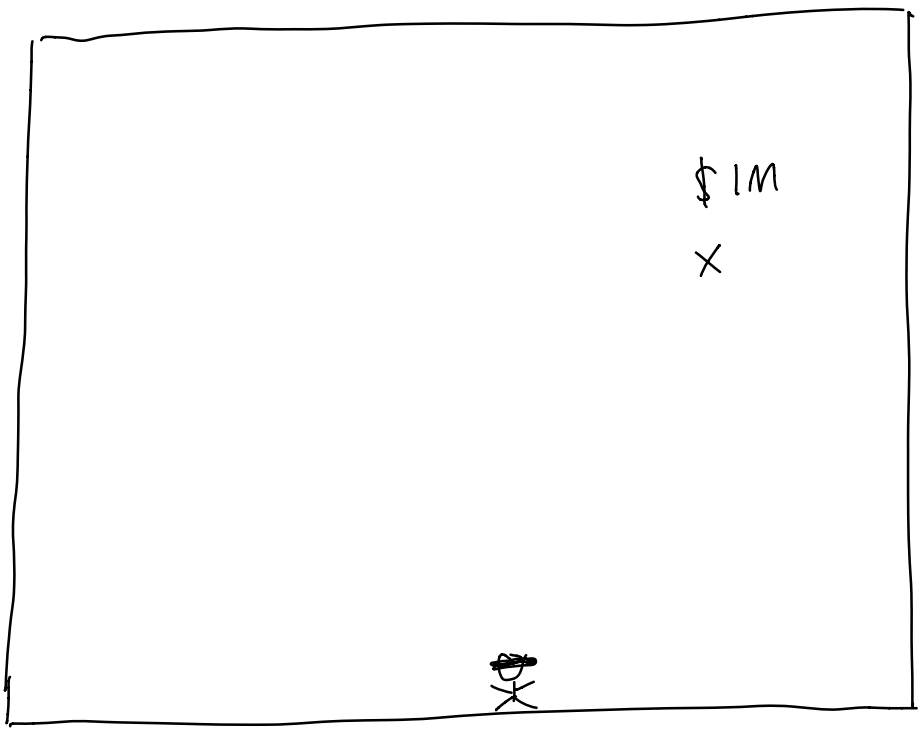
Position = distance ("size") + direction
Velocity = speed ("size") + direction

Others are not
Mass = does not have a direction
Volume
Temperature

We call quantities with both a size and a direction "vectors"
A vector consists of a size (magnitude) and a direction
Velocity: 300 m/s South
Position: Anderson is ~40 miles NE of Indianapolis

Thought exercise:

We are at the gym



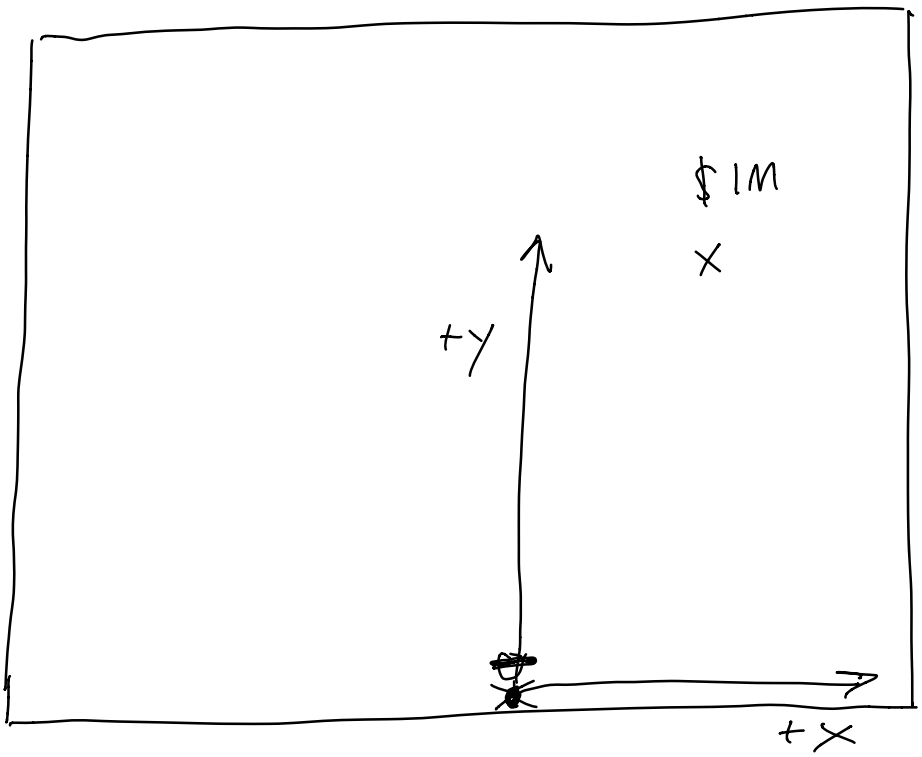
walk 25 yards ... ?

"Turn 30° & walk 50 feet"

"Walk 30 feet to the right, then 40 feet forward"

These are both vectors

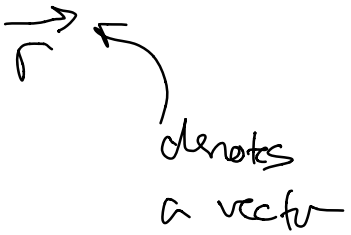
In physics (& math) instead of left + , right +
forward & backward, we use
$\pm x$, $\pm y$



walk 30 feet in the x dir
then 40 feet in the y dir

the xy coordinates are $\langle 30, 40 \rangle$

the position, $\vec{r} = \langle 30, 40 \rangle$



velocity $\vec{v}$

Force $\vec{F}$

$\vec{r}$, $\vec{F}$ when I'm lazy

For Wed

Read 1.4

Start on HW 1