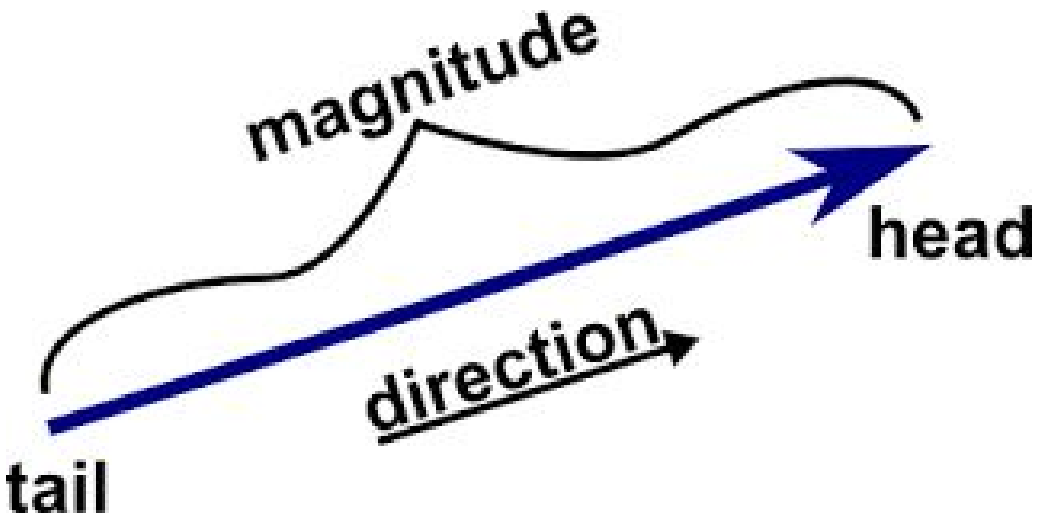
Day 7

Vectors and trigonometric functions

What is a vector?

A quantity/object that has both magnitude (a length) and direction

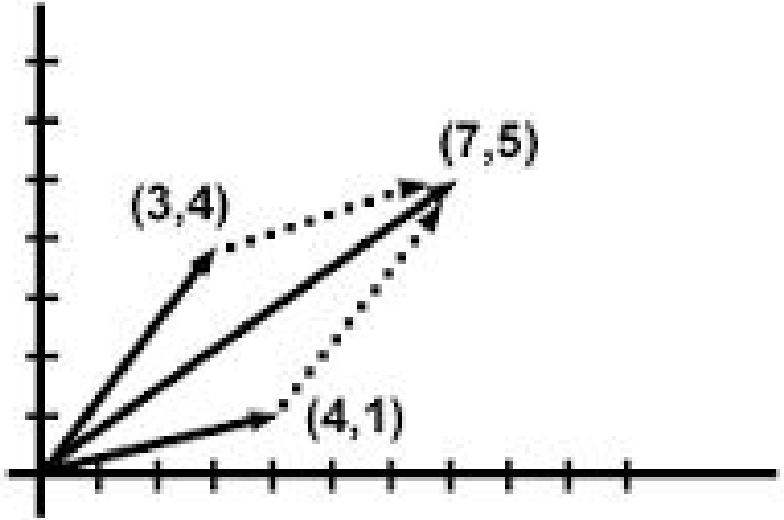


Vector math

Vector addition

Vector a = (3,4) Vector b = (4,1)

a + b = (3, 4) + (4, 1) = (7, 5)



PVector syntax

```
PVector v1, v2;
```

Declaring a new PVector;

```
void setup() {
  v1 = new PVector(40, 20);
  v2 = new PVector(25, 50);
}

void draw() {
  ellipse(v1.x, v1.y, 12, 12);
  ellipse(v2.x, v2.y, 12, 12);
  v2.add(v1);
  ellipse(v2.x, v2.y, 24, 24);
}
```

Setting the x and y components for the vectors

Can call x and y components by using vectorName.x and vectorName.y

Add vectors using .add

Why does this matter? I hate math

Before we manipulated both x and y coordinates to change position

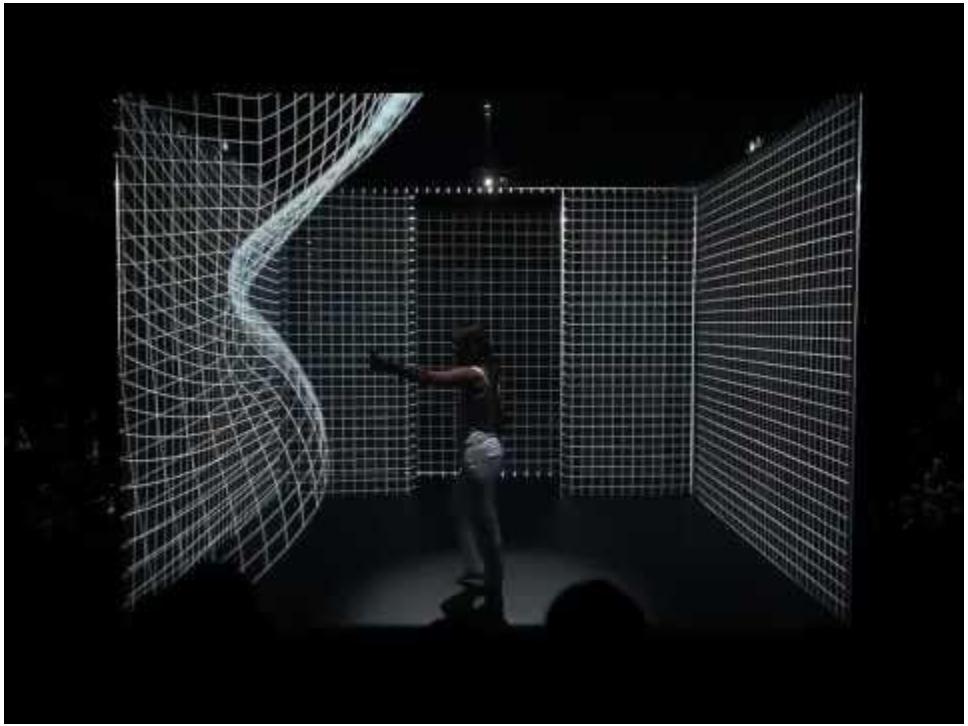
x+= 1; or x++;

y+=1; or y++;

But now!

Can add a velocity vector to a position vector

And check out this cool thing!



Turn in into a PVector!

Acceleration

Just like we used velocity and added it to the position, we can use acceleration to change the velocity

Useful for animations! Things can speed up and slow down

```
PVector position;
PVector velocity;
PVector acceleration;


void draw(){
    velocity.add(acceleration);
    position.add(velocity);
}
```

Gravity!

Gravity is just a change in velocity (acceleration) in the y direction

Acceleration code!

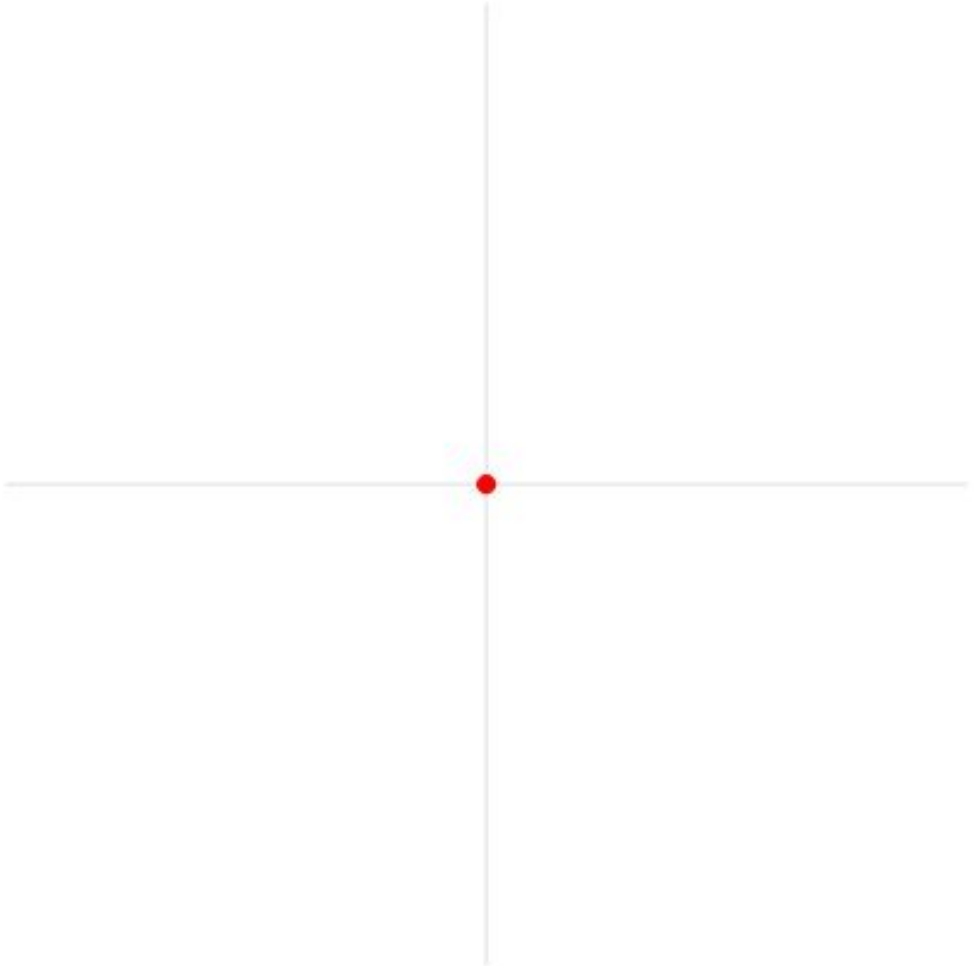
Sine and Cosine

More math!

Unit circle

Circle with center at the origin

Radius of 1

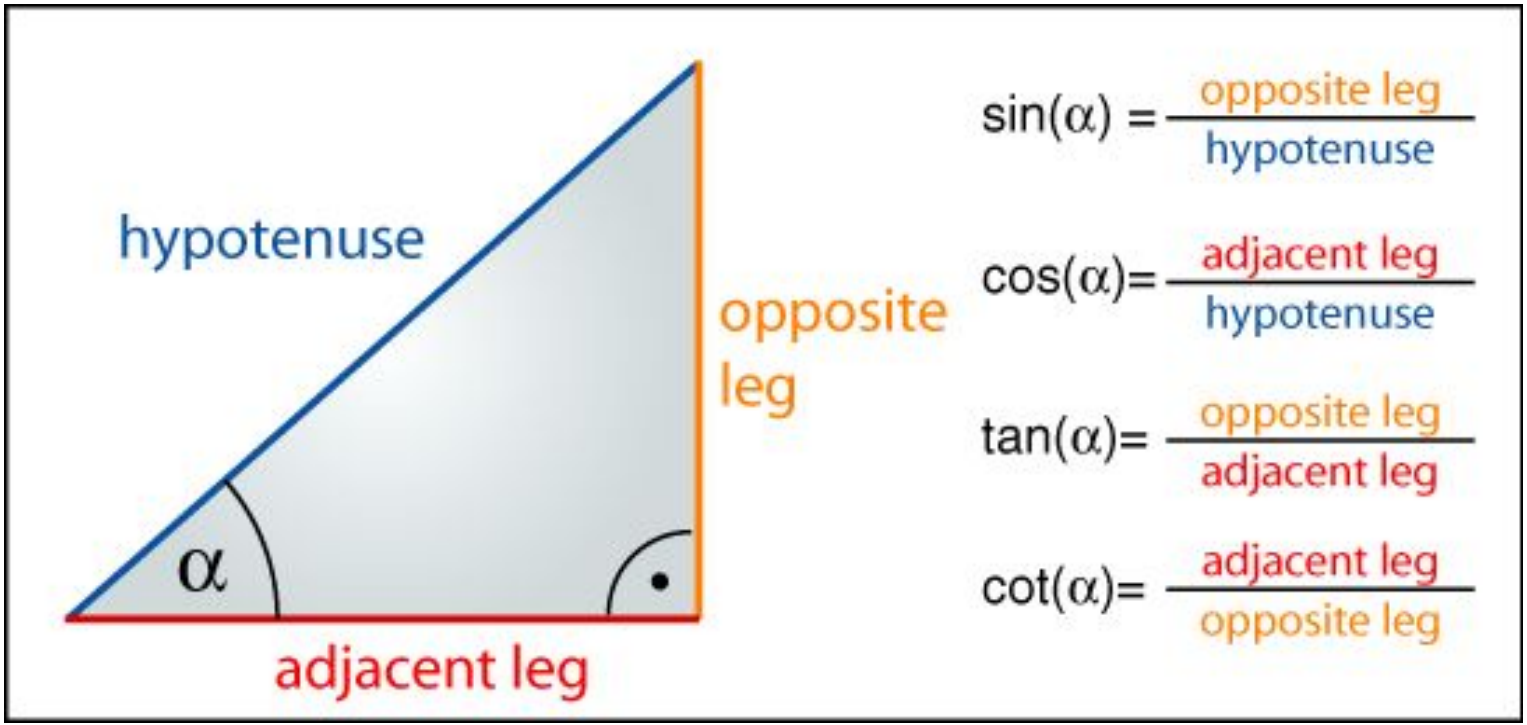


Trig functions

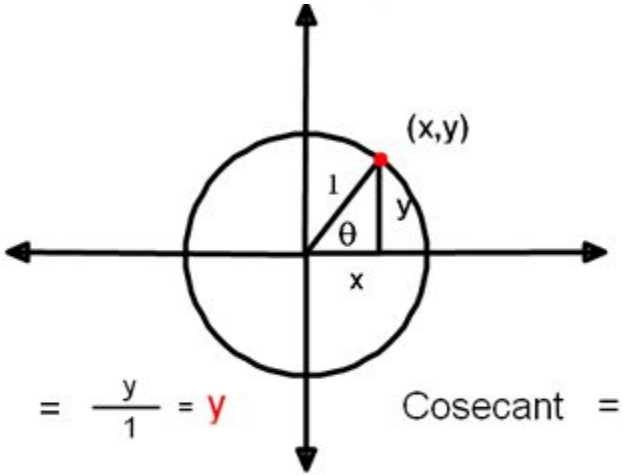
Sin : SOH

Cos : CAH

Tan : TOA



How trig functions relate to the unit circle



Sine $= \frac{y}{1} = y$

Cosine $= \frac{x}{1} = x$

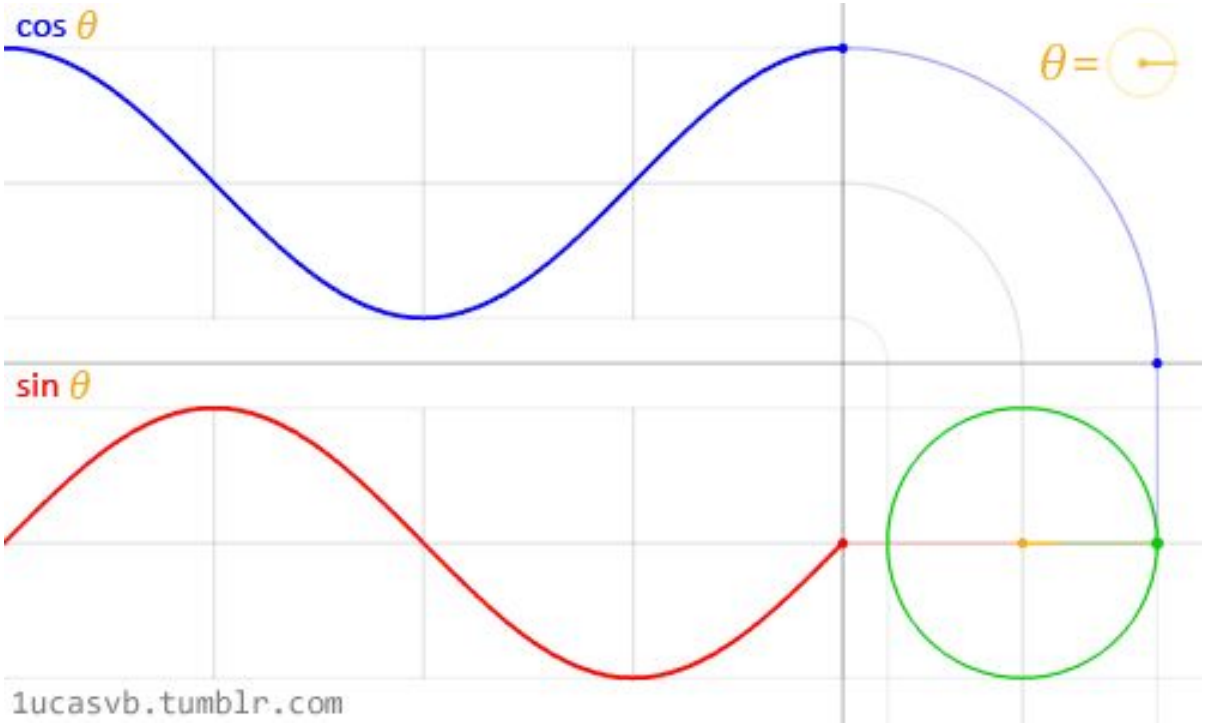
Tangent $= \frac{y}{x}$

Cosecant $= \frac{1}{y}$

Secant $= \frac{1}{x}$

Cotangent $= \frac{x}{y}$

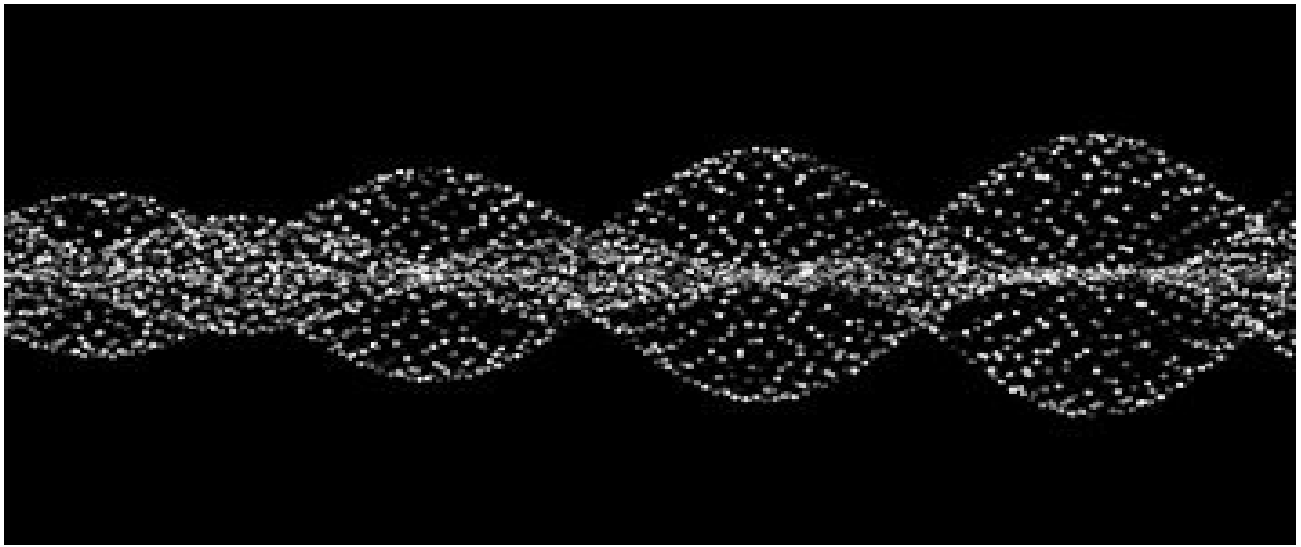
Graphing the sine and cosine functions



Why are we even learning this ?

Sin and cos can be used for a lot of things

Right now, you can use them to create orbits and waves in your animations



http://codepen.io/tmrDevelops/pen/NPBLXJ

http://codepen.io/clindsey/pen/avNxrr

CODE sin and cos

HW assignment

Take a previous sketch (either in class, or from homework, or maybe one online) that used x++ or y++ and update sketch to incorporate vectors. You must show both the original and edited code.

Create a sketch that uses an orbit or wave

If you feel comfortable with this:

Dynamically change your sin and cos functions with vectors

Figure out how to incorporate this into your animation project

Extra resources

Math help

https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/introduction-to-vectors-and-scalars

https://www.khanacademy.org/science/physics/two-dimensional-motion/two-dimensional-projectile-mot/a/what-are-velocity-components

https://www.khanacademy.org/math/geometry/right-triangles-topic/intro-to-the-trig-ratios-geo/v/basic-trigonometry

Processing help

http://natureofcode.com/book/chapter-1-vectors/