3 - Matrices and Transformations

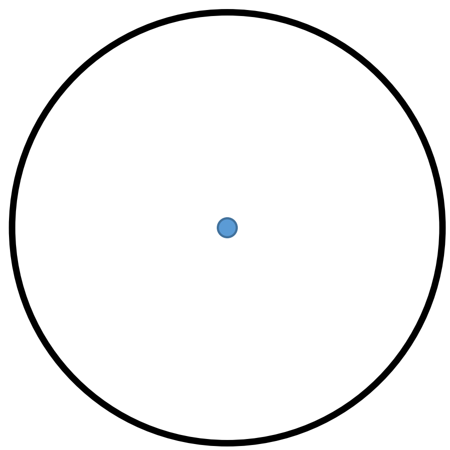
graphics is fun; graphics requires matrix math;

thus, matrix math must be fun

Simple Trig: Angles

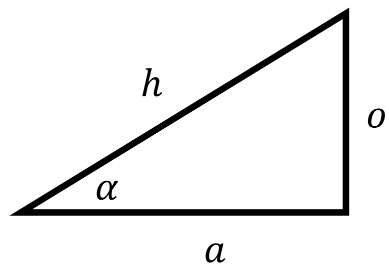
d
r
2π

circumference
radians
degrees



Simple Trig: Angles

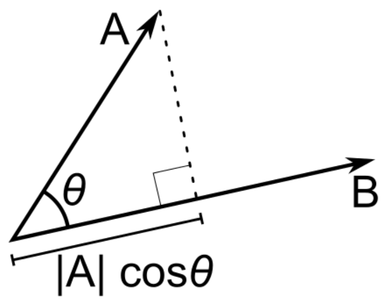
$$a^2 + o^2 = h^2$$



sin, cos, tan,
asin, acos, atan

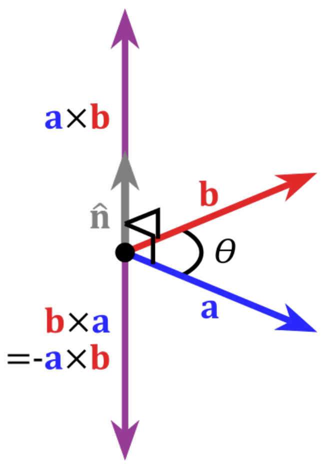
Dot Product

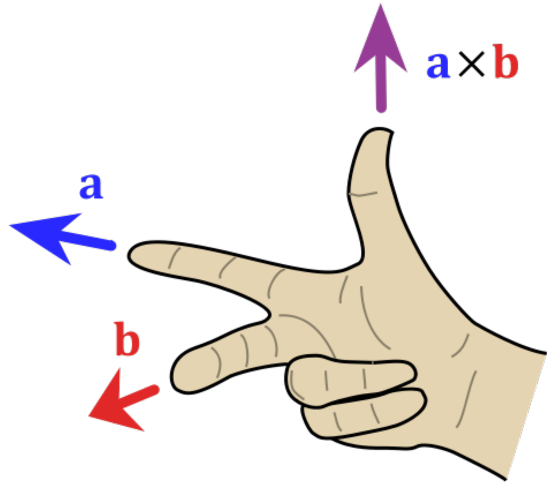
$$\mathbf{A} \cdot \mathbf{B} = \|\mathbf{A}\| \ \|\mathbf{B}\| \cos\theta,$$



Some images from https://en.wikipedia.org/wiki/Dot_product

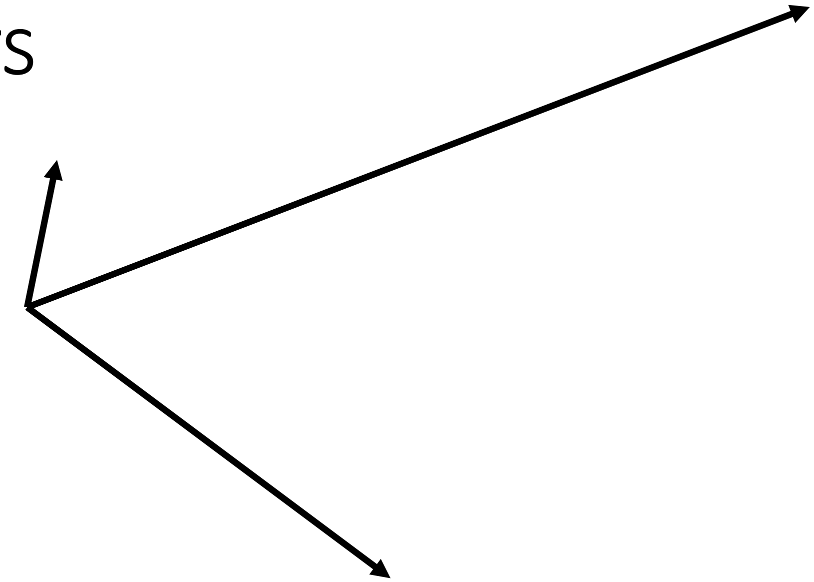
Cross Product





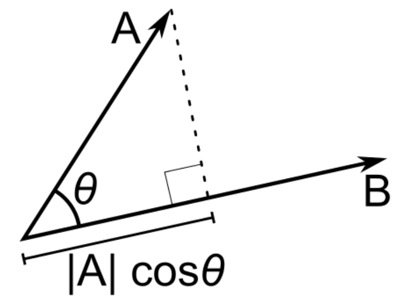
Some images from https://en.wikipedia.org/wiki/Cross_product

Vectors



add/sub
length
scalar mult

3-D Vectors



$$\mathbf{A} \cdot \mathbf{B} = \|\mathbf{A}\| \; \|\mathbf{B}\| \cos\theta,$$

Have length and direction

$$\mathbf{V = [x_v, y_v, z_v]}$$

Length is given by the Euclidean Norm

$$\mathbf{||V|| = \sqrt{(x_v^2 + y_v^2 + z_v^2)}}$$

Dot Product $\quad \mathbf{V \bullet U} \quad \mathbf{= [x_v,y_v,z_v] \bullet [x_u,y_u,z_u]}$

$$\mathbf{= x_v x_u + y_v y_u + z_v z_u}$$

$$\mathbf{= ||V||\ ||U||\ cos\ ß}$$

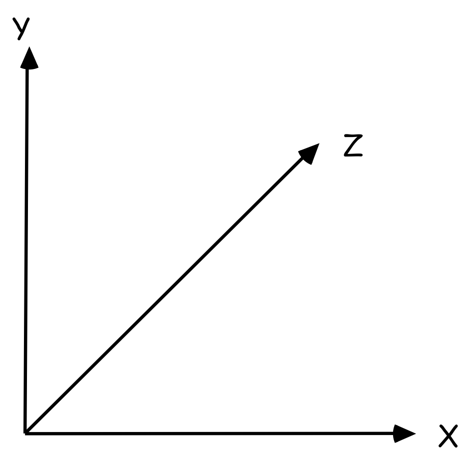
Cross Product $\quad \mathbf{V\ x\ U} \quad \mathbf{= [v_y u_z - v_z u_y, -v_x u_z + v_z u_x, v_x u_y - v_y u_x]}$

$$\mathbf{V\ x\ U = - (U\ x\ V)}$$

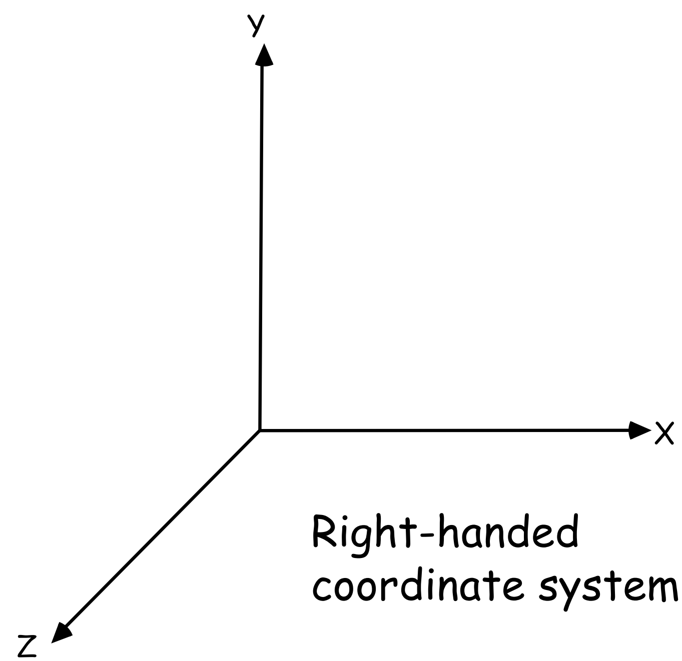
Cartesian Coordinates

- Basis vectors (2D)
- Linear independence
- Coordinates
- Orthogonal
- Orthonormal
  - Cartesian
  - 2D, 3D, 4D,…

3D Coordinate Systems



Left-handed
coordinate system



Right-handed
coordinate system

Matrices: Representation, Operations

Mult, not commutative
Identity
Inverses

Vector Operations with Matrices

Matrices as Transformations on Vectors