**Linear Algebra**

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# Point and Vector

* A point is a physical location on a coordinates system
  + 2D point
  + 3D point
* A vector is a scalar or a direction (non-physical)
  + 2D point
  + 3D point

# Vector

## Properties of Vector

### Commutative

### Associative

### Distributive

Where r is a scalar

## Magnitude of a Vector

* See dot product
* Also known as distance between 2 points
* Also known as length of vector
* Example:
  + Let
    - Vector have a length of 5

## Normalize Vector

* Get the unit vector of the vector
* Each value is between -1 to 1
* Example

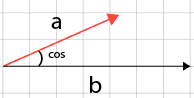
### Magnitude of a normalize vector is always 1

## Dot Product

### General Formulae

* Dot product also known as scalar product
* Dot product also known as inner product
* Example

### Geometric Definition



**Prove:**

### Orthogonal

* Example:
* Meaning two vectors are 90 degrees apart, or perpendicular to each other

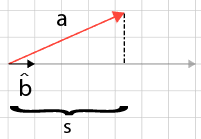
### Parallel

* These two vectors are collinear to each other, points at the same direction

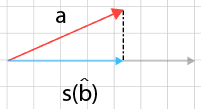
### Tips on the sign of dot product of two vectors

* When Negative value, two vectors lie on the different half
* When value is = 0, two vectors is orthogonal
* When value is = 1 or -1, two NORMALIZE vectors is parallel to each other
  + 1 = facing exactly the same direction
  + -1 = facing the exact opposite direction
* When Positive value, two vectors lie on the same half

### Scenario 1



* Scenario 1, Vector A is not a normalize vector; Vector B is a normalize vector. Dot product yields a scalar numbers which tells us the ratio of Vector A is to Vector B (s:1) units.



* Multiply the scalar with normalize Vector B to get the blue vector in the image above.

### Scenario 2

* Scenario 2, Both Vector A and Vector B is not a normalize vector, normally dot product between these two vectors is use to check the direction of the vector, normalizing the vector is not needed. The scalar is not really useful, except for the sign of the number which tells us the direction between these two vectors are facing. Positive, negative number, and 0 tells us the direction between these two vectors

## Cross Product

* + - * 3D spaces only, Vector 3 only
      * Right-hand rule
      * Finding a 3rd vector that is both perpendicular to the 2 vectors if it exists

# Matrix

A matrix is denoted by

## Type of Matrices

### Row Matrix (horizontal)

### Column Matrix (vertical)

### Square Matrix (Number of Row = Number of Column)

### Zero/Null Matrix

### Identity Matrix

A square matrix contains 0 and 1, where 1 are diagonal across.

### Diagonal Matrix

A square matrix where only the diagonal has value, the rest is 0.

### Scalar Matrix

A square diagonal matrix where all the diagonal values are the same.

## Operation of Matrix

### Add/Subtract

### Multiply

### Scalar Multiply

### Transpose

### Inverse

## Properties of Matrix

### Commutative

### Associative

### Distributive

## Properties of Matrix Multiplication

### Not Commutative

### Associative

### Identity

### Null Matrix

## Find Inverse Matrix for n\*n matrix

### Find Determinant

* + - * 2x2 matrix
      * 3x3 matrix
      * 4x4 matrix

### Gauss Jordan

* + - * Start off with the matrix you are going to inverse on the left and an identity matrix on the right
      * Objective is to make the left side matrix into an identity matrix if determinant is not 0
      * Change the 1st row 1st digit into 1 by dividing by the value which is 4,
      * Divide the whole of 1st row
      * Next, change the other value in the same column to 0 by multiplying and then minus
      * 2nd column is 4, therefore multiply the first row by 4 temporary and then the 2nd column minus away the 1st.
      * Solve the next column:
      * At this point, the method on how to the rest of the column is the exact same method being used for the 1st row and column
      * Solve the rest:

Divide 2nd row, 2nd column by 3:

Change 1st row 2nd column to zero by -1/2 and minus away:

Change 3rd row 2nd column to zero by 4 and minus away:

Since 3rd row, 3rd column is already 1, no action needed, procced to multiply and minus step:

Check:

Summary: Divide, multiply, minus