**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

* 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 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

## 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 (Row = 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