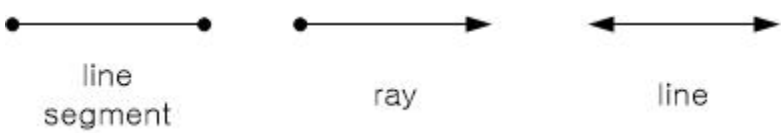
Vector

1 Terminology

Line

Ray

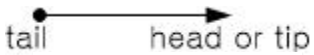
Ling Segment



[Fig] Line Segment, Ray and Line

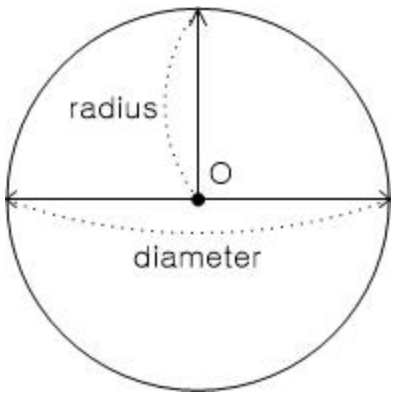
Begin, End

Tail, Head

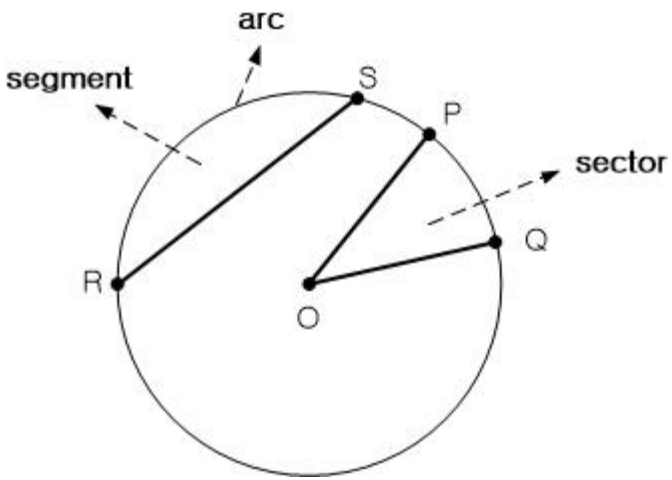


[Fig] Tail and Head

Circle

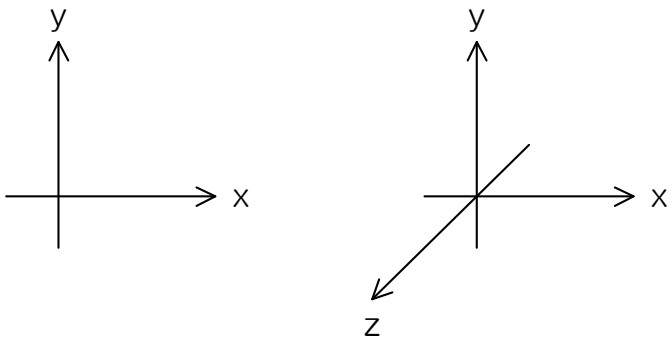


[Fig] Radius and Diameter



[Fig] Sector, Segment and Arc

Coordinate System



[Fig] Standard Axis

Right Hand Coordinate System

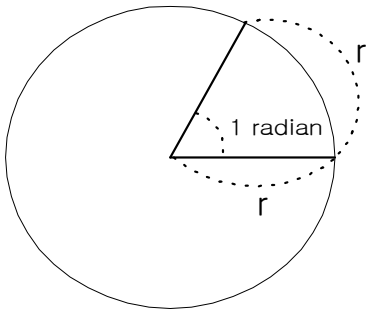
Right Hand Rule

2 Basic Concepts

radian

pi, π

3.141592

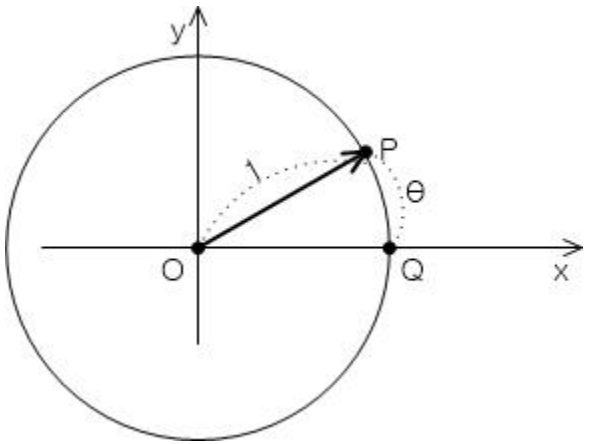


[Fig] Radian

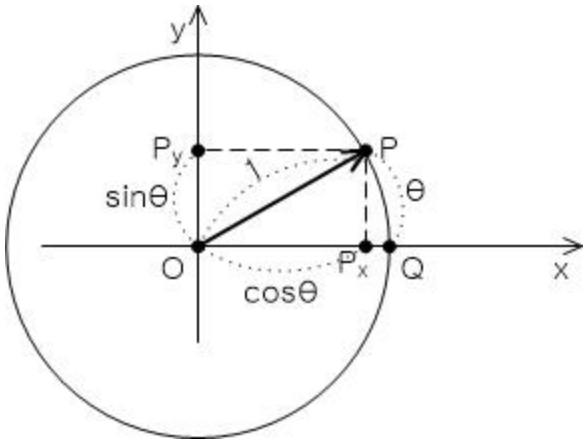
Pi and Degree

pi radian = 180 degree

Trigonemetric Functions



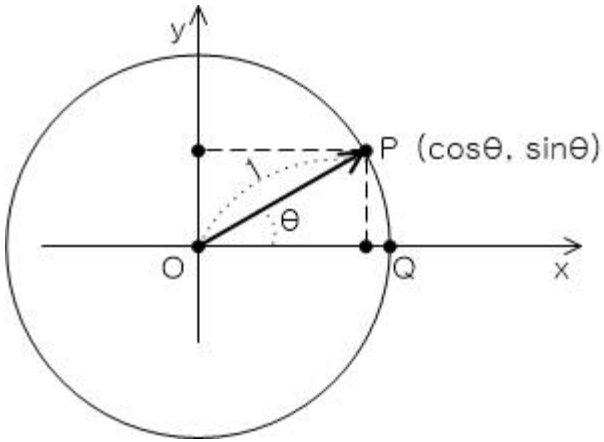
[Fig] unit circle



[Fig] Length of the projected line segment

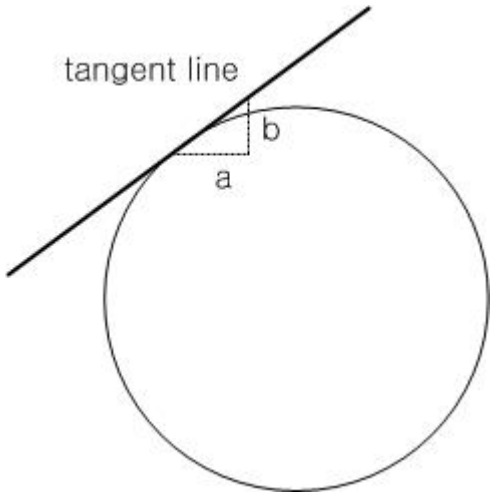
Sine

Cosine

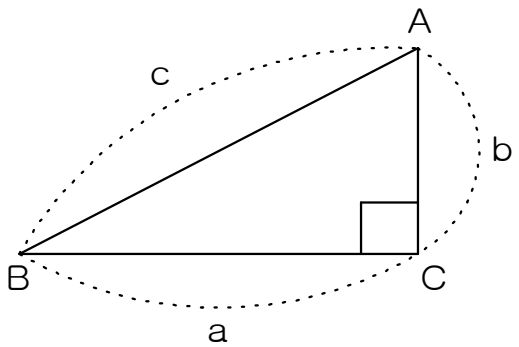


[Fig] Coordiante of P

(cos(θ), sin(θ))



[Fig] tangent line: Slope quotient is b/a



[Fig] Trigonometric Functions

Pythagorean Theorem

$$c^2 = a^2 + b^2,\ c = \sqrt{a^2 + b^2}$$

$$1^2 = \sin^2\theta + \cos^2\theta, 1 = \sin^2\theta + \cos^2\theta$$

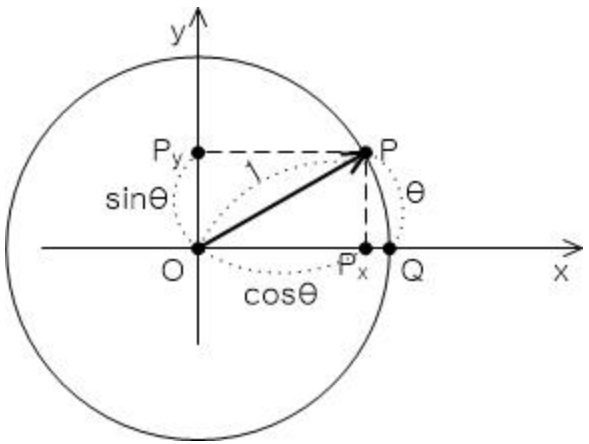
Tayler series

Trigonometric functions

sin(), cos()

Inverse Function

asin(), acos()



[Fig] cos()의 역함수의 정의

Length of Arc θ

Length of OP_x

arc cosine

$$\text{acos}(\cos\theta) = \theta$$

3 Vector

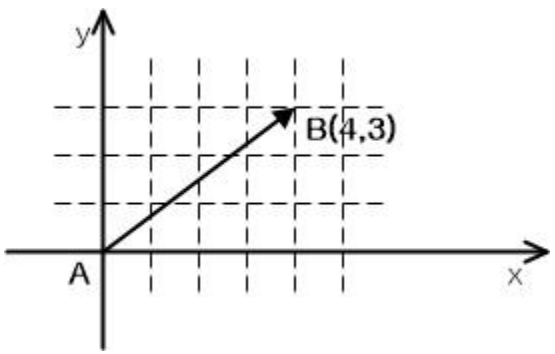
magnitude and direction

scalar

Speed and Velocity

initial point A, terminal point B

$v = \overrightarrow{AB}$



[Fig] Vector: $v = \overrightarrow{AB}$ is expressed as (4,3) or $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$

$v = \overrightarrow{AB}$

row vector (4,3)

column vector $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$

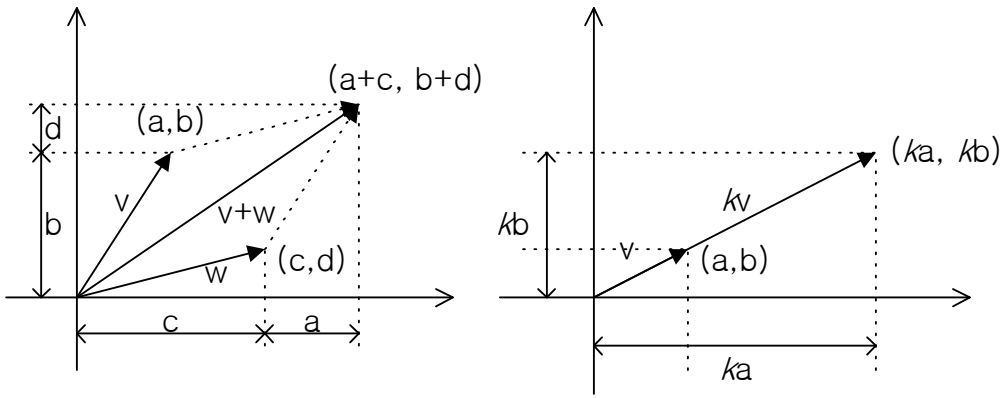
Vector valued funtion f() and g()

apply result of f($\begin{bmatrix} 4 \\ 3 \end{bmatrix}$) to g()

g(f($\begin{bmatrix} 4 \\ 3 \end{bmatrix}$))

g f $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$

Vector Operations



[Fig] Vector Addition and Scalar Multiplication

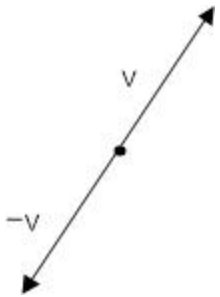
$\vec{v} = (a,b)$, $\vec{w} = (c,d)$

$$\vec{v} + \vec{w} = (a,b) + (c,d) = (a+c,\ b+d)$$

$\vec{v} = (a,b)$, real number k

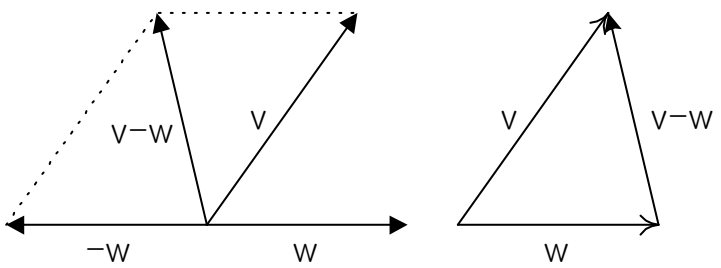
$$k\vec{v} = k(a,b) = (ka,\ kb)$$

Negative Vector



[Fig] Negative Vector

$v=(a,b),\ -v=(-a,-b)$



[Fig]Vector Subtraction

$\vec{v}-\vec{w}=(a-c,\ b-d)$

length or norm

$$|v|$$

$$|v| = \sqrt{a^2 + b^2}$$

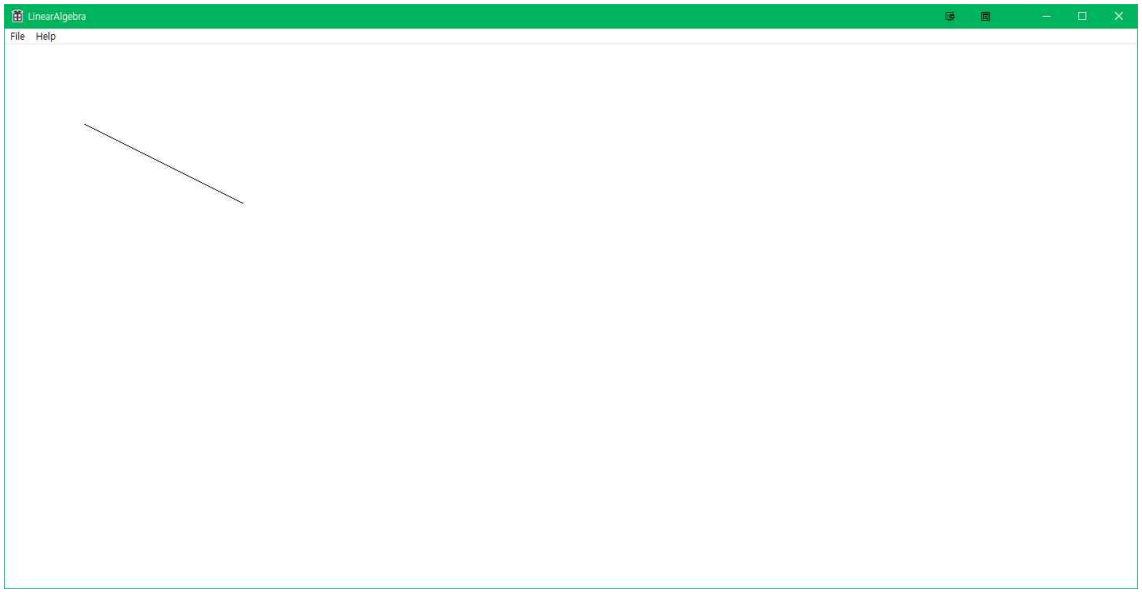
normalization

4 Implementing class KVector2

```
class KVector2
{
public:
    float   x;
    float   y;

public:
    KVector2(float tx, float ty) { x = tx; y = ty; }
    KVector2(int tx, int ty) { x = (float)tx; y = (float)ty; }
};

inline KVector2 operator+(const KVector2& lhs, const KVector2& rhs)
{
```

```
    KVector2 temp(lhs.x + rhs.x, lhs.y + rhs.y);
    return temp;
}

inline KVector2 operator*(float scalar, const KVector2& rhs)
{
    KVector2 temp(scalar*rhs.x, scalar*rhs.y);
    return temp;
}

inline KVector2 operator*(const KVector2& lhs, float scalar)
{
    KVector2 temp(scalar*lhs.x, scalar*lhs.y);
    return temp;
}
```

```
void KVectorUtil::DrawLine(HDC hdc, const KVector2& v0, const KVector2& v1)
{
    MoveToEx(hdc, (int)v0.x, (int)v0.y, nullptr);
    LineTo(hdc, (int)v1.x, (int)v1.y);
}
```



[Fig] LinearAlgebra_Step02 Vectors

Exercise

1. Implement Normalize() member function of class KVector2
2. Draw a line segment of length 200 in direction (3,2).
3. Draw a circle using sin() and cos()

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