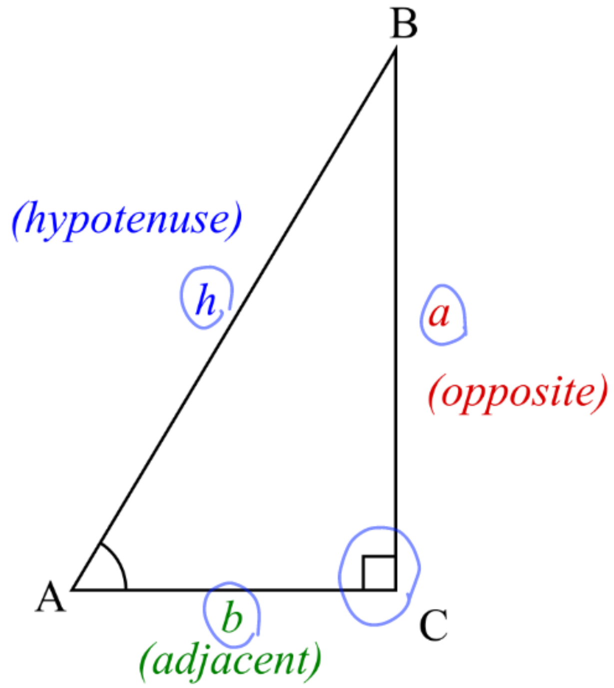
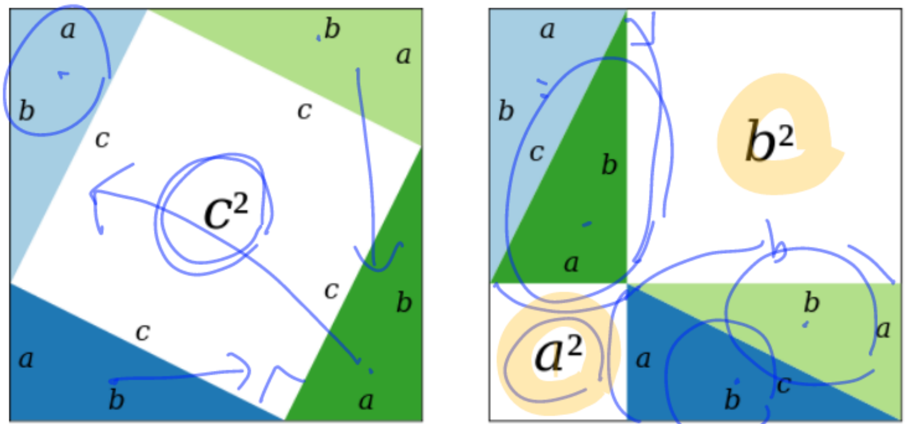


1. Pythagorian theorem
2. Trigonometric functions
3. number space.
4. 2-dimension rotation.

$$h*h = a*a + b*b$$

$$h^2 = a^2 + b^2$$



$$c^2 = a^2 + b^2$$

$$\boxed{\sqrt{4} = 2}$$

$$\boxed{\sqrt{9} = 3}$$

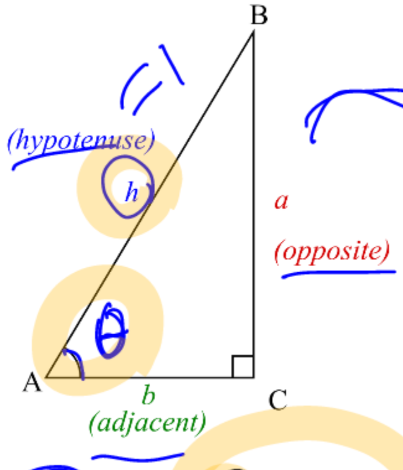
$$c = \sqrt{c^2} = \sqrt{a^2 + b^2}$$

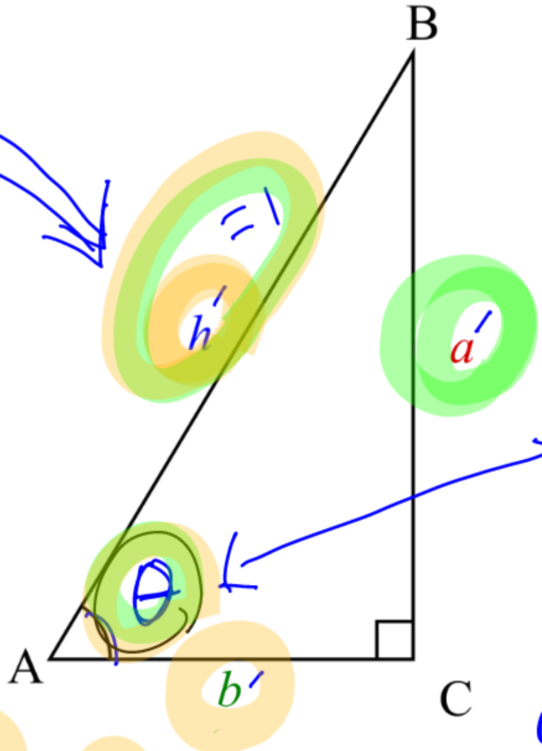
$$2^2 = 4$$

$$\sqrt{4} \rightarrow 2^2$$

$$\sqrt{9} \rightarrow 3^2$$

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





$\frac{a'}{h'} = \sin\theta$

$\frac{b'}{h'} = \cos\theta$

$\frac{b}{h}$

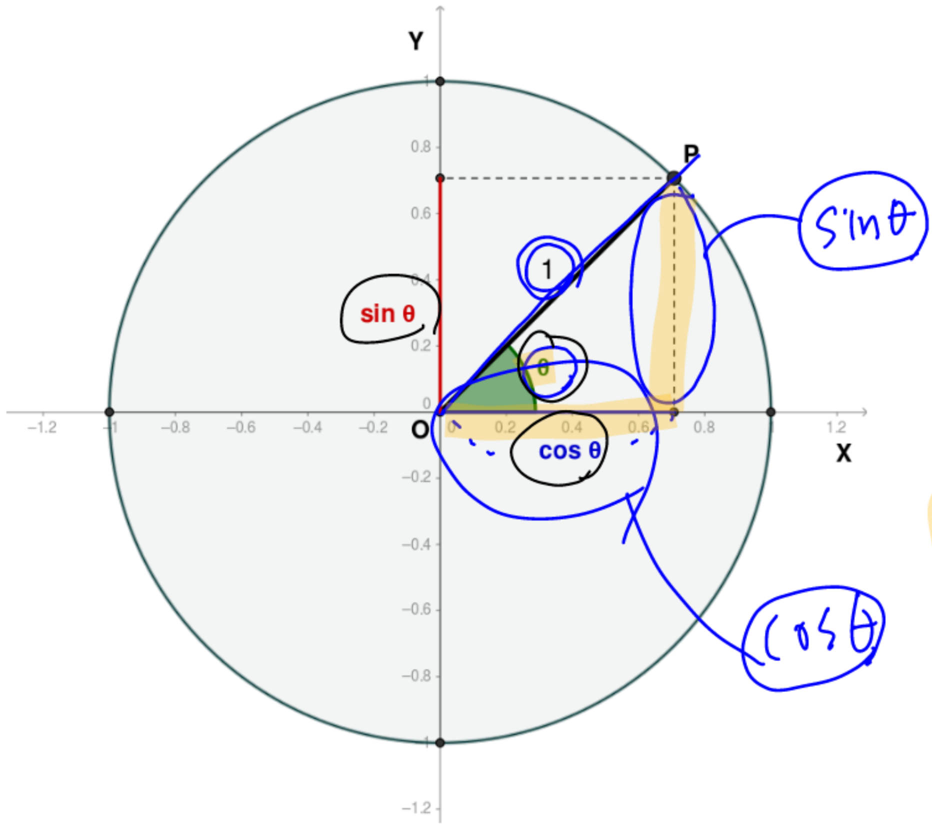
$\frac{a}{h} = \sin\theta$

$\rightarrow 1$

$\frac{b}{h} = \cos\theta$

$\frac{b}{h} = \frac{b}{1} = b = \cos\theta$

$\frac{a}{h} = \frac{a}{1} = \sin\theta$



$1^2 = (\sin\theta)^2 + (\cos\theta)^2$

$\downarrow$

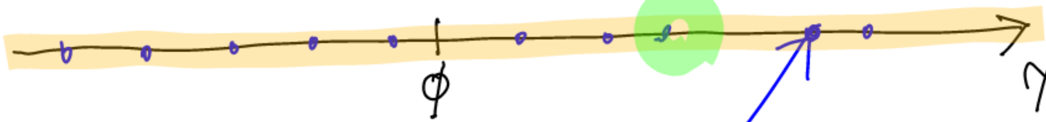
$1 = \sin^2\theta + \cos^2\theta$

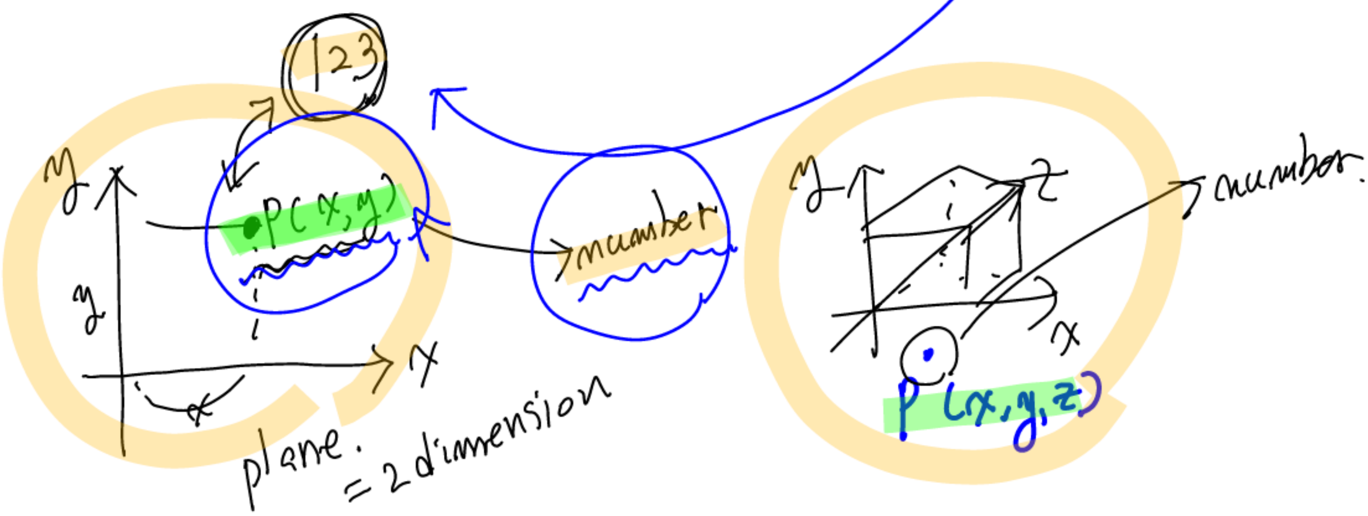
$\boxed{\sin^2\theta + \cos^2\theta = 1}$

123 number
↓ digit

number space.

space.





$\sqrt[2]{4} = 2$

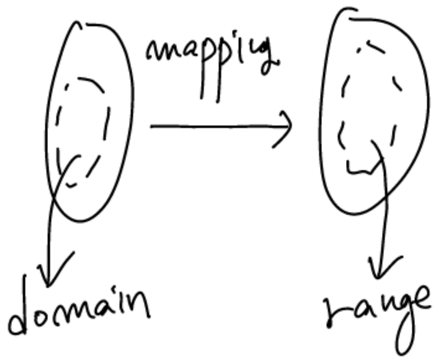
$\sqrt{9} = 3$

$\sqrt{1} = 1$

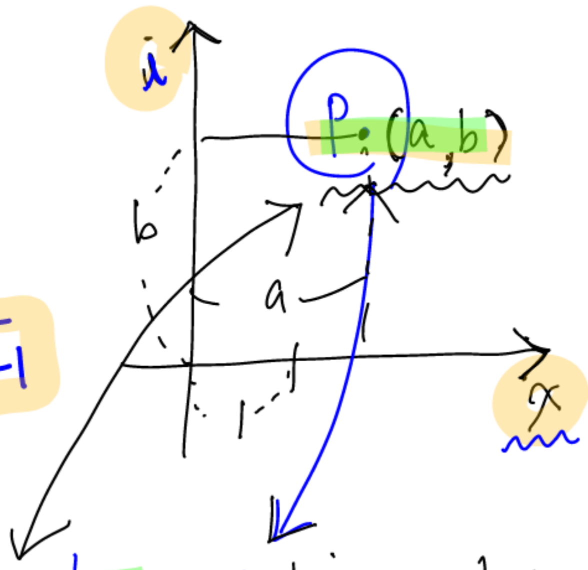
$\sqrt{\bigcirc}$ n > 0

~~$\sqrt{-4} = ?$~~

$\sqrt{-1}$ = imaginary number 허수 = i



$i = \sqrt{-1}$



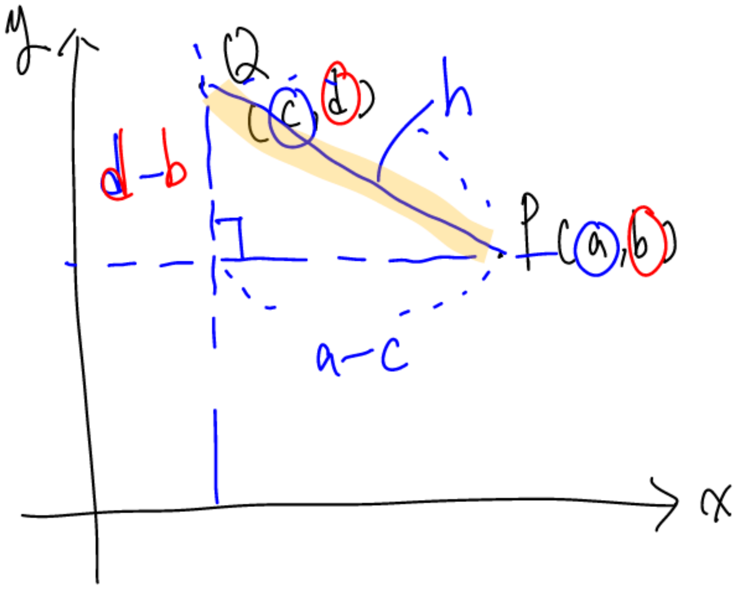
complex number

↓

복소수

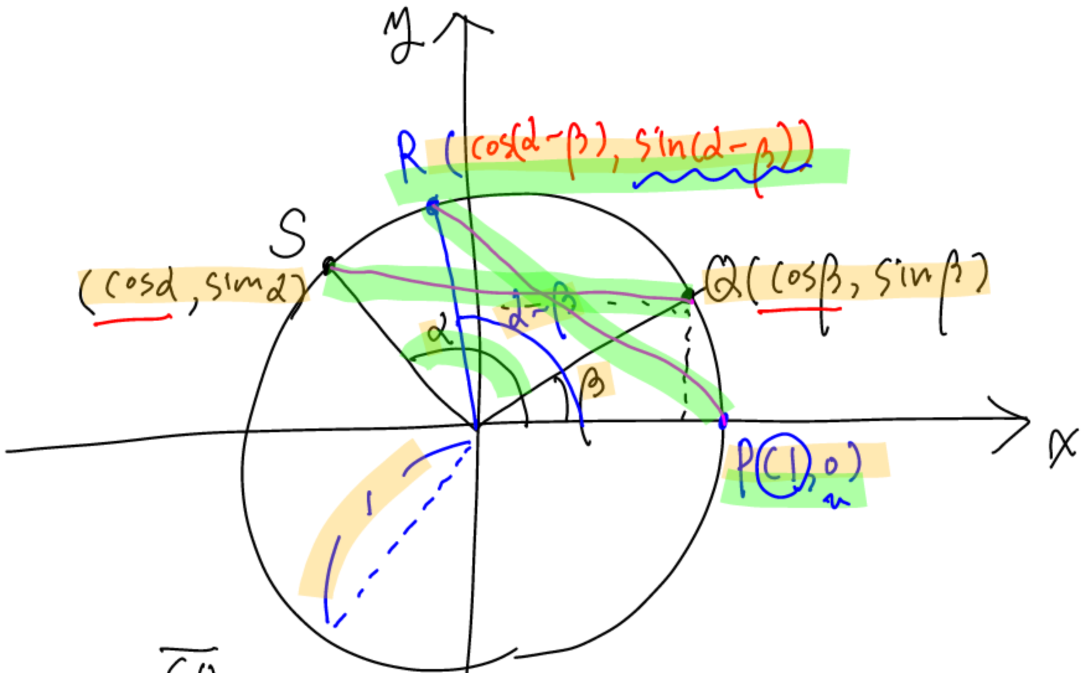
$a\cancel{x} + bi$ complex

$= a + bi \Rightarrow$ number



$$h^2 = (a-c)^2 + (d-b)^2$$

$$h = \sqrt{(a-c)^2 + (d-b)^2}$$



$\overline{SQ}$

$$\overline{SQ} = \overline{RP} = \sqrt{(\cos\alpha - \cos\beta)^2 + (\sin\alpha - \sin\beta)^2}$$

$$= \sqrt{(\cos(\alpha-\beta) - 1)^2 + (\sin(\alpha-\beta) - 0)^2}$$

$(a+b)^2=(a+b)(a+b)=a^2+ab+ba+b^2$

$=a^2+2ab+b^2$

$(a-b)^2=\cdots a^2-2ab+b^2$

$(\cos^2\alpha-2\cos\alpha\cos\beta+\cos^2\beta)+(\sin^2\alpha-2\sin\alpha\sin\beta+\sin^2\beta)$

$=(\cos^2(\alpha-\beta)-2\cos(\alpha-\beta)+1)+\sin^2(\alpha-\beta)$

$\cos^2\alpha+\sin^2\alpha+\cos^2\beta+\sin^2\beta-2\cos\alpha\cos\beta-2\sin\alpha\sin\beta$

$=\cos^2(\alpha-\beta)+\sin^2(\alpha-\beta)-2\cos(\alpha-\beta)+1$

2

1

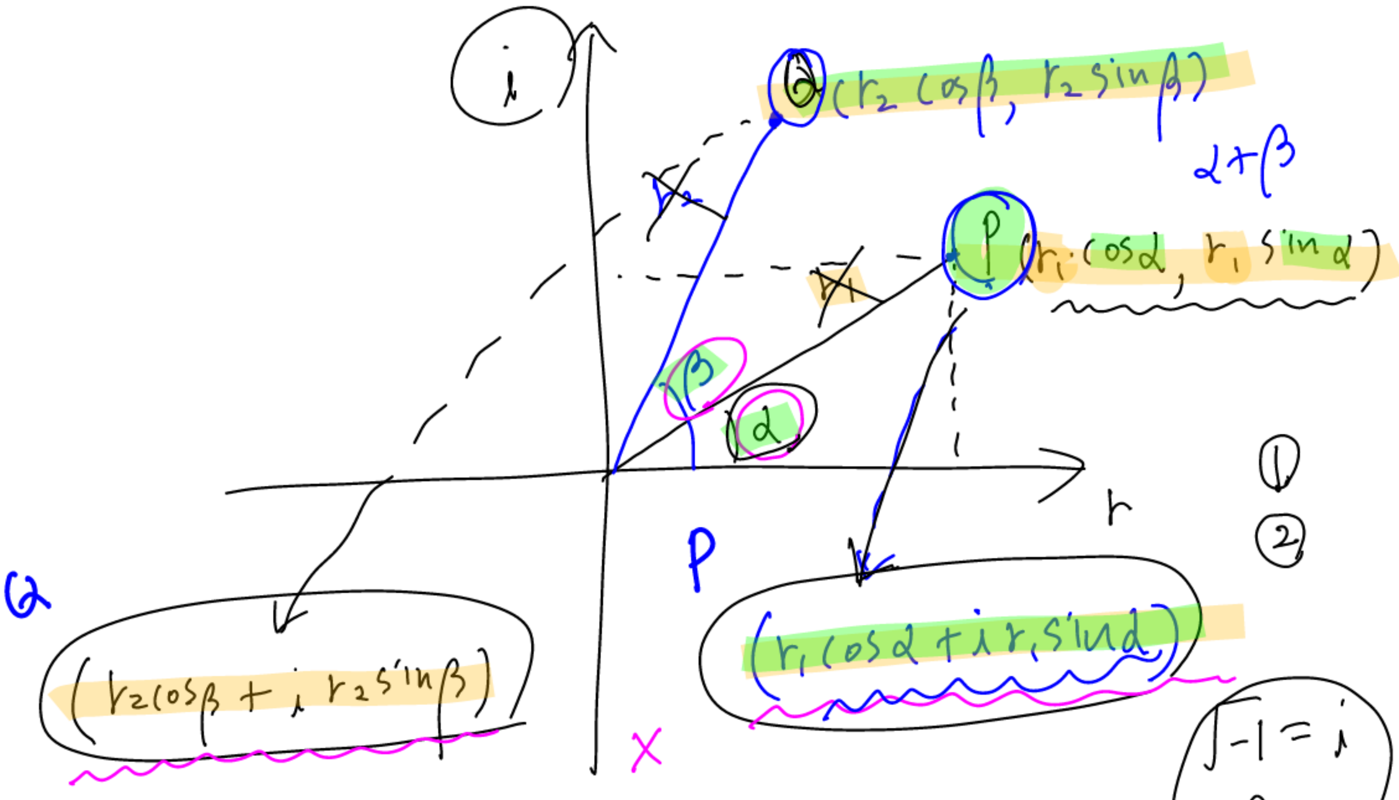
$\cancel{-2}\cos\alpha\cos\beta\ \cancel{-2}\sin\alpha\sin\beta=\cancel{-2}\cos(\alpha-\beta)$

$(\therefore)\ \cos\alpha\cos\beta+\sin\alpha\sin\beta=\cos(\alpha-\beta)$

$\cos(\alpha+\beta)=\cos\alpha\cos\beta-\sin\alpha\sin\beta$

$\sin(\alpha+\beta)=\sin\alpha\cos\beta+\cos\alpha\sin\beta$

$\sin(\alpha-\beta)=\sin\alpha\cos\beta-\cos\alpha\sin\beta$



$$Q * P = (\cos\beta + i \sin\beta) * (\cos\alpha + i \sin\alpha)$$

$$= r_1 r_2 \cos\alpha \cos\beta + i\, r_1 r_2 \sin\alpha \cos\beta + i\, r_1 r_2 \cos\alpha \sin\beta + i^2 r_1 r_2 \sin\alpha \sin\beta$$

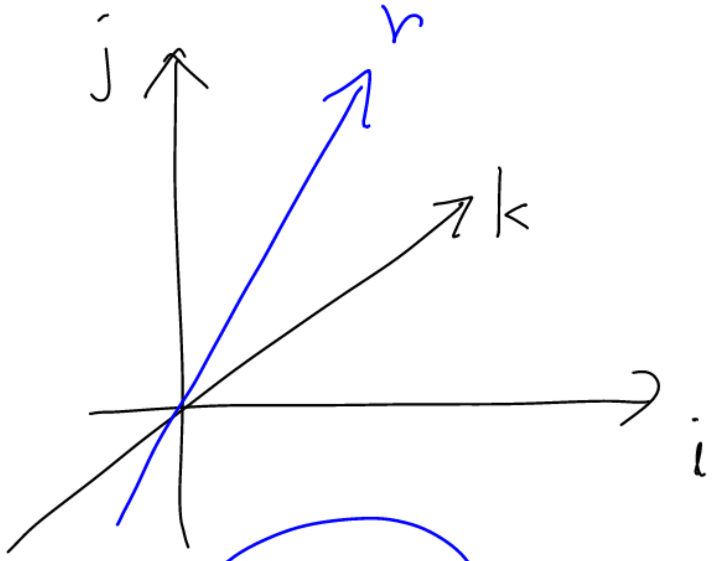
$$= r_1 r_2 \cos\alpha \cos\beta - r_1 r_2 \sin\alpha \sin\beta + i\, r_1 r_2 (\sin\alpha \cos\beta + \cos\alpha \sin\beta)$$

$$= r_1 r_2 \left((\cos\alpha \cos\beta - \sin\alpha \sin\beta) + i (\sin\alpha \cos\beta + \cos\alpha \sin\beta) \right)$$

$$= \left(\cos(\alpha+\beta) + i \sin(\alpha+\beta) \right)$$

$$\Rightarrow (\cos\beta + i \sin\beta) * (\cos\alpha + i \sin\alpha)$$

$$= \cos(\alpha+\beta) + i \sin(\alpha+\beta)$$



$i = \sqrt{-1}$

$j = \sqrt{-1}$

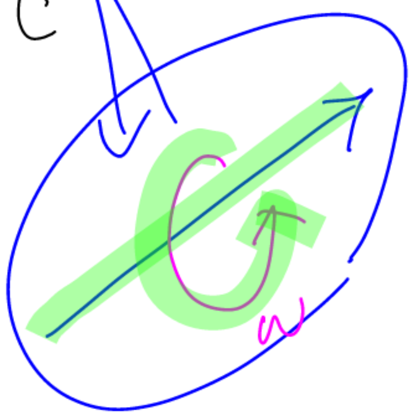
r = real number

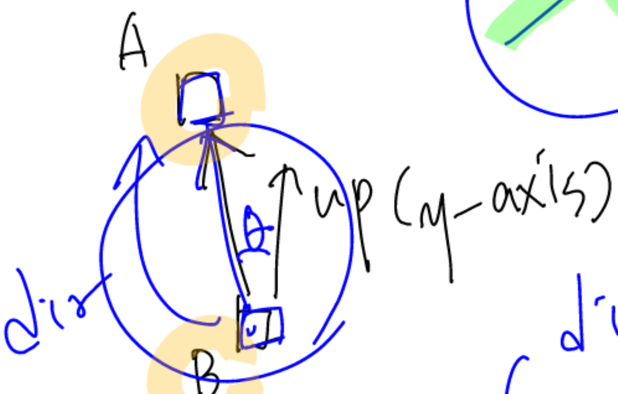
$k = \sqrt{-1}$

$A = (i, j, k, w)$ quaternion.

real number

$B \quad A * B = C$





dir = A.position − B.position.

(up → Quaternion

B.rotation =