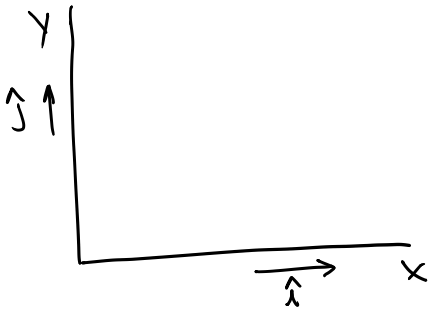
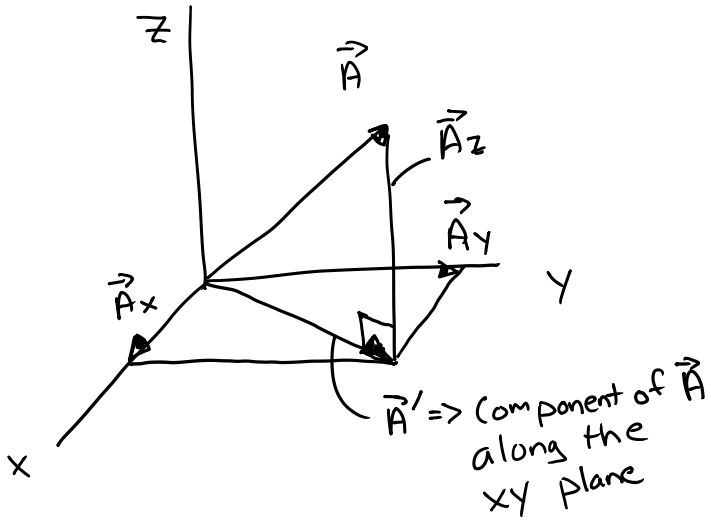
2.4) Vectors in 3-D

Cartesian Vector Notation

$$\vec{F}_x = F_x \hat{\imath}$$
$$\vec{F}_y = F_y \hat{\jmath}$$
$$\vec{F} = \{F_x \hat{\imath} + F_y \hat{\jmath}\}$$
or $\langle F_x, F_y \rangle$



Vectors in 3-D



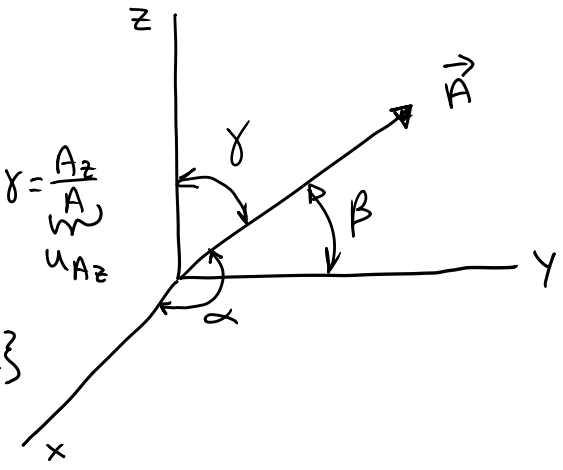
Unit Vector
- Specifies the Direction of **A**
- Unitless
- Magnitudes of 1
- Any vector (Force, Position) that has the same line of action will have the same unit vector

$$\vec{u}_A = \frac{\vec{A}}{A} \quad \text{or} \quad \vec{A} = A\vec{u}_A$$

$\vec{u}_A$: Unit Vector

Coordinate Direction Angles

- Angles from a vector to the x, y, and z axes



$$\cos\alpha = \frac{A_x}{A} \quad \cos\beta = \frac{A_y}{A} \quad \cos\gamma = \frac{A_z}{A}$$

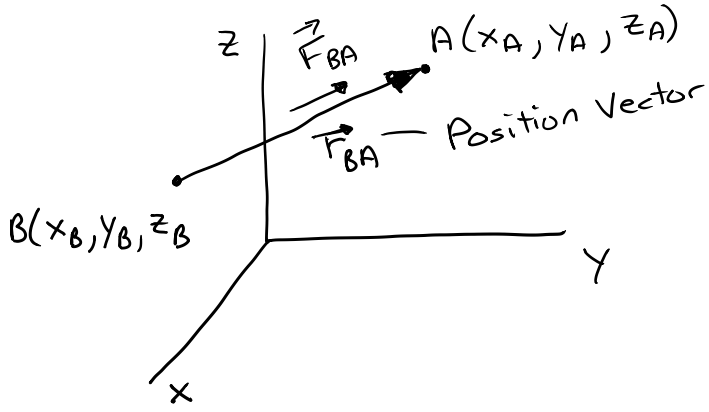
$$u_{Ax} \qquad u_{Ay} \qquad u_{Az}$$

$$\vec{u}_A = \{\cos\alpha\,\hat{i} + \cos\beta\,\hat{j} + \cos\gamma\,\hat{k}\}$$

$$u_A = \sqrt{\cos^2\alpha + \cos^2\beta + \cos^2\gamma} \qquad (u_A = 1)$$

$$\boxed{1 = \cos^2\alpha + \cos^2\beta + \cos^2\gamma}$$

Position Vectors



$$\vec{r}_{BA} = \{(x_A - x_B)\,\hat{i} + (y_A - y_B)\,\hat{j} + (z_A - z_B)\,\hat{k}\}$$

$$\vec{u}_{BA} = \frac{\vec{r}_{BA}}{r_{BA}}$$

$$\vec{F}_{BA} = F_{BA}\,\vec{u}_{BA}$$

Resultant Force

$$F_{Rx} = \Sigma F_x$$

$$F_{Ry} = \Sigma F_y$$

$$F_{Rz} = \Sigma F_z$$