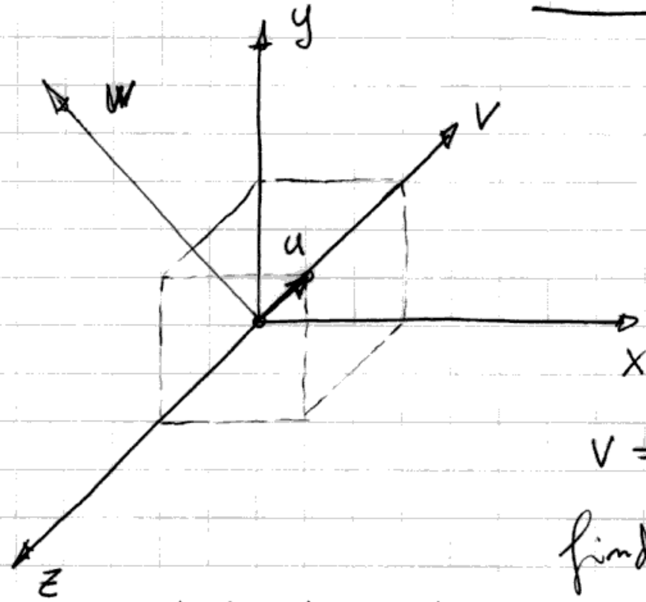
Exercise 5.11



$u = (1, 1, 1)$

$u_N = (1/\sqrt{3}, 1/\sqrt{3}, 1/\sqrt{3})$

find v normal to u $(u \cdot v = 0)$

$v = (1, 1, -2)$ $\quad v_N = (1/\sqrt{6}, 1/\sqrt{6}, -2/\sqrt{6})$

find w normal to both u and v

$$w = \begin{vmatrix} i & j & k \\ 1 & 1 & 1 \\ 1 & 1 & -2 \end{vmatrix} = i \begin{vmatrix} 1 & 1 \\ 1 & -2 \end{vmatrix} - j \begin{vmatrix} 1 & 1 \\ 1 & -2 \end{vmatrix} + k \begin{vmatrix} 1 & 1 \\ 1 & 1 \end{vmatrix}$$

$$= (-3, 3, 0) \qquad w_N = (-3/\sqrt{18}, 3/\sqrt{18}, 0)$$

$$T = \begin{pmatrix} 1/\sqrt{3} & 1/\sqrt{3} & 1/\sqrt{3} & 0 \\ 1/\sqrt{6} & 1/\sqrt{6} & -2/\sqrt{6} & 0 \\ -3/\sqrt{18} & 3/\sqrt{18} & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad T^{-1} = T^T = \begin{pmatrix} 1/\sqrt{3} & 1/\sqrt{6} & -3/\sqrt{18} & 0 \\ 1/\sqrt{3} & 1/\sqrt{6} & 3/\sqrt{18} & 0 \\ 1/\sqrt{3} & -2/\sqrt{6} & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

T makes u coincident with x:

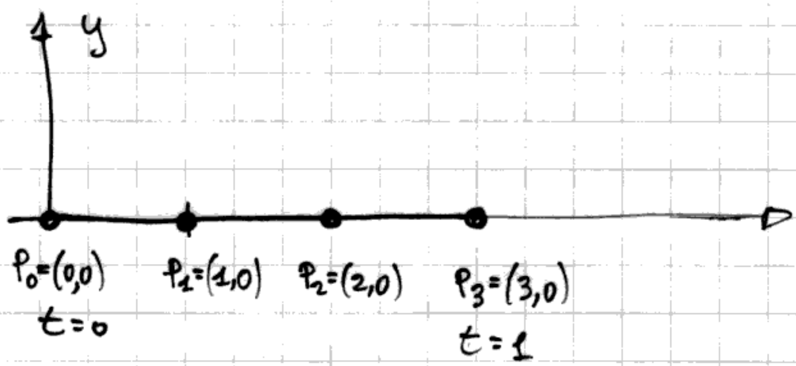
$$T \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 3/\sqrt{3} \\ 0 \\ 0 \end{pmatrix}$$

$$CCW_x = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad P' = \underbrace{T^{-1}\, CCW_x\, T}_{\text{Rotation}}\, P$$

Exercise 11.12

Equations relating G_H to G_B:

$$R_1 = \beta (P_2 - P_1)$$
$$R_2 = \beta (P_4 - P_3)$$



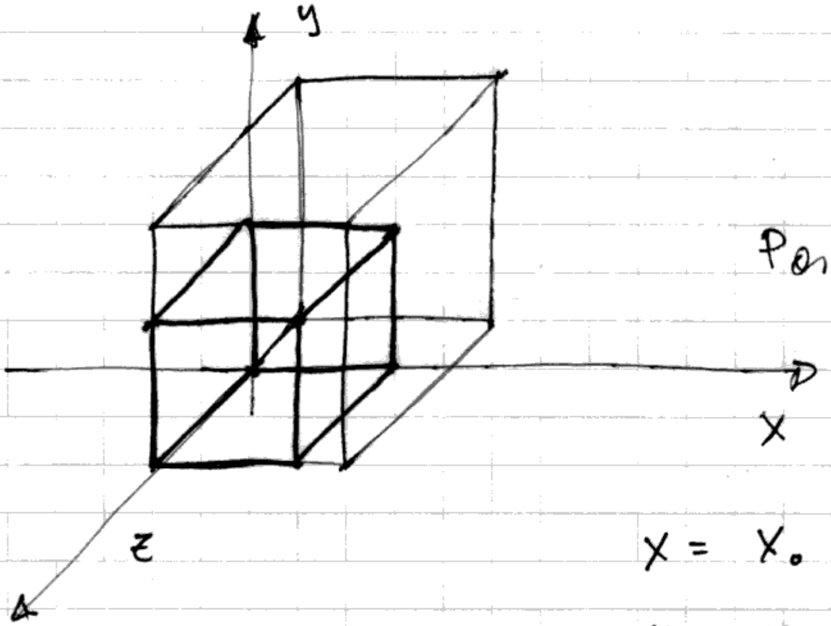
Velocity must be constant:

$$R_1 = R_2 \quad \Rightarrow \quad \beta (P_2 - P_1) = \beta (P_4 - P_3)$$

But $V = \dfrac{\Delta P}{\Delta t} = 3$

So $\beta (P_2 - P_1) = 3$ and $\beta = 3$

Exercise 6.6



$P_0 = (x_0, y_0, z_0)$

$P_1 = (x_1, y_1, z_1)$

Parametric equation:

$$P = P_0 + t\,(P_1 - P_0)$$

$$t \in [0,1]$$

$$x = x_0 + t\,(x_1 - x_0)$$

$$y = y_0 + t\,(y_1 - y_0) \qquad t \in [0,1]$$

$$z = z_0 + t\,(z_1 - z_0)$$

Intersection with $x = A$

$$A = x_0 + t\,(x_1 - x_0) \quad \Rightarrow \quad \frac{A - x_0}{x_1 - x_0} = t \quad \text{if } t \in [0,1]$$

$$y_A = y_0 + \frac{(A - x_0)(y_1 - y_0)}{(x_1 - x_0)} \qquad z_A = z_0 + \frac{(A - x_0)(z_1 - z_0)}{(x_1 - x_0)}$$

intersection point $\begin{pmatrix} A \\ y_A \\ z_A \end{pmatrix}$

Clipping against unit cube $\Rightarrow$ $A = 0$ or $A = 1$