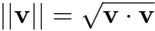
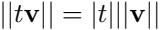
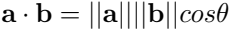


$$\|v\| = \sqrt{v_x^2 + v_y^2 + \dots}$$





$$a \cdot b = axbx + axbx + \dots$$







$$\mathbf{a} \times \mathbf{b} = \begin{bmatrix} a_y b_z - a_z b_y \\ a_z b_x - a_x b_z \\ a_x b_y - a_y b_x \end{bmatrix}$$

$A = \begin{pmatrix} 1 & 1 \\ 2 & 1 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$

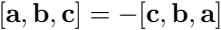


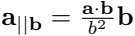




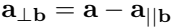
$\frac{dx}{dt} = \frac{dx}{dt} - \frac{dx}{dt}$

$$[a,b,c] = (a \times b) \cdot c = (b \times c) \cdot a = (c \times a) \cdot b$$





$$\mathbf{a}_{||\mathbf{b}} = \frac{1}{b^2} \begin{bmatrix} b_x^2 & b_x b_y & b_x b_z \\ b_x b_y & b_y^2 & b_y b_z \\ b_x b_z & b_y b_z & b_z^2 \end{bmatrix} \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix}$$

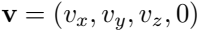


2023-2024

$$u_1 = v_1, u_2 = v_2 - (v_2) / |v_1|, u_3 = v_3 - (v_3) / |v_1| / |v_2| \dots$$

$$\mathbf{a} \otimes \mathbf{b} = \mathbf{a} \mathbf{b}^T = \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} \begin{bmatrix} b_x & b_y & b_z \end{bmatrix}$$

$$= \begin{bmatrix} a_x b_x & a_x b_y & a_x b_z \\ a_y b_x & a_y b_y & a_y b_z \\ a_z b_x & a_z b_y & a_z b_z \end{bmatrix}$$



1 = 1

ALWAYS BE A GOOD PERSON

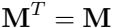
Mathew

=

Mathew

1 = [abc]

$$\mathbf{M} = \begin{bmatrix} X & a & b \\ a & X & c \\ b & c & X \end{bmatrix}$$



$$\mathbf{M} = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$$



$$I_v I_v = v_x^2 + v_y^2 + v_z^2$$

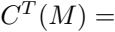
$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

$$\det(\mathbf{M}) = \sum_{i=0}^{n-1} M_{ik} (-1)^{i+k} |\mathbf{M}_{ik}|$$



Q: What is the difference between a function and a procedure?

$$m-1 = \frac{1}{\det(M)} \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$$



$$A^{-1} = \frac{1}{A_{00}A_{11} - A_{01}A_{10}} \begin{bmatrix} A_{11} & -A_{01} \\ -A_{10} & A_{00} \end{bmatrix}$$

$$\mathbf{B}^{-1} = \frac{1}{\det(\mathbf{B})} \begin{bmatrix} B_{11}B_{22} - B_{12}B_{21} & B_{02}B_{21} - B_{01}B_{22} & B_{01}B_{12} - B_{02}B_{11} \\ B_{12}B_{20} - B_{10}B_{22} & B_{00}B_{22} - B_{02}B_{20} & B_{02}B_{10} - B_{00}B_{12} \\ B_{10}B_{21} - B_{11}B_{20} & B_{01}B_{20} - B_{00}B_{21} & B_{00}B_{11} - B_{01}B_{10} \end{bmatrix}$$

$$\mathbf{M}^{-1} = \frac{1}{[a, b, c]} \begin{bmatrix} b \times c \\ c \times a \\ a \times b \end{bmatrix}$$

$$\mathbf{M}^{-1} = \frac{1}{\mathbf{s} \cdot \mathbf{v} + \mathbf{t} \cdot \mathbf{u}} \begin{bmatrix} \mathbf{b} \times \mathbf{v} + y\mathbf{t} & -\mathbf{b} \cdot \mathbf{t} \\ \mathbf{v} \times \mathbf{a} - x\mathbf{t} & \mathbf{a} \cdot \mathbf{t} \\ \mathbf{d} \times \mathbf{u} + w\mathbf{s} & -\mathbf{d} \cdot \mathbf{s} \\ \mathbf{u} \times \mathbf{c} - z\mathbf{s} & \mathbf{c} \cdot \mathbf{s} \end{bmatrix}$$









$$\mathbf{M}^T \mathbf{M} = \begin{bmatrix} a^2 & a \cdot b & a \cdot c \\ b \cdot a & b^2 & b \cdot c \\ c \cdot a & c \cdot b & c^2 \end{bmatrix}$$





$$M_{rot_x}(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$$

$$M_{rot_y}(\theta) = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{bmatrix}$$

$$M_{rot_z}(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$M_{rot}(\theta, \mathbf{a}) = \begin{bmatrix} c + (1 - c)a_x^2 & (1 - c)a_xa_y - sa_z & (1 - c)a_xa_z + sa_y \\ (1 - c)a_xa_y + sa_z & c + (1 - c)a_y^2 & (1 - c)a_ya_z - sa_x \\ (1 - c)a_xa_z - sa_y & (1 - c)a_ya_z + sa_x & c + (1 - c)a_z^2 \end{bmatrix}$$





$$M_{reflect}(\mathbf{a}) = \begin{bmatrix} 1 - 2a_x^2 & -2a_xa_y & -2a_xa_z \\ -2a_xa_y & 1 - 2a_y^2 & -2a_ya_z \\ -2a_xa_z & -2a_ya_z & 1 - 2a_z^2 \end{bmatrix}$$

$$Minvol(\mathbf{a}) = \begin{bmatrix} 2a_x^2 - 1 & 2a_xa_y & 2a_xa_z \\ 2a_xa_y & 2a_y^2 - 1 & 2a_ya_z \\ 2a_xa_z & 2a_ya_z & 2a_z^2 - 1 \end{bmatrix}$$

$$M_{scale}(s_x, s_y, s_z) = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & s_z \end{bmatrix}$$

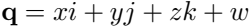
$$M_{scale}(s, \mathbf{a}) = \begin{bmatrix} (s-1)a_x^2 + 1 & (s-1)a_x a_y & (s-1)a_x a_z \\ (s-1)a_x a_y & (s-1)a_y^2 + 1 & (s-1)a_y a_z \\ (s-1)a_x a_z & (s-1)a_y a_z & (s-1)a_z^2 + 1 \end{bmatrix}$$

$$M_{skew}(\theta, \mathbf{a}, \mathbf{b}) = \begin{bmatrix} a_x b_x \tan \theta + 1 & a_x b_y \tan \theta & a_x b_z \tan \theta \\ a_y b_x \tan \theta & a_y b_y \tan \theta + 1 & a_y b_z \tan \theta \\ a_z b_x \tan \theta & a_z b_y \tan \theta & a_z b_z \tan \theta + 1 \end{bmatrix}$$

Mathematics for
the 21st Century

$$\mathbf{H} = \begin{bmatrix} \mathbf{M} & \mathbf{t} \\ \mathbf{0} & \mathbf{1} \end{bmatrix}$$

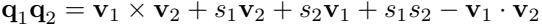
$$H^{-1} = \begin{bmatrix} M^{-1} & -M^{-1}t \\ 0 & 1 \end{bmatrix}$$



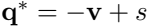


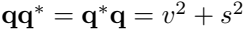
$$Q = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \psi^* \psi + \int_{-\infty}^{\infty} \psi^* \psi$$

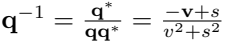


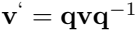


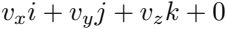
$Q_1 = Q_2 = 2V_1 \times V_2$



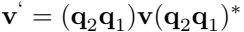




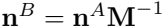








$$\mathbf{M}_{rot}(\mathbf{q}) = \begin{bmatrix} 1 - 2y^2 - 2z^2 & 2(xy - wz) & 2(xz + wy) \\ 2(xy + wz) & 1 - 2x^2 - 2z^2 & 2(yz - wx) \\ 2(xz - wy) & 2(yz + wx) & 1 - 2x^2 - 2y^2 \end{bmatrix}$$



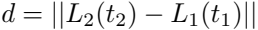
$\mathbb{E}[\ln A] = \mathbb{E}[\ln B]$

$$a = \sqrt{x^2 - \frac{(v \cdot v)^2}{v^2}}$$

$$d = \sqrt{\frac{(u \times v)^2}{v^2}}$$

$$\begin{bmatrix} t_1 \\ t_2 \end{bmatrix} = \frac{1}{(v_1 \cdot v_2)^2 - v_1^2 v_2^2} \begin{bmatrix} -v_2^2 & v_1 \cdot v_2 \\ -v_1 \cdot v_2 & v_1^2 \end{bmatrix} \begin{bmatrix} (p_2 - p_1) \cdot v_1 \\ (p_2 - p_1) \cdot v_2 \end{bmatrix}$$

$$p_1 p_2 \dots p_{i-1} p_{i+1} \dots p_{j-1} p_{j+1} \dots p_{n-1} p_n$$



$$a = \sqrt{\frac{(p_2 - p_1) \times v_1}{v_1^2}}$$

$f \cdot p = 0, f = [v_x v_y v_z]$
 $= [v_x v_y v_z]$



2021

$$\mathbf{H}_{reflect}(\mathbf{f}) = \begin{bmatrix} 1 - 2n_x^2 & -2n_xn_y & -2n_xn_z & -2n_xd \\ -2n_xn_y & 1 - 2n_y^2 & -2n_yn_z & -2n_yd \\ -2n_xn_z & -2n_yn_z & 1 - 2n_z^2 & -2n_zd \\ 0 & 0 & 0 & 1 \end{bmatrix}$$



$$P = \frac{d_1(n_3 \times n_2) + d_2(n_1 \times n_3) + d_3(n_2 \times n_1)}{[n_1, n_2, n_3]}$$

$$P = \frac{d_1(v \times n_2) + d_2(n_1 \times v)}{v^2}$$



$f_1 \circ f_2 \circ \dots \circ f_n = f_1 \circ f_2 \circ \dots \circ f_n$

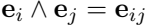
1991-1992



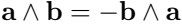
$$Q = \frac{v_1 \cdot w_2 + v_2 \cdot w_1}{v_1 \times v_2}$$

$$\{v_B\} = \{v_A\} + t \{v_A\}$$

$$a \wedge b = (a_y b_z - a_z b_y) e_{23} + (a_z b_x - a_x b_z) e_{31} + (a_x b_y - a_y b_x) e_{12}$$



$$a \wedge b = (a_y b_z - a_z b_y) e_1 + (a_z b_x - a_x b_z) e_2 + (a_x b_y - a_y b_x) e_3$$





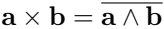
$$a \wedge b \wedge c = (a_1 b_1 c_1 + a_2 b_2 c_2 + a_3 b_3 c_3 - a_1 b_2 c_3 - a_2 b_1 c_3 - a_3 b_1 c_2)(e_1 \wedge e_2 \wedge e_3)$$

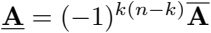
or **A** *or* **B** $=$ *or* **A** $+$ *or* **B**

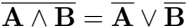
Q. A. B. 19(A) B. A.

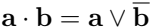
THE FIRST PART OF THE











$$P_1 q_1 (q_1 - p_1) e_{11} + (q_1 - p_1) e_{12} + (q_2 - p_2) e_{13} + (p_1 q_2 - p_2 q_1) e_{31} + (p_2 q_1 - p_1 q_2) e_{12}$$

$$P_1 I = (L_{m1} P_2 - L_{m2} P_1) \overline{e_1} + (L_{m1} P_2 - L_{m2} P_1) \overline{e_2} + (L_{m1} P_2 - L_{m2} P_1) \overline{e_3} + (L_{m1} P_2 - L_{m2} P_1) \overline{e_4}$$





$$f_1 g_1 = (f_2 g_2 - f_3 g_3) e_{11} + (f_2 g_3 - f_3 g_2) e_{12} + (f_3 g_1 - f_1 g_3) e_{13} + (f_3 g_2 - f_2 g_3) e_{21} + (f_1 g_3 - f_3 g_1) e_{22} + (f_1 g_2 - f_2 g_1) e_{23} + (f_2 g_1 - f_1 g_2) e_{31} + (f_1 g_2 - f_2 g_1) e_{32} + (f_2 g_3 - f_3 g_2) e_{33}$$

$$I = (L_{m_1} f_1 - L_{m_2} f_2) e_1 + (L_{m_2} f_2 - L_{m_3} f_3) e_2 + (L_{m_3} f_3 - L_{m_4} f_4) e_3 + (L_{m_4} f_4 - L_{m_5} f_5) e_4$$



A pixelated, grayscale representation of the word "Lew". The letters are thick and blocky, with a jagged, pixelated edge. The color is a dark gray, and the background is white. The font style is reminiscent of early digital typography or video game text.





$$[abc]^{-1} = \frac{1}{a \wedge b \wedge c} \begin{bmatrix} \underline{b \wedge c} \\ -\underline{a \wedge c} \\ \underline{a \wedge b} \end{bmatrix}$$

$$[abcd]^{-1} = \frac{1}{\underline{a \wedge b \wedge c \wedge d}} \begin{bmatrix} \underline{b \wedge c \wedge d} \\ -\underline{a \wedge c \wedge d} \\ \underline{a \wedge b \wedge d} \\ -\underline{a \wedge b \wedge c} \end{bmatrix}$$