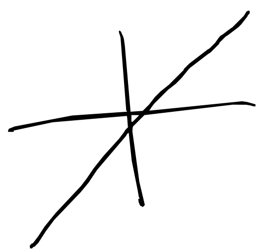
linear

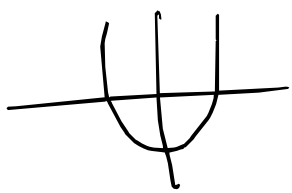
if:

additive: $F(x+y) = F(x) + F(y)$

$F(aX) = aF(x)$

if $a \in \mathbb{R}$





higher order polynomials

$x^2, \ x^3,$

w/ degree > 1

<u>lin eq</u>

$b = a_1 x_1 + a_2 x_2 + \cdots + a_n x_n$

$a_1 \ldots a_n$ parameters

$x_1 \ldots x_n$ variables

$b_1 =$ } linear system
b_2

tanks purchased from NATO allies by Ukraine ↓ $1 \ldots i \ldots n$

y_i

$y_i = 20$

$x_i =$ # of visits by country i to UK

$y_i = \boxed{20} + \boxed{2} x_i$

↳ $y = \underline{m} x + \underline{b} \longrightarrow y = \beta_0 + \beta_1 x$

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2$

sps: france has 1 visit, 3
germany has 2, 4

$$\left|\begin{aligned} 3 &= \beta_0 + \beta_1 \cdot \boxed{1} \\ 4 &= \beta_0 + \beta_1 \cdot 2 \end{aligned}\right|$$

$4 - 3 = \cancel{\beta_0 -} \beta_0 + 2\beta_1 - 1\beta_1$

$1 = \beta_1$

$3 = \beta_0 + 1 \cdot 1$

$\beta_0 = 2$

Stored as:

final grades	HW 1	HW 2	HW 3	Final
95	5	10	100	45
30	0	10	13	40
100	100	0	100	100

$$\begin{bmatrix} 95 \\ 30 \\ 100 \end{bmatrix} = \begin{bmatrix} 5 & 10 & 100 & 45 \\ 0 & 10 & 13 & 40 \\ 100 & 0 & 100 & 100 \end{bmatrix} \begin{bmatrix} \text{HW 1} \\ \text{HW 2} \\ \text{HW 3} \\ \text{Fina} \end{bmatrix}$$

$$\begin{bmatrix} 4 \\ 3 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}$$

$$4 = \beta_0 + 2\beta_1$$

$$3 = \beta_0 + \beta_1$$

matrices

$m \times n$ matrices have: m rows, n columns

$\mathbb{R} \times \mathbb{C}$

Roman catholic

Rum & coke

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

$$\begin{array}{ccccc} 1 & 2 & 3 & \cdots & n \end{array}$$
$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & & \\ a_{m1} & \cdots & a_{mn} \end{bmatrix}$$

M <- c(1, 2, 3), c(1, 4, 5), rowwise = T

$$\begin{bmatrix} 1 & 1 \\ 2 & 4 \\ 3 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} | & | & & | \\ \vec{C}_1 & \vec{C}_2 & \cdots & \vec{C}_n \\ | & | & & | \end{bmatrix}$$

$$\vec{C}_i = \begin{bmatrix} a_{1i} \\ \vdots \\ a_{mi} \end{bmatrix}$$

$$= \begin{bmatrix} - \vec{R}_1' - \\ - \vec{R}_2 - \\ \vdots \end{bmatrix}$$

$$\vec{R}_i' = \begin{bmatrix} a_{i1} & \cdots & a_{in} \end{bmatrix}$$

$$R^T = R' = \begin{bmatrix} 1 & \cdot & \cdot & \cdot & n \end{bmatrix}$$

$$R = \begin{bmatrix} 1 \\ \vdots \\ n \end{bmatrix}$$

$$\begin{bmatrix} R \\ \vdots \\ R_2 \end{bmatrix} \qquad \begin{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} \\ \\ \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} \end{bmatrix}$$

$$\Sigma \, \Pi \, [X] = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$$

$$\begin{bmatrix} 4 \\ 3 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}$$

$$= \begin{bmatrix} 1\beta_0 + 2\beta_1 \\ 1\beta_0 + 1\beta_1 \end{bmatrix}$$

$A \cdot \beta$

$$X = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$$

$$Y = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$