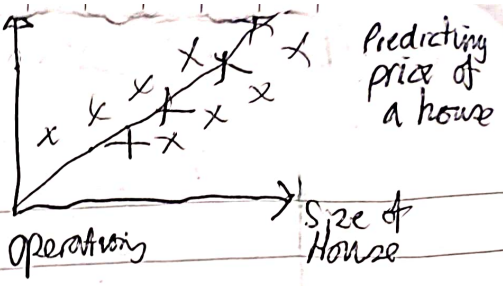
③ Machine Learning and AI

① Model training — using linear algebra for multiple matrix multiplication → Matrix arithmetic operations



→ Linear Equations

Equation of a straight line — $ax + by + c = 0$

$y = mx + c$

② Dimensionality Reduction

PCA — Linear Algebra algorithms ~~used~~ ~~linear~~

uses EIGEN VALUE & EIGEN VECTOR

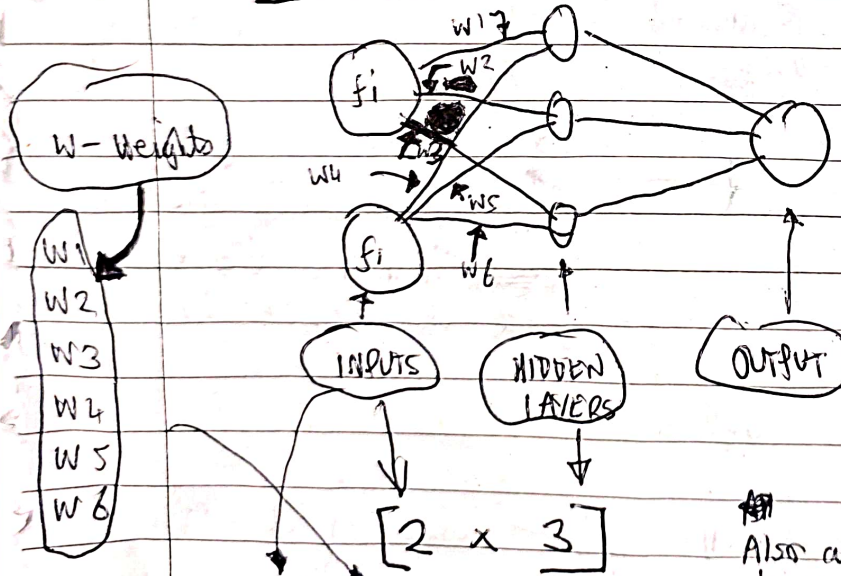
↓

Helps to reduce Higher Dimension to Lower Dimensions

③ Neural Networks — Forward Propogation and Backward Propogation

Example

INPUT: Area (f_1), No. Rooms (f_2) → OUTPUT: Price



$[2 \times 3]$

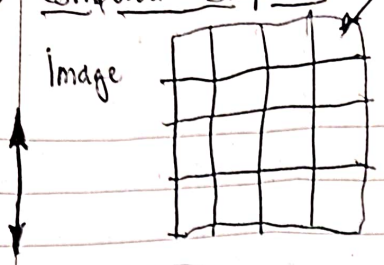
Also add bias

$\begin{bmatrix} f_1 \\ f_2 \end{bmatrix}$ $\begin{bmatrix} w_1 & w_2 & w_3 \\ w_4 & w_5 & w_6 \end{bmatrix}$ = Requires Matrix Multiplication

Forward propogation

- GPU - cores - parallel
- Tensorflow - Tensors
- Values turned into Tensors

(4) (B) Computer Graphics



0 - 255
Each Pixel has a RGB value

changes in
— Scale, rotate, colour

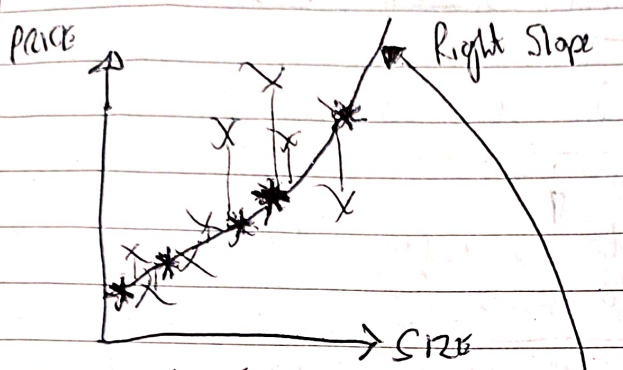
done by ~~image~~ linear algebra to transform image

(5) Optimisation

= regression

Solving equations → linear equation → $y = mx + c$

equation of a straight line



Slope or coefficient

~~intercept~~ intercept

* correct points
x out of range

This is calculated using

$y = mx + c$ → finds right slope and intercept

~~fitting~~

use a function

$f(x)$ - maximise function to ~~find~~ minimise the error to find the right line

This is called Optimisation

Will use Gradient Descend — uses an Optimiser

INPUT → OUTPUT

(1, 2) = ∅ ← Predicted Eraser

x = (1, 2) y = ∅

∅ - Eraser
1 - Pencil

W = 0.1, 0.3
b = 0.5

$z = w_1 \cdot x_1 + w_2 \cdot x_2 + b$

~~1 × 0.1 + 2~~

$0.1 \times 1 + 0.3 \times 2 + 0.5$

$0.1 + 0.6 + 0.5$

= 1.2. Weighted sum

$f(x) = \begin{cases} 1 \Rightarrow \emptyset & \text{Pencil} \checkmark \\ \emptyset < \emptyset & \end{cases}$

Model is Wrong

Weights and/or bias is wrong

OTHER NOTE – changing weight 0.3 to −0.3 would change weighted sum for first example
– Not 2.8 but −1.4 ∞

INPUTS (2, 7) would not be 1 they'd be ∅

TRUE: $y_T = 1$ ↑ correct

FALSE: $y_F = 0$ ↑ wrong prediction

UPDATE WEIGHTS AND FORMULA

$$w_i = w_i + \eta \cdot (Y_{TRUE} - Y_{PRED}) \cdot x_i$$

$$b = b + \eta \cdot (y_{TRUE} - y_{PRED})$$

$y_T = 1$
$y_P = \emptyset$

x (2, 7)
W (0.1, −0.3)
b (0.5)
η (0.1)

b = b

y_T y_P

$0.5 + 0.1 \times 1$
$0.6 + 0.1$

~~$w_1 = 0.1 + 0.1 \cdot ($ $)$~~

$w_1 = 0.1 + 0.1 \times (1 - 0) \times 2 = 0.3$

$w_2 = -0.3 + 0.1 \times (1 - 0) \times 7 = 0.4$

$0.1 + 0.1 \times 1 \times 2$
$0.1 + 0.1 \times 2$
$0.1 + 0.2 = 0.3$

$-0.3 + 0.1 \times 1 \times 7$
$-0.3 + 0.1 \times 7$
$-0.3 + 0.7$
$= 0.4$

$z = w_1 \cdot x_1 + w_2 \cdot x_2 + b$

$0.3 \times 2 + 0.4 \times 7 + 0.5$

$0.6 + 2.8 + 0.5$

= ~~3.9~~ 4.0

$f(x) = \begin{cases} 1 \Rightarrow \emptyset & \checkmark \\ \emptyset < \emptyset & \end{cases}$

CORRECT PREDICTION WITH UPDATED FORMULA