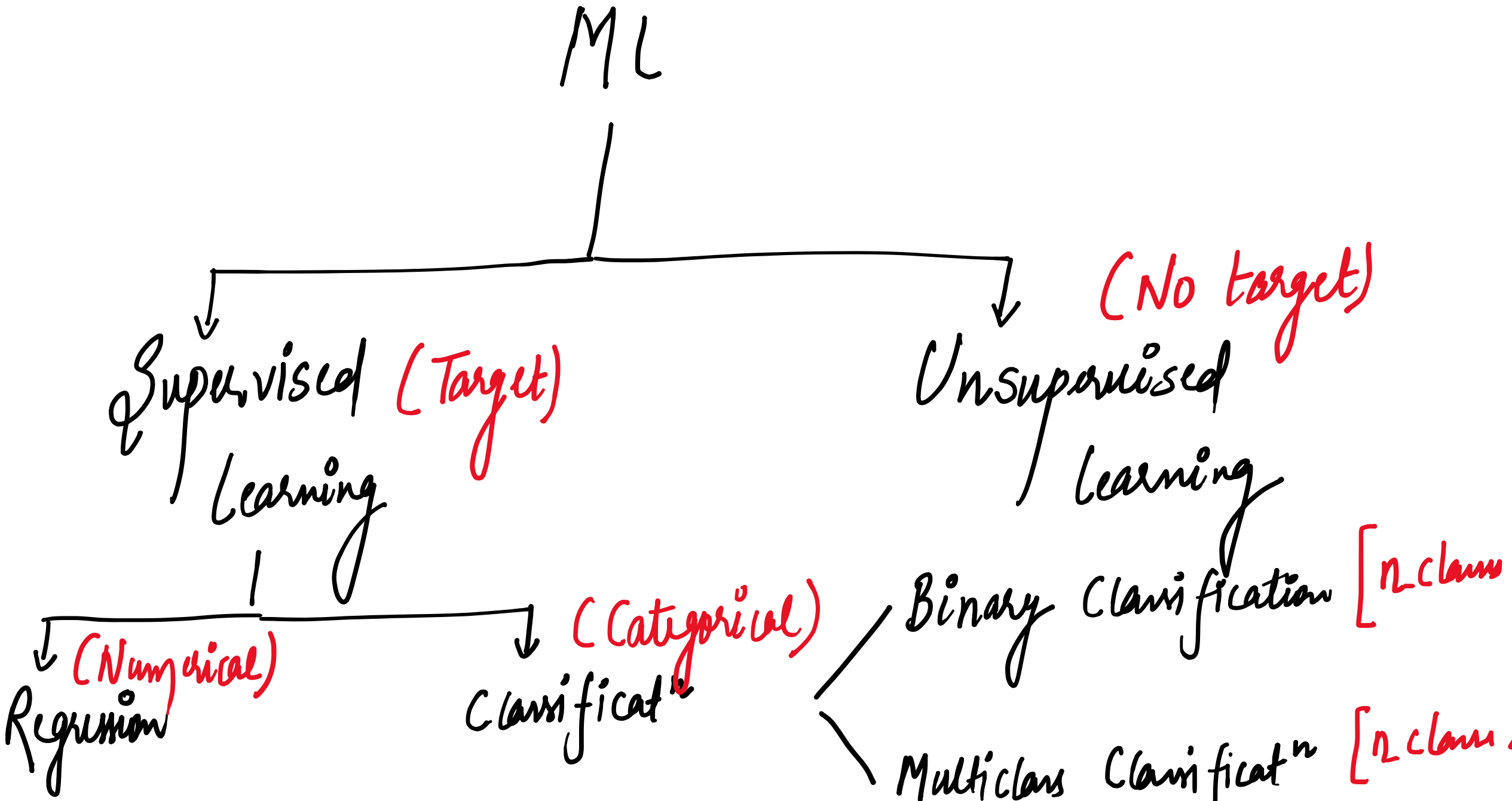
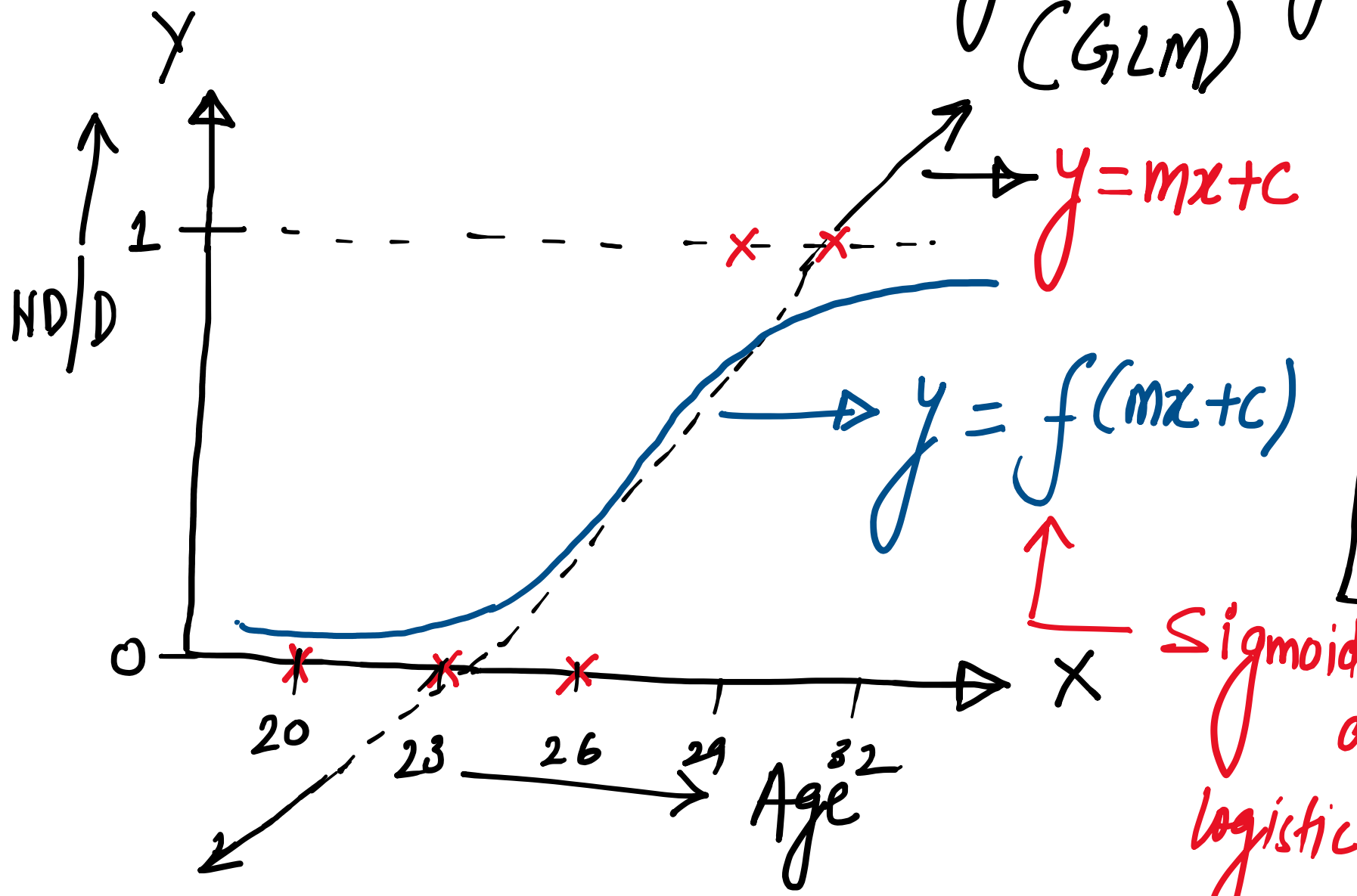

ML
Supervised Learning
(Target)
Unsupervised learning
(No target)
Regression
(Numerical)
Classificat"
(Categorical)
Binary Classification
Multiclass Classificat"

→ Applications :-

* Approval/Rejection of CC/loan application (fintech)
* Churn/Non-Churn of Customer (telecom)
* Customer reviews Sentiment analysis (Positive/Negative/Neural)
* Customer will purchase Upgrad course or not (Marketing)

Intitution behind logistic regression :- (GLM)

D → 1 (+
ND → 0



$y = mx + c$

$y = f(mx+c)$

Sigmoid transformatn
or
logistic transformatn (logit)

X	Y
Age	D/ND
20	0
22	0
24	0
28	1
30	1

→ Linear Regression :-

$$y \in [-\infty, \infty]$$

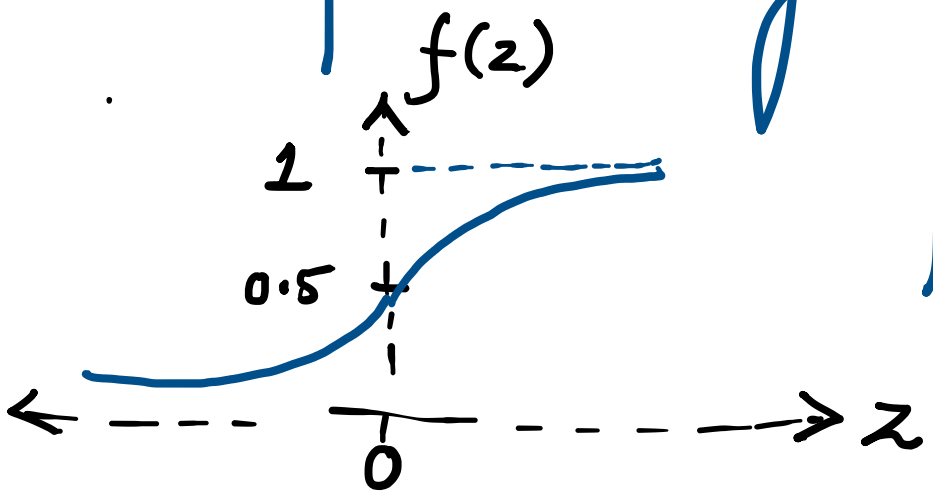
→ {Logistic Regression} :- ↓ transformation (logistic) or Sigmoid

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

* Generalised linear model

→ Sigmoid fⁿ :- f(z)

* S-Shaped curve
* $f(z) \in [0, 1]$
* Mathematically,



$$f(z) = \frac{1}{1+e^{-z}}$$

* $y = f(mx+c)$

$$y = \frac{1}{1+e^{-(mx+c)}}$$

→ final eqⁿ for logistic regression

Ques :- Calculate the value of $f(z)$ for $z = 1000$!

Sol $$f(z) = \frac{1}{1+e^{-z}}$$

$$= \frac{1}{1+e^{-1000}} \quad e^{-1000} \to 0 \quad \approx 1$$

Ques :- Calculate the value of $f(z)$ for $z = -1000$?

Sol $$f(z) = \frac{1}{1+e^{-z}}$$

$$= \frac{1}{1+e^{-(-1000)}} = \frac{1}{1+e^{1000}} = \frac{1}{\text{very big number}}$$

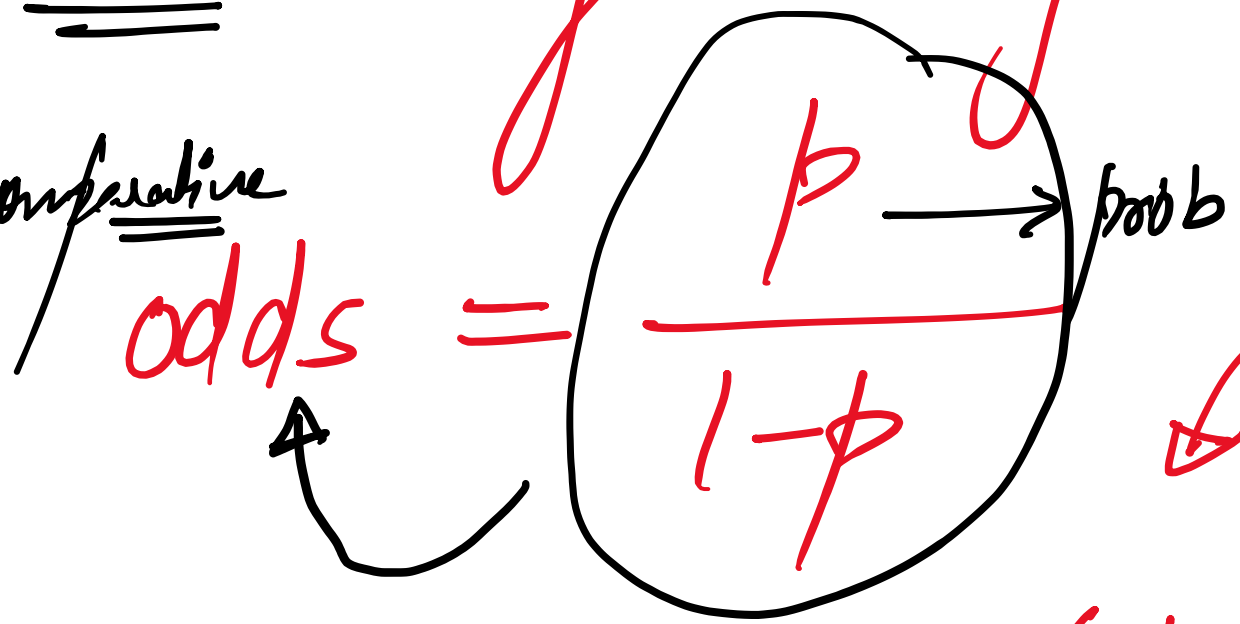
$$\simeq 0$$

→ Odds :- Ratio of prob. of any event happening to the prob of same event (not) happening.

$$\text{Odds}(X=1) = \frac{P(X=1)}{P(X\neq 1)} = \frac{1/6}{1-1/6} = \underline{\underline{1/5}}$$

$$\text{odds}(X=h) = \frac{P(X=h)}{P(X\neq h)} = \frac{1/2}{1/2} = 1$$

→ Log odds :- Logarithm of odds



$$\text{log odds} = \log\left(\frac{p}{1-p}\right) = \log\left(\frac{y}{1-y}\right)$$

→ Mathematical Derivation :-

$$\log\left(\frac{y}{1-y}\right) = mx + c$$

→ Logit fⁿ

→ log odds follows linear equatⁿ

$$\frac{y}{1-y} = e^{mx+c}$$

$$y = (1-y)e^{mx+c}$$

$$y = e^{mx+c} - ye^{mx+c}$$

$$y + ye^{mx+c} = e^{mx+c}$$

$$y(1+e^{mx+c}) = e^{mx+c}$$

$$y = \frac{e^{mx+c}}{1+e^{mx+c}}$$

$$y = \frac{\frac{e^{mx+c}}{e^{mx+c}}}{\frac{1+e^{mx+c}}{e^{mx+c}}}$$

$$y = \frac{1}{\frac{1}{e^{mx+c}} + \frac{e^{mx+c}}{e^{mx+c}}}$$

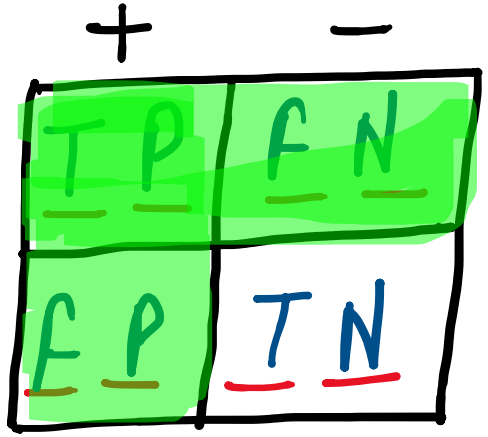
$$\rightarrow \boxed{y = \frac{1}{1 + e^{-(mx+c)}}}$$

Evaluation Metrics :-

1 → +ve
0 → -ve

* Confusion Matrix :- 2 x 2 matrix

↑ TP → True positives (+ → +) ✓
↑ TN → True negatives (− → −) ✓
↓ FP → False positives (− → +) ✗
↓ FN → False negatives (+ → −) ✗



A

P

0^- → $0^- - 0^- - 0^-$ } TN
0^- → $1^+ - 0^- - 1^+$ } FP
1^+ → $0^- - 1^+ - 0^-$ } FN
1^+ → $1^+ - 1^+ - 1^+$ } TP

→ Accuracy :-

$$A = \frac{\text{Correct Predictions}}{\text{Total Predictions}}$$

$$A = \frac{TP + TN}{TP + FP + TN + FN}$$

→ Recall / Sensitivity / True Positive Rate (TPR) :-

$$R = \frac{\text{Corrected predicted +ve}}{\text{Total actual +ve}}$$

$$R = \frac{TP}{TP + FN}$$

→ Precision :-

$$P = \frac{\text{Correctly predicted +ve}}{\text{Total predicted +ve}}$$

$$P = \frac{TP}{TP + FP}$$

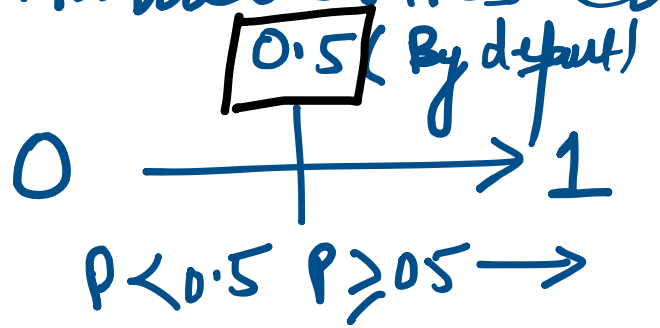
→ F1-Score :- (Combination of Precision & Recall)

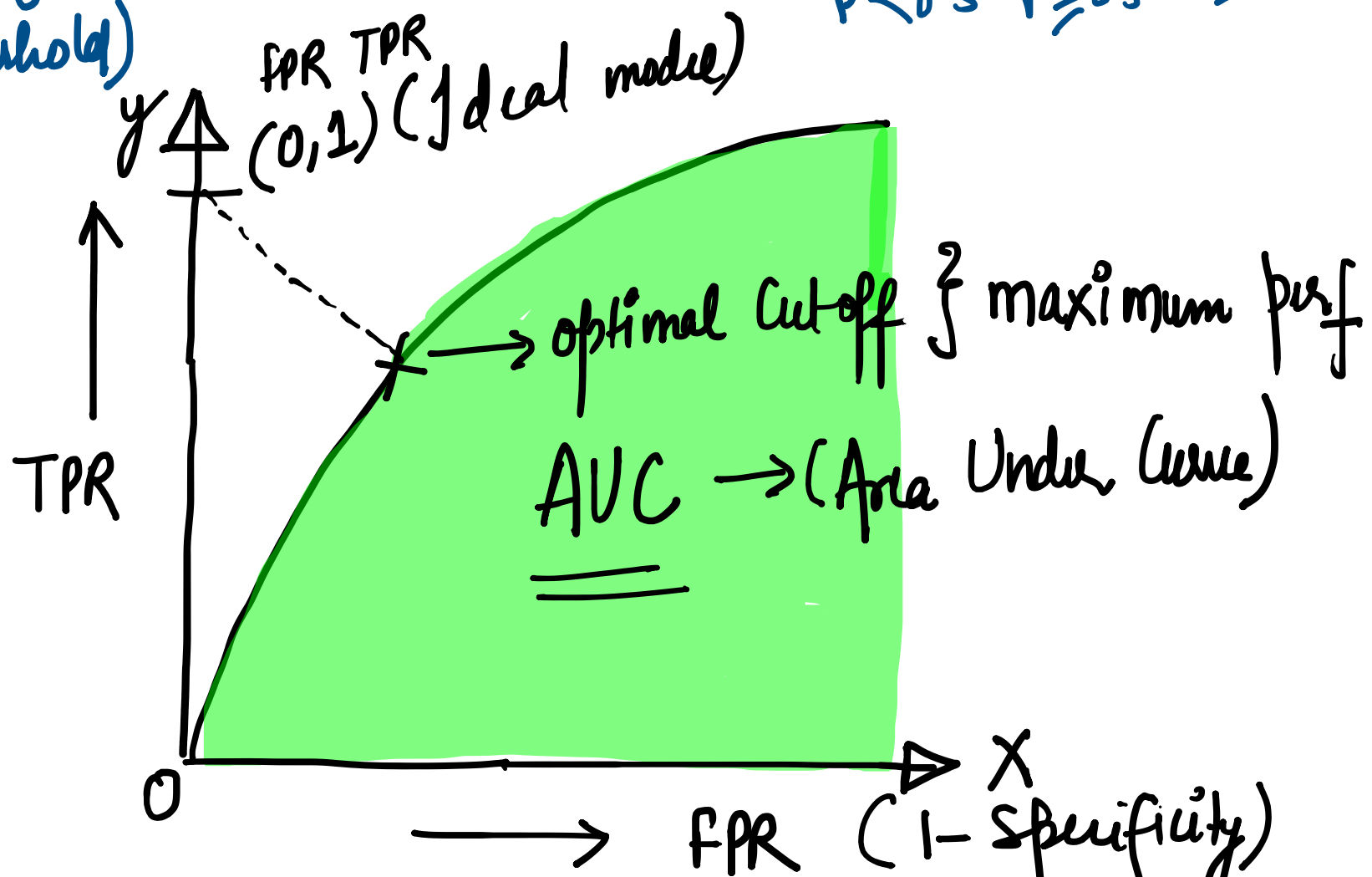
$$\text{F1-Score} = \frac{2 \times P \times R}{P + R}$$

* Harmonic mean of Precision & recall.

→ ROC-AUC :- Receiver Operating Characteristics Curve

* Performance of classificatn model (AUC)
* model cutoff (threshold)





1 p_1

2 p_2

3 p_3

$\Big\}$ $\max(p_1, p_2, p_3)$ $\longrightarrow$ final Ans