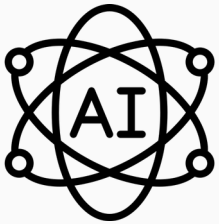
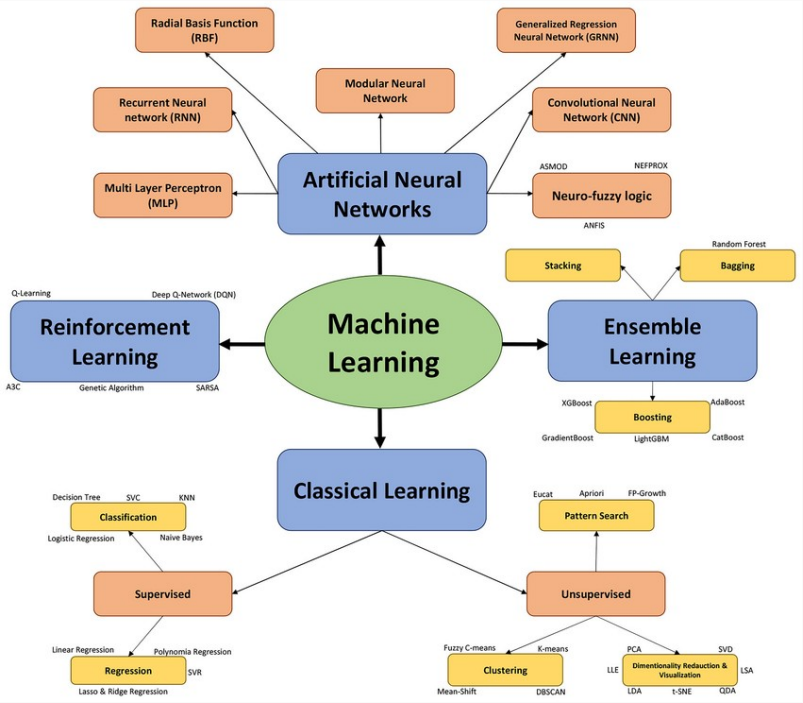


4 Days Workshop on

Artificial Intellegence

Machine Learning Algorithms



Regression And Classification

What exactly is AI Model ? How does it learn ?

- An AI model is made up of math and numbers that help it make decisions.
- Inside a model, it has **Inputs** (what we give it), **Weights** (how important each input is), **Rules** (math formulas to process the inputs) and **Outputs** (the result or prediction).
- Models try to make predictions.
- They calculate the error between prediction and actual value.
- The model adjusts it’s weights to reduce this error (training).

Revisiting Linear Regression

[redacted]. The following show the improvement (gain in reading speed) of 8 students in a speed reading program and the number of weeks they have been in program.

Number of weeks	4	5	3	9	7	10	4	5
Speed gain	85	120	48	192	164	234	74	110

2

[redacted]

b. Find the regression equation of speed gain on number of weeks.

c. Estimate speed gain of a student who has been in program for 6 weeks and interpret the slope of the line.

Regression

- Input: **X’s** (features, independent, predictors, explanatory variables).
- Output: **y** (outcome, response, dependent variable)

- **Goal**: Find a regression function: **$y = f(x, b)$**
- Simple Linear Regression: **$y = b_0 + b_1 * x$**
- Multiple Linear Regression: **$y = b_0 + b_1x_1 + b_2x_2 + ... + b_nx_n$**

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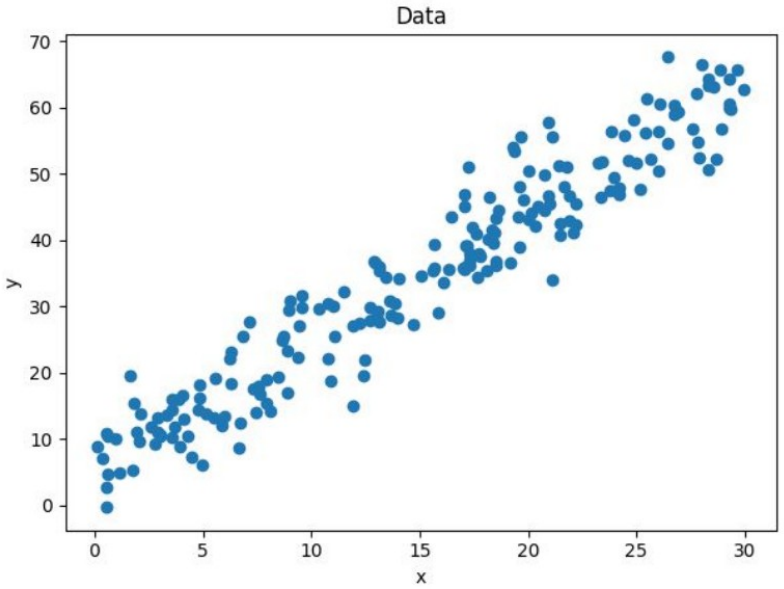
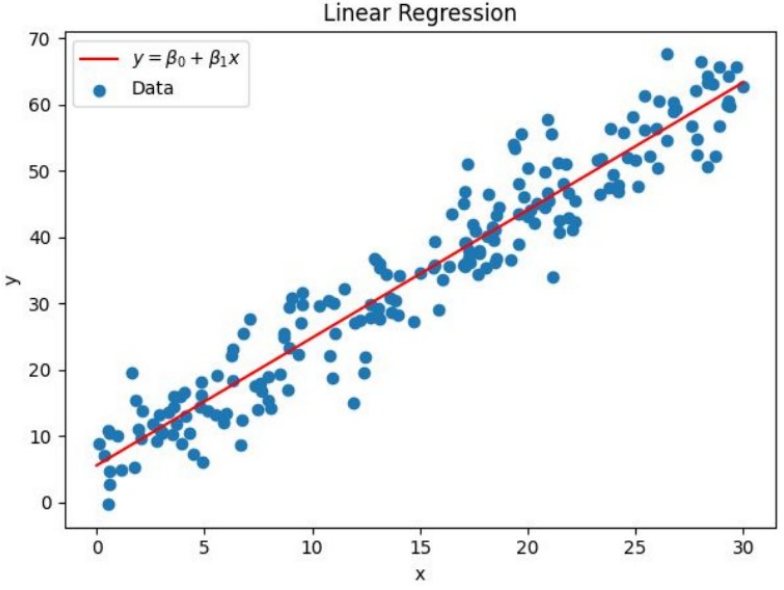
Linear Regression

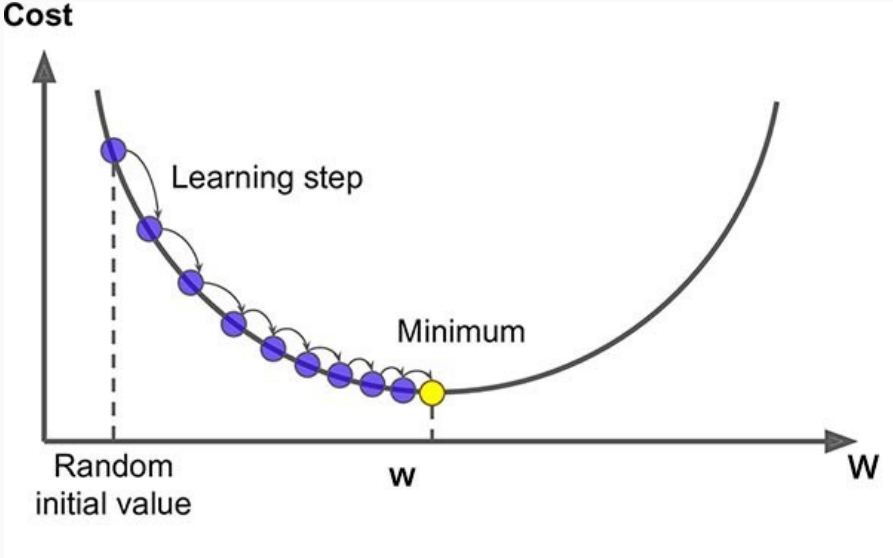




Ways to solve Linear Regression

- Non-Iterative Method: $\mathbf{B = (X^T X)^{-1} X^T y}$

- Gradient Descent method:



Performance Metrics for Regression

$$RSS = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$MAE = \frac{1}{n} \sum_{i=1}^{n} |y_i - \hat{y}_i|$$

R-squared:

- how well model performs compared to a “mean model”

Observations → $\mathbf{y}$ → $(y_1, y_2, \ldots, y_n)$

Predictions → $\hat{\mathbf{y}}$ → $(\hat{y_1}, \hat{y_2}, \ldots, \hat{y_n})$

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i$$

$$SS_{tot} = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

$$SS_{reg} = \sum_{i=1}^{n} (\hat{y_i} - \bar{y})^2$$

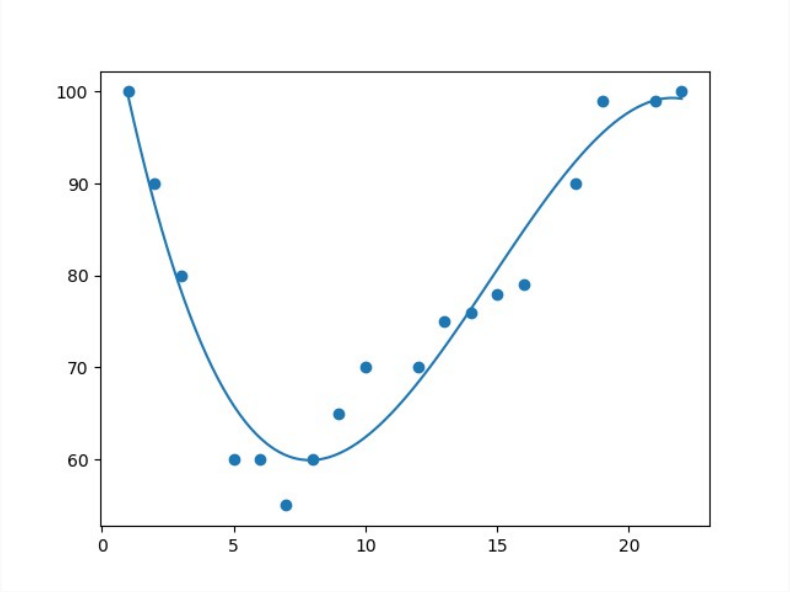
$$SS_{res} = \sum_{i=1}^{n} (y_i - \hat{y_i})^2$$

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}}$$

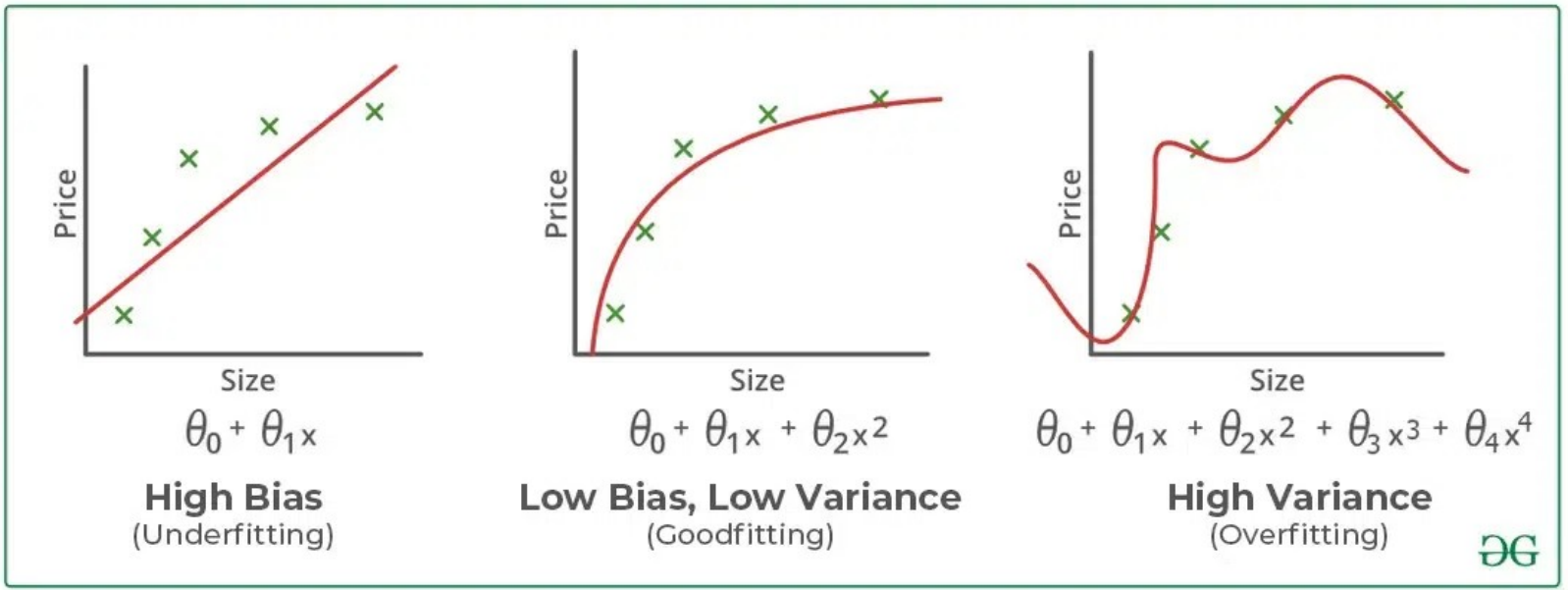
Polynomial Regression

- Polynomial regression: non-linear relationship between x and y

$$Y = ax^2 + bx + c$$



Overfitting vs Underfitting

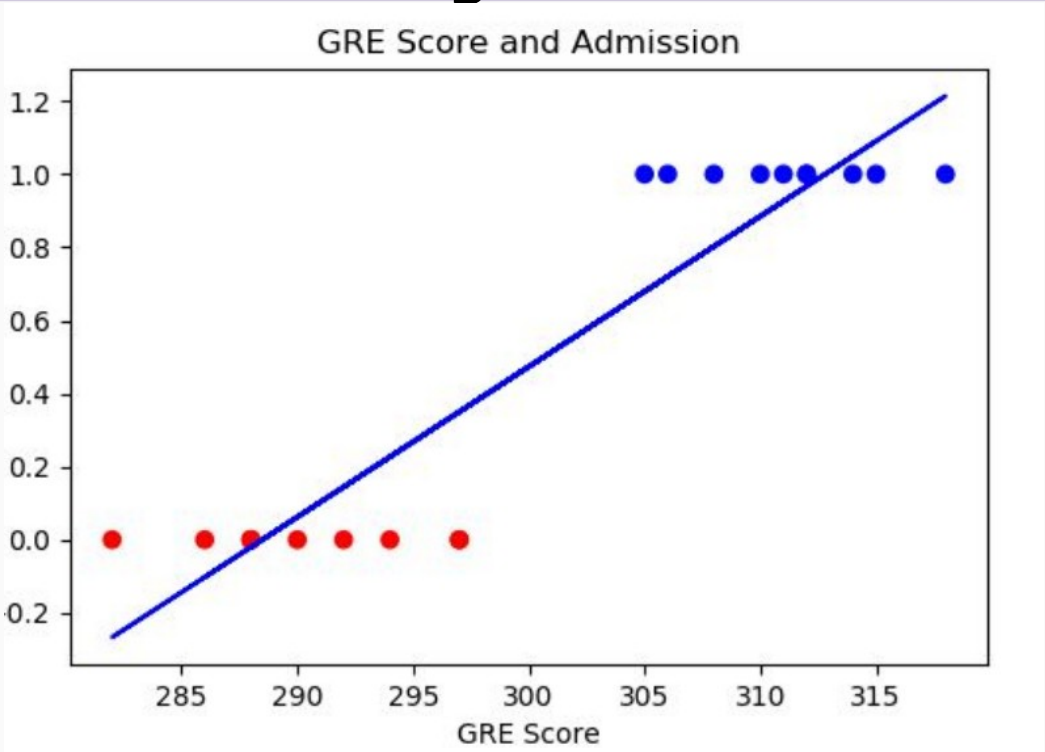


Classification

You have a GRE score of 320. Will you get an admission in a university?

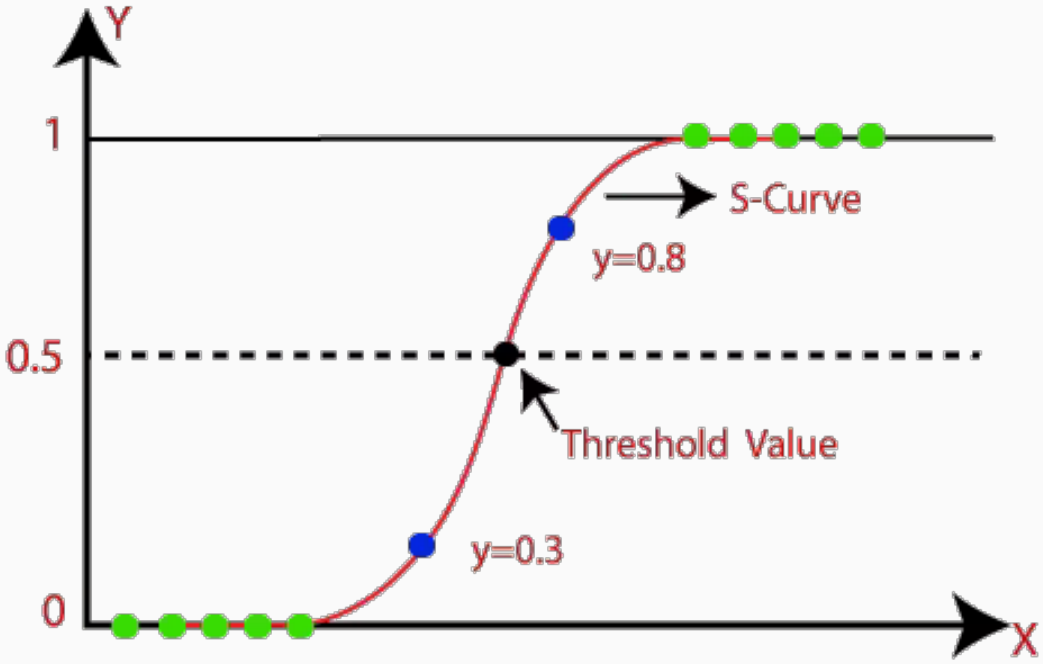
- Get admission – 1
- No admission - 0

Can we use Linear Regression ?

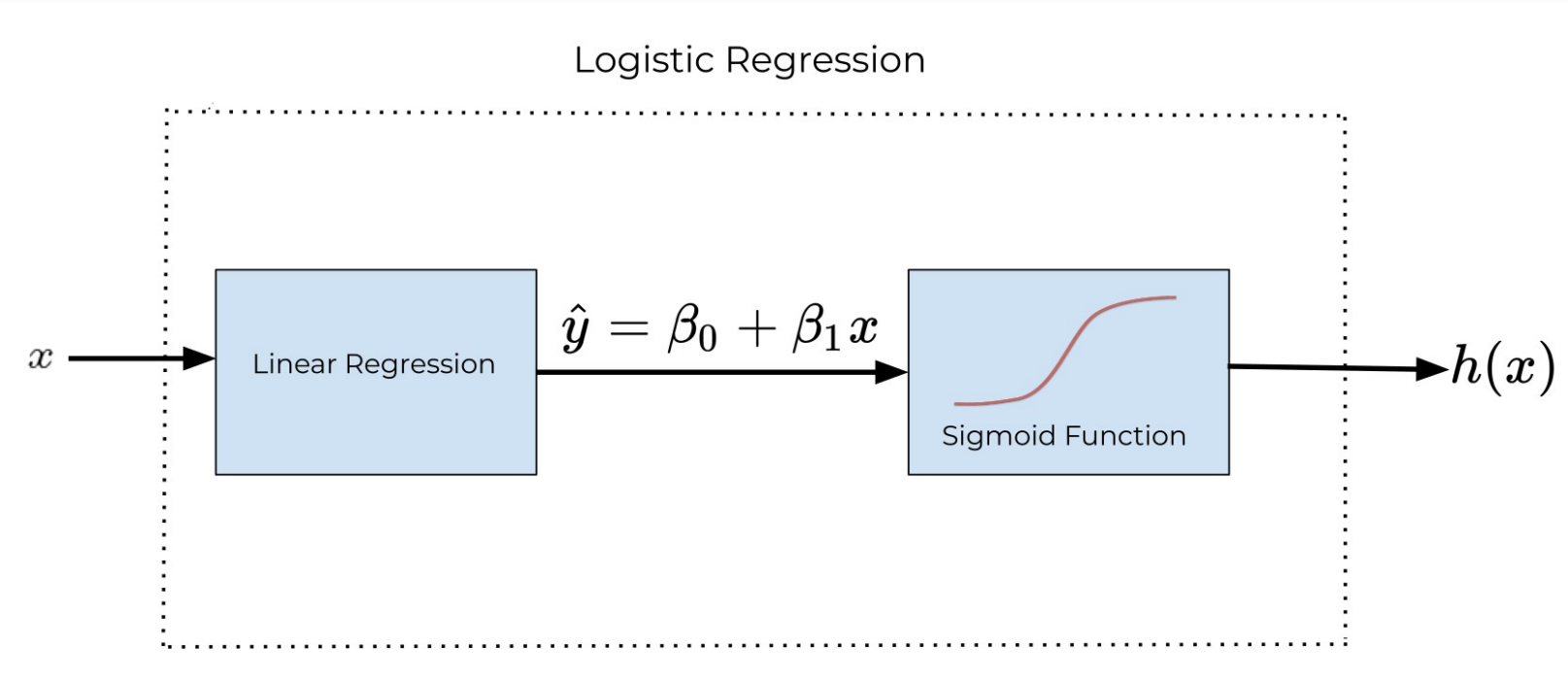


Sigmoid Function

$$A = \frac{1}{1+e^{-x}}$$



Logistic Regression



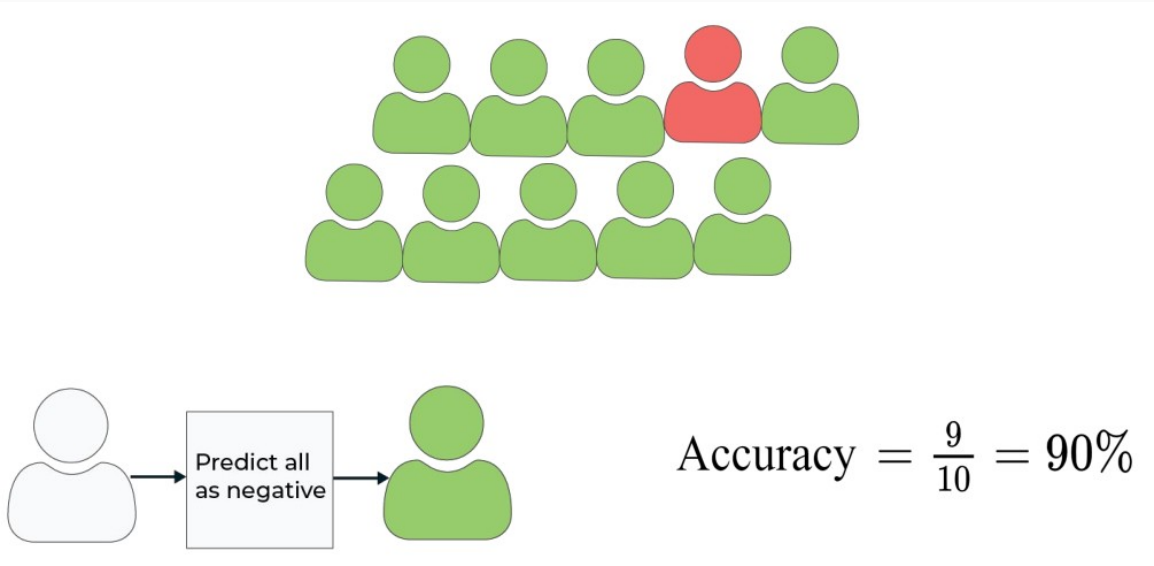
Performance Metrics for Classification

- **Accuracy:** The fraction of predictions that the classifier predicted correctly.

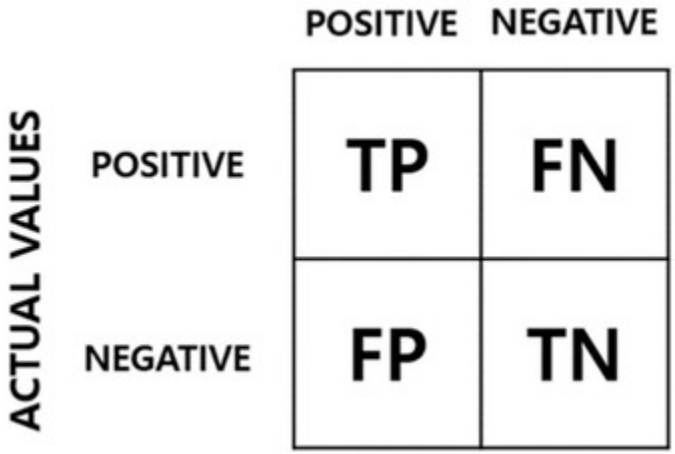
$$\text{Accuracy} = \frac{\text{No. of correct predictions}}{\text{Total no. of predictions}}$$

Accuracy Paradox

Predictive Models with a high level of Accuracy always may not have greater Predictive Power than Models with lower accuracy.



Confusion matrix & F1 Score



$$Precision = \frac{TP}{TP + FP} \qquad Recall = \frac{TP}{TP + FN}$$

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

$$F1\ Score = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$