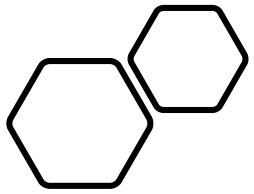


Basic Machine Learning: Linear & Logistic Regression

Final Project Group

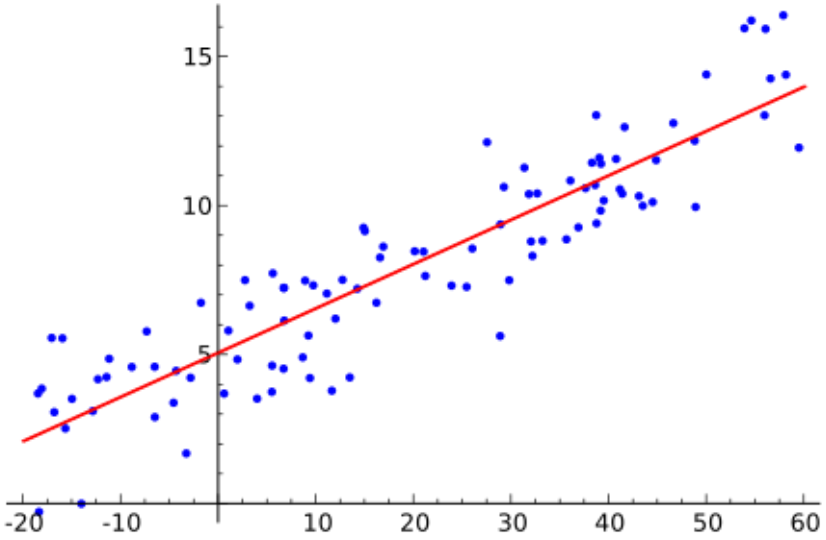
Team A
Ferdiansyah
Nugraha
Andre Fajar Nugroho
Alina Florencia Karuniawati
Muhammad Daffa Ramandha

Team B
Nur Imam Masri
Reyhansyah Prawira
Arih wicaksono
Fauzan Muzakki
Hanif Satrio
Adri Prasetyo

Goal

Goal

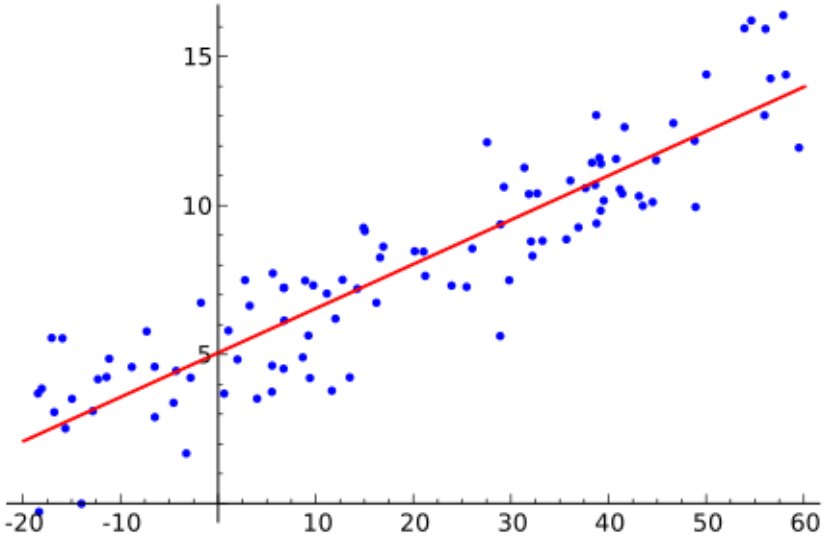
Understanding one of basic algorithm to easily create a smart system in AI which is linear & logistic regression algorithm.



Outline

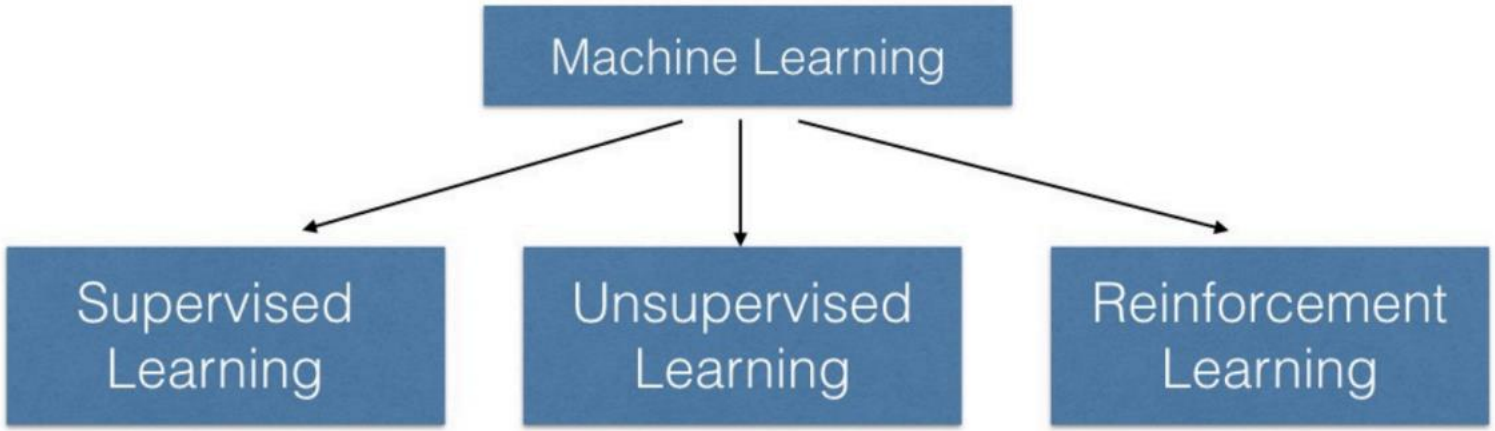
Outline

- Supervised vs Unsupervised Learning
- Linear & Logistic Regression Algorithm
  - ❑ Concept
  - ❑ Scikit Learn
  - ❑ Pros and Cons



Content

Supervised vs Unsupervised Learning

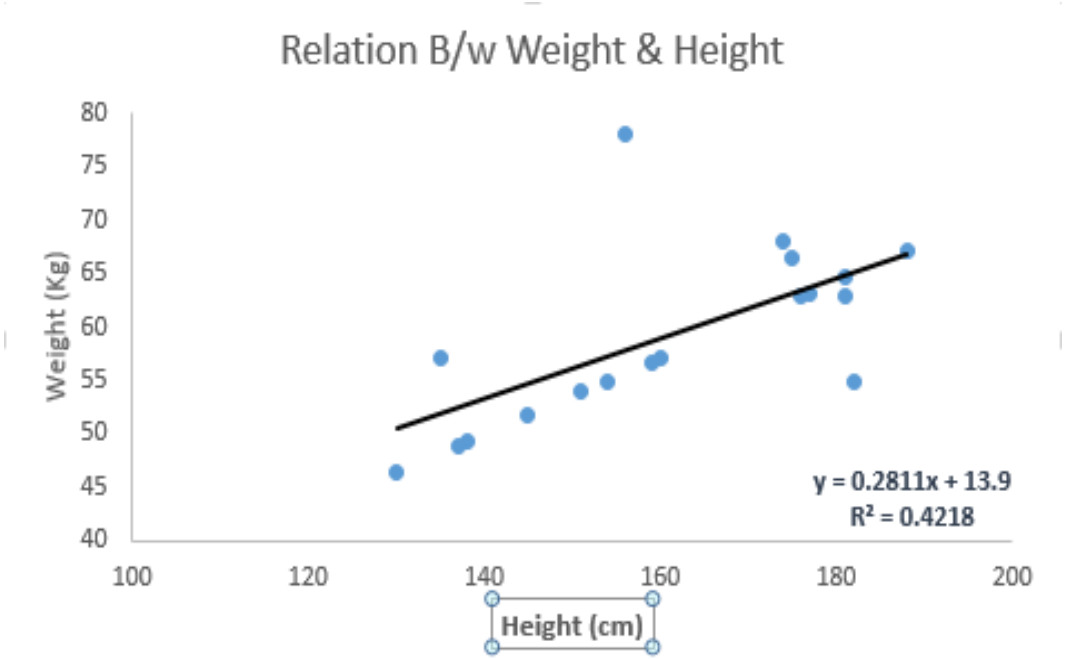


Linear Regression Algorithm (Concept)

- Linear regression is usually among the first few topics which people pick while learning predictive modelling

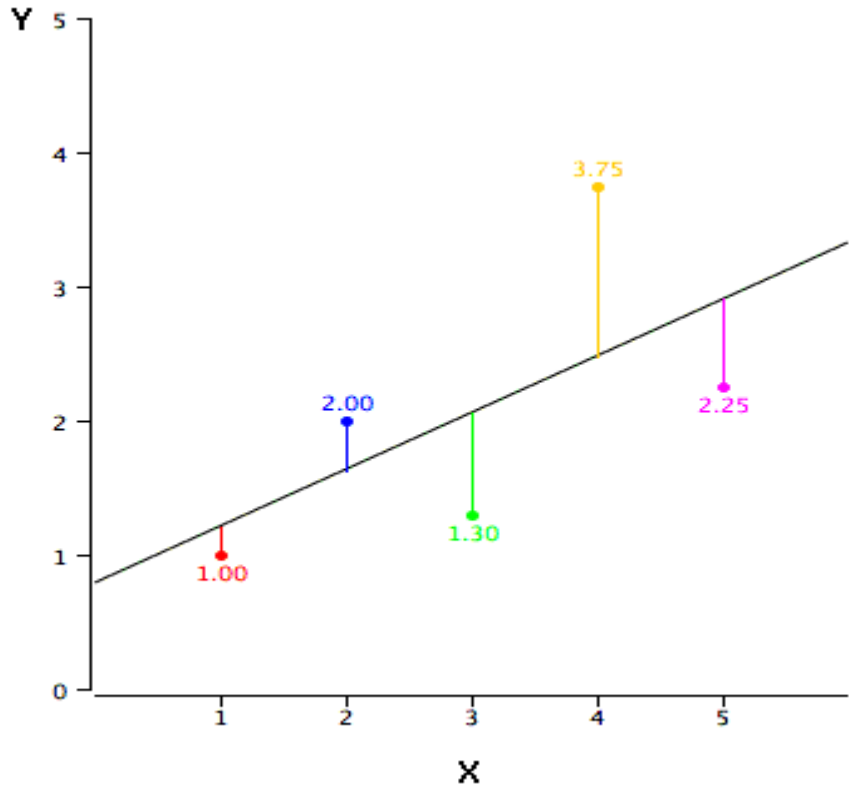
- In this technique:
  - The dependent variable is continuous
  - Nature of regression line is linear

- Now, the question is *"How do we obtain best fit line?"*



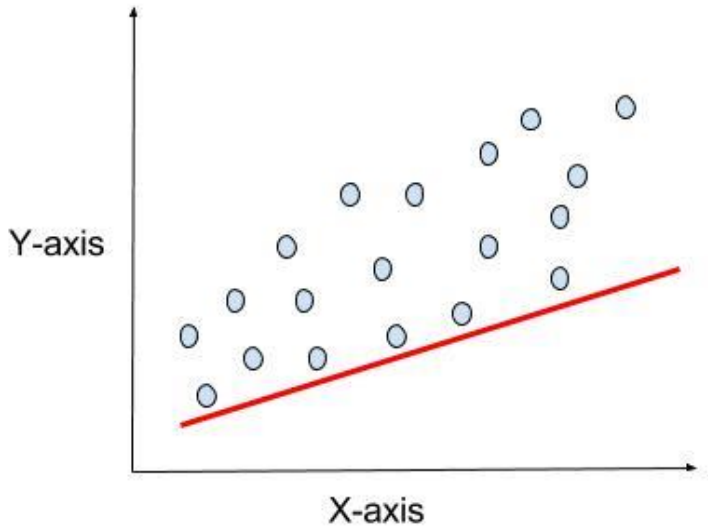
Linear Regression Algorithm (Concept)

- How to obtain best fit line (value of a and b)?
- This task can be easily accomplished by Least Square Method
- We can evaluate the model performance using the metric R-square

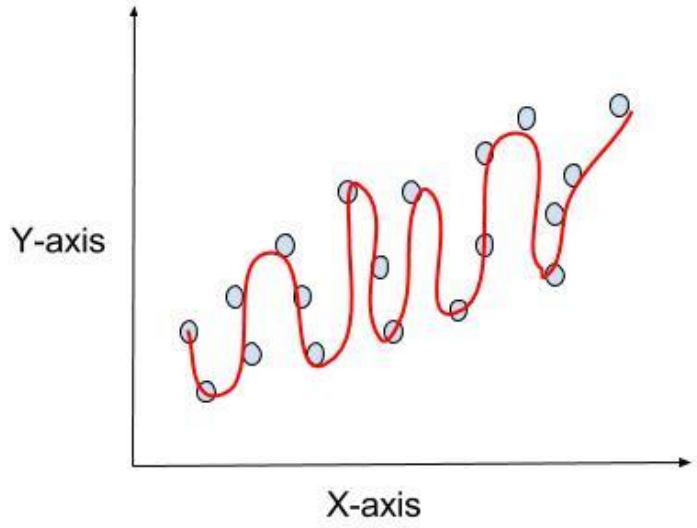


Linear Regression Algorithm (Concept)

- The model should fit to the datapoint with the most less error
- No underfitting, no overfitting



Underfitting



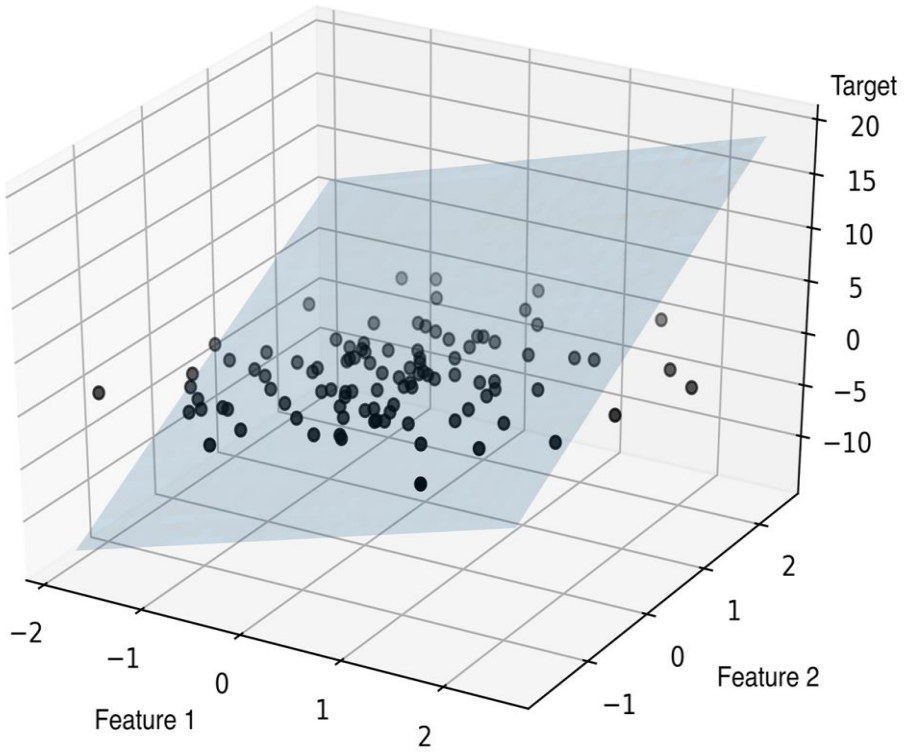
Overfitting

Linear Regression Algorithm (Concept)

- **Simple linear regression**: one-to-one relationship between the input variable and the output variable

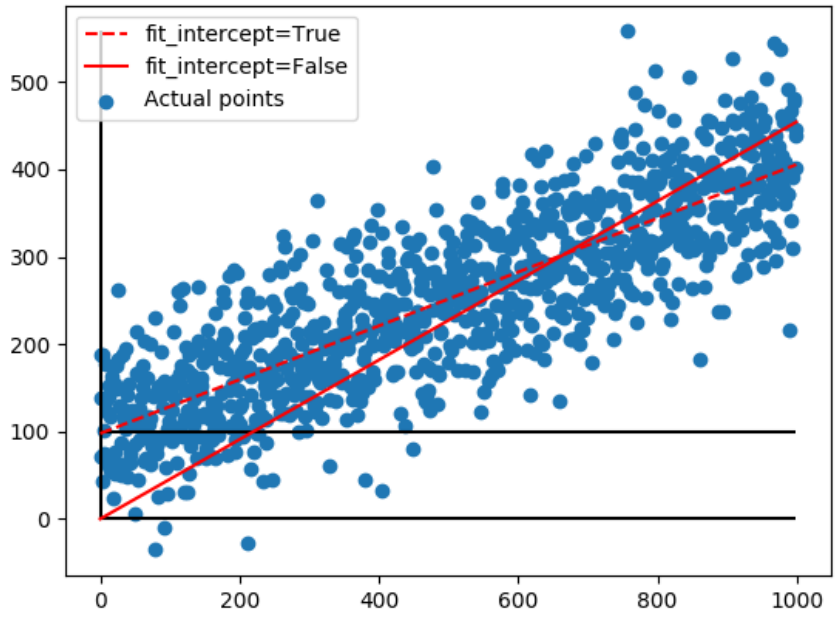
- **Multiple linear regression**: many-to-one relationship, instead of just using one input variable, you use several

$$y = w_0 x_0 + w_1 x_1 + \ldots + w_m x_m = \sum_{i=0}^{m} w_i x_i = w^T x$$



Linear Regression Algorithm (Scikit Learn)

- **Fit_intercept** : boolean, optional, default True
  - Whether to calculate the intercept for this model. If set to False, no intercept will be used in calculations (e.g. data is expected to be already centred).
- **Normalize** : boolean, optional, default False
  - This parameter is ignored when fit_intercept is set to False. If True, the regressors X will be normalized before regression by subtracting the mean and dividing by the l2-norm. If you wish to standardize, please use sklearn.preprocessing.StandardScaler before calling fit on an estimator with normalize=False



class `sklearn.linear_model.` **LinearRegression** (*fit_intercept=True, normalize=False, copy_X=True, n_jobs=1*)

Linear Regression Algorithm (Scikit Learn)

- **Fit** : Estimates the best representative function for the the data points. With that representation, you can calculate new data points

- **Predict** : Utilizing incoming data points to find the new output based on model representation from the fit method

- **Score:** Returns the coefficient of determination R^2 of the prediction.

Linear Regression Algorithm (Pros and Cons)

Pros:

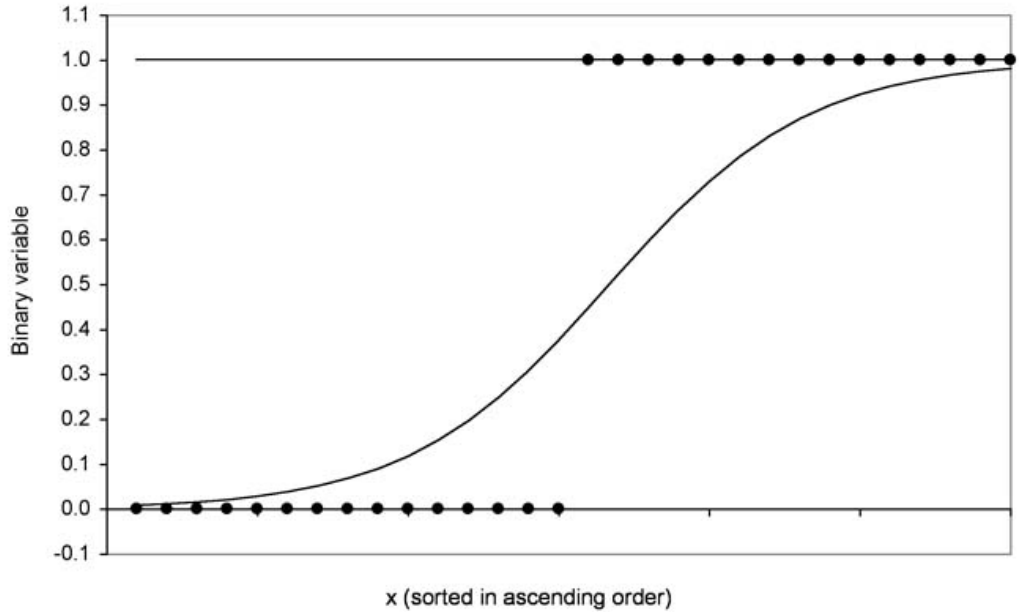
1. Easy to understand
2. Easy to implement and achieve good scores
3. The ability to identify outliers or anomalies

Cons:

1. Linear regression is limited to linear relationships
2. Linear Regression Is Sensitive to Outliers

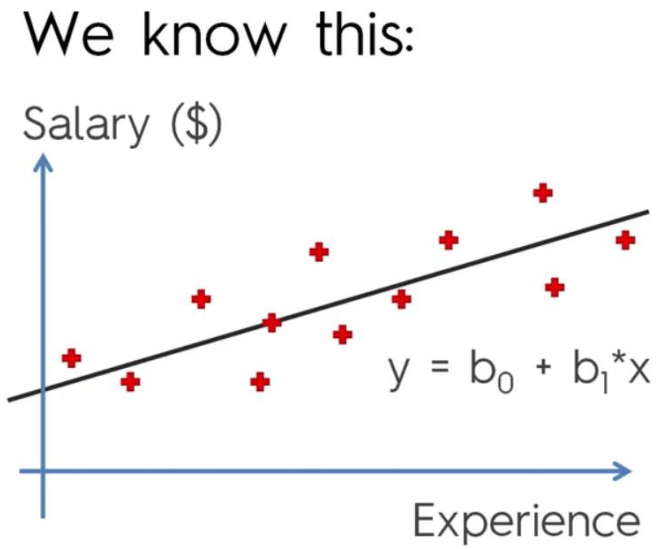
Logistic Regression Algorithm (Concept)

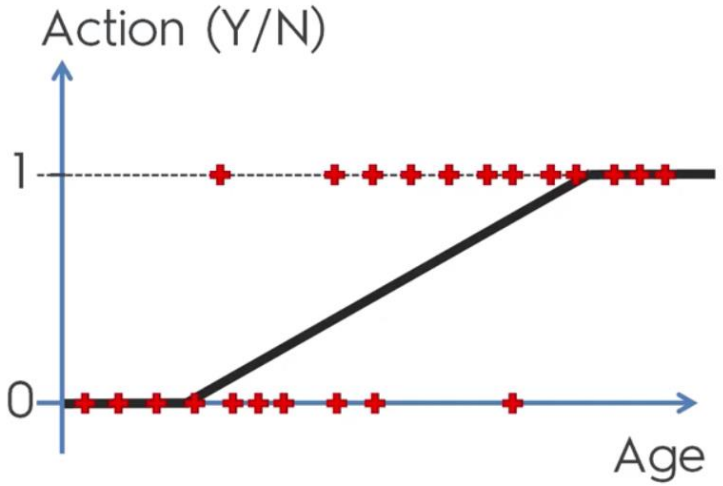
- It is not a regression model
- Logistic regression predicts the probability of occurrences of an event by fitting data to a logit function by using sigmoid function



Logistic Regression Algorithm (Concept)

Why not use Linear Regression algorithm?



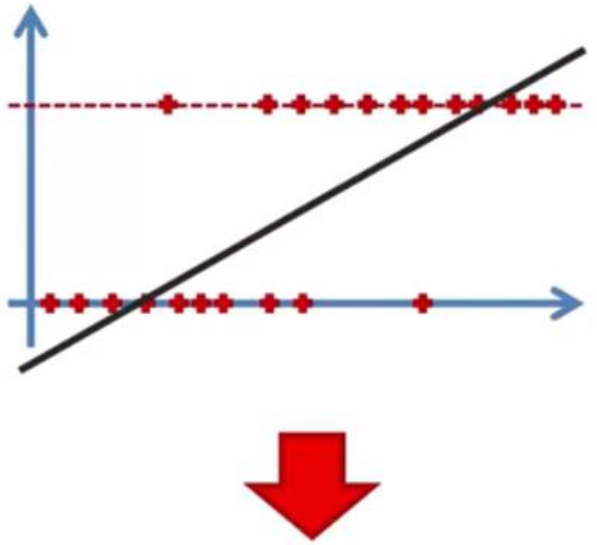


Logistic Regression Algorithm (Concept)

Apply softmax function to logistic regression.

Think of it as probabilities!

$$\text{Softmax}(x_i) = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$



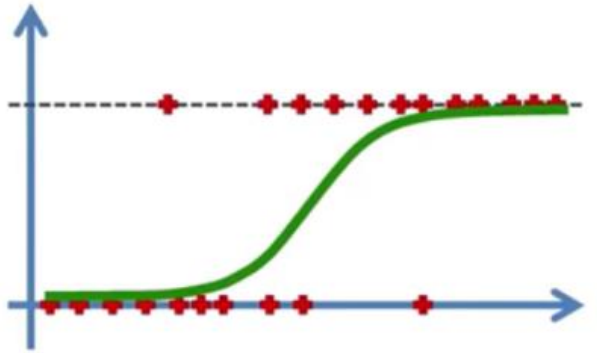
Example :

$$\begin{bmatrix} 8 \\ 5 \\ 0 \end{bmatrix}$$

$$e^{z_1} = e^8 = 2981.0$$
$$e^{z_2} = e^5 = 148.4$$
$$e^{z_3} = e^0 = 1.0$$

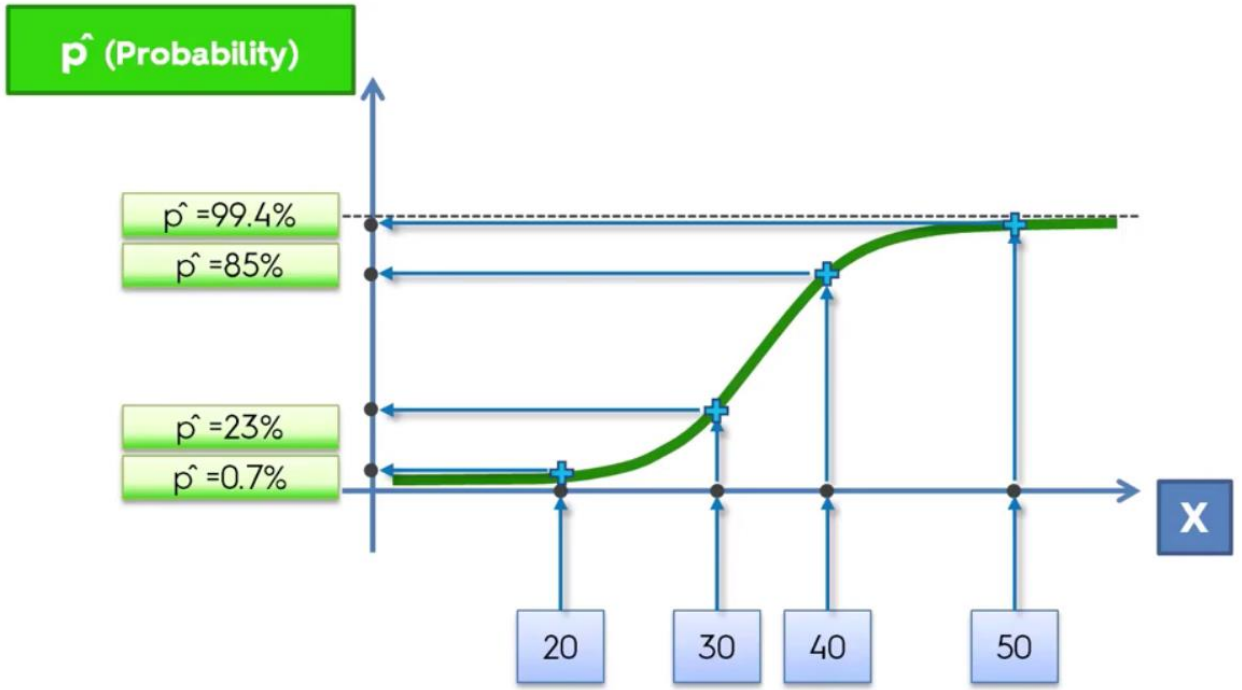
$$\sigma(\vec{z})_1 = \frac{2981.0}{3130.4} = 0.9523$$
$$\sigma(\vec{z})_2 = \frac{148.4}{3130.4} = 0.0474$$
$$\sigma(\vec{z})_3 = \frac{1.0}{3130.4} = 0.0003$$

$$\sum_{j=1}^{K} e^{z_j} = e^{z_1} + e^{z_2} + e^{z_3} = 2981.0 + 148.4 + 1.0 = 3130.4$$



Logistic Regression Algorithm (Concept)

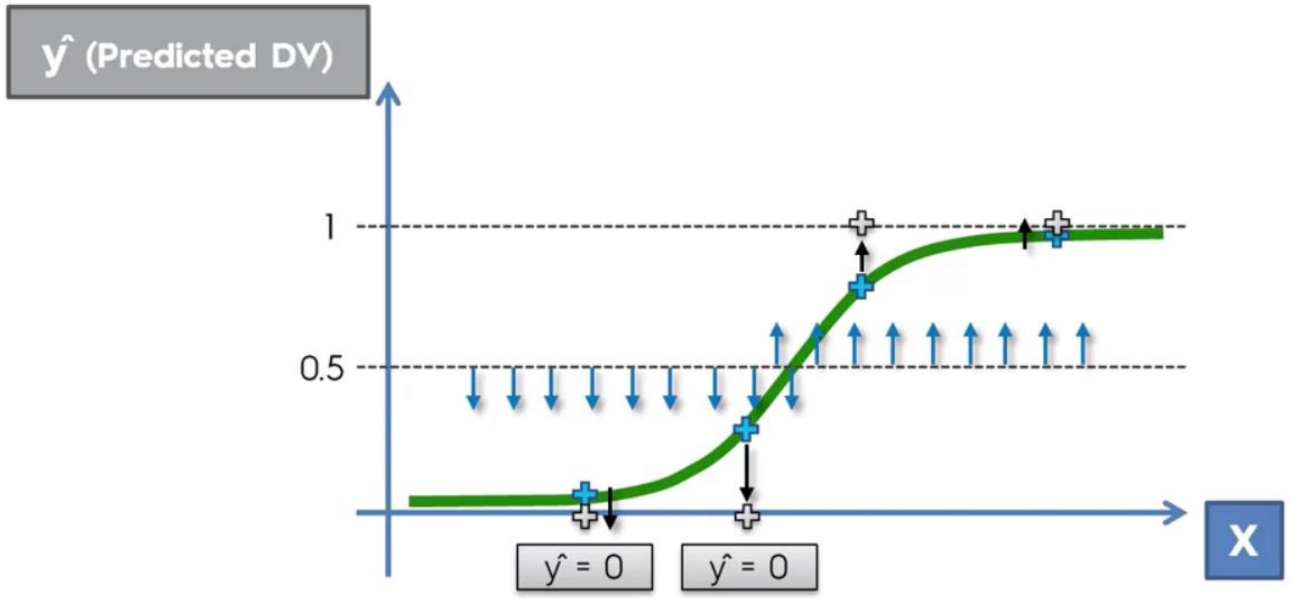
Logistic regression can be seen from probabilities point of view



Logistic Regression Algorithm (Concept)

Threshold determine whether one data is considered as one class or the other.

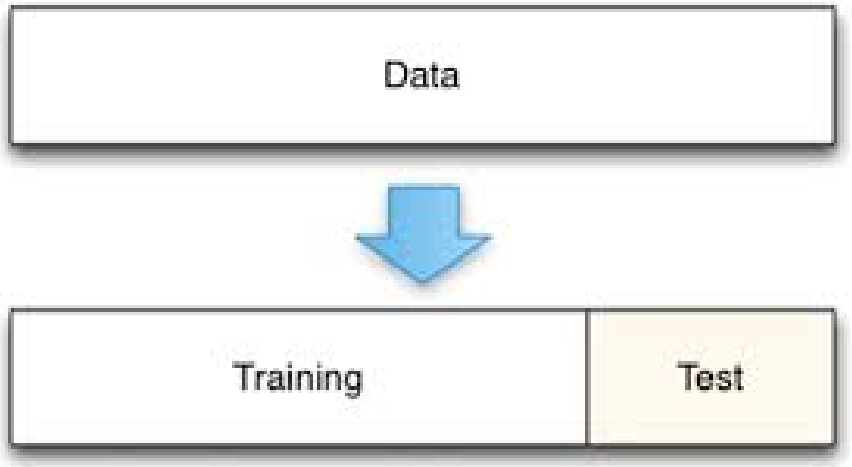
This is the fundamental concept of Deep Learning.

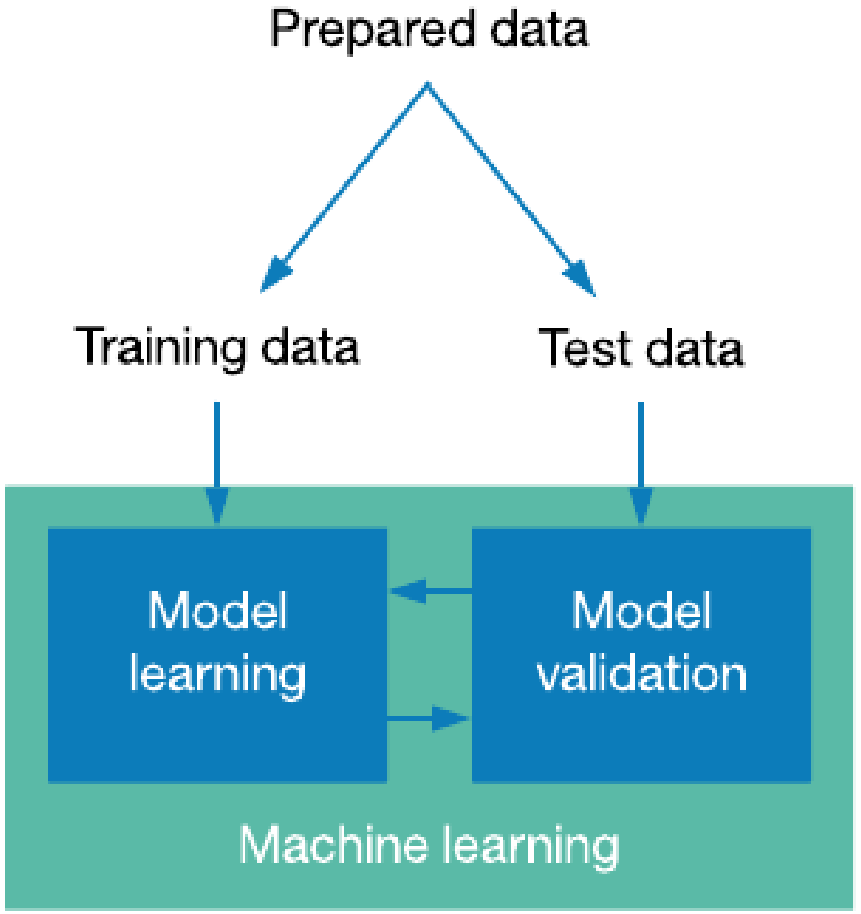


Logistic Regression Algorithm (Concept)

Linear Regression	Logistic Regression
Linear regression is used to predict the continuous dependent variable using a given set of independent variables.	Logistic Regression is used to predict the categorical dependent variable using a given set of independent variables.
Linear Regression is used for solving Regression problem.	Logistic regression is used for solving Classification problems.
In Linear regression, we predict the value of continuous variables.	In logistic Regression, we predict the values of categorical variables.
In linear regression, we find the best fit line, by which we can easily predict the output.	In Logistic Regression, we find the S-curve by which we can classify the samples.
Least square estimation method is used for estimation of accuracy.	Maximum likelihood estimation method is used for estimation of accuracy.
The output for Linear Regression must be a continuous value, such as price, age, etc.	The output of Logistic Regression must be a Categorical value such as 0 or 1, Yes or No, etc.
In Linear regression, it is required that relationship between dependent variable and independent variable must be linear.	In Logistic regression, it is not required to have the linear relationship between the dependent and independent variable.
In linear regression, there may be collinearity between the independent variables.	In logistic regression, there should not be collinearity between the independent variable.

Data Splitting





Assignment 2

- Lakukan Data Visualization, Data Preprocessing dan Data Modelling dengan menggunakan datasets *boston_housing.csv* untuk membangun AI yang bisa memprediksi harga rumah

- Setelah melakukan proses *training*, lakukan evaluasi dan kesimpulan dari *accuracy* yang berhasil dicapai

Thanks!