Machine Learning

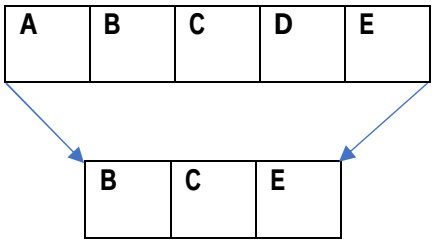
- Sub field of AI
- It's an ability to make machine learn by itself and make predictions.
- Its about giving machines ability to think and act.

Types

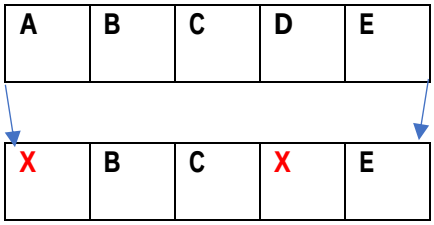
- **Supervised ML:** providing labeled data i.e., i/p as well as output for training and then providing only i/p and ask machine to predict o/p based on the training.
- **Unsupervised ML:** I/p is unlabeled data i.e., only i/p is provided for training and based on those predictions are made.
- **Reinforcement Learning:** Treat based / acknowledgment-based learning where if the predictions are made proper treat/ positive acknowledge is given otherwise punishment/ negative acknowledge is provided. Based upon acknowledgment machine learns by itself.

Factures:

- **Features:** Is the individual attribute or the column in dataset.
- **Feature set:** Is the collections of features.
- **Dimension of Dataset:** number of input variables or features.
- **Dimensionality reduction:** reducing the number of features for training model as those features are not relevant for model building.
    - **Feature selection:** Is about selecting the required features only.



    - **Feature Extraction:** Is about discarding the irrelevant features.

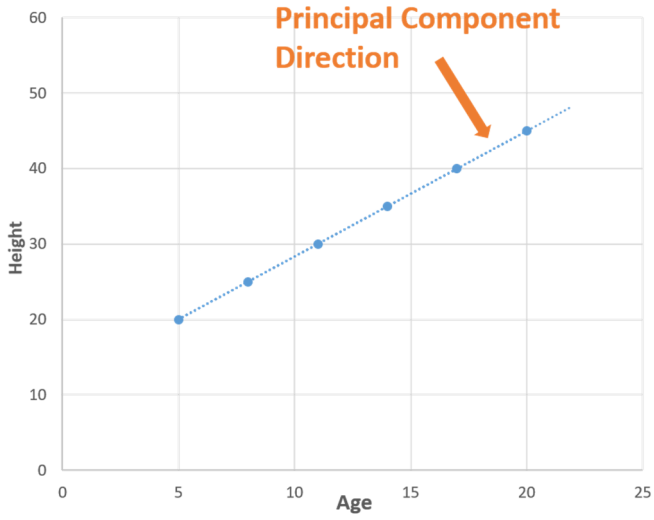


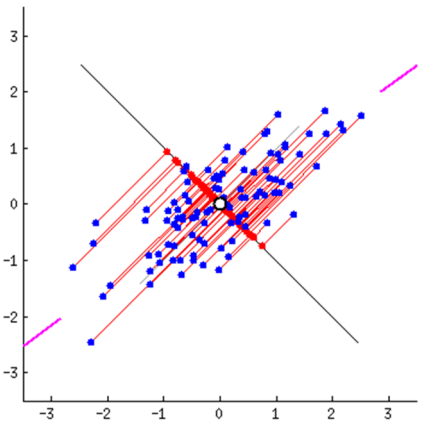
- **Dimensionality reduction techniques:** *"lesser the features more accurate is the output".*
    - **PCA *(Principal Compound Analysis):*** Based on linear algebra.
        - ✓ Unsupervised learning Technique.

✓ In PCA, we find new dimensions (features) that capture maximum variance (i.e., information).

Age	Weight	Height
5	20	4
8	25	4
11	30	4
14	35	4
17	40	4
20	45	4

✓ For e.g., here height is same so it's not relevant drop height. Next Age and weight (2 dimension) can be reduced to the single dimension (blue dotted lines).





✓ **PCA in sklearn:** sklearn. decomposition. PCA

Reference: https://www.analyticsvidhya.com/blog/2021/02/diminishing-the-dimensions-with-pca/

- **LDA (*Linear Discriminant Analysis*):**
  - ✓ Supervised classification technique.
  - ✓ used in areas like image recognition and predictive analysis in marketing.
  - ✓ LDA focuses primarily on projecting the features in higher dimension space to lower dimensions. You can achieve this in three steps:
    1. Firstly, you need to calculate the separability between classes which is the distance between the mean of different classes. This is called the between-class variance.

$$S_b = \sum_{i=1}^{g} N_i(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})^T$$

    2. Secondly, calculate the distance between the mean and sample of each class. It is also called the within-class variance.

$$S_w = \sum_{i=1}^{g}(N_i - 1)S_i = \sum_{i=1}^{g}\sum_{j=1}^{N_i}(x_{i,j} - \bar{x}_i)(x_{i,j} - \bar{x}_i)^T$$

    3. Finally, construct the lower-dimensional space which maximizes the between-class variance and minimizes the within-class variance. P is considered as the lower-dimensional space projection, also called Fisher's criterion.

$$P_{lda} = \arg\max_P \frac{\left|P^T S_b P\right|}{\left|P^T S_w P\right|}$$

  - ✓ class **sklearn.discriminant_analysis.LinearDiscriminantAnalysis**(solver='svd', shrinkage=None, priors=None, n_components=None, store_covariance=False, tol=0.0001, covariance_estimator=None)