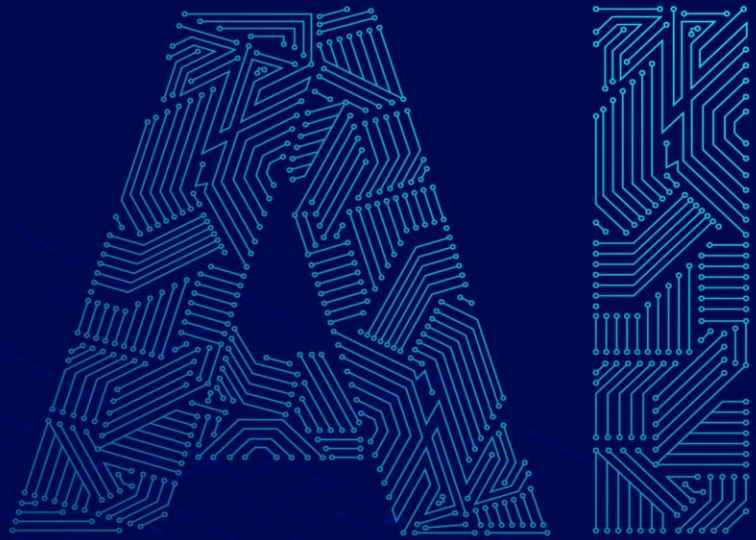




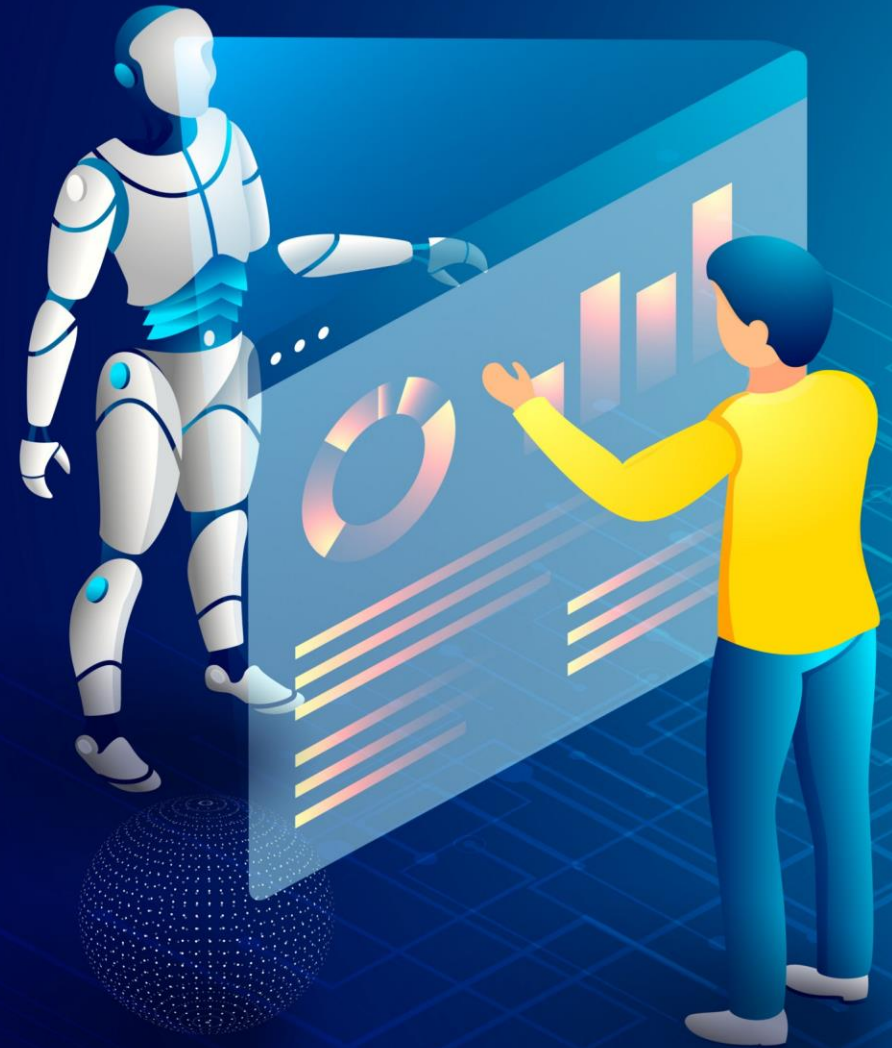
# From AI to ML

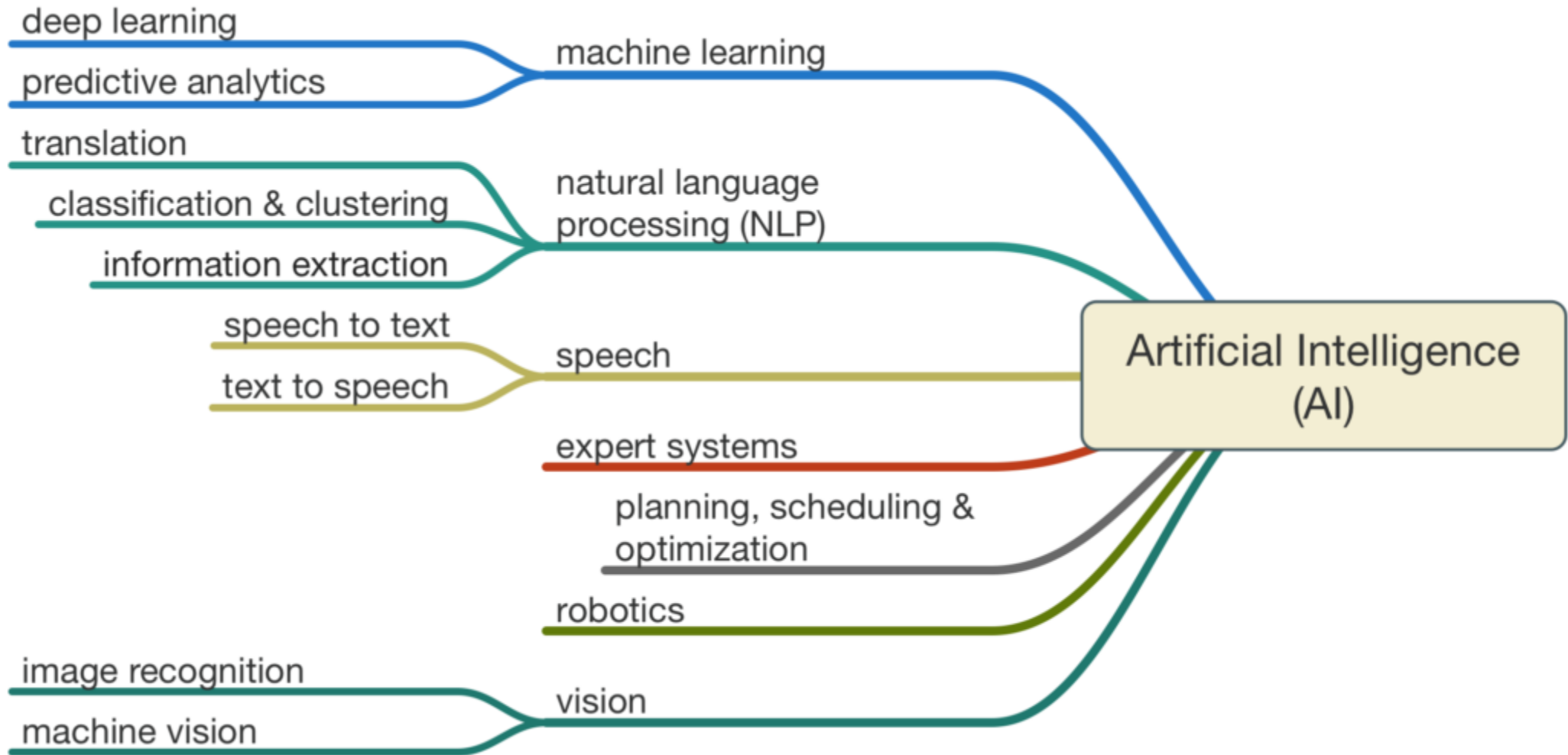
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BY MXK

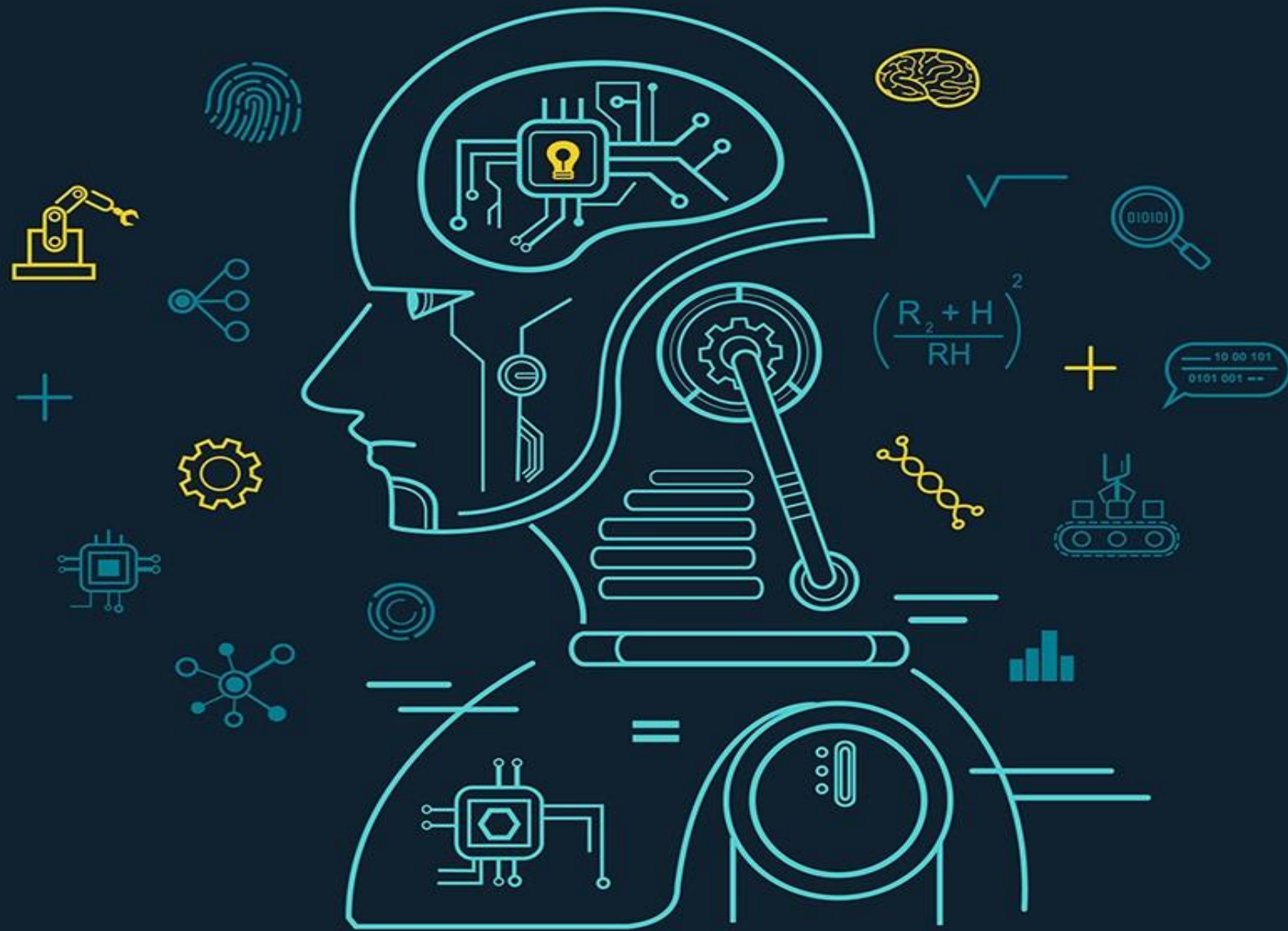


ARTIFICIAL INTELLIGENCE

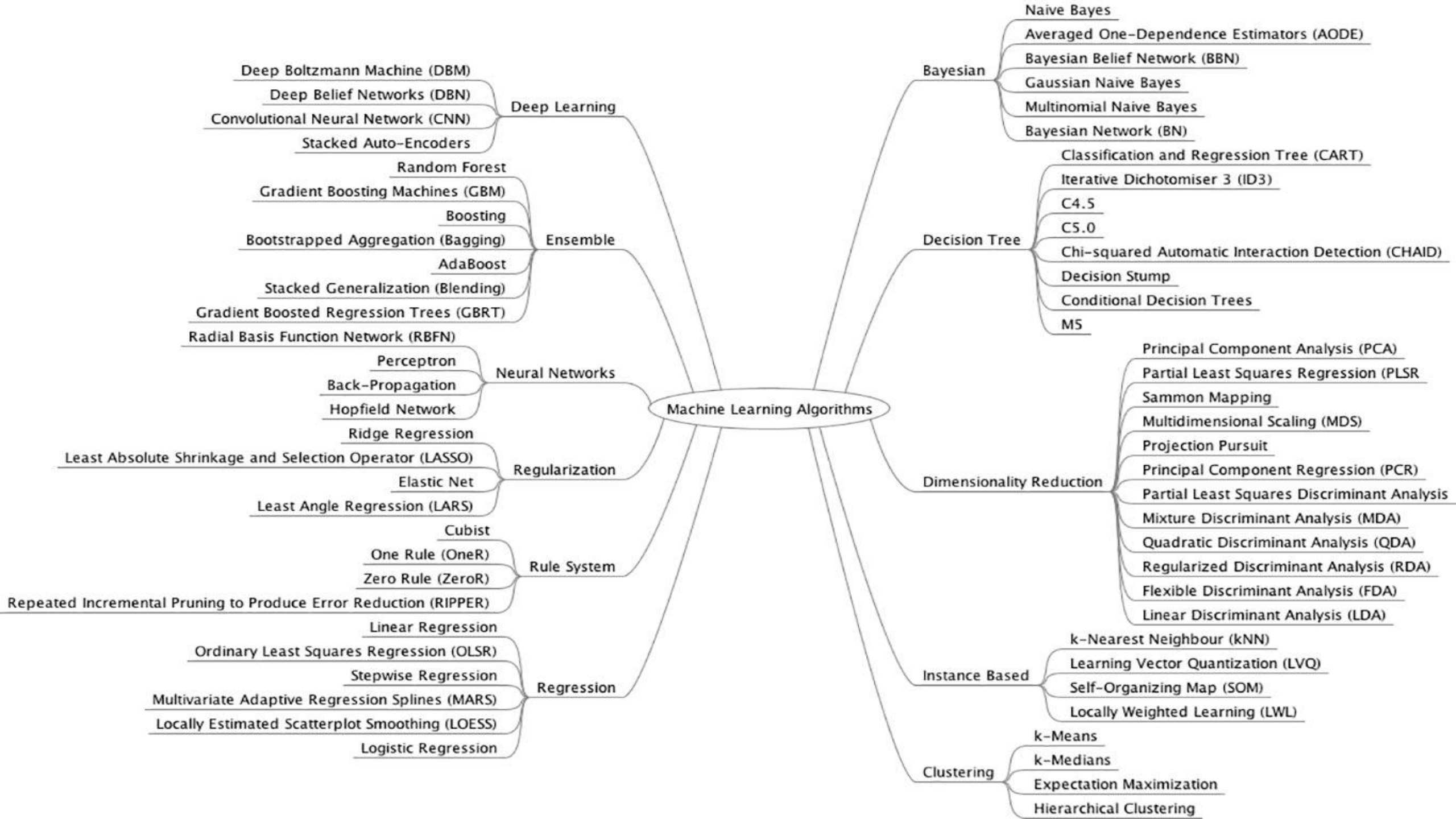








# MACHINE LEARNING



# CLASSICAL MACHINE LEARNING

Data is pre-categorized  
or numerical

## SUPERVISED

Predict  
a category

### CLASSIFICATION

«Divide the socks by color»



Predict  
a number

### REGRESSION

«Divide the ties by length»



Data is not labeled  
in any way

## UNSUPERVISED

Divide  
by similarity

### CLUSTERING

«Split up similar clothing  
into stacks»



Identify sequences

Find hidden  
dependencies

### ASSOCIATION

«Find what clothes I often  
wear together»



### DIMENSION REDUCTION (generalization)

«Make the best outfits from the given clothes»

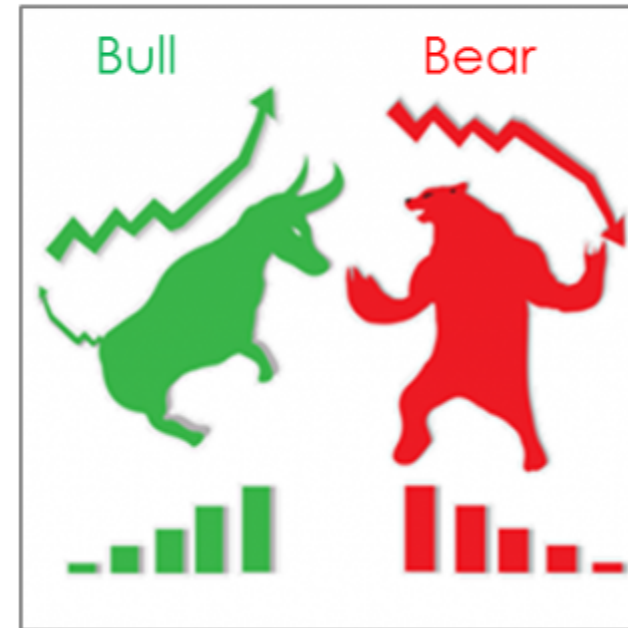
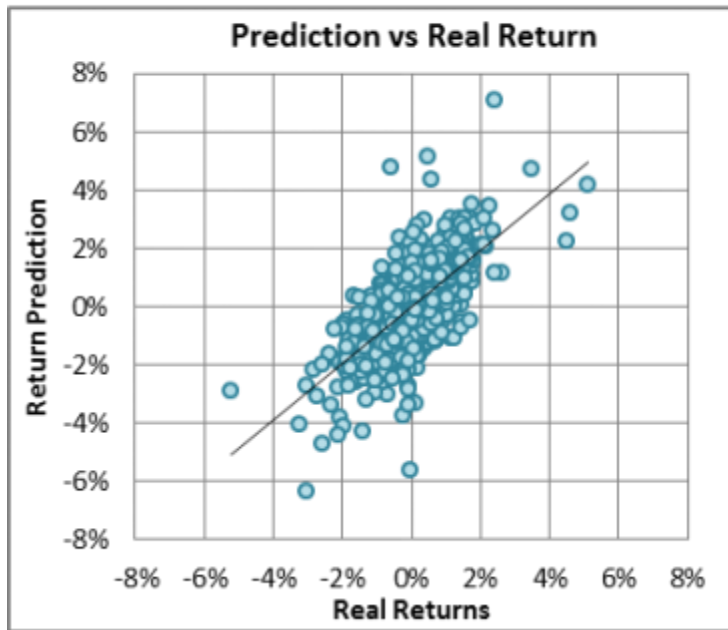


# Supervised Machine Learning

Regression

vs

Classification



## 4 types of classification:





# Binary Classification

Binary classification refers to those classification tasks that have two class labels.

Examples include:

- Email spam detection (spam or not).
- Churn prediction (churn or not).
- Conversion prediction (buy or not).

Popular algorithms that can be used for binary classification include:

- Logistic Regression
- k-Nearest Neighbors
- Decision Trees
- Support Vector Machine
- Naive Bayes

Code for a use case

# Multi-Class Classification

Multi-class classification refers to those classification tasks that have more than two class labels.

Examples include:

- Plant species classification.
- Optical character recognition.

Algorithms that are designed for binary classification can be adapted for use for multi-class problems using the following techniques

- One-vs-Rest: Fit one binary classification model for each class vs. all other classes.
- One-vs-One: Fit one binary classification model for each pair of classes.

Popular algorithms that can be used for multi-class classification include:

- Logistic Regression (binary and multi-class).
- Random Forest.

Code for a use case:

# Multi-Label Classification

Multi-label classification refers to those classification tasks that have two or more class labels, where one or more class labels may be predicted for each example.

Examples include:

Photo classifications where a given photo may have multiple objects in the scene and a model may predict the presence of multiple known objects in the photo, such as "bicycle," "apple," "person," etc.

Specialized versions of standard classification algorithms can be used:

- Multi-label Decision Trees.
- Multi-label Random Forests.
- Multi-label Gradient Boosting.

Code for a use case:

# Imbalanced Classification

Imbalanced classification refers to classification tasks where the number of examples in each class is unequally distributed.

Examples include:

- Fraud detection.
- Outlier detection.
- Medical diagnostic tests.

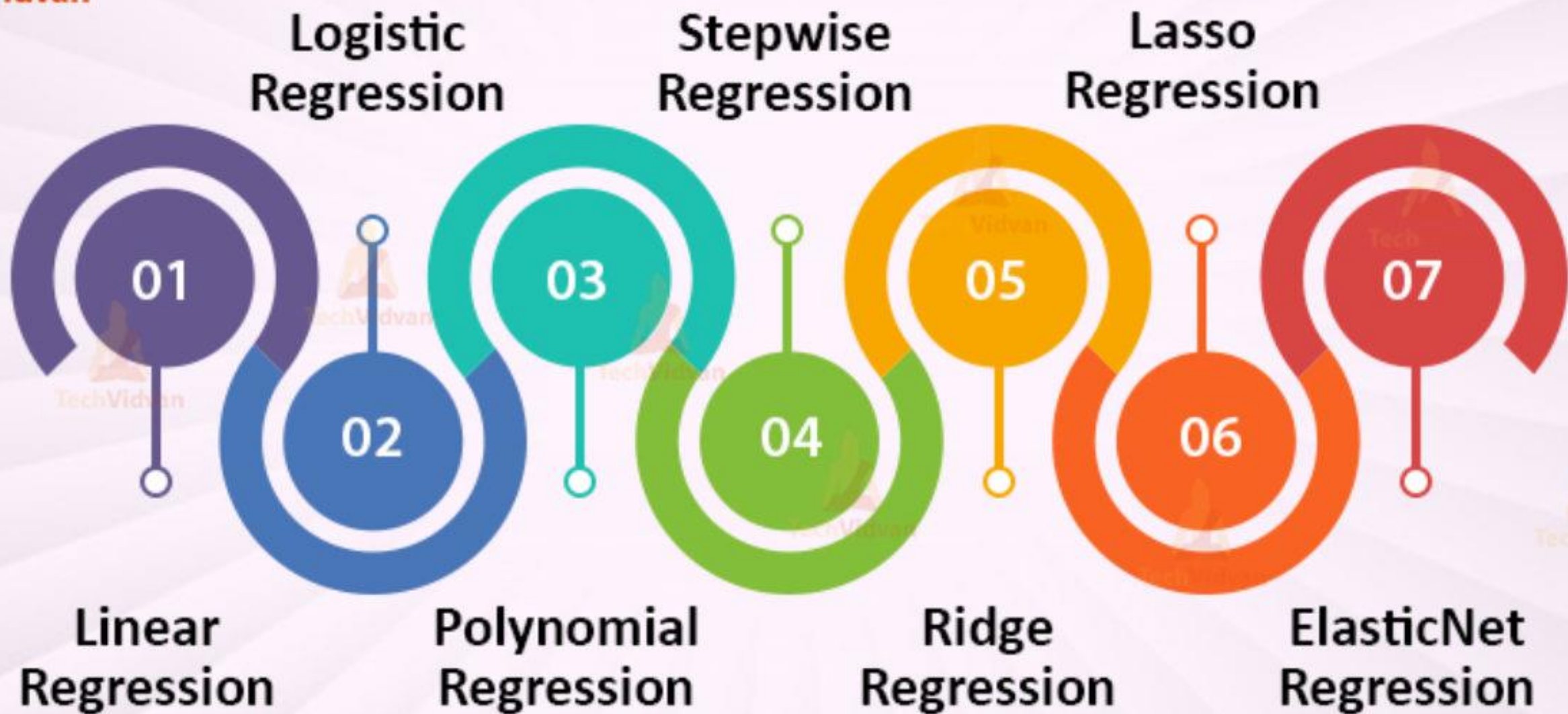
Specialized modeling algorithms may be used that pay more attention to the minority class when fitting the model on the training dataset:

- Cost-sensitive Logistic Regression.
- Cost-sensitive Decision Trees.
- Cost-sensitive Support Vector Machines.

Code for a use case:



# Types of Regression



## Types of Regression Part 1

### Linear regression

is used for predictive analysis. Linear regression is a linear approach for modeling the relationship between the criterion or the scalar response and the multiple predictors or explanatory variables.

$$Y = bX + A.$$

### Logistic regression

is used when the dependent variable is dichotomous. Logistic regression is used to deal with data that has two possible criteria and the relationship between the criteria and the predictors.

$$Y = b_0 + b_1X_1 + b_2X_2.$$

### Polynomial regression

is used for curvilinear data. Polynomial regression is fit with the method of least squares. The goal of regression analysis is to model the expected value of a dependent variable  $y$  in regards to the independent variable  $x$ .

$$Y = b_0 + b_1X_1 + e$$

## Types of Regression Part 2

### Stepwise regression

is used for fitting regression models with predictive models. It is carried out automatically. With each step, the variable is added or subtracted from the set of explanatory variables. The approaches for stepwise regression are forward selection, backward elimination, and bidirectional elimination.

### Ridge regression

is a technique for analyzing multiple regression data. When multicollinearity occurs, least squares estimates are unbiased. A degree of bias is added to the regression estimates, and as a result, ridge regression reduces the standard errors.

## Types of Regression Part 3

### Lasso Regression

is a regression analysis method that performs both variable selection and regularization. Lasso regression uses soft thresholding. Lasso regression selects only a subset of the provided covariates for use in the final model.

### ElasticNet Regression

is a regularized regression method that linearly combines the penalties of the lasso and ridge methods. ElasticNet regression is used for support vector machines, metric learning, and portfolio optimization.



# ENSEMBLE LEARNING

# Ensemble Methods

```
graph TD; A[Ensemble Methods] --> B[Bagging]; A --> C[Boosting]; A --> D[Stacking];
```

Bagging

Boosting

Stacking

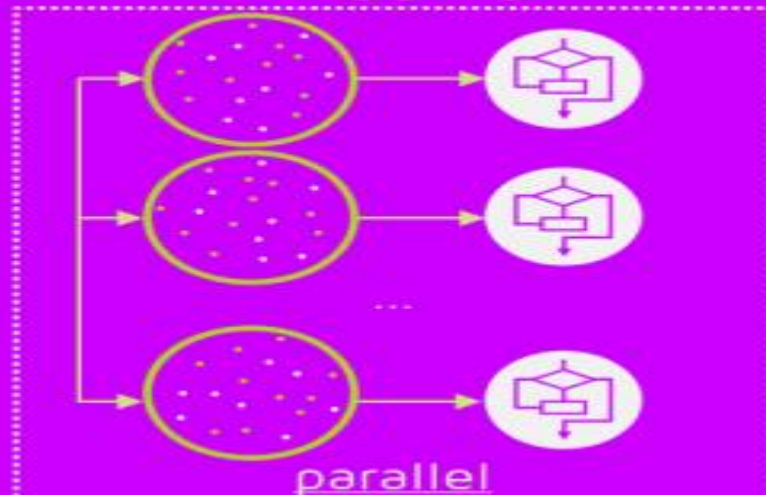
	Bagging	Boosting	Stacking
Partitioning of the data into subsets	Random	Giving mis-classified samples higher preference	Various
Goal to achieve	Minimize variance	Increase predictive force	Both
Methods where this is used	Random subspace	Gradient descent	Blending
Function to combine single models	(Weighted) average	Weighted majority vote	Logistic regression

single

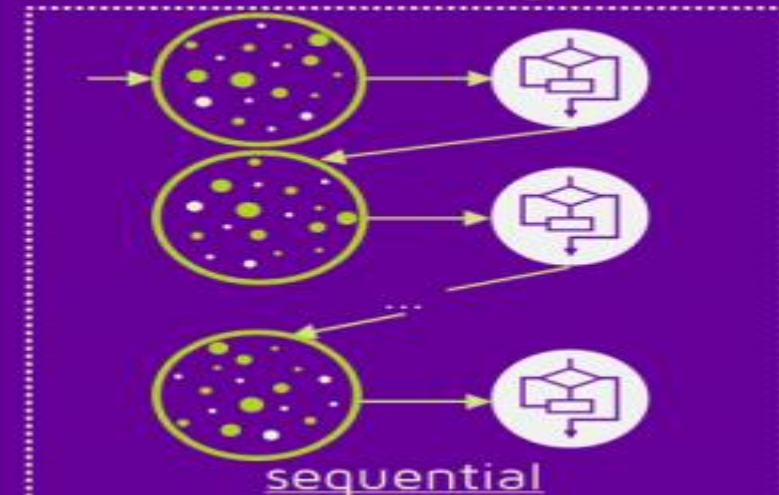


1 iteration

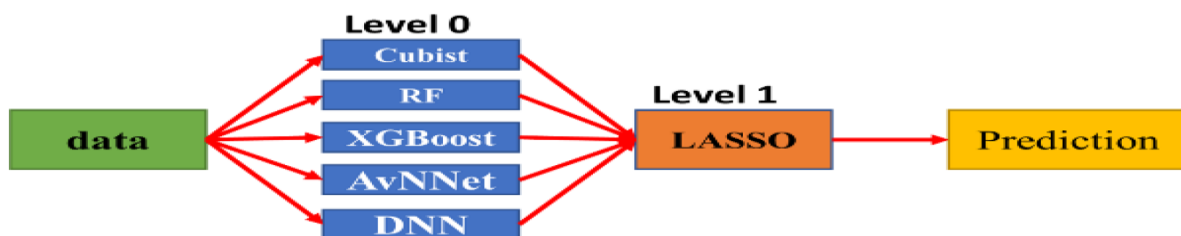
bagging



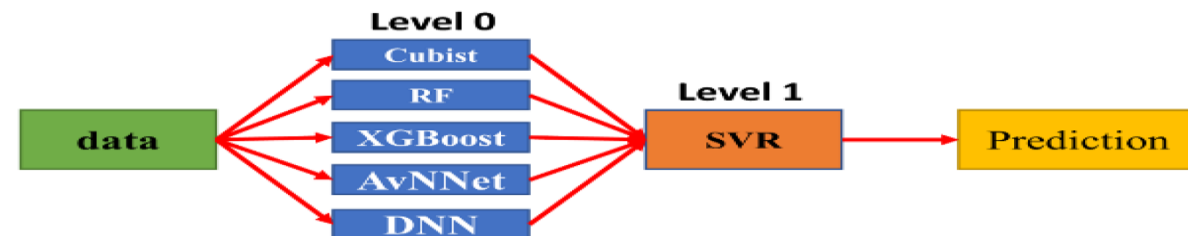
boosting



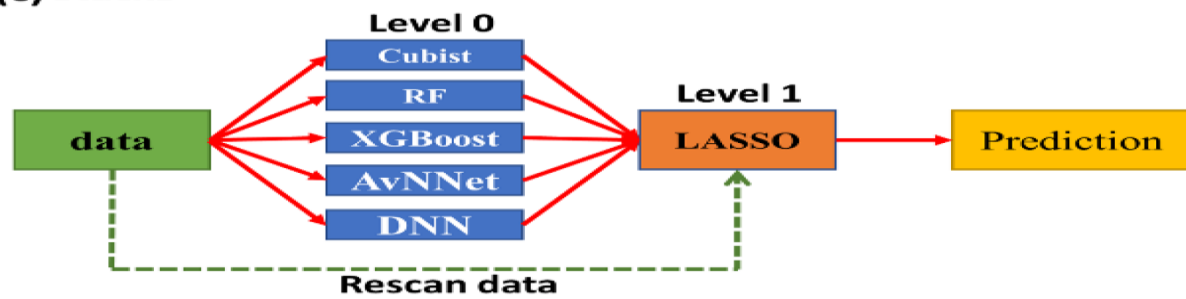
(a) Stack1



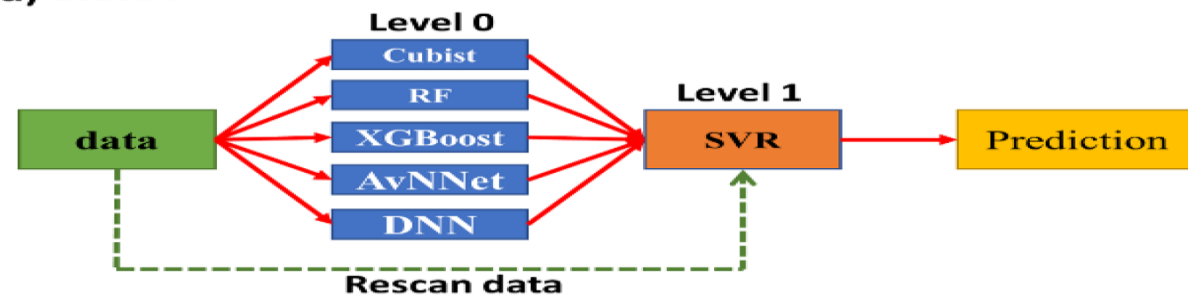
(b) Stack2



(c) Stack3



(d) Stack4





The background of the image is a complex, abstract network of interconnected nodes and lines. The nodes are represented by small circles in various shades of brown, tan, and grey. The lines connecting them are thin and light-colored, creating a dense, web-like pattern that fills the entire frame. The overall aesthetic is modern and digital, suggesting a theme of connectivity or data.

Colab Time 😊

The background is a complex, abstract network of interconnected nodes and lines. The nodes are represented by small circles in various shades of brown, tan, and grey. The lines connecting them are thin and light-colored, creating a dense, web-like pattern across the entire image. The overall aesthetic is modern and digital.

Kahoot Time 😊