Introduction to Traditional Machine Learning

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20-06-2023

Agenda

- Overview of Machine Learning
- Traditional Machine Learning vs. Deep Learning
- Key Concepts in Traditional Machine Learning
- Common Algorithms in Traditional Machine Learning
- Conclusion and Future Trends

Traditional Programming

Machine Learning

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Overview of Machine Learning

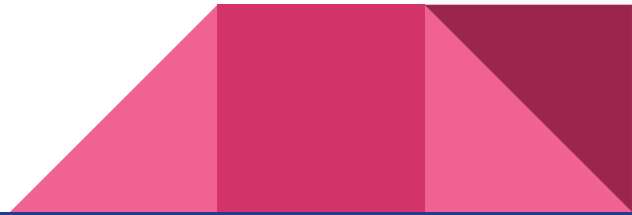
- **Definition of Machine Learning: The field of study that gives computers the ability to learn and improve from experience without being explicitly programmed.**
- **Three main types of Machine Learning:**
  - **Supervised Learning**
  - **Unsupervised Learning**
  - **Reinforcement Learning**

Traditional Machine Learning vs. Deep Learning

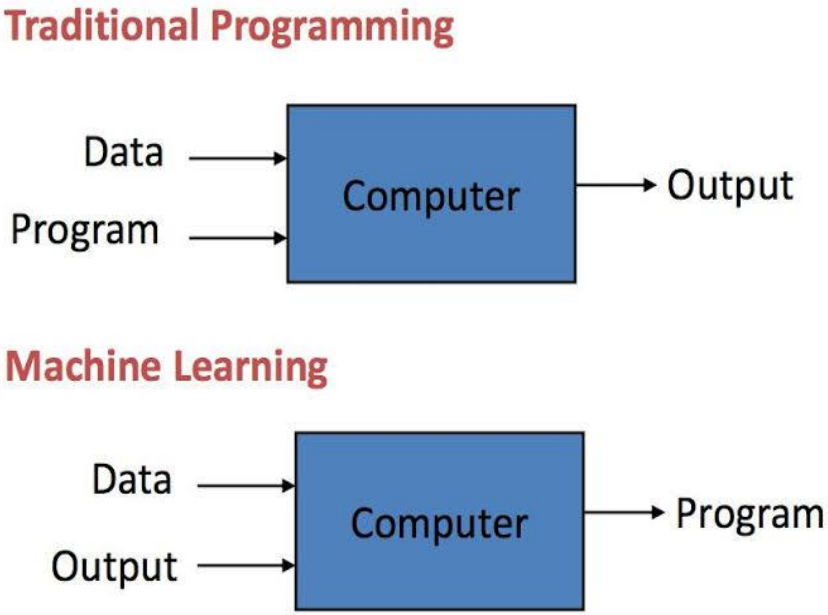
- **Traditional Machine Learning:**
  - Relies on manually engineered features
  - Uses statistical algorithms to make predictions
  - Suitable for structured data and smaller datasets
- **Deep Learning**:
  - Learns features automatically from raw data
  - Utilizes deep neural networks for prediction
  - Performs well on unstructured data and large datasets

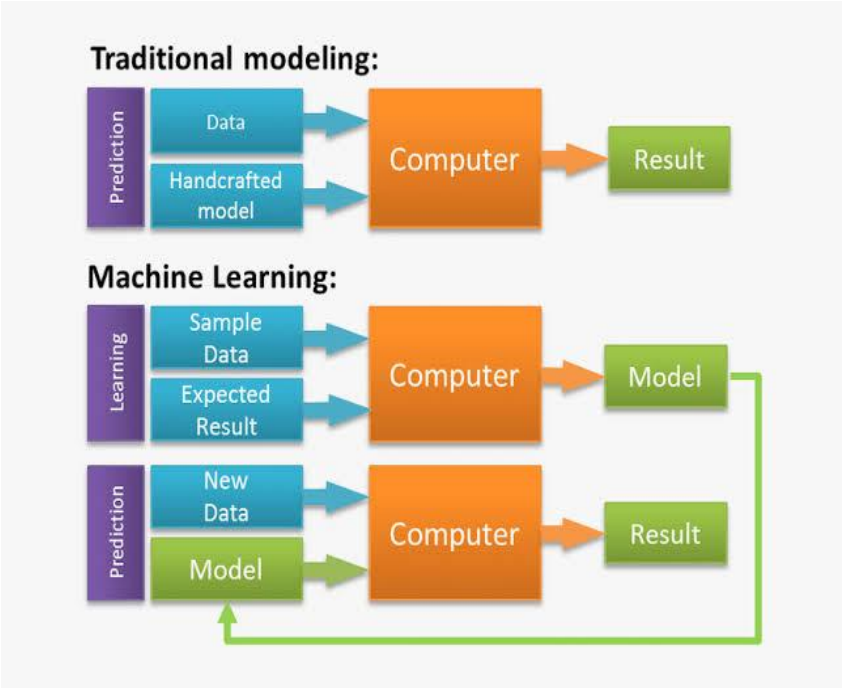
Key Concepts in Traditional Machine Learning

- Features: Representations of the input data used for learning and prediction.
- Training Data: Examples used to train the machine learning model.
- Labels: Known outputs corresponding to the training data used for supervised learning.
- Model: Mathematical representation of the relationship between inputs and outputs.
- Loss Function: Measures the model's performance and guides the learning process.
- Optimization: The process of adjusting model parameters to minimize the loss function.



Visual Overview





Common Algorithms in Traditional Machine Learning

- Linear Regression
  - Gradient descent
- Logistic Regression
- Decision Trees
- Random Forests
- Support Vector Machines (SVM)
- Naive Bayes
- k-Nearest Neighbors (k-NN)

Linear Regression

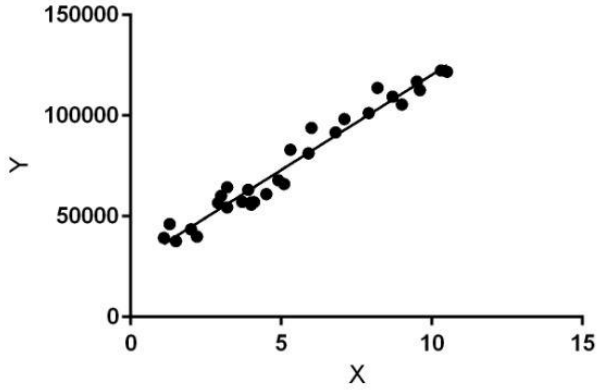
computes the linear relationship between a dependent variable and one or more independent features

Hypothesis function for Linear Regression :

$$\hat{Y} = \theta_1 + \theta_2 X$$

OR

$$\hat{y}_i = \theta_1 + \theta_2 x_i$$



Cost function

$$\text{Cost function}(J) = \frac{1}{n} \sum_n^i (\hat{y}_i - y_i)^2$$

Gradient Descent

start with random θ1 and θ2 values and then iteratively update the values, reaching minimum cost

$$\theta_1 = \theta_1 - \alpha \left(J'_{\theta_1}\right)$$
$$= \theta_1 - \alpha \left(\frac{2}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)\right)$$
$$\theta_2 = \theta_2 - \alpha \left(J'_{\theta_2}\right)$$
$$= \theta_2 - \alpha \left(\frac{2}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)\cdot x_i\right)$$

Decision Trees

- flowchart-like tree structure
- recursively splitting the training data into subsets based on the values of the attributes
- **Entropy**

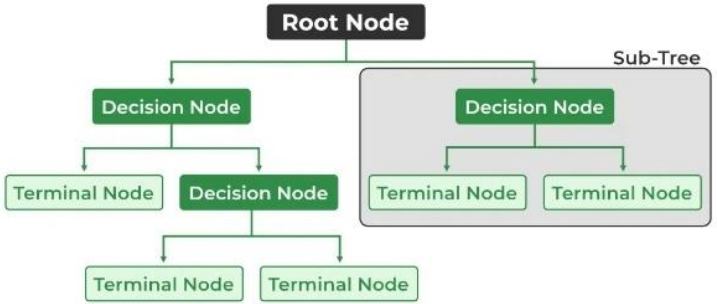
  measure of the degree of randomness

  or uncertainty in the dataset

- **Gini Impurity or index**

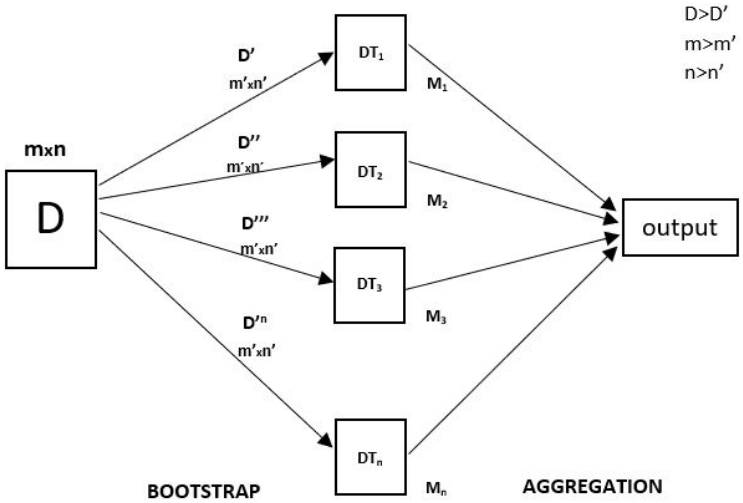
  a score that evaluates how accurate

  a split is among the classified groups



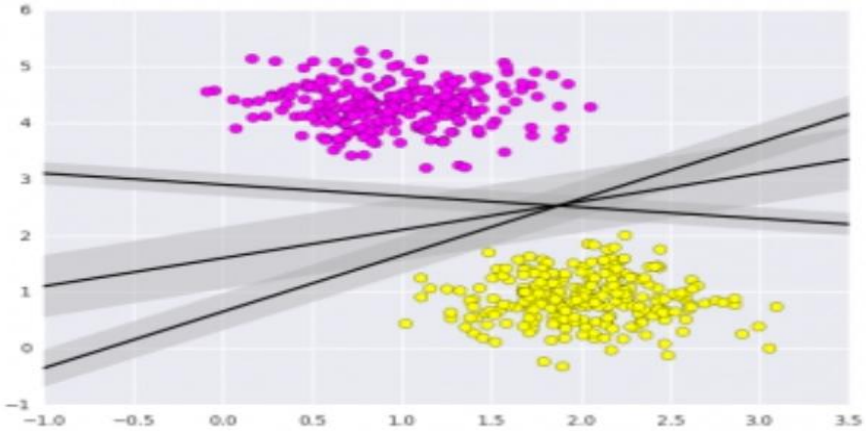
Random Forests

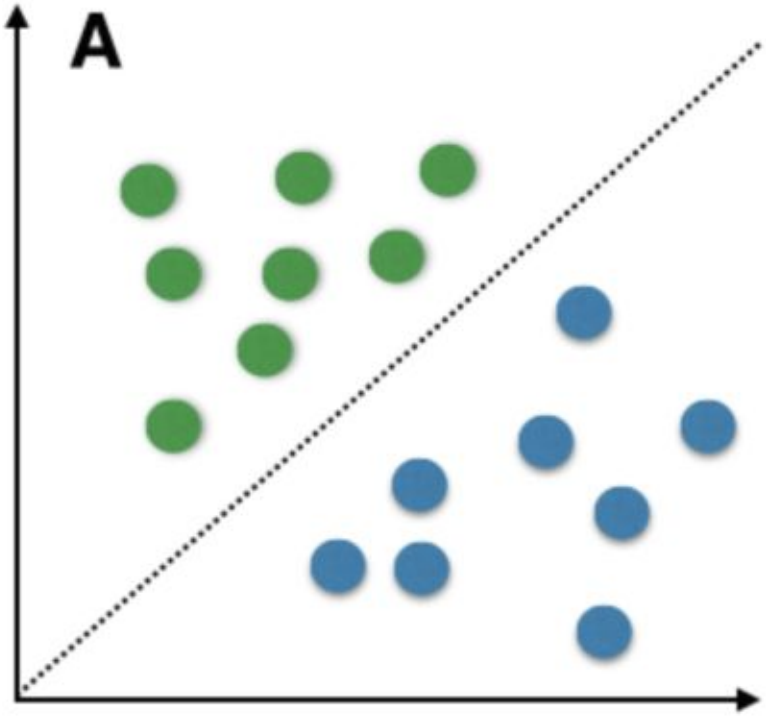
output doesn't depend on one decision tree but on multiple decision trees



Support Vector Machine

Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other

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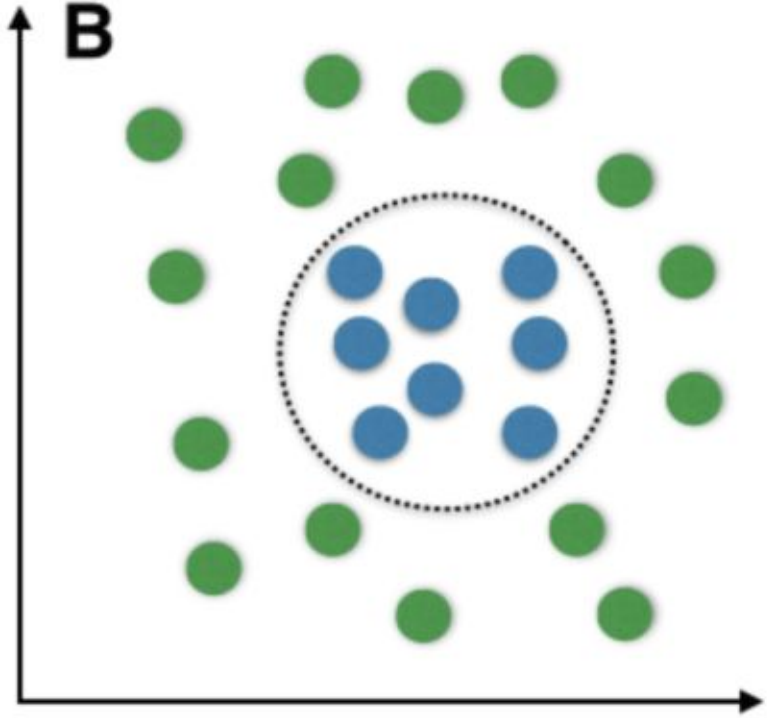
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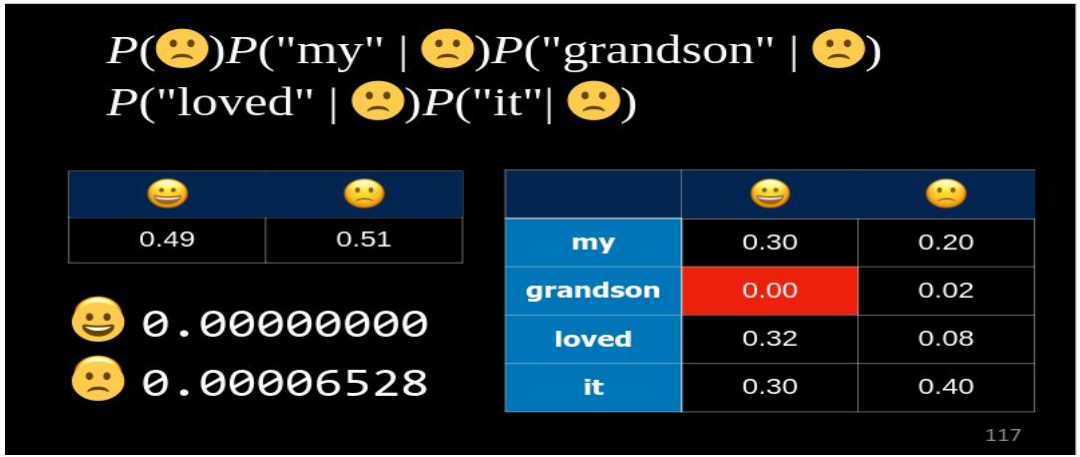
Naive Bayes

- Naive Bayes is a probabilistic classifier based on Bayes' theorem.
- It assumes that the features are conditionally independent given the class.
- The algorithm calculates the probability of an instance belonging to a particular class and predicts the class with the highest probability.



K-nearest Neighbour [Unsupervised]

an Unsupervised Machine Learning algorithm, which groups the unlabeled dataset into different clusters

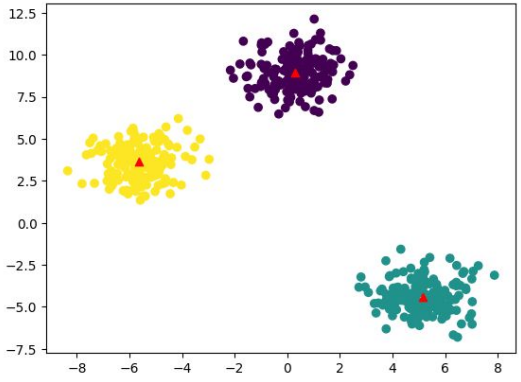
- randomly initialize k points, called

  means or cluster centroids

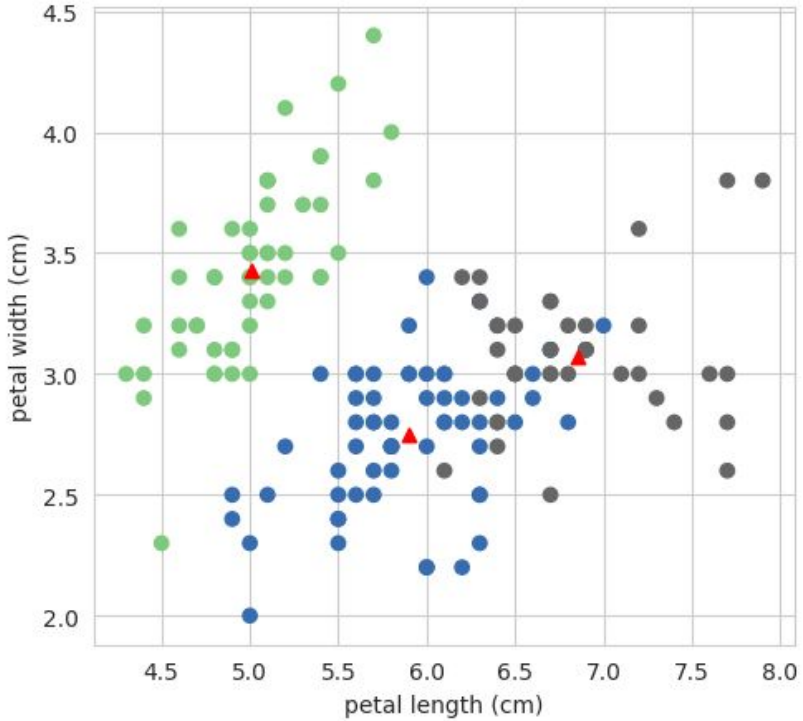
- categorize each item to its closest mean

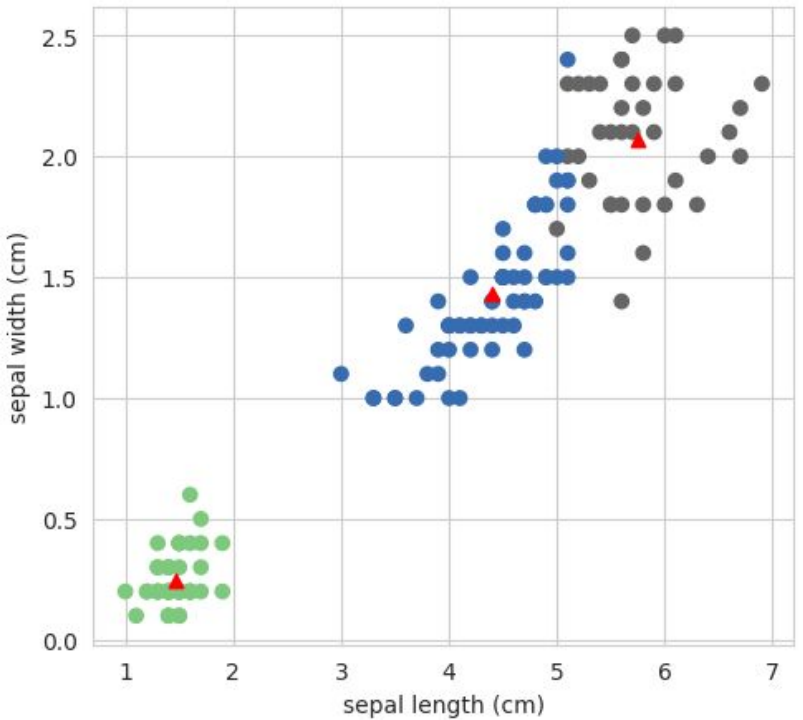
. and we update the mean's coordinates

- After some iterations, we have our clusters



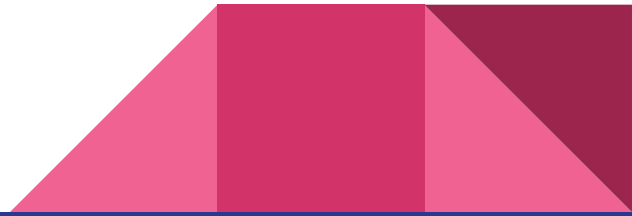
A practical Example





Conclusion and Future Trends

- Traditional machine learning remains a valuable and widely used approach.
- Deep learning has achieved remarkable success in various domains.
- Future trends:
  - Combination of traditional and deep learning techniques.
  - Advances in interpretability and explainability of machine learning models.
  - Handling unstructured and multimodal data.
  - Development of efficient algorithms for large-scale machine learning.



Acknowledgments

- ChatGPT
- GeeksForGeeks

Any Questions???

Thank You!