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Date: 14th December 2023

○ **How Machine Learning works:**

- Build prediction models.
- Learns from pervious data and predicts future outputs.
- Helps get solution of complex problems in a simpler manner.

○ **Features of Machine Learning:**

- Use data to predict patterns
- Improve automatically
- Data-driven technology
- Deal with huge amounts of data

○ **Importance for Machine Learning:**

- Rapid production of data
- Solve complex problems
- Optimized decision making
- Identify hidden patterns and extract information

○ **Types of data:**

- Structured:
 - Stored in relational databases
 - Highly organized
 - Labelled
 - Well-defined
 - Example like names, dates, addresses, credit card numbers, stock information, geolocation
- Unstructured:
 - No predefined format
 - Much more difficult to process
 - For example emails, word processing documents, PDF files, audio files, videos, images, etc

- Semi-structured:
 - Organized but not highly
 - Not stored in relational databases
 - For example HTML, XML, JSON documents, NoSQL databases, etc.
- Metadata:
 - Data about data
 - Describes data
- **Classification of Machine Learning Techniques:**
 1. Supervised Machine Learning
 - Train on labelled data
 - Test model on sample data to predict accuracy
 - Map input data to output data
 - Types: Classification and Regression
 2. Unsupervised Learning
 - Learn without Supervision
 - Data not labelled
 - Restructure data into new groups
 - Types: Clustering and Association
 3. Semi-supervised Learning
 - Hybridization of supervised and unsupervised learning
 4. Reinforcement Learning
 - Feedback based learning
 - Right action: reward, Wrong action: Penalty
 - Goal: get most reward points
- **Classification Analysis**
 - **Binary classification**
 - Have two classes
 - Differentiate in two things
 - **Multiclass classification**
 - Have more than two class labels
 - Works on range of specified classes

- **Multi-Label classification**
 - One element associated with several classes
 - Hierarchically structured
- **Naive Bayes (NB):**
 - Follow Bayes' theorem
 - Works for both binary and multiclass.
 - Classify data and build model
 - Small amount of training data
- **Linear Discriminant Analysis (LDA)**
 - Linear decision boundary classifier
 - Differentiate in two things
- **Logistic Regression**
 - Probabilistic based statistical model
 - Uses a logistic function to estimate the probabilities
 - Can be used for both classification and regression problems
- **K-nearest neighbors (KNN)**
 - Instance based learning algorithm
 - Differentiate in two things
- **Support vector machine (SVM)**
 - Constructs a hyper-plane or set of hyper-planes
 - Behave differently based on different mathematical functions
 - Does not perform well on very noisy data
- **Decision Tree**
 - Non-parametric supervised learning method
- **Random forest (RF)**
 - Parallel ensembling on sub-samples
 - Series of decision trees
 - More accurate
- **Adaptive Boosting**
 - Iterative approach to improve poor classifiers
 - Meta-learning
 - Combines many classifiers for accuracy
 - Learns from errors

- **Extreme gradient boosting**
 - Generates a final model based on a series of individual models
 - Fast to interpret
 - Handles large-sized datasets well
- **Stochastic gradient descent**
 - Iterative method
 - Optimize functions
 - Large scale models
- **Rule-based Classification**
 - Makes use of IF-THEN rules for class prediction
 - Decision tree is rule-based classification algorithm
 - Easier to interpret
 - Used to produce descriptive models
- **Applications of Machine Learning:**
 - Image Recognition
 - Deep Learning
 - Face Detection
 - Image Classification
 - Speech Recognition
 - Communication
 - Convert voice to text
 - Recommender Systems
 - Customized services
 - Recommend content based on search history and preferences
 - Fraud Detection
 - Live detection of frauds
 - Alert Systems
 - Self-Driving Cars
 - Automated driving
 - Medical Diagnosis
 - Disease classification
 - Disease prediction and detection
 - Plant disease related tasks

- Stock Market Trading
 - Predict future trends and prices
 - Time series forecasting
 - Sequential data
- Virtual Try On
 - Identification of landmarks
 - Tracking objects
 - Virtual object placement
 - Artificial Reality