LOVELY PROFESSIONAL UNIVERSITY

INT 423
Machine Learning-II

Lecture #0

Agenda, Roadmap & Expectations

Course details

- **LTP – 2 0 2**
- **Credits – 3.0**
- **Mode – BYOD**

Course Assessment Model

• **Marks break up**	
• **Attendance**	5
• **CA**	25
• **MTE (MCQ based)**	**20**
• **ETE (MCQ+ Subjective)**	50
• **Total**	**100**

Course Assessment

CA Category

- CA1: Project
- CA2: Test (Code based)

Rubrics for Project

S.No.	Criteria	Max Marks	Description
1	Report	10	- Clear problem statement - Proper data explanation - Evaluation results
2	Implementation	10	- Code quality - Model training/tuning - Use of libraries/tools
3	Presentation & Viva	10	- Explain workflow clearly - Understanding ML concepts - Good Q&A response

Text and Reference Books

- MACHINE LEARNING : A PRACTITIONER by CHANDRA S.S., VINOD HAREENDRAN S., ANAND, PHI Learning

- MACHINE LEARNING by Kamalkant Hiran, Dr. Ruchi Doshi, Ritesh Kumar Jain, Dr. Kamlesh Lakhwani, BPB PUBLISHING

Edu-Revolution

Code	Mooc Course Name	Agency	Web URL
INT423	Introduction To Machine Learning	NPTEL	https://onlinecourses.nptel.ac.in/noc25_cs91/preview

Course Outcomes

CO1 :: Explain the core concepts of unsupervised learning and implement K-Means clustering with evaluation techniques such as the elbow method.

CO2 :: Analyze various advanced clustering algorithms and anomaly detection methods including PCA, Isolation Forest, hierarchical and DBSCAN clustering.

CO3 :: Evaluate the effectiveness of clustering algorithms using evaluation metrics

CO4 ::Describe the principles of reinforcement learning including policy formulation, MDPs, Monte Carlo and Temporal Difference methods.

CO5 :: Determine Q-learning and deep reinforcement learning techniques such as DQN, Double DQN, and Dueling DQN for sequential decision-making tasks.

CO6 :: Develop various recommender systems using collaborative, content-based, and hybrid filtering approaches

Program Outcomes

PO1::Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3::Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO4::Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5::Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Program Outcomes

PO6::Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7:Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8::Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9::Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10::Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Program Outcomes

PO11::Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12::Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Educational Objectives (PEO)

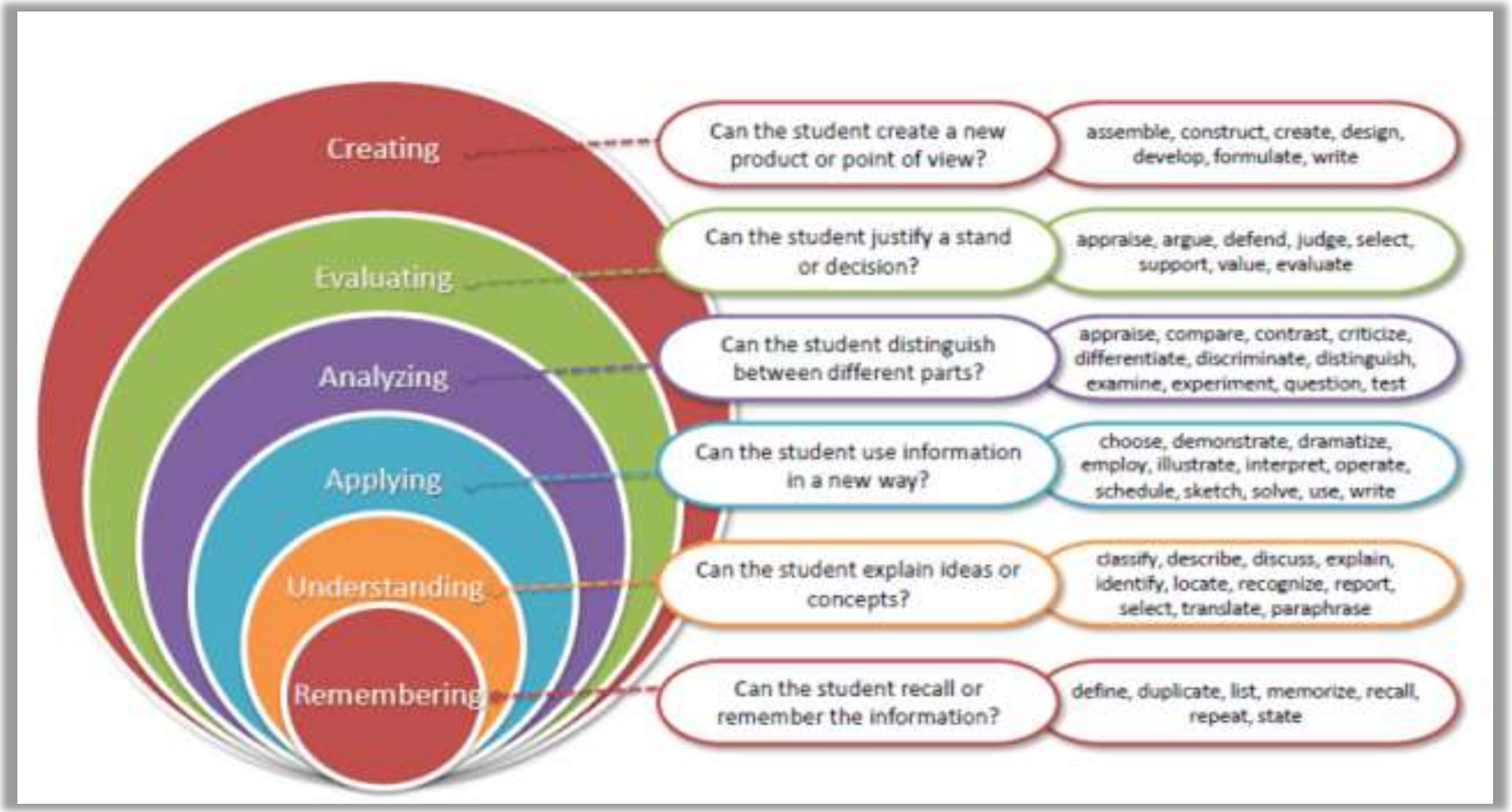
- The graduates shall demonstrate professional advancement through expanded leadership capabilities and technical accomplishment providing solutions to local and global societal issues through mindful engagement.
- The graduates shall undertake higher education or global certifications or exhibit impactful research accomplishments.
- The graduates shall extend global technology development and deployment expertise by becoming entrepreneurs, consultants, and innovators.
- Graduates shall embrace ethics and lifelong learning to adapt to a fast-changing world and enhance global employability in diverse work environments.

PSO’s

PSO1::Apply acquired skills in software engineering, networking, security, databases, intelligent systems, cloud computing, and operating systems to adapt and deploy innovative software solutions for diverse applications.

PSO2::Apply diverse IT skills to design, develop, and evaluate innovative solutions for business environments, considering risks, and utilizing interdisciplinary knowledge for efficient real-time projects benefiting society.

Revised Bloom's Taxonomy



Vision

To become one of the leading Schools globally in Computer Science and Engineering recognized for its academics and innovations by nurturing professionals, researchers and entrepreneurs for sustainable growth of industry and society.

Mission

M1: To provide a learning-based environment on technical concepts applied to real-life situations with measurable outcomes.
M2: To establish connections with the industry for curriculum design, and creating internship cum career opportunities.
M3: To address societal issues related to regional, national and global challenges through meaningful research.
M4: To inspire graduates for pursuing lifelong learning in professional careers.
M5: To develop leadership potential in ethically competent entrepreneurs.

Syllabus before Mid-Sem

The course contents: Unit 1

- **Introduction to Unsupervised Learning & K-Means**:
- Introduction to unsupervised learning, what is clustering? K-means intuition, K-means algorithm, Optimization objective, Initializing K-means, Choosing the number of clusters, hard versus soft clustering, using the elbow method to find the optimal number of clusters.

The course contents: Unit 2

- **Advanced Clustering Techniques**:
- Anomaly detection algorithm-: Isolation Forest, Anomaly detection vs. supervised learning, Choosing what features to use (PCA), organizing clusters as a hierarchical tree, agglomerative clustering, DBSCAN clustering.

The course contents: Unit 3

- **Clustering metrics for Clustering:**
- Silhouette Score, Davies-Bouldin Index, Dunn Index, Adjusted Rand Index (ARI), Normalized Mutual Information (NMI), Homogeneity, Completeness, and V-measure, Fowlkes-Mallows Index, Adjusted Mutual Information (AMI).

Syllabus After Mid-Sem

The course contents: Unit 4

- **Foundations of Reinforcement Learning**:
- What is Reinforcement Learning and its concepts? Markov Decision process (MDP), Policies and Value Functions, Learning Methods- Monte Carlo Learning, Temporal Difference Learning, Exploration Vs Exploitation Bellman Equation.

The course contents: Unit 5

- **Q-Learning & Deep Q- Networks**:
- Introduction to Q learning, Q learning algorithm, epsilon-greedy strategy, deep Q-networks, Double DQN, Dueling DQN.

The course contents: Unit 6

- **Recommender Systems:**
- Recommendation strategies and use cases, Collaborative filtering algorithm, Binary labels: favs, likes and clicks, Mean normalization, Content-based filtering, Collaborative filtering vs Content based filtering, Hybrid recommender System.

List of Practicals

- Write a Program to implement K-means clustering algorithm on a given dataset
- Write a program to find the optimum value of K for K means clustering using the elbow method on a given dataset.
- Write a program to implement the anomaly detection algorithm.
- Write a program to implement the hierarchical clustering algorithm on a given dataset.
- Write a program to implement the agglomerative clustering algorithm on a given dataset. • Write a program to implement the DBScan clustering algorithm on a given dataset.
- Write a program to implement PCA for dimension reduction for a given dataset.

List of Practicals

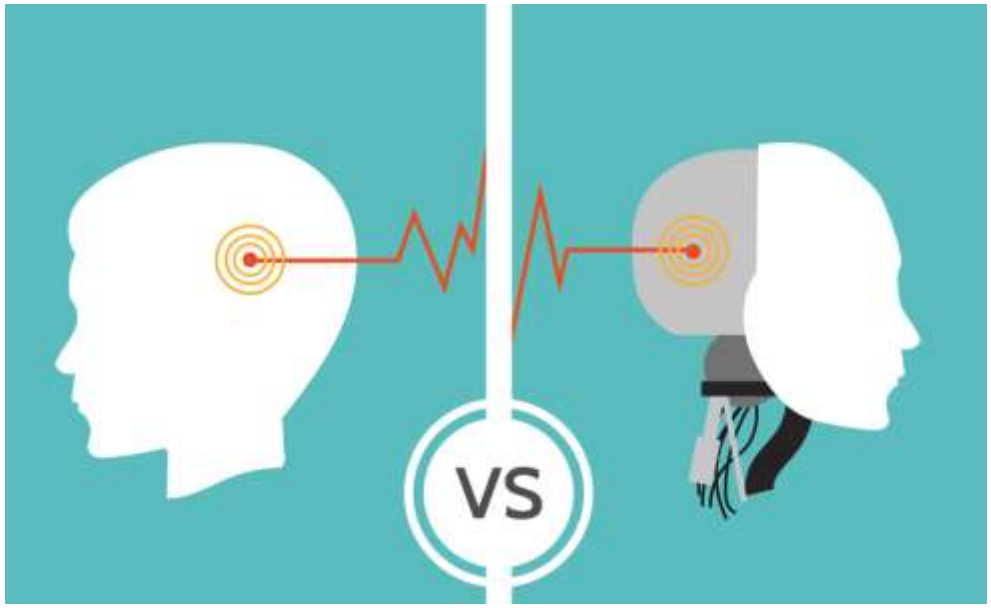
- Write a program to evaluate the performance of clustering algorithms using different evaluation metrics.
- Write a program to demonstrate the reinforcement learning task.
- Write a program to implement the reinforcement learning using Q learning approach.
- Write a program to make a simple recommendation system using a rule base approach.
- Write a program to implement a recommendation system using collaborative filtering approach.

MOOC’s

- https://onlinecourses.nptel.ac.in/noc25_cs91/preview
  NPTEL: Introduction To Machine Learning – IIT MADRAS

  Academic Benefits: Exemption from MTE and all ATs

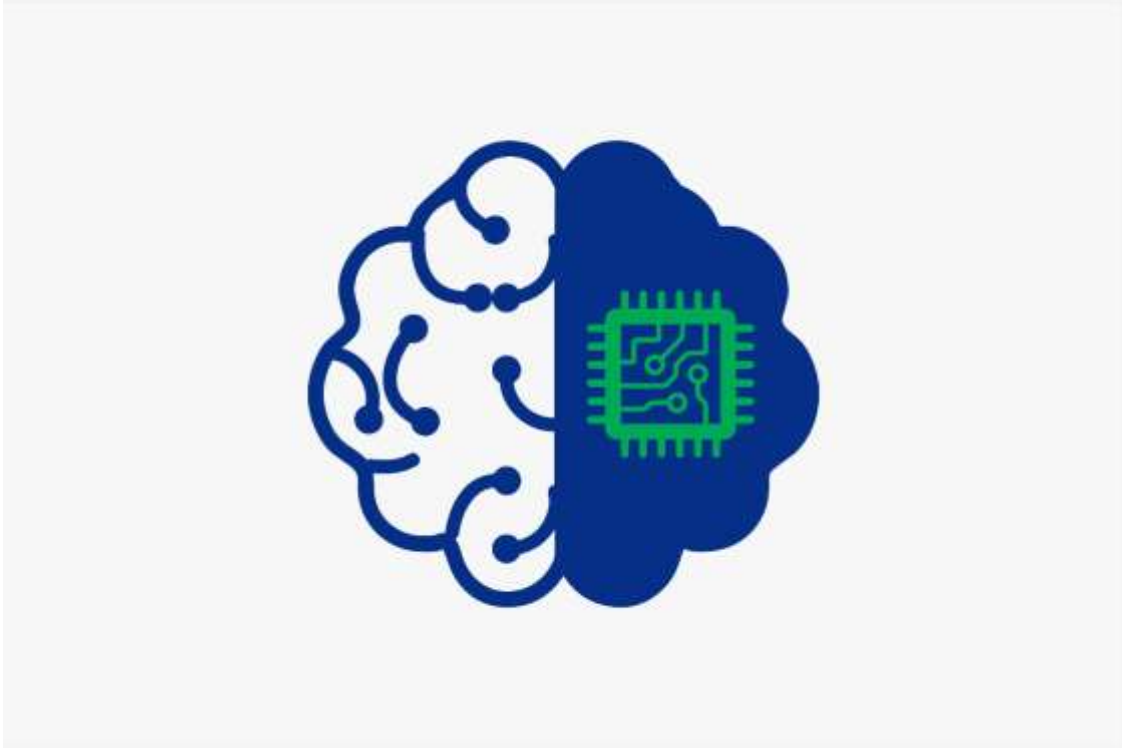
You v/s Computers



- **Everything is a PATTERN**
- **Natural ability to learn, unlearn and relearn**

- **Everything is DATA**
- **Will need code to understand data, visualize data and extract meaning**

Machine Learning



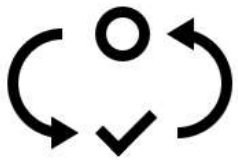
TYPES OF MACHINE LEARNING

Supervised Learning

Train an algorithm to perform classifcation and regression with a labelled data set.

Unsupervised Learning

Train an algorithm to find clusters and associations in an unlabelled data set.



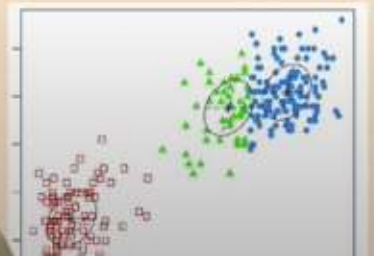
Reinforcement Learning

Train an agent to take certain actions in an environment without a data set.

Unsupervised Learning

- ➔ Unlabeled data X
- ➔ Learn X
- ➔ Generate fakes, insights

"This product does what it is supposed to. I always keep three of these in my kitchen just in case ever I need a replacement cord."



Supervised Learning

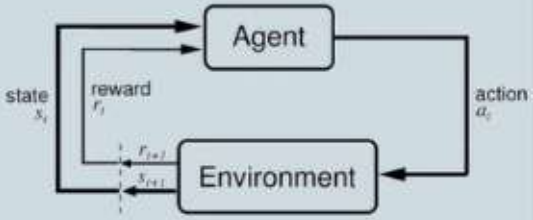
- ➔ Labeled data X and Y
- ➔ Learn X -> Y
- ➔ Make Predictions

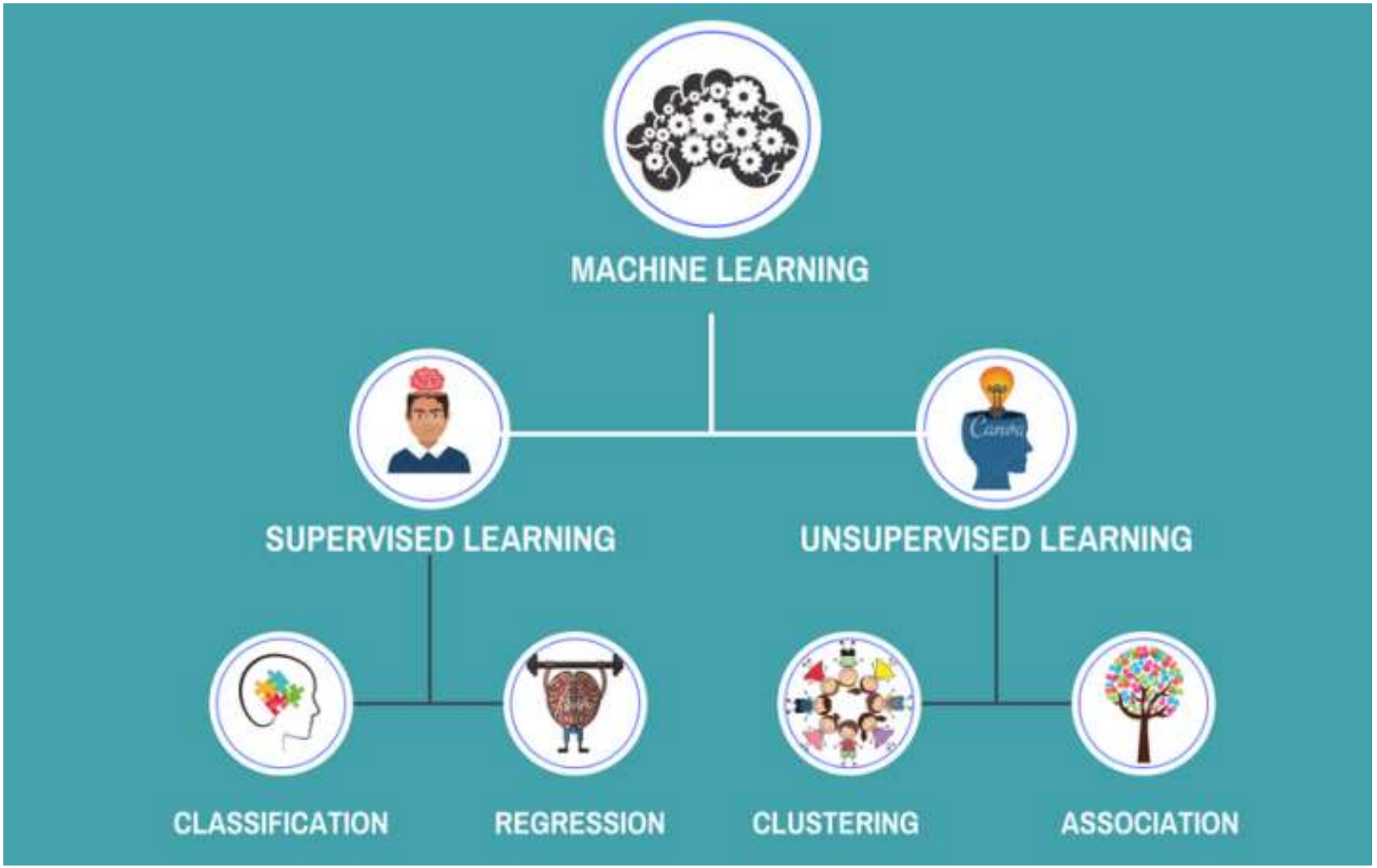
→ *cat*

→ *"Hey Siri"*

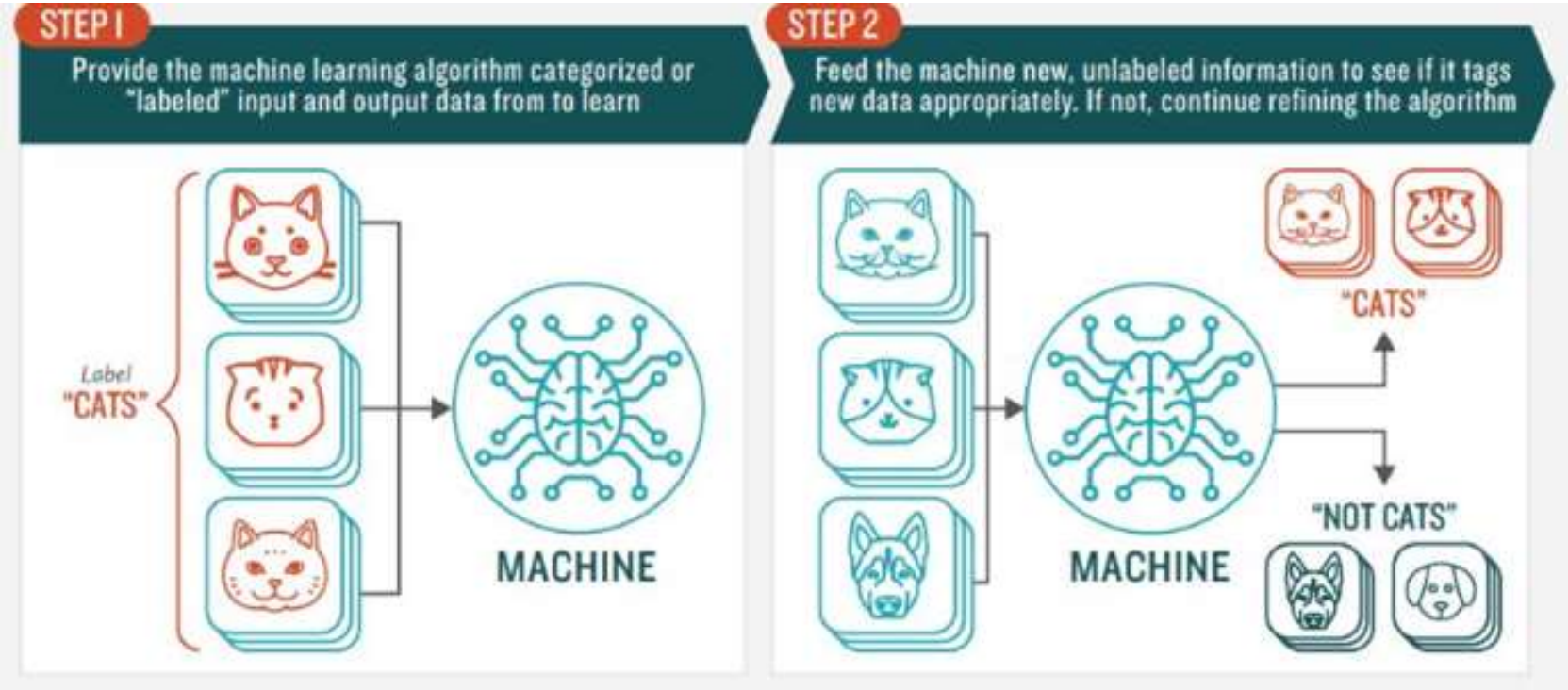
Reinforcement Learning

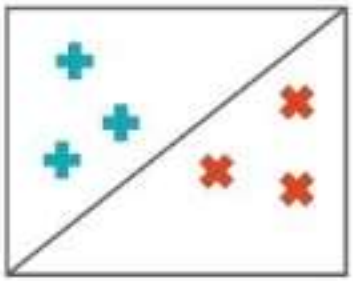
- ➔ Learn how to take Actions in an Environment




MACHINE LEARNING
SUPERVISED LEARNING
UNSUPERVISED LEARNING
CLASSIFICATION
REGRESSION
CLUSTERING
ASSOCIATION

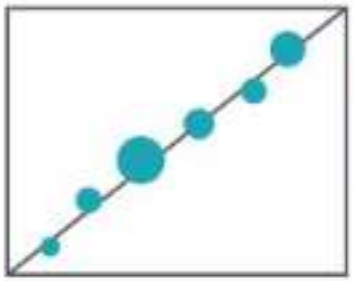
Classification





CLASSIFICATION

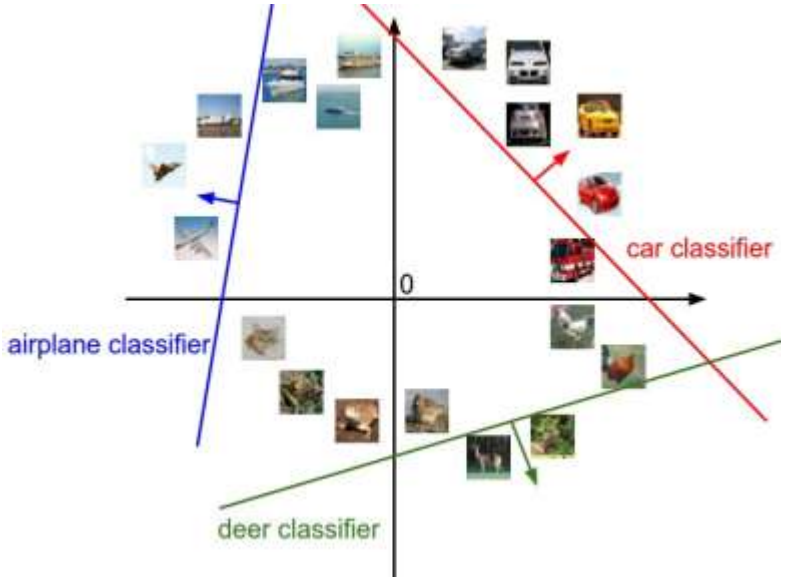
Sorting items into categories

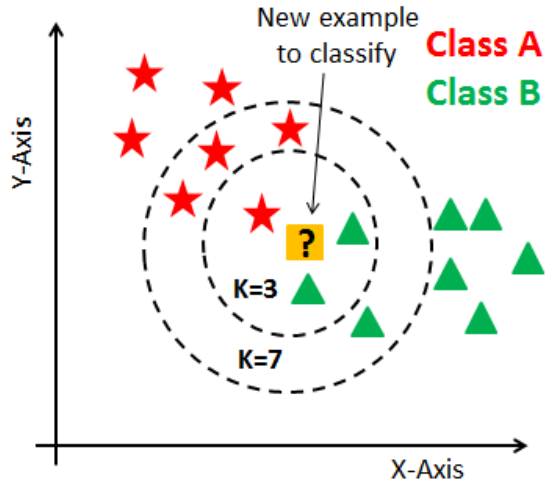


REGRESSION

Identifying real values (dollars, weight, etc.)

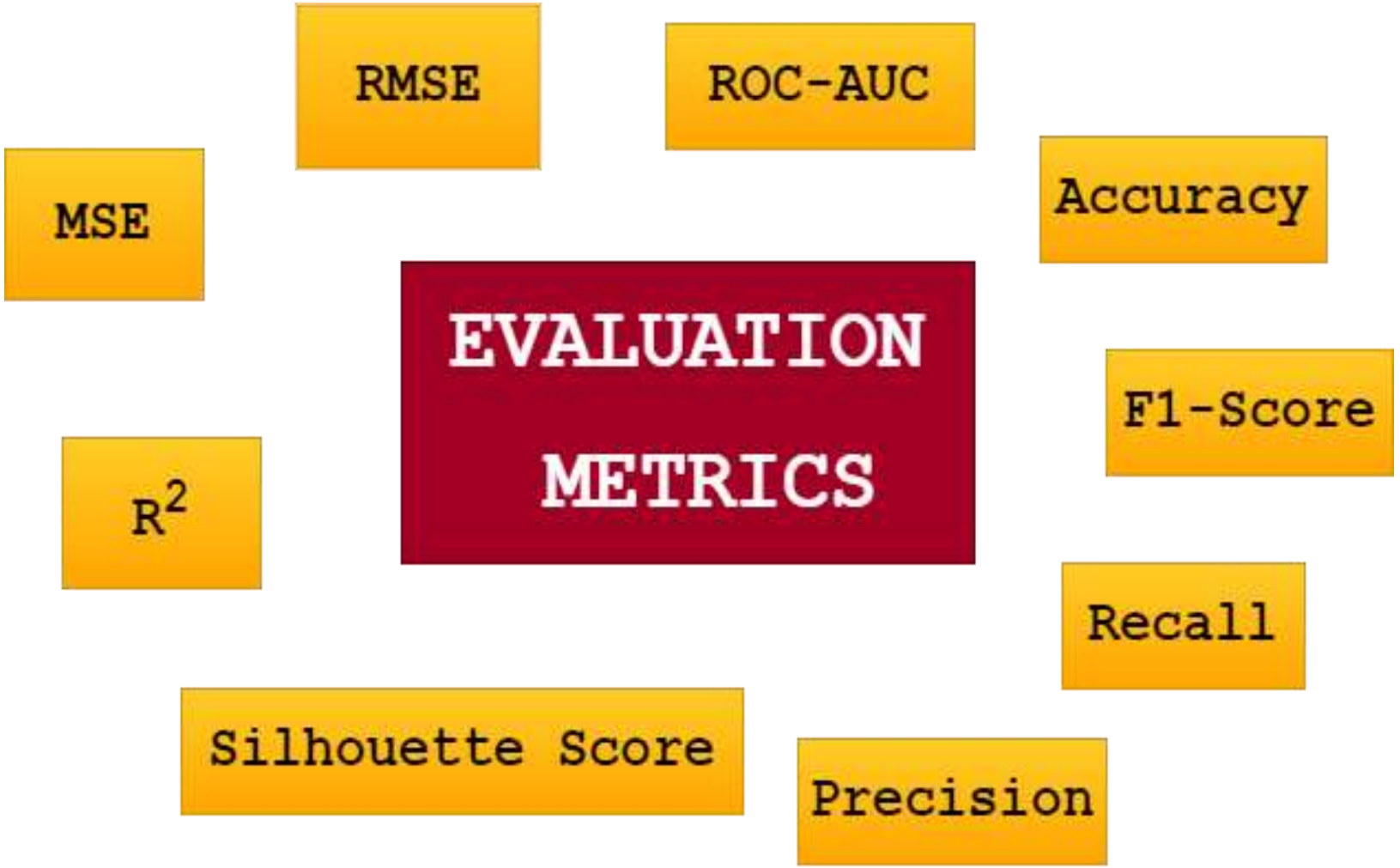
Scikit-learn classifiers



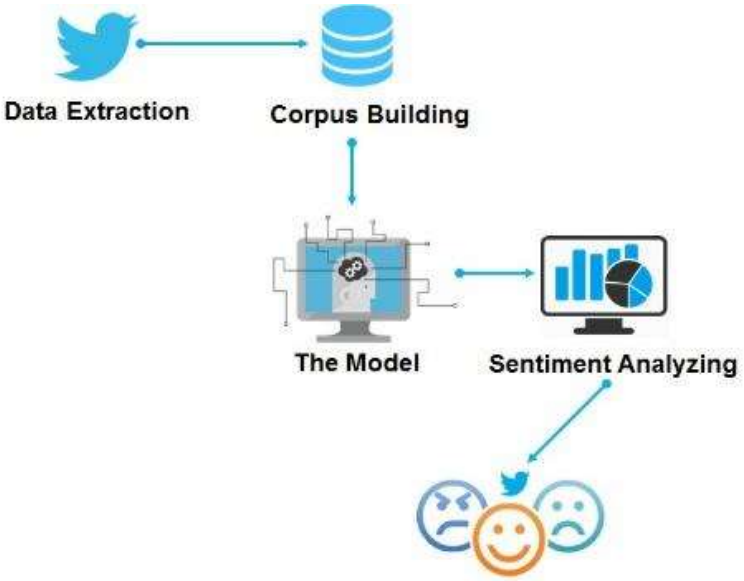


SVM, K-NN, Bayesian Algorithms

Model evaluation

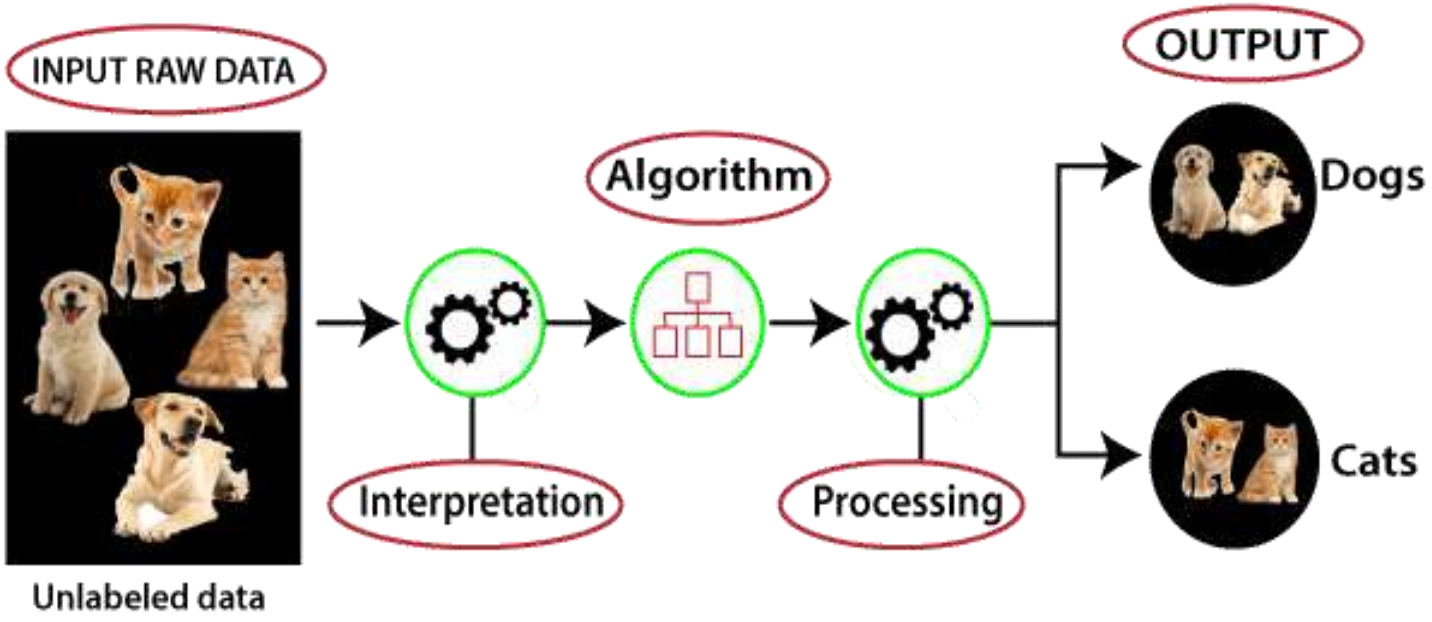


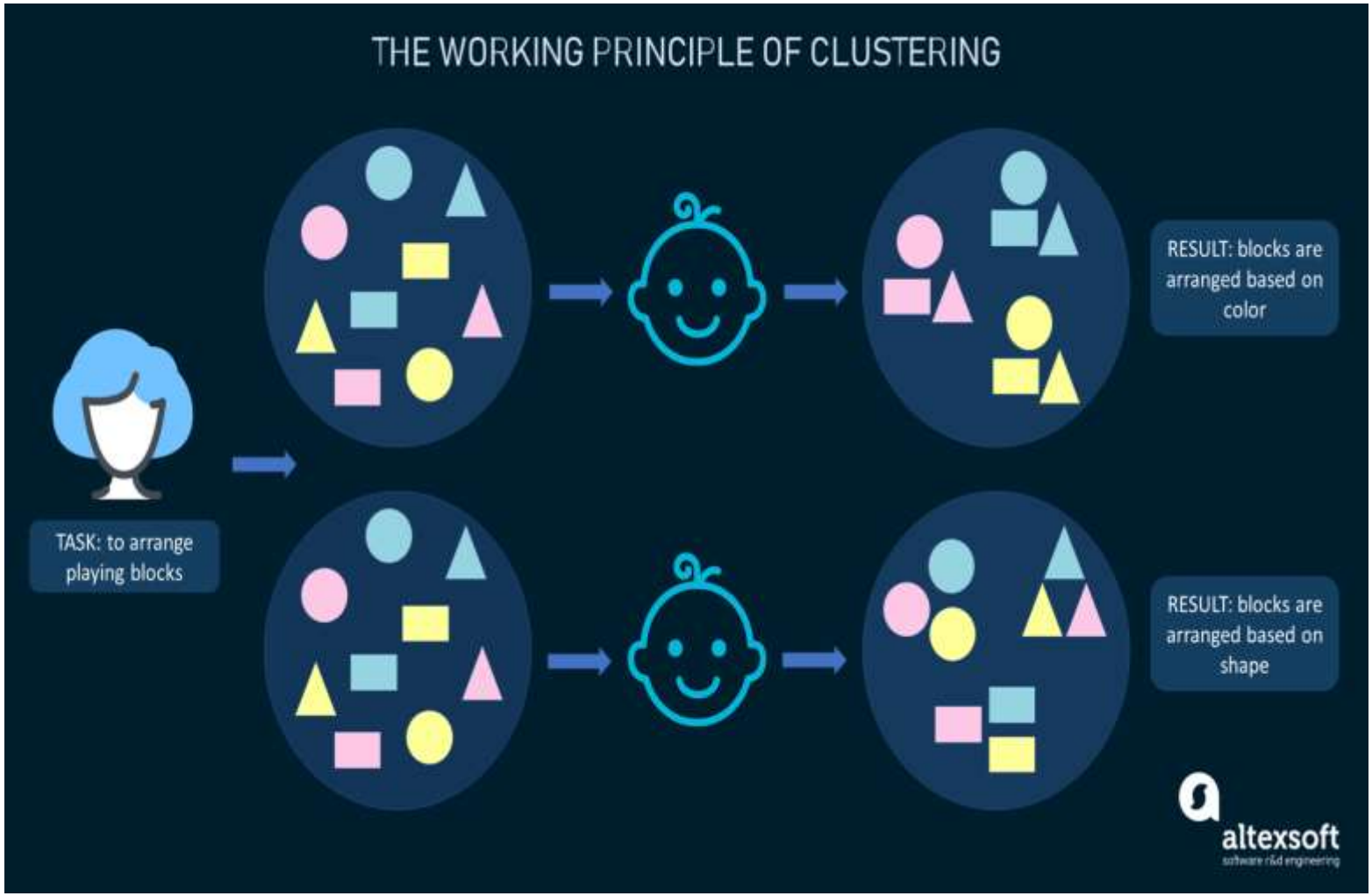
Application of ML



Sentiment Analysis

Unsupervised Machine Learning Example




THE WORKING PRINCIPLE OF CLUSTERING
TASK: to arrange playing blocks
RESULT: blocks are arranged based on color
RESULT: blocks are arranged based on shape
altexsoft
software r&d engineering

Innovative Pedagogy

1. **Flipped Classroom:** In a flipped classroom, students are provided with lecture materials (videos, readings) to study at home, while class time is dedicated to exercises, projects, and discussions.
2. **Project-Based Learning (PBL):** PBL involves students working on projects over an extended period of time, which allows them to explore and apply the course concepts in real-world scenarios.
3. **Case-Based Learning:** This method uses real-world cases to stimulate critical thinking and apply theoretical knowledge.
4. **Gamification:** Incorporating game elements into the learning process can make it more engaging and motivating for students. Implement a point-based system where students earn points for completing exercises, quizzes, and projects.

What are Cohorts

- A group of students of a common programme who intend to attain similar characteristics by means of learning similar skills in order to target a particular career opportunity.

Purpose of Cohorts

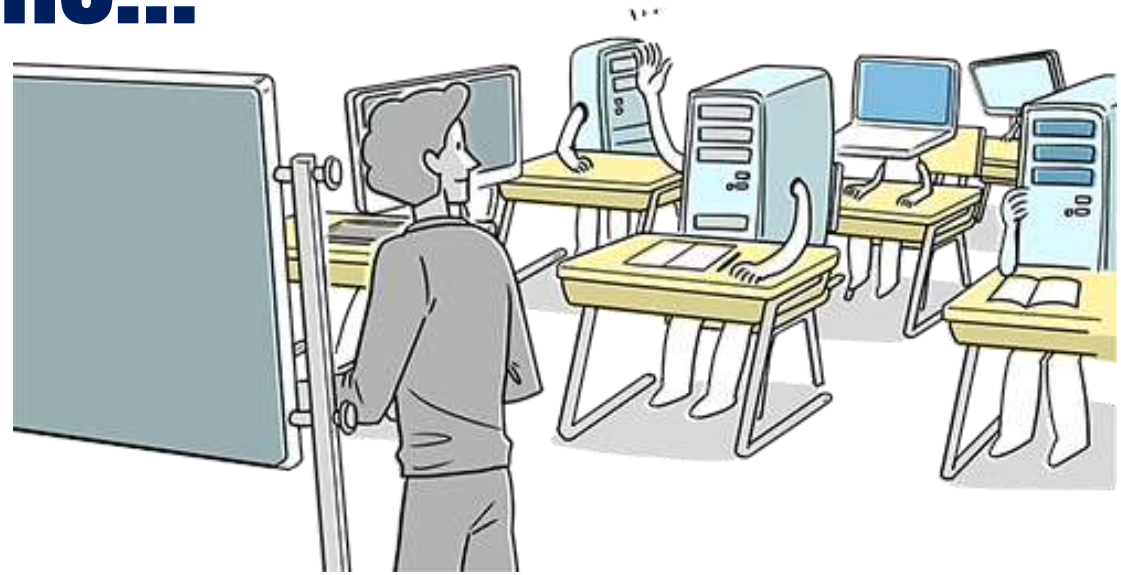
- Student shall be able to have a goal oriented approach for his/her career
- Student identifies the goal in the very first year
- Student shall be able to follow the stage wise career progression.
- Early identification of skill set required for selected goal.

- Cohort 1: Software Development (Product Based)
- Cohort 2: Data Science
- Cohort 3: Cyber Security
- Cohort 4: Full Stack Web Development
- Cohort 5: Machine Learning
- Cohort 6: Cloud Computing
- Cohort 7: Software Methodologies And Testing
- Cohort 8: Software Development (Service Based)
- Cohort 9: Entrepreneurship
- Cohort 10: Mobile Application Development
- Cohort 11: Government jobs/Higher studies

INT 423– Cohort 5

Get Set Go!!!

Get trained to TRAIN systems...



Build futuristic solutions...

Edu-Revolution: Be the Change Initiatives

Category	Criteria
Recognition of Prior Learning (RPL)	To avail the benefits under RPL, the student must possess a certificate related to Machine Learning course. Once the certificate is approved by the Machine Learning domain team, the student will be required to appear for a Benchmark test to qualify for the benefit.
MOOC: NPTEL/SWAYAM	https://onlinecourses.nptel.ac.in/noc25_cs91/preview Introduction to Machine Learning- IIT Madras By Prof. Balaraman Ravindran

Interfaces and Contact Information

- UMS link to apply for EDU Revolution initiatives:

  UMS Navigation --- LMS → EDU Revolution: BE THE CHANGE

- In case of any query in this regard the student can approach for resolution through RMS at the following path:

  UMS Navigation--- Relationship management system → EDU Revolution: BE THE CHANGE

- OR get your queries resolved through the **Helpline Number: 01824-520150.**

Innovative Pedagogies

Strategy	Application in the Course
Case-based Learning	Unit I, II, IV, and VI To implement real-world examples like Exploring Clustering-Based Reinforcement Learning for Personalized Book Recommendation in Digital Library or Deep Reinforcement Learning Real-Time Recommendation Model Based on Long and Short-Term Preference.
Flipped Classrooms	Unit IV Pre-recorded videos and reading material shared before class; live sessions for hands-on implementation and doubt clearance.
Quiz	At the end of each Unit
Events/ Competitions / Workshops	Hackathons like Smart India Hackathon, Kaggle competitions, and in-house ML events

Open Educational Resources

Unit Mapped	Broad Topic	Sub Topic	Source Type	Source Title	%age Mapped	Source URL
Unit I	Introduction to Unsupervised Learning & K-Means	Introduction to unsupervised learning, what is clustering? K-means intuition, K-means algorithm, Optimization objective, Initializing K-means, Choosing the number of clusters, hard versus soft clustering, using the elbow method to find the optimal number of clusters.	Video Course	NPTEL: ML for Engineering & Science Applications	75%	https://archive.nptel.ac.in/courses/106/106/106106198/
Unit II	Advanced Clustering Techniques	Anomaly detection algorithm-: Isolation Forest, Anomaly detection vs. supervised learning, Choosing what features to use (PCA), organizing clusters as a hierarchical tree, agglomerative clustering, DBSCAN clustering	Video Course	NPTEL: Data Science and Artificial Intelligence	70%	https://elearn.nptel.ac.in/shop/completed-courses/execedu-closed/dsai-leadership-essentials/?v=c86ee0d9d7ed
Unit III	Clustering metrics for Clustering	Silhouette Score, Davies-Bouldin Index, Dunn Index, Adjusted Rand Index (ARI), Normalized Mutual Information (NMI), Homogeneity, Completeness, and V-measure, Fowlkes-Mallows Index, Adjusted Mutual Information (AMI)	Lecture PDF	NPTEL: Business Intelligence and Analytics	70%	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://elearn.psgcas.ac.in/nptel/courses/video/106106361/lec35.pdf

Unit Mapped	Broad Topic	Sub Topic	Source Type	Source Title	%age Mapped	Source URL
Unit IV	Foundations of Reinforcement Learning	What is Reinforcement Learning and its concepts?, Markov Decision process (MDP), Policies and Value Functions, Learning Methods- Monte Carlo Learning, Temporal Difference Learning, Exploration Vs Exploitation Bellman Equation	Video Course	NPTEL: Reinforcement Learning	75%	https://onlinecourses.nptel.ac.in/noc19_cs55/preview
Unit V	Q-Learning & Deep Q-Networks	epsilon-greedy strategy, deep Q-networks, Double DQN, Dueling DQN	Video Course	NPTEL: Deep Learning – Part 1	80%	https://nptel.ac.in/courses/106106143
Unit VI	Recommender Systems	Recommendation strategies and use cases, Collaborative filtering algorithm, Binary labels: favs, likes and clicks, Mean normalization, Content-based filtering, Collaborative filtering vs Content based filtering, Hybrid recommender System	Video Course	NPTEL: Deep Learning – Part 2	85%	https://onlinecourses.nptel.ac.in/noc24_ge35/preview

Assessment expectations & example