

SE488 Ai Driven Software Development

Introduction

Outline

- Introduction
- Syllabus
- Introduction to AI

Introduction

- Me
- You



Introduction

- Dr. Wael Kessentini
 - PhD, University of Montreal, Canada
 - Main research interests
 - Software engineering
 - Software evolution
 - Software testing
 - Software quality
 - Software migration
 - Model-Driven engineering
 - ...



Office Location: CDM 841

Office Phone: (312) 362-7080

Introduction

- Me
- You



- Introduce yourself
 - Your background / experiences
 - Artificial Intelligence course before SE488 ?
 - Future plan (Dream job)

Outline

- Introduction
- Syllabus
- Introduction to AI

Instructor

- **Instructor: Dr. Wael Kessentini**
- Email: wkessent@depaul.edu
- For Course questions : Use Microsoft Teams
- Office Location: CDM 841
- Office Hours:
 - Mon 2:30 – 4:00pm
 - Zoom Meeting ID : 927 8887 4370
 - First Come , First served (You have to wait in the zoom waiting room)

Course Learning Outcomes

- At the end of this course:
 - Understand and define various AI algorithms such as : Metaheuristics algorithms, machine learning algorithms, neural network algorithms.
 - Design and apply metaheuristics and machine learning techniques to solve optimization problems related to the software engineering field
 - Analyze the performance and behavior of metaheuristics.
 - Stay current with recent developments and trends in AI-driven software development through readings, research papers, discussions

Prerequisite and References

- Prerequisite :

SE450 or SE456

- **Object Oriented programming background**

Prerequisite and References

- References:
- **No mandatory book**
- **I will provide readings , recent research papers in the field of AI in software engineering**

Assignments

- Assignments:
 - 3 Assignments
 - 1 Quizz
 - Research Paper Review and presentation

Exams and Assessment

- **Exams**
- Final exam

SE433 Platforms

- You can find
 - On D2L: Lecture slides, class activity, materials related to the course
 - On Microsoft Teams : General information, discussion, Q&A etc.
- To join Microsoft Teams **(REQUIRED)**:
 - Name of the Team: SE488 Fall 2024
 - Access code: **230gdk0**

Tentative Schedule (may change)

Week	Lecture Topics	Assignment/Project Release date	Student s Presentations (Schedule will be added in a separate document)
09/05/2024	<ul style="list-style-type: none"> Introduction to AI-driven Software Development 		
09/12/2024	<ul style="list-style-type: none"> Algorithms in AI : Learning Algorithms I 		
09/19/2024	<ul style="list-style-type: none"> Algorithms in AI : Learning Algorithms II Problem solving, Searching 	<ul style="list-style-type: none"> Assignment 1 	
09/26/2024	<ul style="list-style-type: none"> Local Search Algorithms 		
10/03/2024	<ul style="list-style-type: none"> Population-Based Algorithms I 	<ul style="list-style-type: none"> Assignment 2 (miniproject1) 	
10/10/2024	<ul style="list-style-type: none"> No lecture (Quizz) 		
10/17/2024	<ul style="list-style-type: none"> Population-Based Algorithms II 		
10/24/2024	<ul style="list-style-type: none"> Neural Networks/ Deep learning 	<ul style="list-style-type: none"> Assignment 3 (miniproject2) 	
10/31/2024	<ul style="list-style-type: none"> Diverse AI algorithms applied to SE 	<ul style="list-style-type: none"> Paper Presentations 	
11/7/2024	<ul style="list-style-type: none"> Review 	<ul style="list-style-type: none"> Paper Presentations 	
11/14/2024	<ul style="list-style-type: none"> Final Exam 		

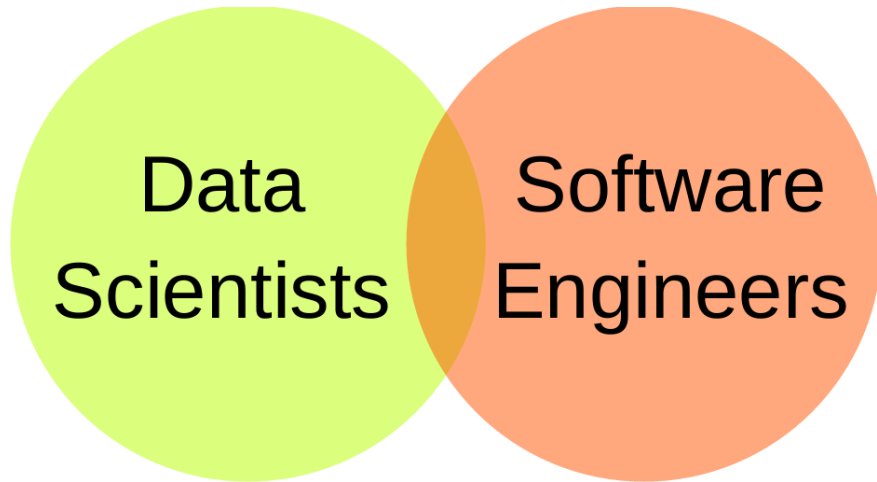
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- Introduction
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quizz

- Polleverywhere quiz

Overview

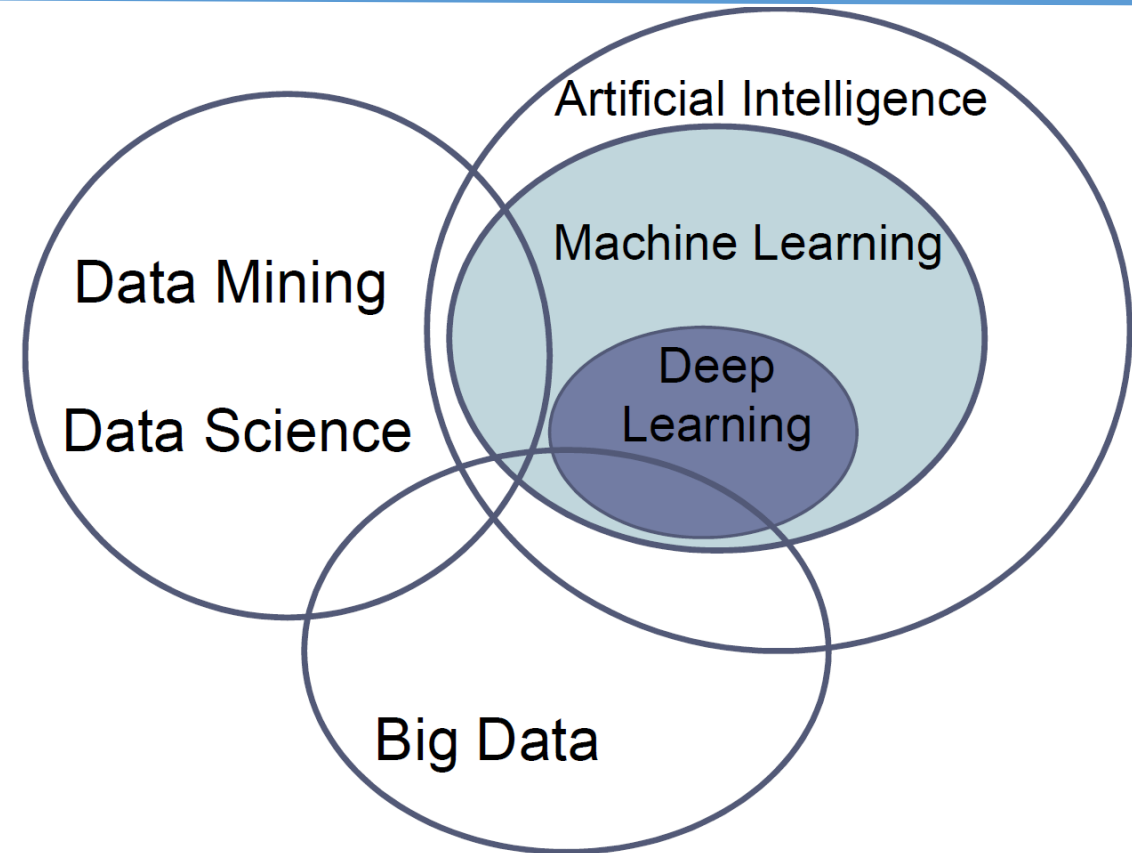


Artificial Intelligence:

Computers acting humanly / thinking humanly / thinking rationally / acting rationally -- [Russel and Norvig, 2003](#)

Machine Learning:

A computer program is said to learn from experience E with respect to some task T and some performance measure P , if its performance on T , as measured by P , improves with experience E . -- [Tom Mitchell, 1997](#)



Deep Learning:

Specific learning technique based on neural networks

What is Artificial Intelligence ?

- Abbreviation : AI
- Multifaceted discipline within the larger field of computer science.
- Goal : devise systems that can perform tasks requiring human intelligence and make decisions much like a human would.
- AI : concept of building “intelligent agents”.
 - System that perceives its environment through sensors and interacts with it through actuators, guided by objectives. It is an entity that senses, understand, learns, plans and can actuate to meet its goals.
 - Example : self-driving car, smartphone

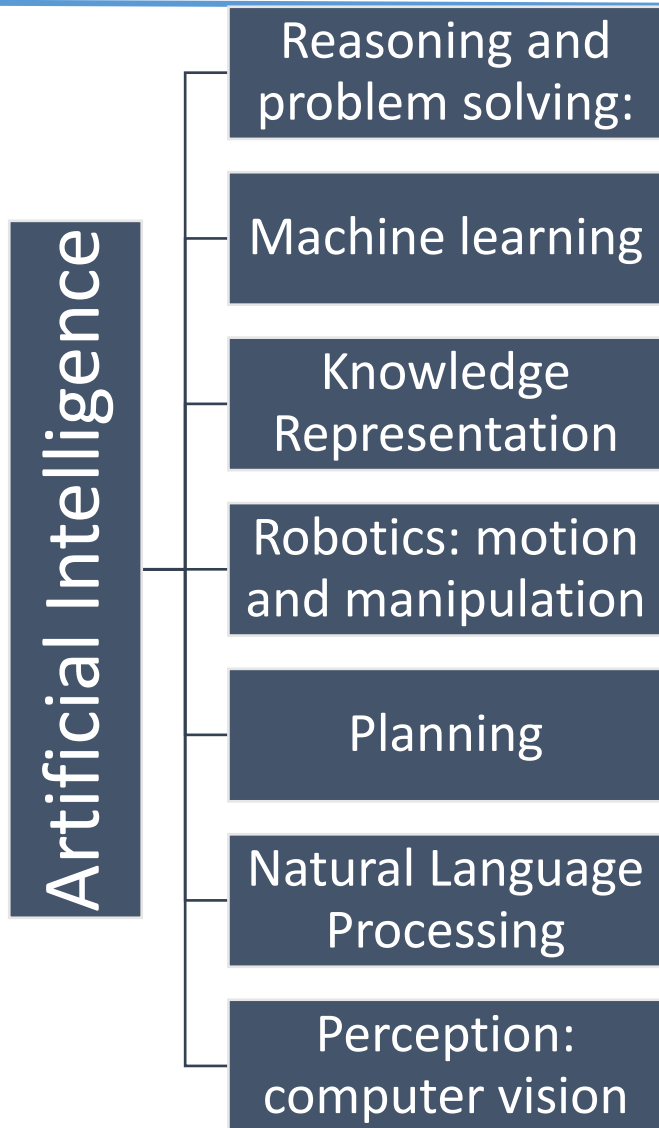
AI challenges/problems

- Blackbox problem
- Data privacy
- Bias
- Ethic

Artificial Intelligence



Branches of AI

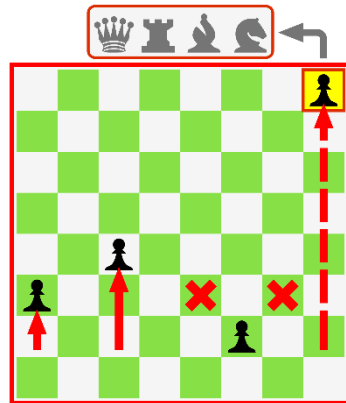


- Reasoning and problem solving: generates conclusions from available knowledge using logical techniques. Then use that knowledge to solve problems.
- Machine learning: the techniques to give computer systems the ability to "learn".
- Knowledge Representation: representing information about the world in a form that a computer system can utilize to solve complex tasks
- Robotics: motion and manipulation. Making the robots capable of navigating different environment
- Planning: decision making tasks performed by the robots or computer programs to achieve a specific goal
- Natural Language Processing: helps computers understand, interpret and manipulate human language
- Perception: computer vision methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information

History of AI

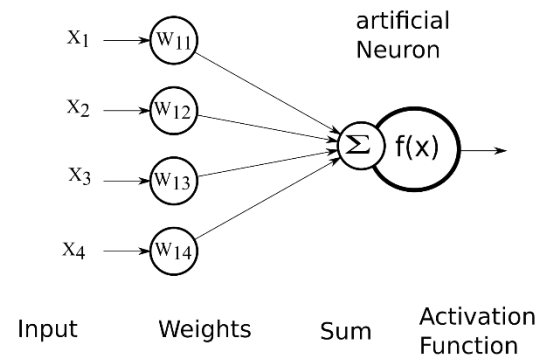
FIRST ERA

- 1950s – 1970s
- Search methods
- Simple Neural Networks



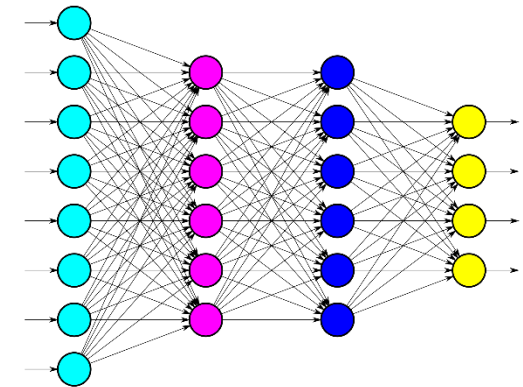
SECOND ERA

- 1980s – 2010s
- Advances Neural Networks
- Machine learning
- Data mining



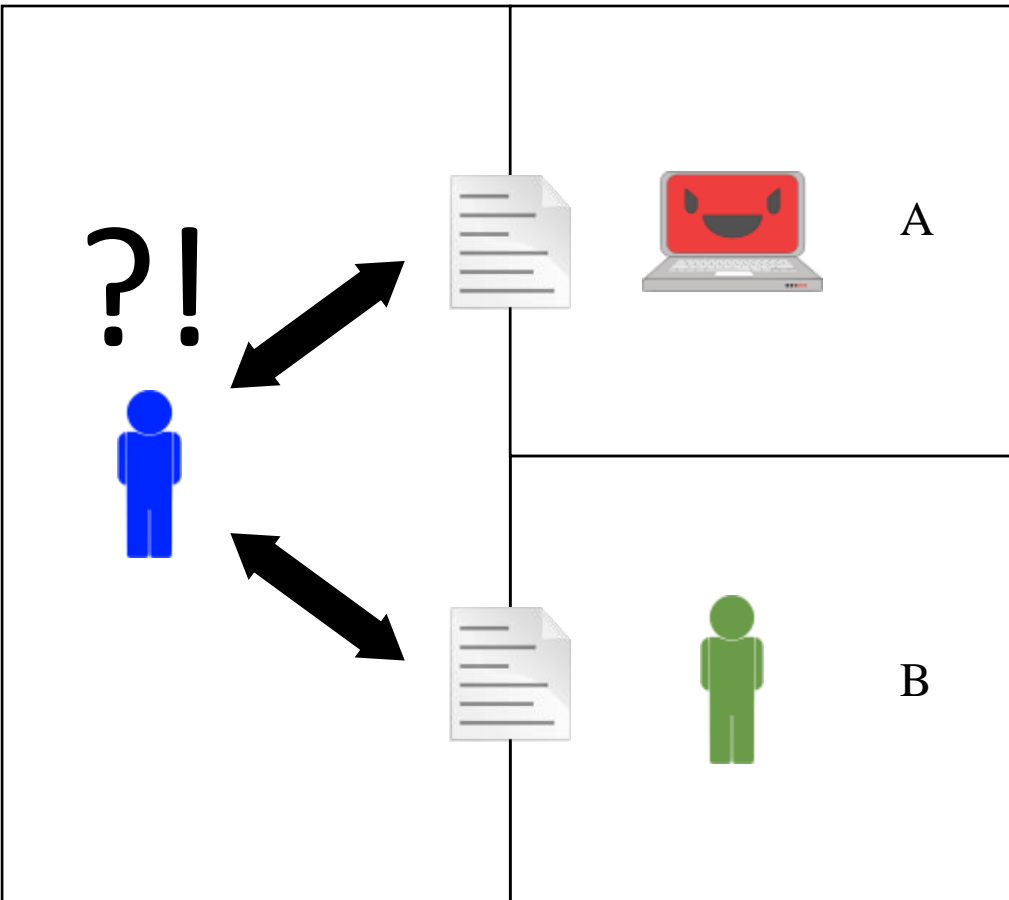
THIRD ERA

- Present
- Deep Learning
- Big data



- 1950: Alan Turing, the father of AI, proposed a Turing test
- 1956, The Dartmouth Conference marked the birth of AI as a field. John McCarthy, Marvin Minsky, Allen Newell, and Herbert Simon, the founding fathers of AI defined AI as "the science and engineering of making intelligent machines." From there, the dream of creating an artificial brain took off.
- 1961, The first robotic arm was added to the production line of General Motors in USA.
- 1964: Simple programs to process natural language
- 1965: Simple chatbots
- 1974: First autonomous vehicle

TURING TEST



Objective: a test of a machine's ability to show intelligent behaviour equivalent to, or indistinguishable from a human

Method: Three rooms, two humans, one computer (machine). Communications is done via text

Theory: If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test.

Second ERA

- 1986, Rumelhart, Hinton, and Williams introduced backpropagation for training multi-layer neural networks, breathing new life into neural network research.
- 1989: first Autonomous vehicle using NNs
- 1997: Garry Kasparov was beaten in chess by a program (deep blue)
- 1999: AIBO designed by Sony
- 1999: First emotional robot in MIT lab
- 2009: Google start to build self-driving cars

Third ERA

- 2011: Siri and Cortana
- 2014: A chatbot is said to beat the Turing test
- 2014: Researchers called for a new Turing test
- 2015: Elon Musk and other elites donated \$1B for Open AI project
- 2015-2018: Data science, Tesla, ...

- 2018: GPT 1 : models to generate coherent and contextually relevant sentences
- 2020: GPT3 human-like text
- 2022 : ChatGPT based on GPT-3
- 2022/2023 : GPT4 , Bard, AI-Computer vision, etc.
- 2024 : ...

Types of AI

- Narrow AI
- General AI – AGI (Artificial General Intelligence)
- Superintelligent AI

Type of AI :Narrow AI

- Narrow AI, also known as Weak AI, represents AI systems that are designed to perform a specific task, and their functionality doesn't extend beyond that specific task
- Narrow AI focuses on a single task and is constrained by constraints to not go beyond that, leaving it unable to solve unfamiliar problems.
- Weak refers to specialization not to capability

Type of AI :Narrow AI (examples)

- Personal Assistants :They use natural language processing and voice recognition technologies to understand and respond to user commands.
- Recommendation systems : are another prevalent example of Narrow AI. These systems employ machine learning algorithms to analyze user behavior and preferences, predict potential interests, and recommend relevant items or content.
- Autonomous Vehicles : represent a complex and advanced application of Narrow AI. Companies like Tesla have developed self-driving cars that use a combination of computer vision, sensor technology, and machine learning to navigate roads, interpret traffic signs, and avoid obstacles.

Type of AI :General AI – AGI (Artificial General Intelligence)

- General AI can manage to perform a broad range of tasks by using human-like cognitive capabilities
- Strong AI, allows machines to apply knowledge and skills in different contexts.
- The objective of AGI is to create machines that can reason and think just like a human is capable of doing.

Narrow AI Vs General AI

Narrow AI	General AI
○ Application specific/ task limited	○ Perform general (human) intelligent action
○ Fixed domain models provided by programmers	○ Self-learns and reasons with its operating environment
○ Learns from thousands of labeled examples	○ Learns from few examples and/or from unstructured data
○ Reflexive tasks with no understanding	○ Full range of human cognitive abilities
○ Knowledge does not transfer to other domains or tasks	○ Leverages knowledge transfer to new domains and tasks

Type of AI :Superintelligent AI

- Super AI can be able to outperform human intelligence.
- Solve problems like : climate change, disease, poverty etc.
- Extinction of the human race ?

Major Components of AI

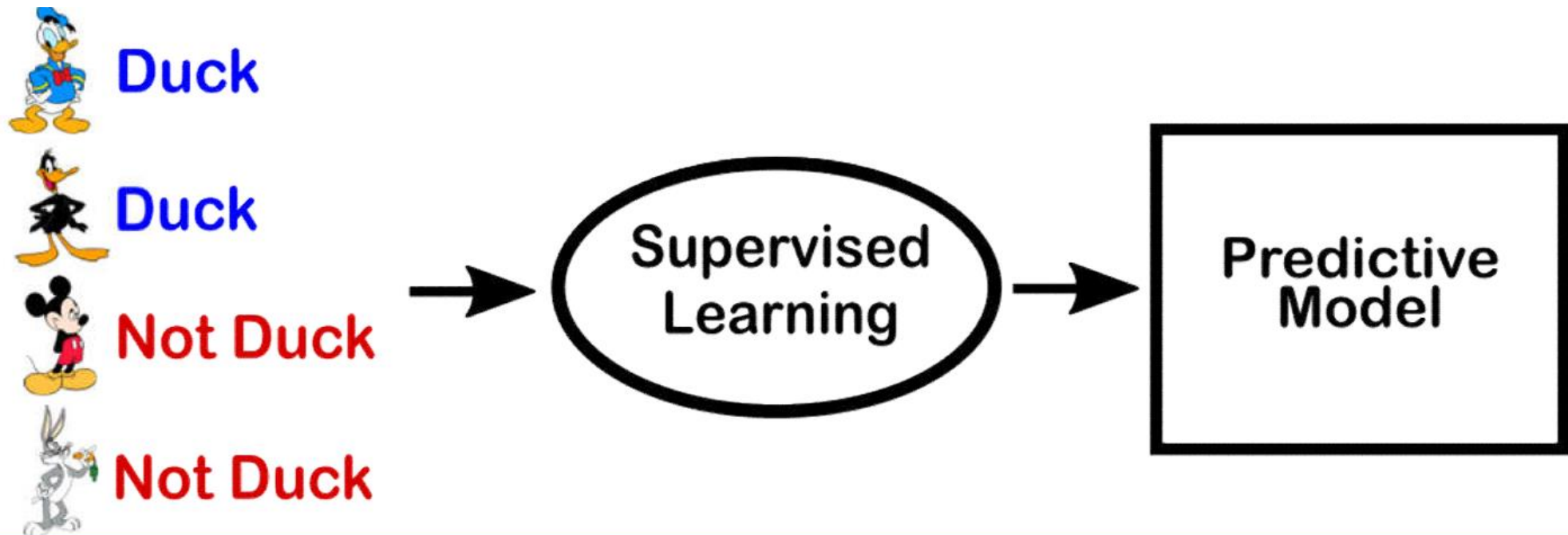
- Machine Learning
- Natural Language Processing
- Robotics
- Computer Vision
- Expert Systems

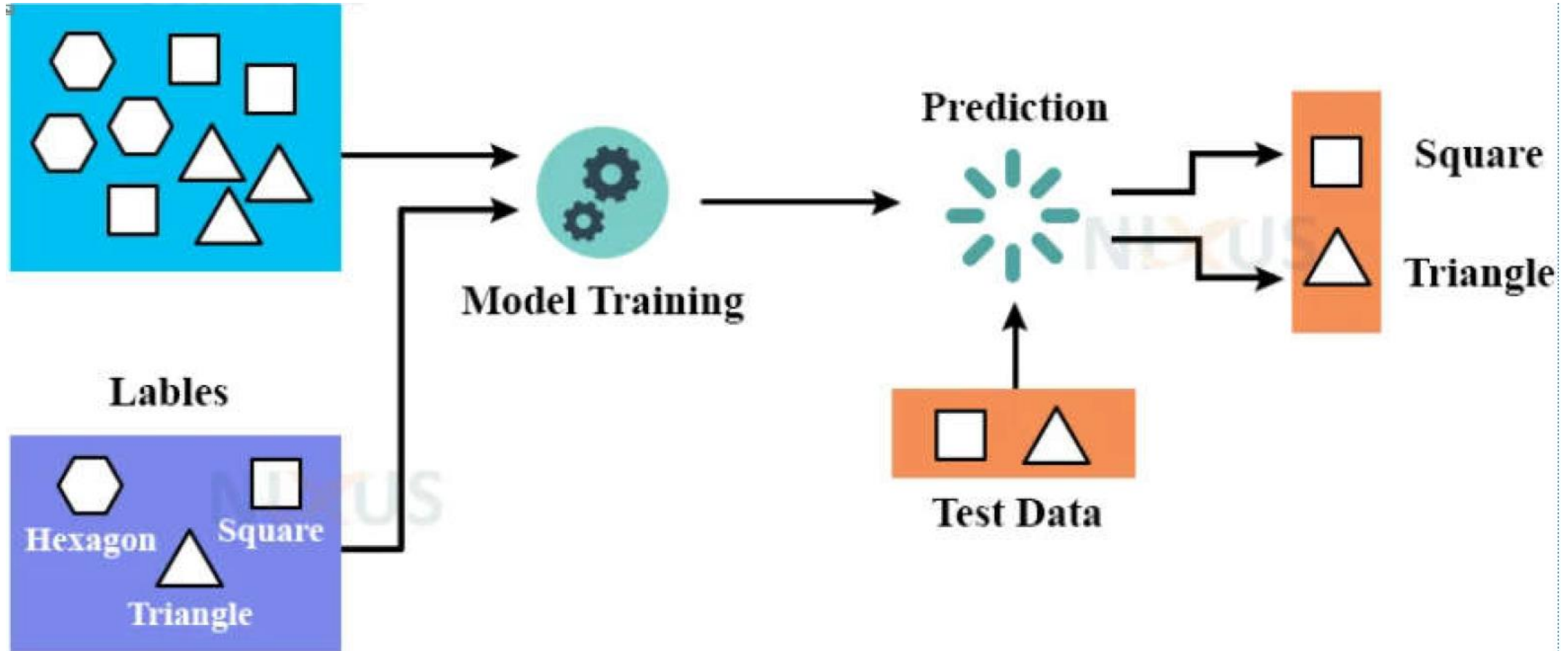
Algorithms in AI

- Deterministic, Terminating, Feasible
- Optimization, Automation, Innovation
- Types :
 - Supervised Learning Algorithms
 - Unsupervised Learning Algorithms
 - Reinforcement Learning Algorithms

Supervised Learning Algorithm

- Supervised learning is a crucial part of machine learning and it's all about making educated predictions based on data that has already been labelled manually.



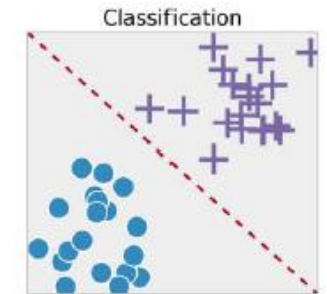


Examples Supervised Learning Algorithm

- Linear Regression: Think of this as an algorithm that helps us guess future values based on past trends. For instance, if we know the size, location, and age of several houses along with their prices, linear regression helps us predict how much a new house might cost based on these features. It does this by finding the best-fitting line, known as the regression line, that represents the relationship between these factors (or variables).
- Logistic Regression: Despite having 'regression' in its name, this is actually about classifying things into categories. For instance, it could be used to decide whether an email is spam (labeled as 1) or not spam (labeled as 0) based on the email's content, sender, and so on.
- Support Vector Machines: SVM is a versatile algorithm used for categorizing things, even when the categories aren't easily separated. This could be classifying emails as 'business' or 'personal', even when there's a lot of overlap between the two. It works by finding a boundary (the hyperplane) that best divides the categories based on the data.

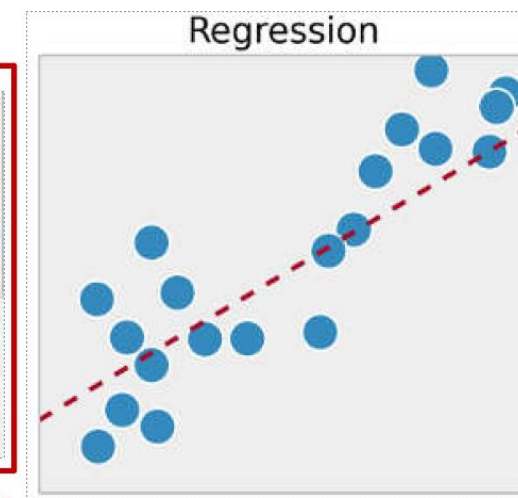
Outlook	Temperature	Humidity	Wind	PlayTennis
Sunny	Hot	High	Weak	No
Sunny	Hot	High	Strong	No
Overcast	Hot	High	Weak	Yes
Rain	Mild	High	Weak	Yes
Rain	Cool	Normal	Weak	Yes
Rain	Cool	Normal	Strong	No
Overcast	Cool	Normal	Strong	Yes
Sunny	Mild	High	Weak	No
Sunny	Cool	Normal	Weak	Yes
Rain	Mild	Normal	Weak	Yes

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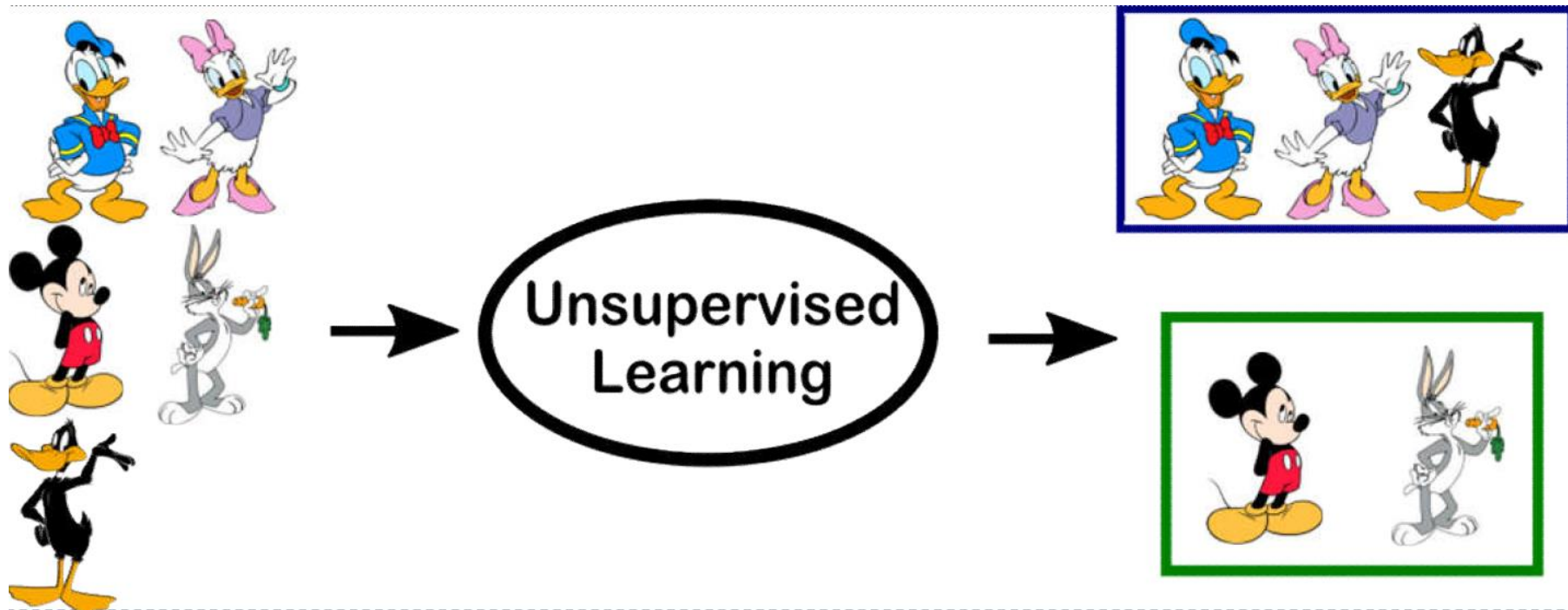
Source : Machine Learning, Chapter 3, Tom M. Mitchell, McGraw-Hill, 1997

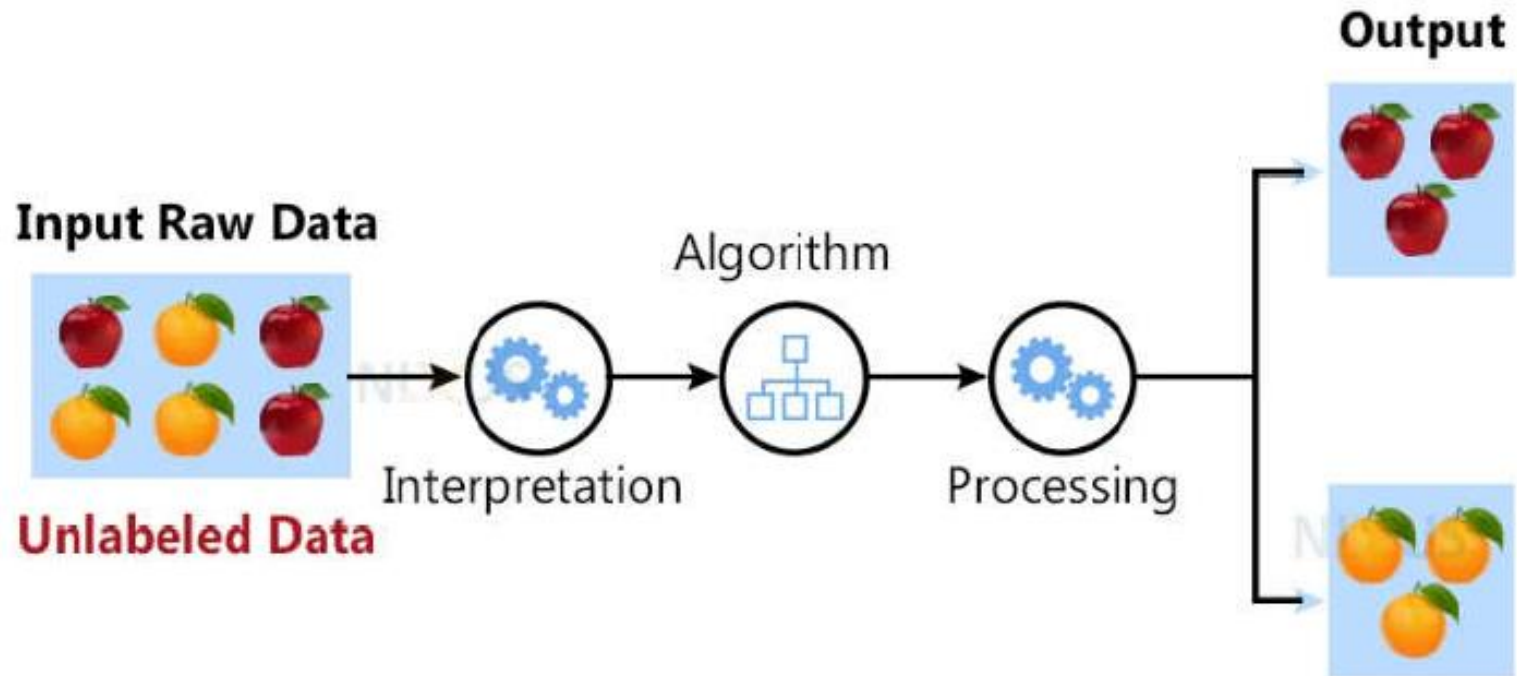
R&D Spend	Administration	Marketing Spend	State	Profit
165349.2	136897.8	471784.1	New York	192261.83
162597.7	151377.59	443898.53	California	191792.06
153441.51	101145.55	407934.54	Florida	191050.39
144372.41	118671.85	383199.62	New York	182901.99
142107.34	91391.77	366168.42	Florida	166187.94
131876.9	99814.71	362861.36	New York	156991.12



Unsupervised Learning Algorithms

- Unsupervised learning is about understanding, structuring, and extracting meaningful information from unlabeled data.

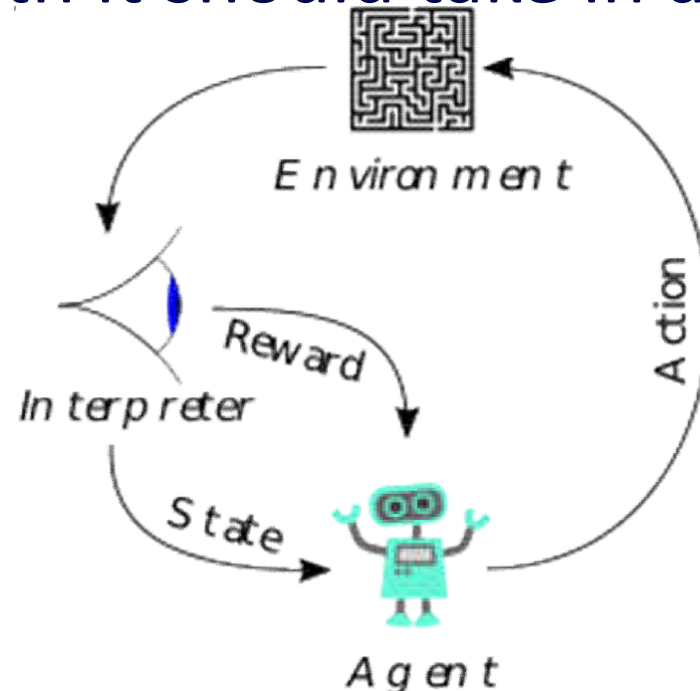




- K-means clustering: Imagine you're a librarian with a pile of books that haven't been sorted by genre. K-means clustering is an algorithm that helps you sort these books into distinct groups based on common attributes like book title, author, or even the first sentence. Similarly, this algorithm can help businesses understand their customers better by grouping them based on their purchasing behaviors.
- Principal Component Analysis (PCA): Sometimes, we have more data than we know what to do with. PCA is a technique that reduces this data to a manageable size, while keeping its important structure and relationships intact. It's like summarizing a lengthy book into a few key points that still capture the essence of the story.

Reinforcement Learning Algorithms

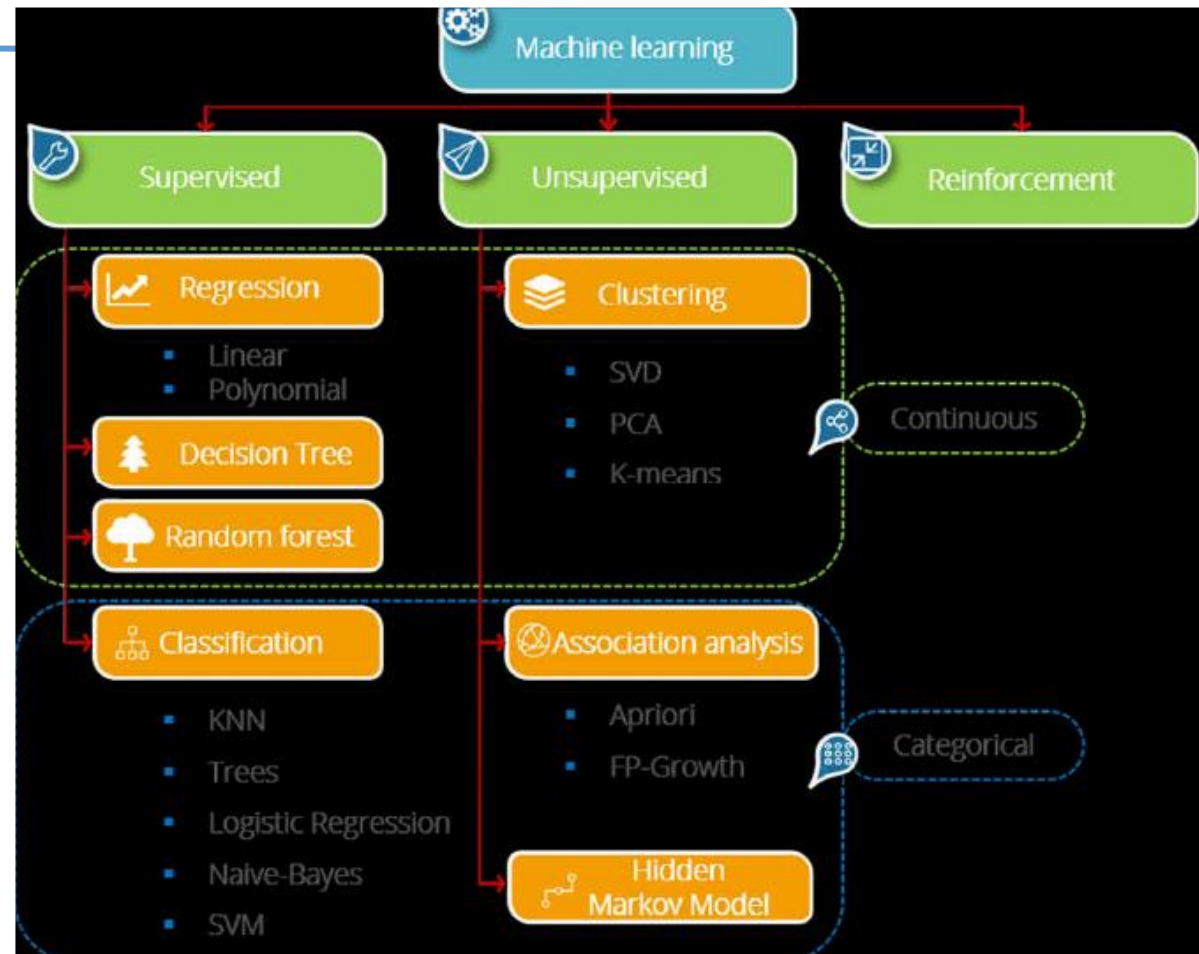
- Reinforcement learning is about taking suitable action to maximize reward in a particular situation. It is employed by various software and machines to find the best possible behavior or path it should take in a specific context.





Source : <https://techvidvan.com/>

- *Q-learning*: It's a strategy-free reinforcement learning algorithm. Imagine teaching a robot to navigate a maze. The robot tries different paths (actions), and each time it hits a dead-end or finds the exit, it learns more about the maze (current state). Over time, the robot learns the most efficient way to navigate the maze.
- Deep Q Network (DQN): This is an advanced form of Q-learning that works well with more complex problems. It combines Q-learning with deep neural networks to handle large and complicated situations, like playing video games at superhuman levels.



Practical Applications and Future Directions

- ChatGPT an AI-powered language model developed by OpenAI, capable of generating human-like text based on context and past conversations.
- GoogleBard similarly to [ChatGPT](#), with the biggest difference being that Google's service will pull its information from the web.
- Claude2 : Great for Text generation and Text summarization
- Adobe FireFly : Creative Generative AI. Can create images from text prompts.
- RunwayML : Text/Image to video Generative AI
- GitHub Copilot : AI pair programmer that offers autocomplete-style suggestions as you code.

AI and Generative AI news Websites

- AI magazine
- MIT NEWS ai
- OpenAi Blog

Youtube Channels (AI specific)

- Two Minute Papers
- Lex Fridman
- Siraj Raval
- 3 blue1brown
- codebullet
- ...

Open Questions

- **AI will take over all technical jobs ?**
- **Only data science experts can use AI ?**
- **AI still needs a human touch ?**
- **How can we protect our privacy as automated systems increasingly track us?**
- **Is it safe for an AI program to know everything about you? Why or why not?**
- **What kind of unexpected failures might occur in a world built upon AI?**

Quizz

- **Thinking about customer service, which of the following uses artificial intelligence (AI)?**
 - 1- A detailed Frequently Asked Questions webpage
 - 2- An online survey sent to customers that allows them to provide feedback
 - 3- A contact page with a form available to customers to provide feedback
 - 4- A chatbot that immediately answers customer questions

- **When playing music, which of the following uses artificial intelligence (AI)?**
 1. Using Bluetooth to connect to wireless speakers
 2. A playlist recommendation
 3. A wireless internet connection to stream the music
 4. Shuffle play from a chosen playlist

- **When using email, which of the following uses artificial intelligence (AI)?**
 1. The email service marking an email as read after the user opens it
 2. The email service allowing the user to schedule an email to send at a specific time in the future
 3. The email service categorizing an email as spam
 4. The email service sorting emails by time and date

Thinking about health products, which of the following uses artificial intelligence (AI)?

1. Wearable fitness trackers that analyze exercise and sleeping patterns
2. Thermometers that are placed under someone's tongue to detect a fever
3. At-home COVID-19 tests
4. Pulse oximeters that measure a person's oxygen level of the blood

Thinking about online shopping, which of the following uses artificial intelligence (AI)?

1. Storage of account information, such as shipping addresses
2. Records of previous purchases
3. Product recommendations based on previous purchases
4. Product reviews from other customers

Thinking about devices in the home, which of the following uses artificial intelligence (AI)?

- Programming a home thermostat to change temperatures at certain times
- A security camera that sends an alert when there is an unrecognized person at the door
- Programming a timer to control when lights in a home turn on and off
- An indicator light that turns red when a water filter needs to be replaced

Homework

- Join Microsoft Teams Channel
- Introduce yourself in the appropriate channel