Artificial Intelligence Applications

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Theory

- Intro to AI, ML, Natural Language Processing, Speech Recognition, Image Processing and Computer Vision
- BOT Technologies, Virtual Assistants
- Image Processing and Computer Vision, Applications
- Reinforcement Learning, Applications
- Smart Applications

1. Supervisely - Perform Data Labelling for various images using object recognition
2. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons
3. Teachable Machine - In Browser Object Recognition through Brain.JS
4. Liv.ai - App for Speech recognition and Synthesis through APIs
5. Building a Chatbot using Pandora bots
6. Configure an existing Neural Network by manipulating various parameters

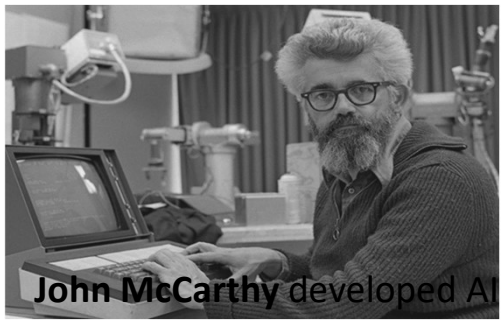
Practical

UNIT-1

- Introduction to Artificial intelligence
  - Basics of AL Agents and Environment
  - The Nature of Environment
- List of Experiment(s)
  - Implementation of toy Problems
    - ✓8-Puzzle
    - ✓ Wumpus World
    - ✓Vacuum-clean Example

Introduction to Artificial Intelligence

- Artificial Intelligence is composed of two words **Artificial** and **Intelligence**, where Artificial defines *"man-made,"* and intelligence defines *"thinking power"*, hence AI means *"a man-made thinking power.“*
- "It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions."
- With Artificial Intelligence you do not need to preprogram a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the awesomeness of AI
- In 1956, The word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field.



John McCarthy developed AI

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- Artificial Intelligence is an approach to make a computer, a robot, or a product to think how smart humans think.
- AI is a study of how the human brain thinks, learns, decides and works, when it tries to solve problems. And finally this study outputs intelligent software systems.
- The aim of AI is to improve computer functions which are related to human knowledge, for example, reasoning, learning, and problem-solving.

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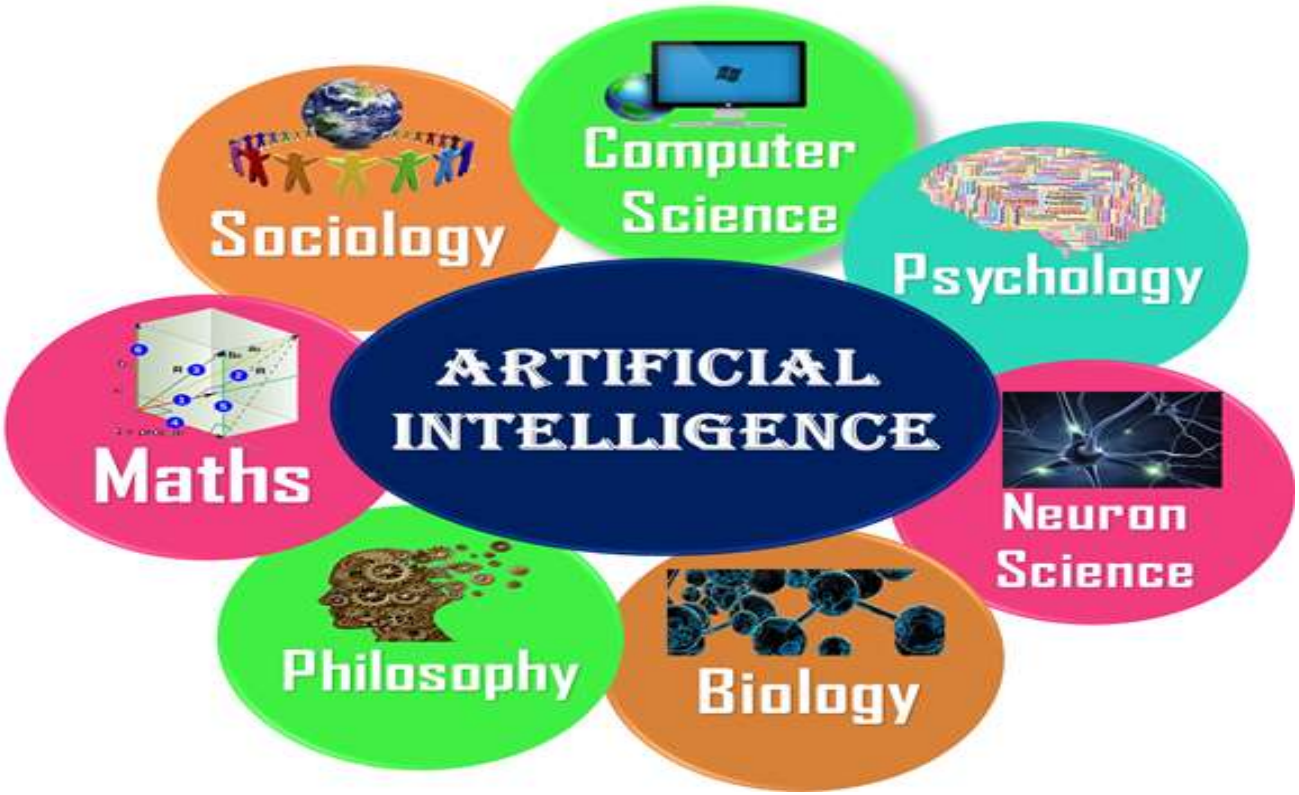
- Some definitions of AI. they are organized into four categories as below:
    1. Systems that think like humans.
    2. Systems that think rationally.
    3. Systems that act like humans.
    4. Systems that act rationally.

- Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problems.

- To achieve the above factors for a machine or software, Artificial Intelligence requires the following discipline:



Why Artificial Intelligence?

Importance of AI:

- With the help of AI, you can create
  - Software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.
  - Personal virtual Assistant, such as Google Assistant, Siri, Windows 10 Cortana, etc.
  - Robots which can work in an environment where survival of humans can be at risk.

- AI opens a path for other new technologies, new devices, and new Opportunities.

https://www.youtube.com/watch?v=D5VN56jQMWM

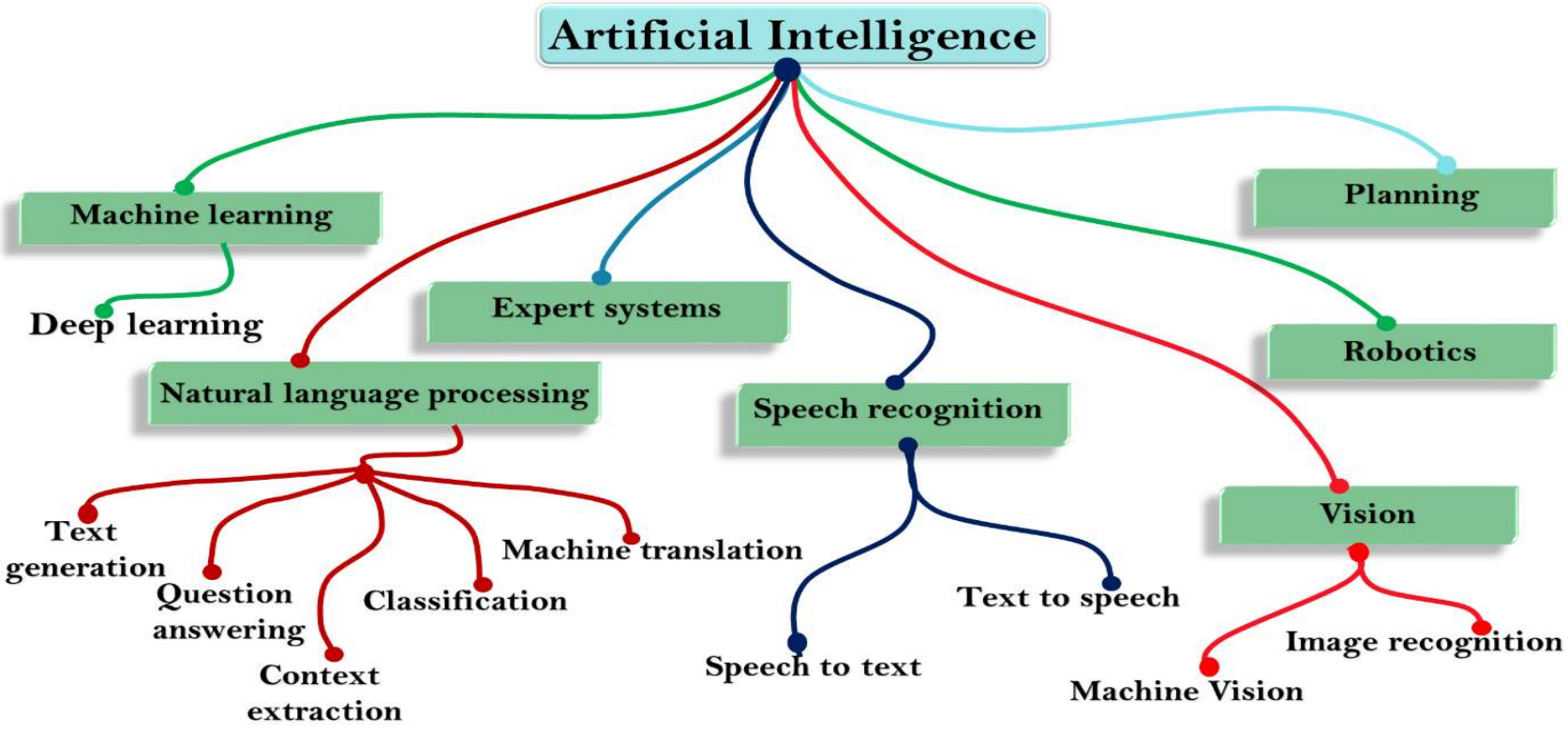
Advantages of Artificial Intelligence

- **High Accuracy with less errors:** AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- **High-Speed:** AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.
- **High reliability:** AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- **Useful for risky areas:** AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.
- **Digital Assistant:** AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.
- **Useful as a public utility:** AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.

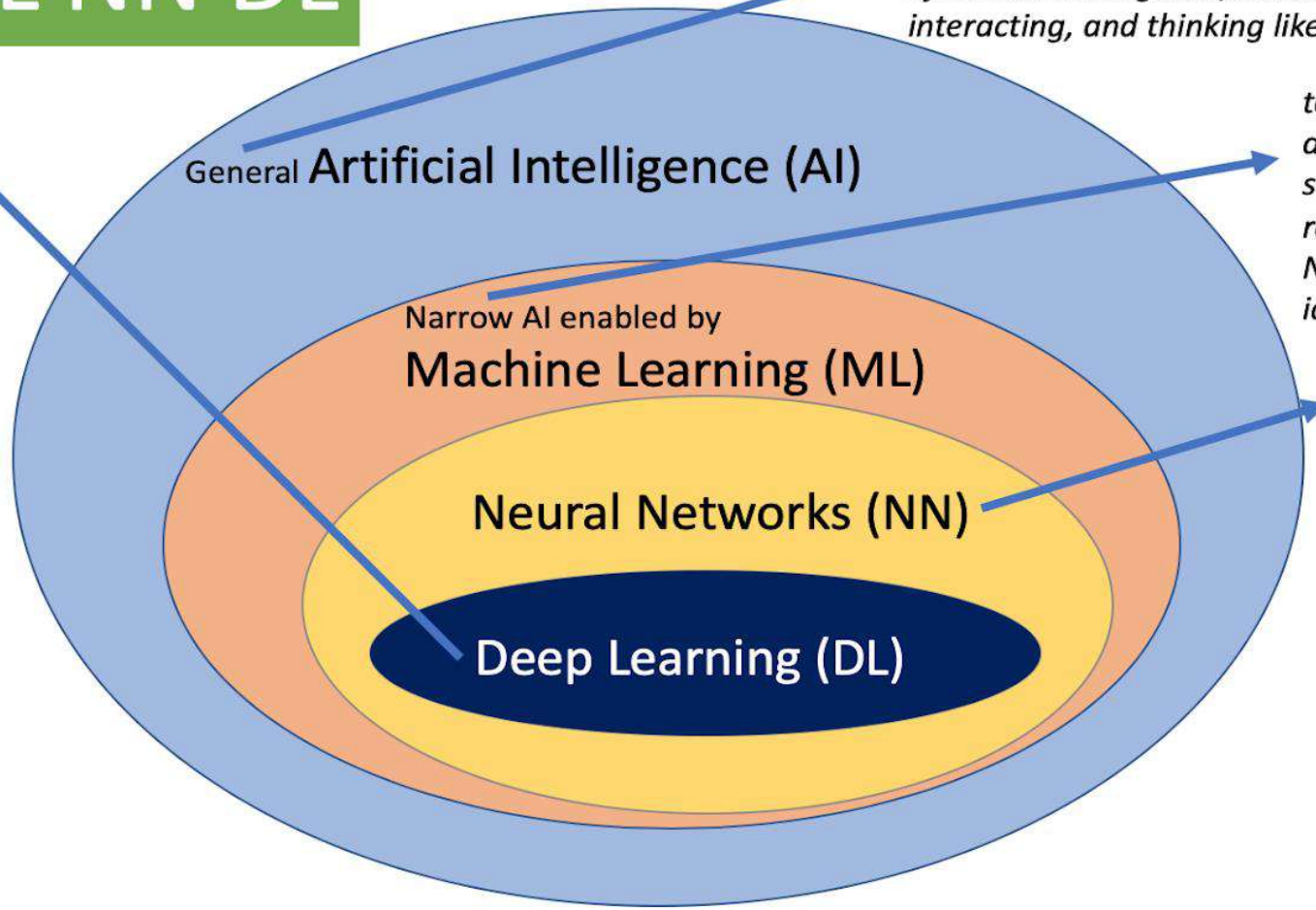
Disadvantages of Artificial Intelligence

- **High Cost:** The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.
- **Can't think out of the box:** Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.
- **No feelings and emotions:** AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.
- **Increase dependency on machines:** With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.
- **No Original Creativity:** As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Subsets of Artificial Intelligence



AI ML NN DL



computers possessing the same characteristics of human intelligence, including reasoning, interacting, and thinking like we do

technologies that can accomplish specific tasks such as playing chess, recommending your next Netflix TV show, and identifying spam emails

neural networks are a specific group of algorithms used for machine learning that model data using graphs of Artificial Neurons. Those neurons are a mathematical model that "mimics approximately how a neuron in the brain works"

the word "deep" comes from the fact that DL algorithms are trained/run on deep neu ral networks. These are just neural networks with (usually) three or more "hidden" layers

Artificial Intelligence/Machine Learning/ Deep Learning

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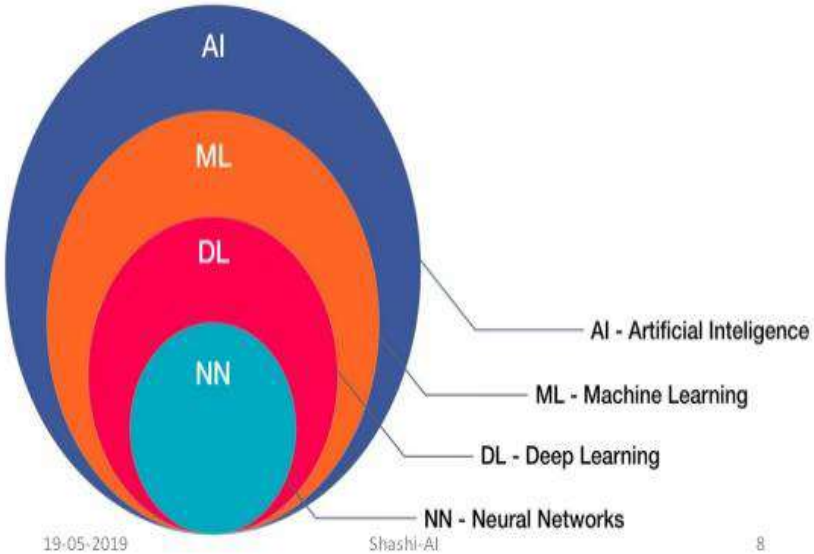
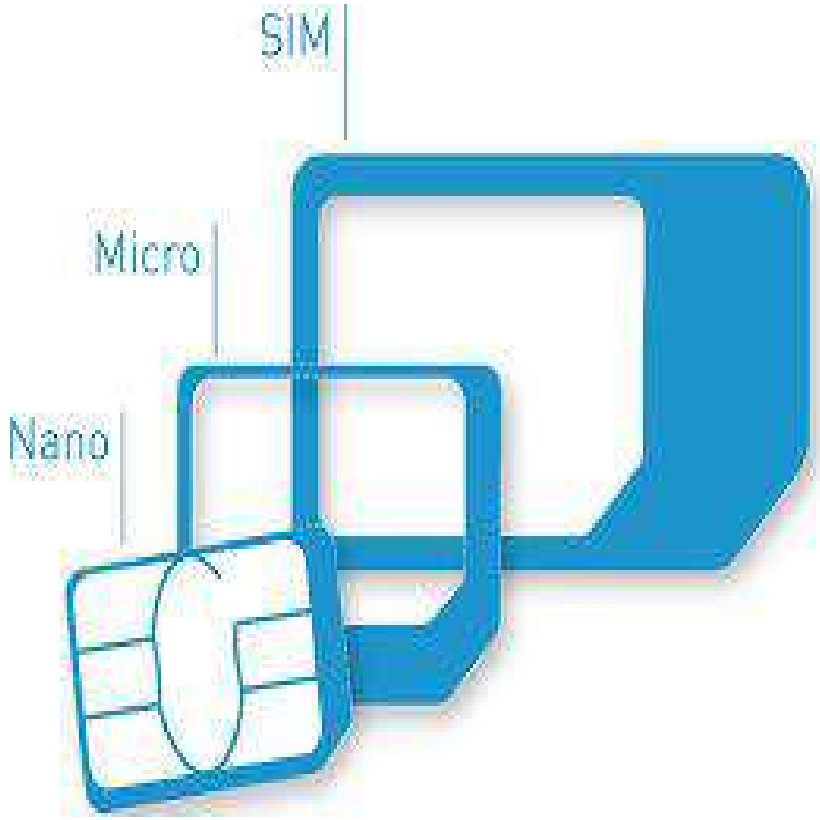
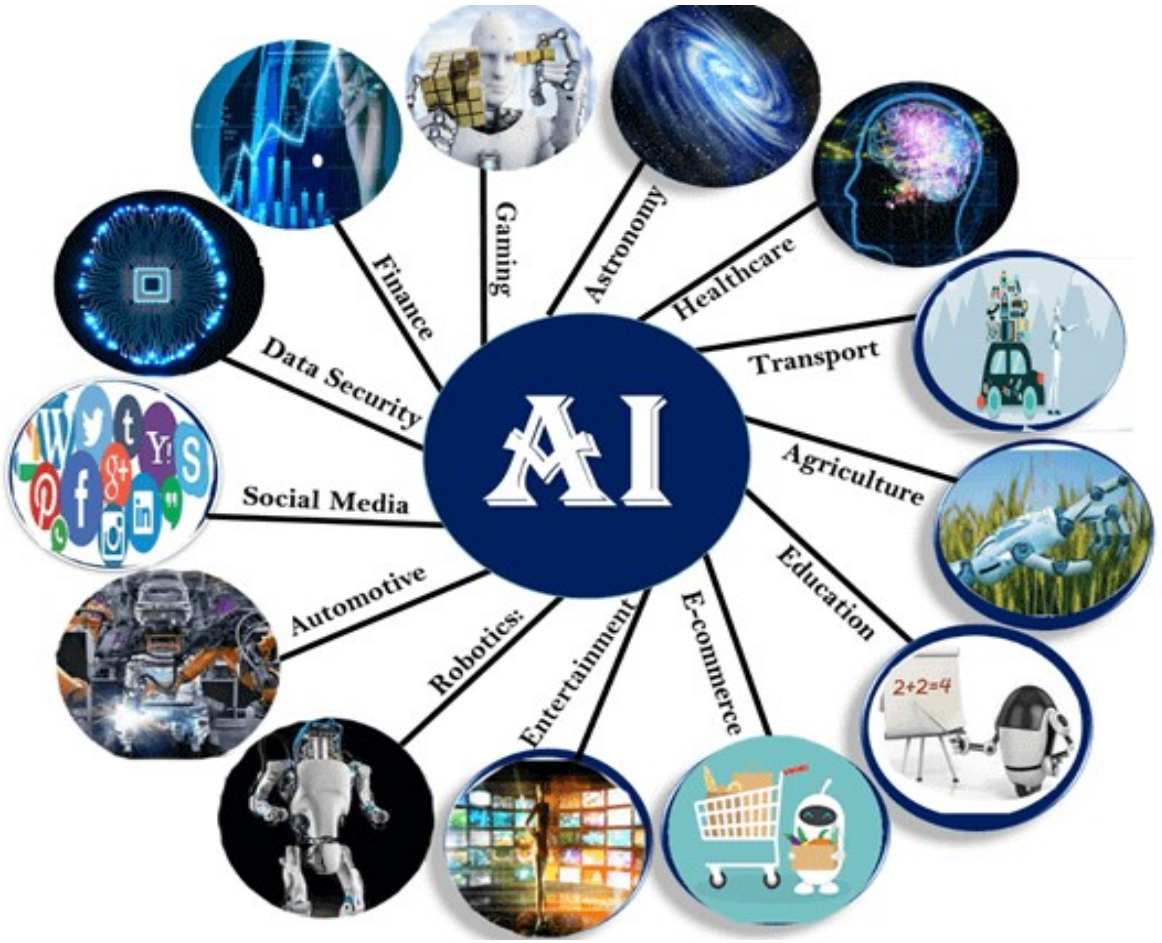


19-05-2019 Shashi-AI 8

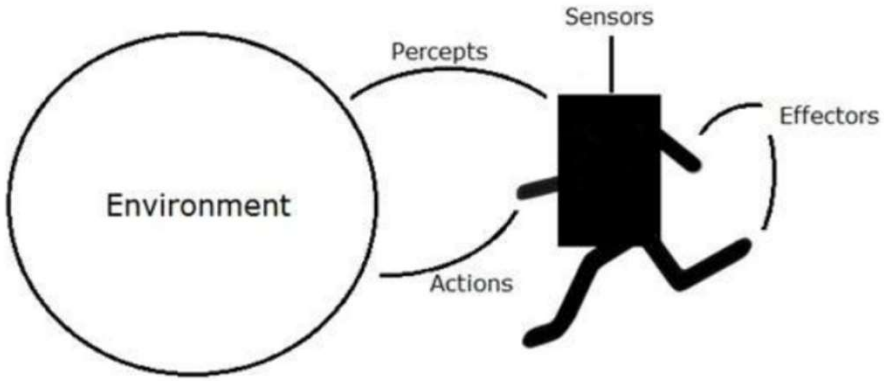


Applications of AI



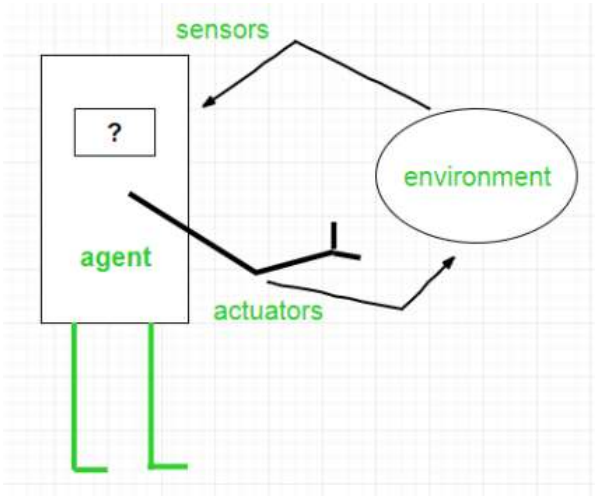
Basics of AI Agents and Environment

- An **agent** is anything that can perceive its environment through **sensors** and acts upon that environment through **effectors.**
- A **human agent** has sensory organs such as eyes, ears, nose, tongue and skin parallel to the sensors, and other organs such as hands, legs, mouth, for effectors.
- A **robotic agent** replaces cameras and infrared range finders for the sensors, and various motors and actuators for effectors.
- A **software agent** has encoded bit strings as its programs and actions.



Basics of AL Agents and Environment

- An AI system is composed of an **agent and its environment**. The agents act in their environment. The environment may contain other agents
- An agent is anything that can be viewed as
  - perceiving its environment through **sensors** and
  - acting upon that environment through **actuators**



Agent Environment in AI

- As per Russell and Norvig, an environment can have various features from the point of view of an agent:
  - Fully observable vs Partially Observable
  - Static vs Dynamic
  - Discrete vs Continuous
  - Deterministic vs Stochastic
  - Single-agent vs Multi-agent
  - Episodic vs sequential
  - Known vs Unknown
  - Accessible vs Inaccessible

The Nature of Environment

- Some programs operate in the entirely **artificial environment** confined to keyboard input, database, computer file systems and character output on a screen.
- In contrast, some software agents (software robots or softbots) exist in rich, unlimited softbots domains.
- The simulator has a **very detailed, complex environment**.
- The software agent needs to choose from a long array of actions in real time.
- A softbot designed to scan the online preferences of the customer and show interesting items to the customer works in the **real** as well as an **artificial** environment.
- The most famous **artificial environment** is the **Turing Test environment**, in which one real and other artificial agents are tested on equal ground.
- This is a very challenging environment as it is highly difficult for a software agent to perform as well as a human.

Turing Test

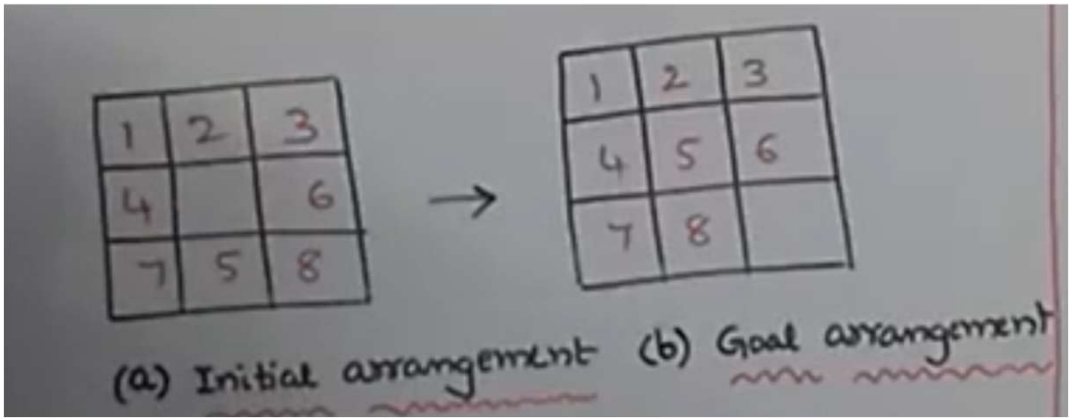
- The success of an intelligent behavior of a system can be measured with Turing Test.
- Two persons and a machine to be evaluated participate in the test.
  - Out of the two persons, one plays the role of the tester. Each of them sits in different rooms. The tester is unaware of who is machine and who is a human. He interrogates the questions by typing and sending them to both intelligences, to which he receives typed responses.
- This test aims at fooling the tester. If the tester fails to determine machine's response from the human response, then the machine is said to be intelligent.

8-Puzzle Problem

→ In 8-puzzle problem, There are 8-tiles which are numbered from 1 to 8 placed on a 9-tile capacity square frame.

→ The objective of 8-puzzle problem is to transform the arrangement of tiles from Initial arrangement to a goal arrangement

→ The Initial and Goal arrangement is shown in below figures.



(a) Initial arrangement (b) Goal arrangement

→ There is always an empty slot in the Initial arrangement.

→ Legal moves are the moves in which the tiles adjacent to empty slot are moved to either

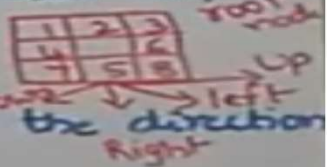
left, Right, up, Down.

→ The Initial arrangement is called as Initial Stage and goal arrangement is called as goal State.

→ The State space Tree for 8-puzzle is large because, there can be 8! Different arrangements A partial State space is shown in below fig.

→ In the StateSpace Tree, the nodes are numbered as per the level.

→ Each next move is generated based on empty slot positions.

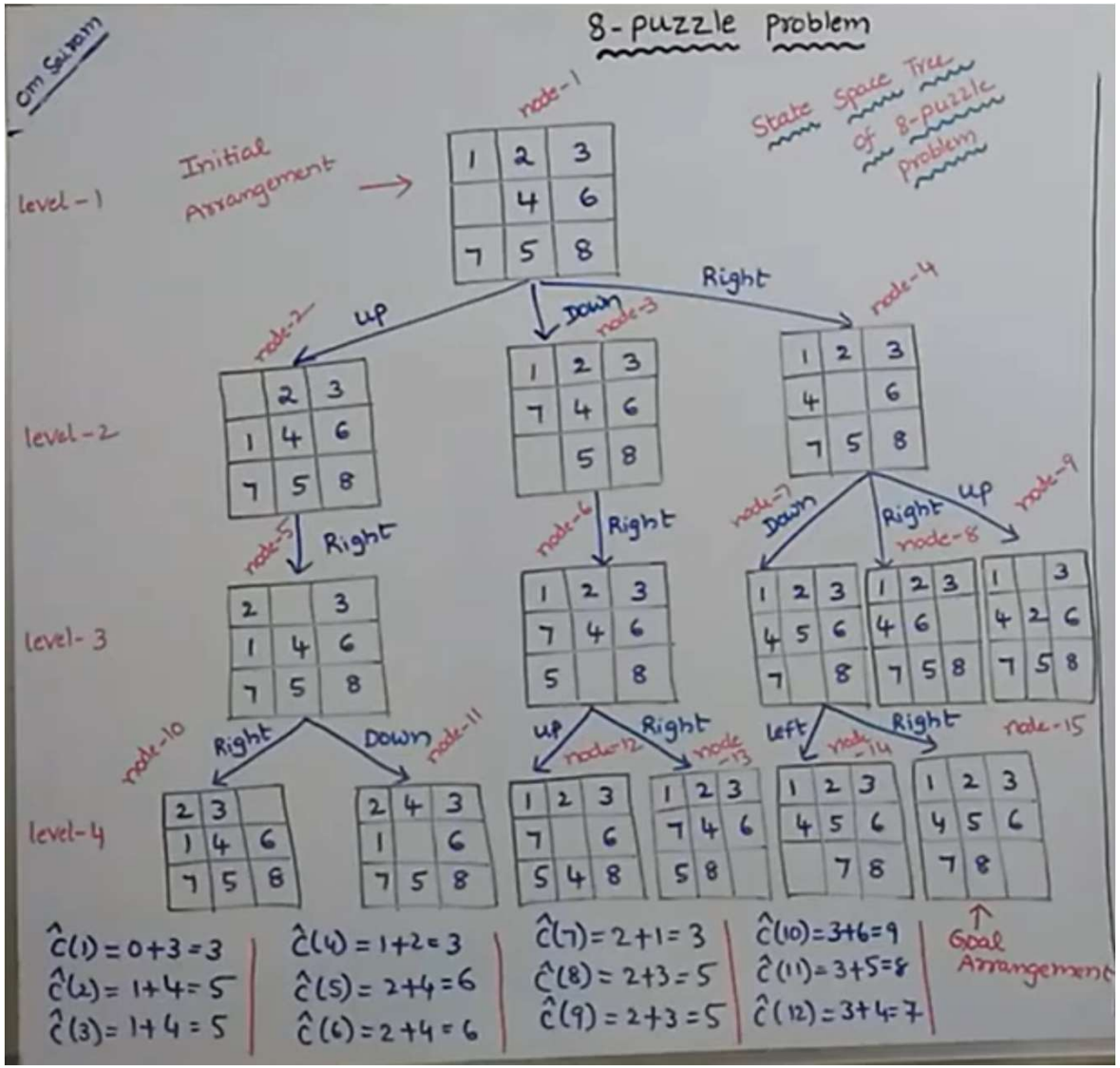


→ Edges are labelled according to the direction in which empty space moves.

→ The root node becomes the E-node.

→ We can decide which node to become an E-node based on estimation formula

8-Puzzle Problem using Branch and Bound



$$\hat{c}(x) = f(x) + \hat{g}(x)$$

where

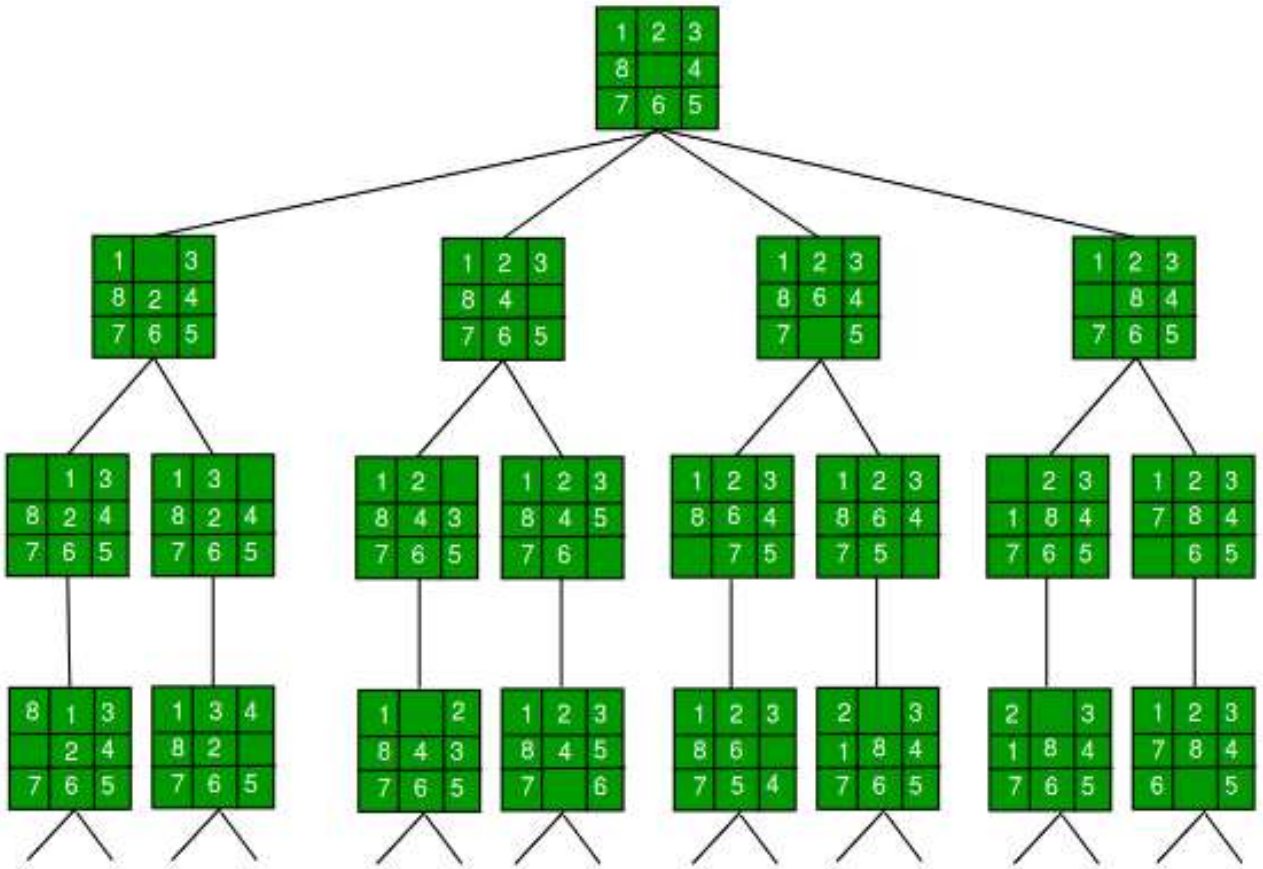
$\hat{c}(x)$ = lower Bound cost of node 'x'

$f(x)$ = length of the path from root node to node 'x'.

$\hat{g}(x)$ = Number of non-blank tiles which are not in their goal position.

8-Puzzle Problem using DFS(Brute-Force)

- We can perform a depth-first search on state-space (Set of all configurations of a given problem i.e. all states that can be reached from the initial state) tree.



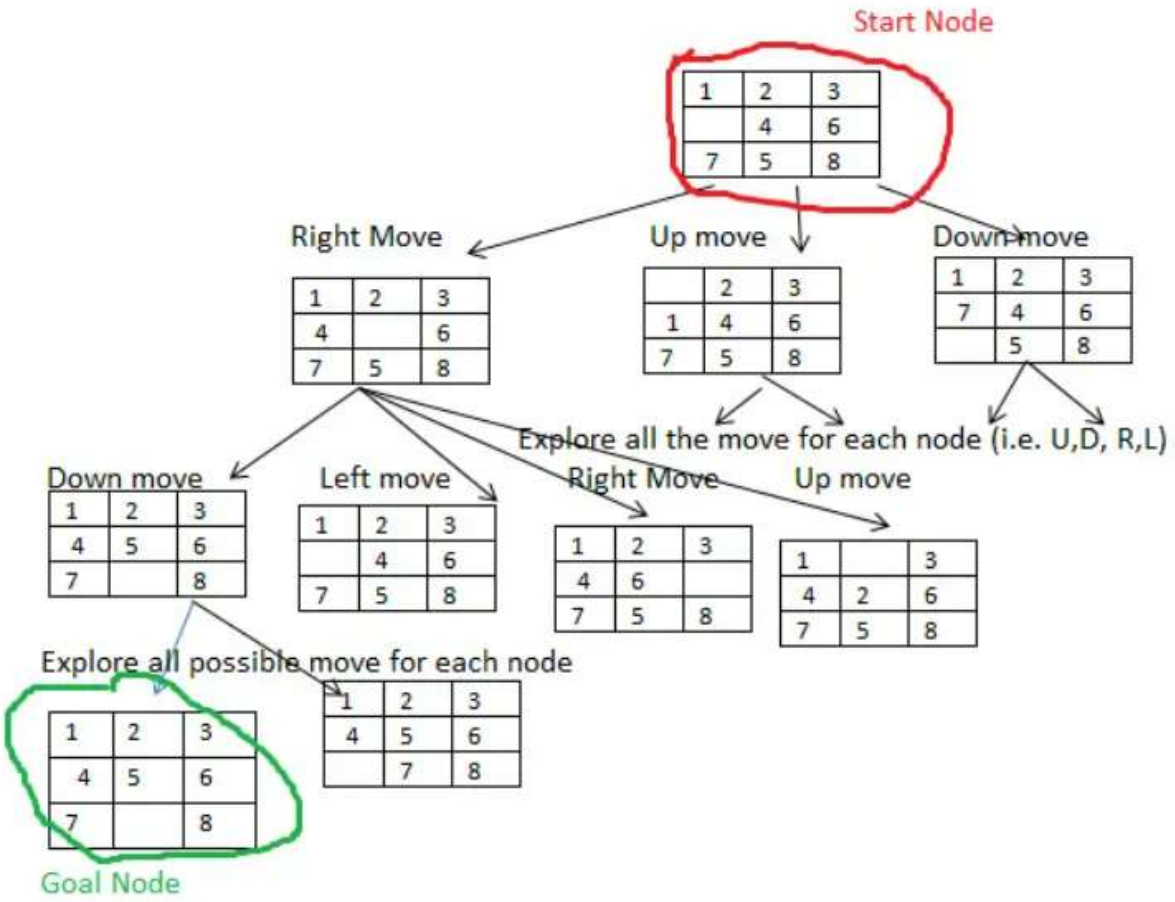
State Space Tree for 8 Puzzle

In this solution,

- successive moves can take us away from the goal rather than bringing us closer.
- The search of state-space tree follows the leftmost path from the root regardless of the initial state.
- An answer node may never be found in this approach.

8-Puzzle Problem using BFS

- We can search the state space tree using a **breadth-first approach**. It always locates the **goal state that is closest to the root**. However, the algorithm tries the **same series of movements as DFS** regardless of the initial state.


Start Node
Right Move
Up move
Down move
Explore all the move for each node (i.e. U,D, R,L)
Down move
Left move
Right Move
Up move
Explore all possible move for each node
Goal Node