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Course Title - Logic Programming for Artificial Intelligence

Topic Title - Outcome Based Education (OBE)

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 01
Presentation Date – 23/08/2024

Course Overview

Artificial intelligence (AI) focuses on studying and creating systems that replicate intelligent human behaviours in machines, especially in computer systems. This course introduces the concepts, methods, and problem-solving approaches that enable AI to address real-world challenges autonomously. Additionally, AI serves as a mathematical framework that allows for the precise and clear expression of knowledge, making it ideal for use in AI systems. By exploring theoretical concepts and practical applications, students will develop a comprehensive understanding of how AI systems are designed and how they function in complex, real-world scenarios.

Course Objectives

The students will try to learn:

I. The characteristics of Intelligent agents and the way the AI agents plan and act in the real world.

II. Various search strategies and knowledge representation techniques to solve AI problems.

III. The ways of planning and acting in the real world.

IV. Handling uncertainty, reasoning the complex problems and models behind the AI applications.

Course Outcomes

After successful completion of the course, students should be able to:

- **Illustrate** the ability to design a plan for the real-world problems and mapping it to the digital world.
- **Relate** appropriate problem-solving methods to optimize the search results.
- **Interpret** uninformed and informed search strategies, and select the appropriate approach for different AI problems.

Course Outcomes (Contd..)

- **Demonstrate** computable functions and predicates in computational system to construct logical expressions.
- **Develop** a comprehensive understanding of advanced AI planning strategies and diverse learning paradigms to solve complex problems.
- **Examine** the uncertainty in designing AI systems and propose methods for reasoning.

Syllabus
Logic Programming for Artificial Intelligence (ACAD01)

Module -1 (Introduction)

Introduction - Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

Module -2 (Production Systems)

Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs.

Module -3 (Problem Solving Methods and Knowledge Representation)

Problem solving Methods - Search Strategies - Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Backtracking Search - Performance of Search Algorithms.

Using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Properties of Wff, Clausal Forms, Conversion to clausal forms, Resolution.

Module -4 (Planning and Learning)

Planning with State-Space Search - Partial-Order Planning - Planning Graphs - Planning and Acting in the Real World - Plan Generation Systems.

Learning – Learning and its types – Discovery – Clustering – Analogy - Neural Net and Genetic Learning - Reinforcement Learning.

Module -5 (Uncertain Knowledge and Reasoning)

Symbolic Reasoning Under Uncertainty: Introduction to Non monotonic Reasoning - Logics for Non monotonic Reasoning - Implementation Issues - Augmenting a Problem-solver.

Uncertainty - review of probability - probabilistic Reasoning - Bayesian networks - inferences in Bayesian networks - Temporal models - Hidden Markov models.

Text Books and Reference Books

Text Books

1. S. Russel, P. Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education, 2015.
2. Artificial Intelligence – Saroj Kaushik

Reference Books

1. Kevin Night, Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Third Edition, McGraw Hill, 2017.
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Introduction to Artificial Intelligence

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 02
Presentation Date – 27/08/2024

Course Outcome

At the end of the course, students should be able to:

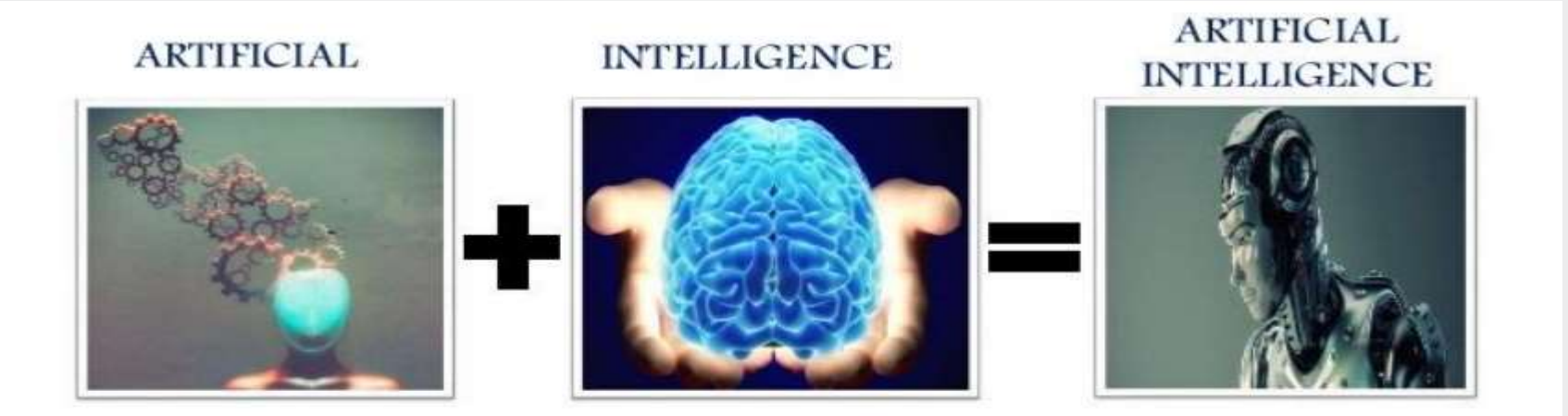
CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand the key concepts, techniques, and applications of artificial intelligence to analyze, design, and implement AI-driven solutions across various domains.

Introduction to Artificial Intelligence

What is Artificial Intelligence ?



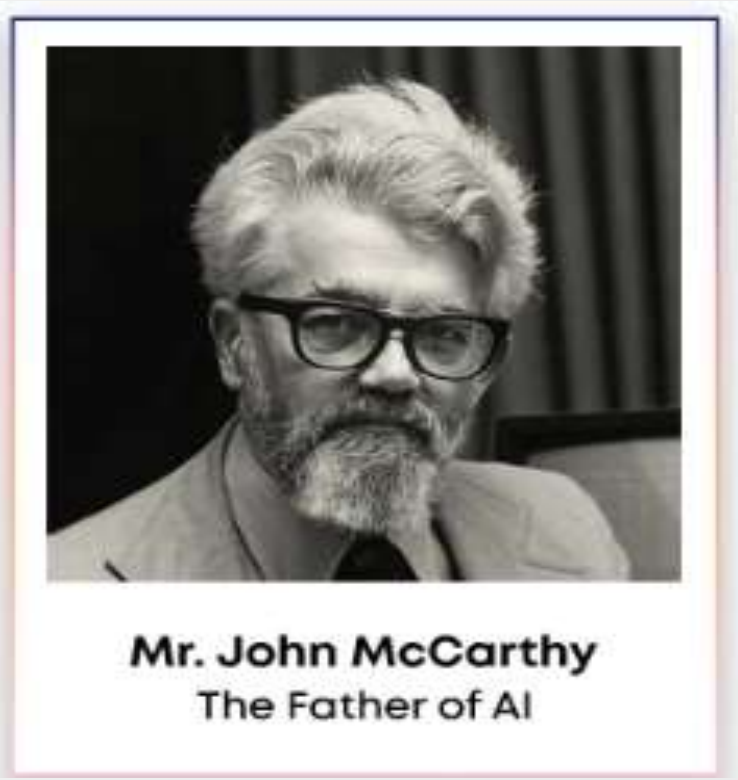
- **Artificial: "**The man made"
- **Intelligence**: "The capacity to learn and solve problems".
- **Artificial Intelligence**: Artificial Intelligence(AI) is the

"simulation of human intelligence by machines".

What is Artificial Intelligence ?

- According to the father of Artificial Intelligence, **John McCarthy**, it is "***The science and engineering of making intelligent machines, especially intelligent computer programs***".

- Artificial Intelligence is a **way of making a computer, a computer-controlled robot, or a software think intelligently**, in the similar manner the intelligent humans think.



What is Artificial Intelligence ?

AI is **engaged in two significantly different enterprises**:

- *Science of* ***human intelligence.***
- An engineering discipline concerned with ***building smarter physical systems.***

Definitions of Artificial Intelligence

- AI is the study of **making computers do things intelligently**.

- Artificial Intelligence (AI, also called as **machine intelligence**) is the **intelligence demonstrated by machines**, in contrast to the natural intelligence displayed by humans and other animals.

- Artificial Intelligence (AI) makes it possible for **machines to learn from experience, adjust to new inputs and perform human like tasks.**

Definitions of Artificial Intelligence (Contd..)

- AI is a branch of Science which **deals in development of modern machines,** which can find solutions to complex problems in human like fashion.

- It **is a multidisciplinary field** based on the work done in different disciplines such as logic, cognition, linguistics, psychology, anthropology, computing etc.

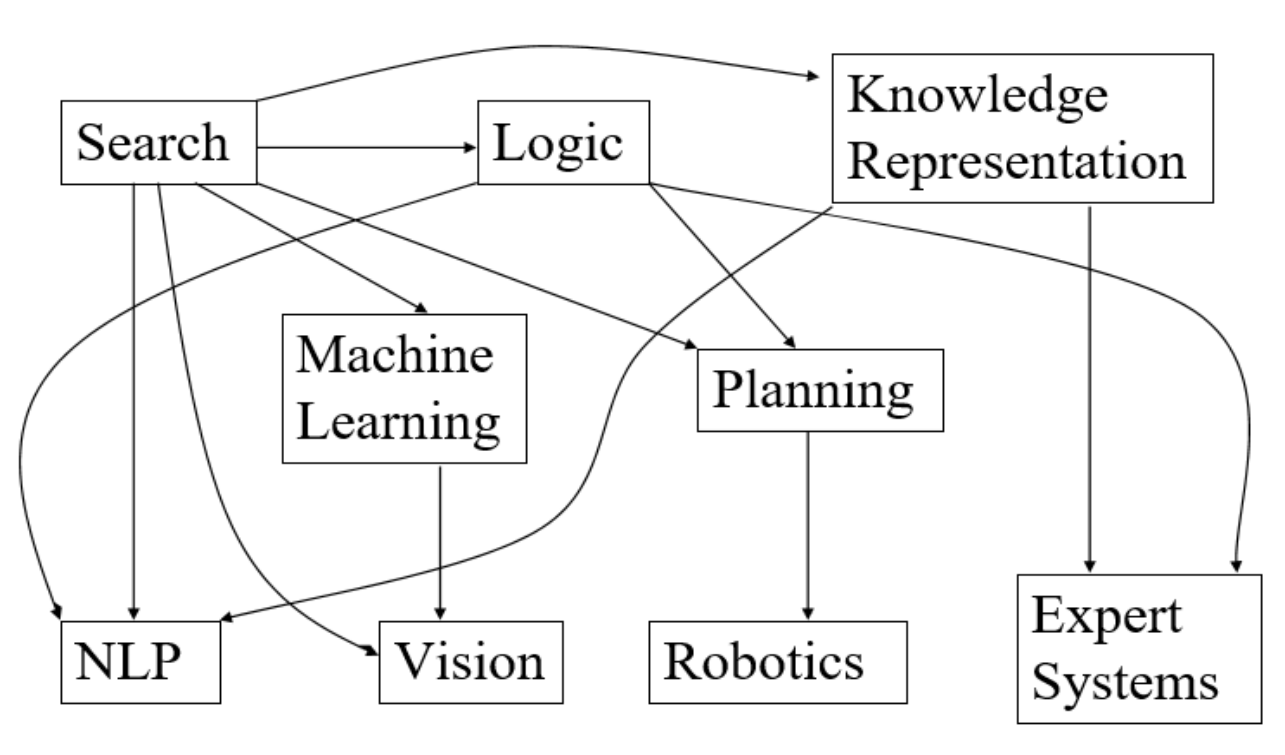
Goals of Artificial Intelligence

- **To create Expert Systems** – The systems which exhibit intelligent behaviour, learn, demonstrate, explain and advice its users.
- **To implement Human Intelligence in machines** – Creating systems that understand, think, learn and behave like humans.

Activities of Artificial Intelligence

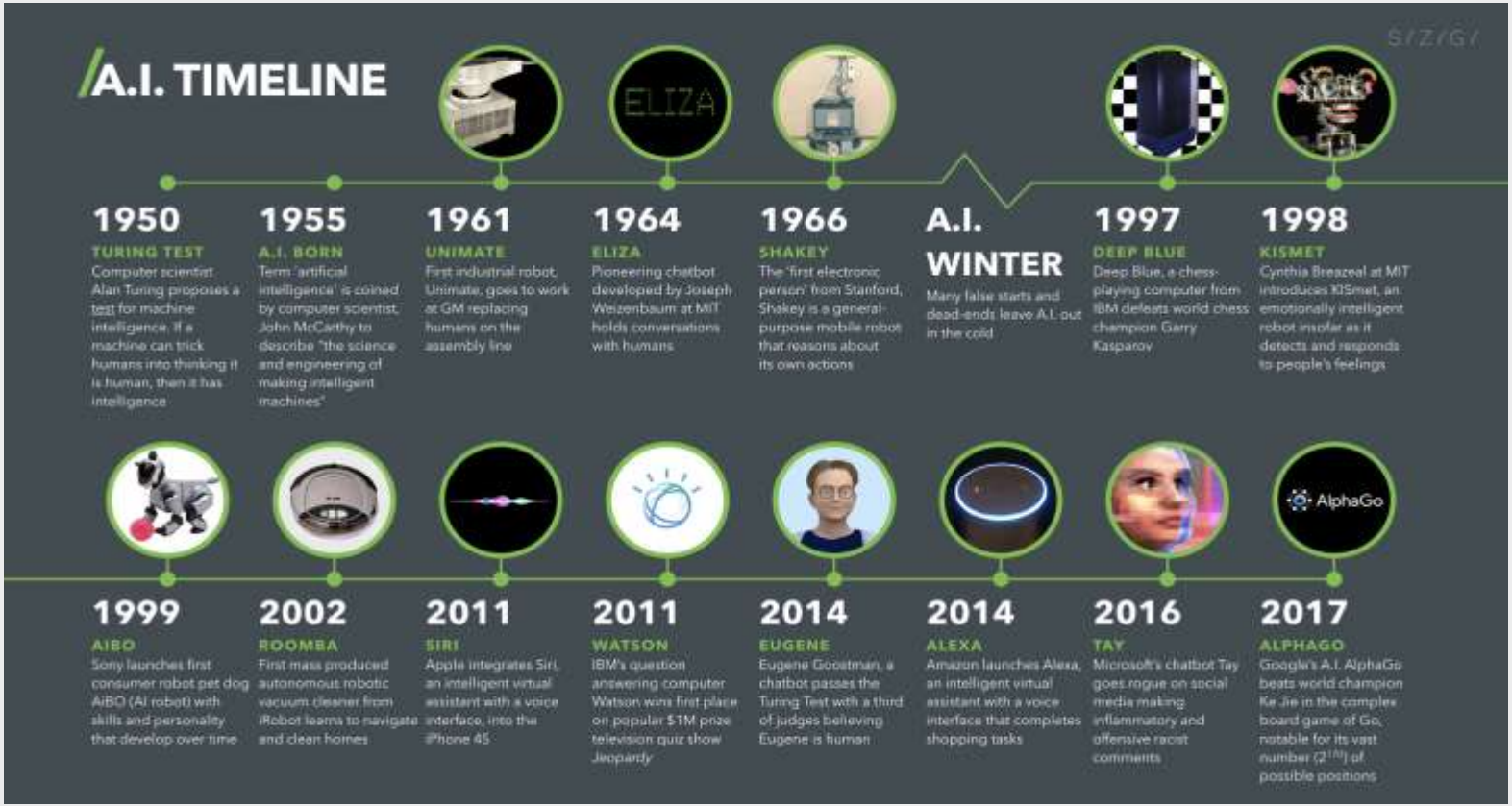
- Speech Recognition
- Knowledge representation
- Perception
- Learning
- Planning
- Problem Solving
- Reasoning
- Ability to manipulate and move objects

Areas of AI and some Dependencies



Artificial Intelligence Timeline (The History)

History of Artificial Intelligence



1940

- In the year 1940, **William Grey Walter created the first artificial intelligence robot called *Mechanical Tortoise*.**

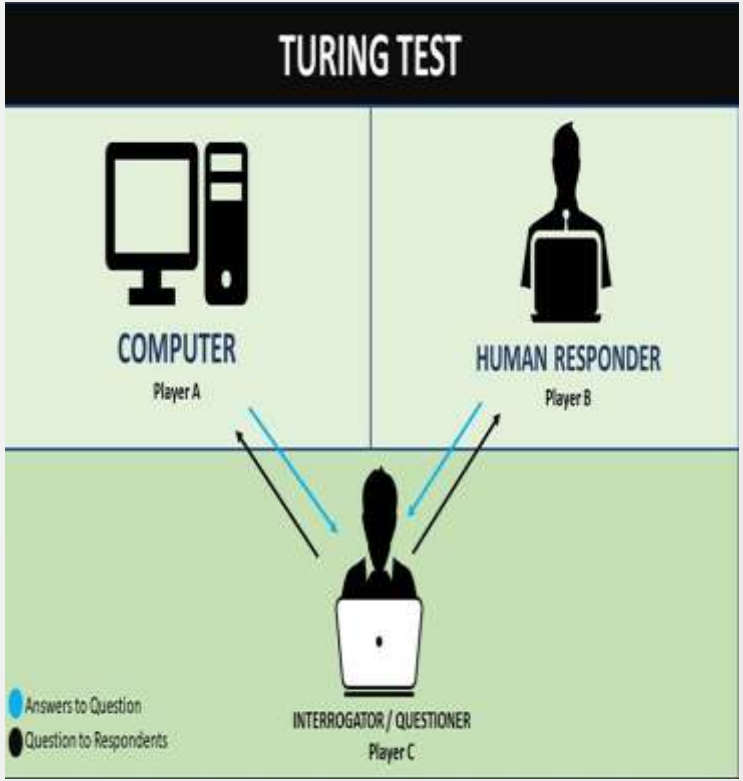
- This Tortoise was a robot able to see via a very primitive photocell that could **detect light**. Photocell with rotating head to scan the room for light.

Mechanical Tortoise

1950

- In the Year 1950, **Alan Turing proposed the Turing test.** A test that could ***measure human intelligence***. So he made a machined bar and gave the name Turing test.

- The same year **Issac Asimov** Proposed the three laws of Robotics.

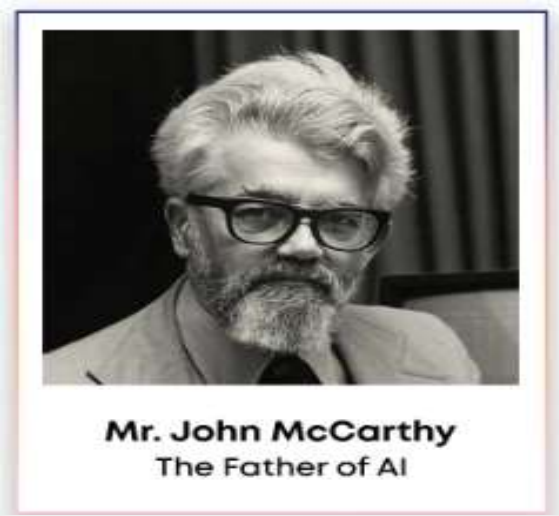


1951

- In the year 1951, The first AI-based program was written (**GAME AI**) by **Christopher Strachey.**

1955

- In the Year 1955, Computer Scientist **John McCarty** created ***the self Learning game plan***. We can say, it was the **birth of AI.**



1959

- In the year 1959, The **first AI laboratory was set up**, and the name of that laboratory was the **MIT AI lab**. It was ***dedicated to the research of artificial intelligence*.**

1961

- In the year 1961, GMR (**General Motors Robot**) was introduced to GMs (General Motors) assembly line.

1964

- In the year 1964, An **AI program** was introduced, and this Artificial Intelligence had the ability **to understand natural language.**

1966

- In the year 1966, The **first AI chatbot called ELIZA** was introduced.

1974

- In the year 1974, the **first autonomous vehicle** was created by **Carnegie Mellon**, using a neural network.

1999

- In the year 1999, Sony Corporation introduced **AIBO(AI robot)**. AIBO is a **robotic pet** developed by Sony. The cost of this AIBO pet is about $1800.

2004

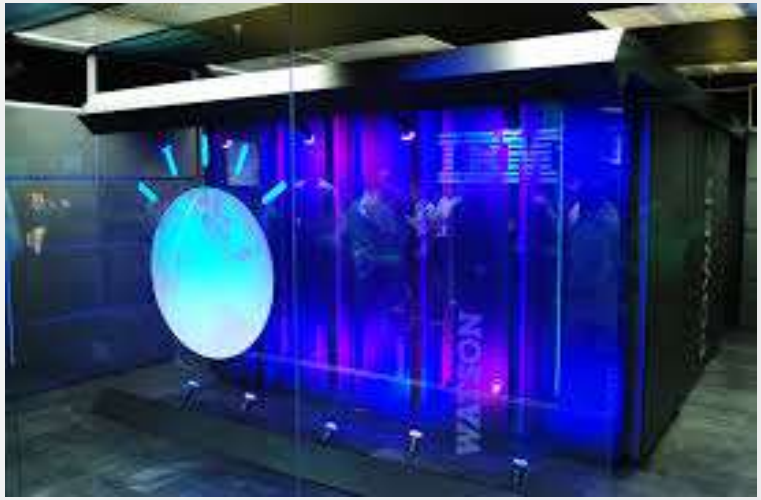
- In the year 2004, **DARPA** (The Defence Advanced Researched Project Agency) introduced the **autonomous robotic car**, and the name of that robotic car was **Stanley** and won the DARPA Grand Challenge.

2009

- **Google** introduced the **self-driving car** on the 17th of January 2009. Well, this project was organized by an American autonomous driving technology development company called **Waymo LLC.**

2011

- In the year 2011, **IBM's** (International Business Machines) **Watson** won at Jeopardy against two of the world's best players, Brad Rutter and Ken Jennings. IBM's Watson is a **question-answering computer system**. It is capable of answering questions asked in natural language.

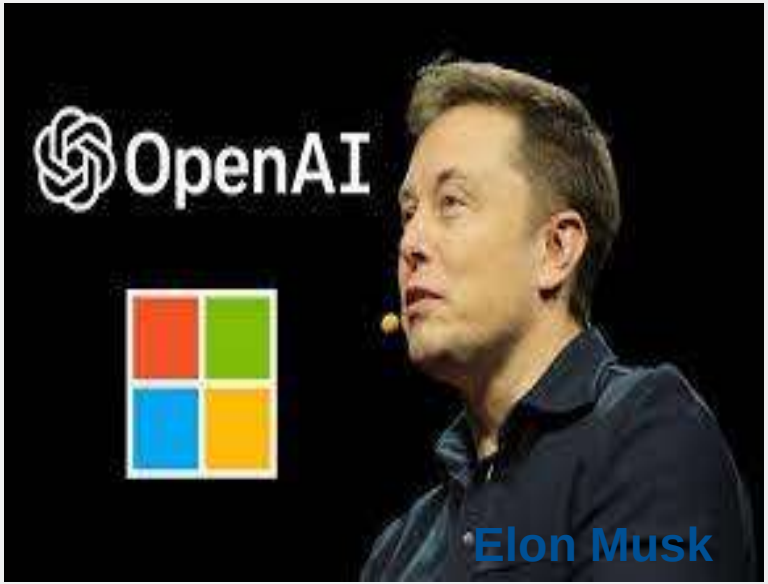


2011-2014-2016

- These are the years, when **Siri (2011), Google Assistant (2016), Cortana (2014), Alexa (2014),** were introduced among us. These all are the Assistant that we all use in our daily life. We tell them to do some work from playing music to book a hotel etc.

2015

- In the year 2015, **SpaceX Founder Elon Musk** established **OpenAI**.
- It was founded on the 11th of December 2015.
- Open AI is a **non-profit research organization company** that goal is to develop Artificial Intelligence.



2016

- In the year 2016, Google DeepMind defeated the Korean best player AlphaGo Champion. **AlphaGo** *is a computer program* that *plays board games.* AlphaGo has developed three more powerful features, that implemented one by one. The name of that three-sector is **AlphaGo Master, AlphaGo Zero, Alpha Go.**

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
- NPTEL

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Introduction to Artificial Intelligence

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 03
Presentation Date – 27/08/2024

Course Outcome

At the end of the course, students should be able to:

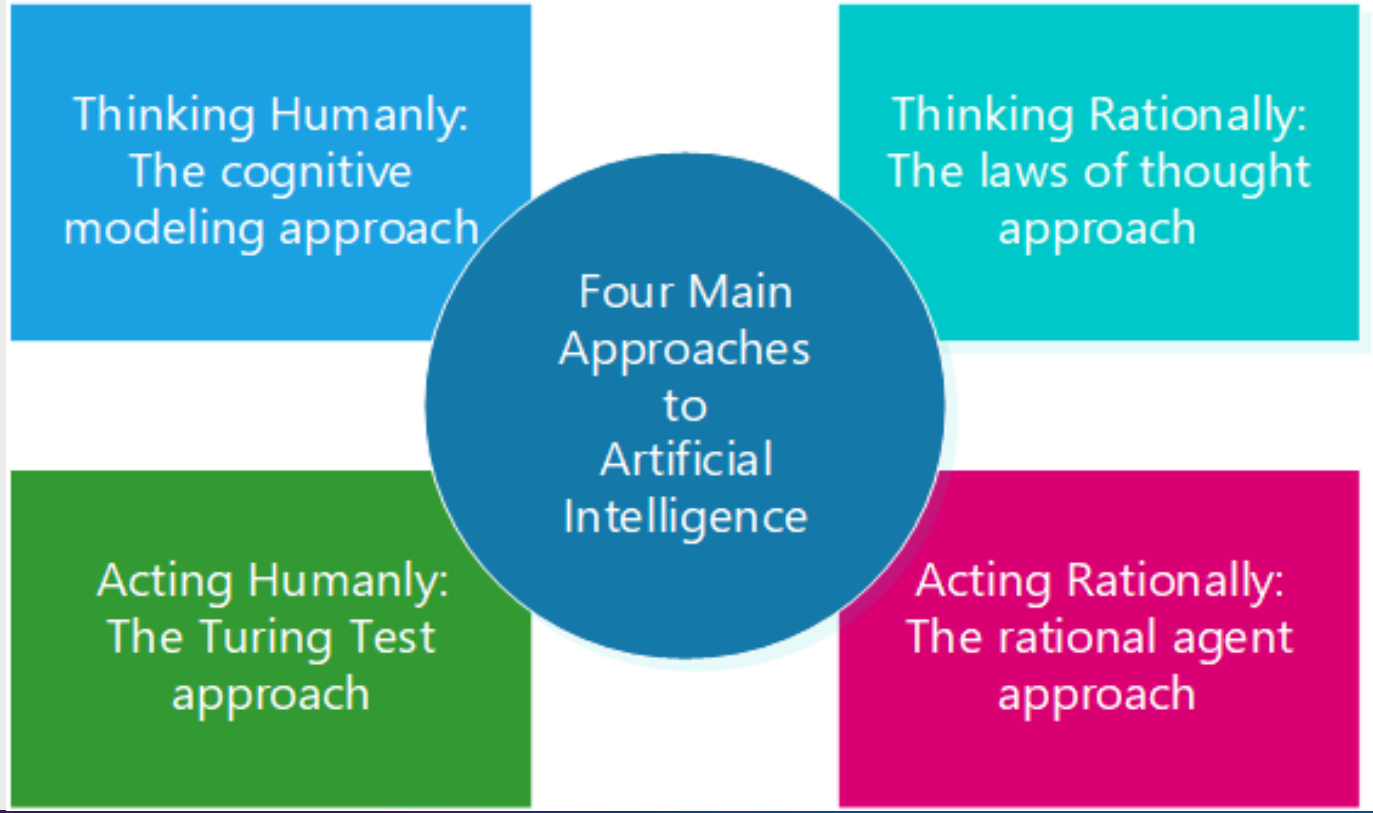
CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand the key concepts, techniques, and applications of artificial intelligence to analyze, design, and implement AI-driven solutions across various domains.

Dimensions / Approaches / Views / Perspectives of Artificial Intelligence (4 Different Definitions of AI)

Dimensions / Approaches / Views / Perspectives of AI



Dimensions / Approaches / Views / Perspectives of AI

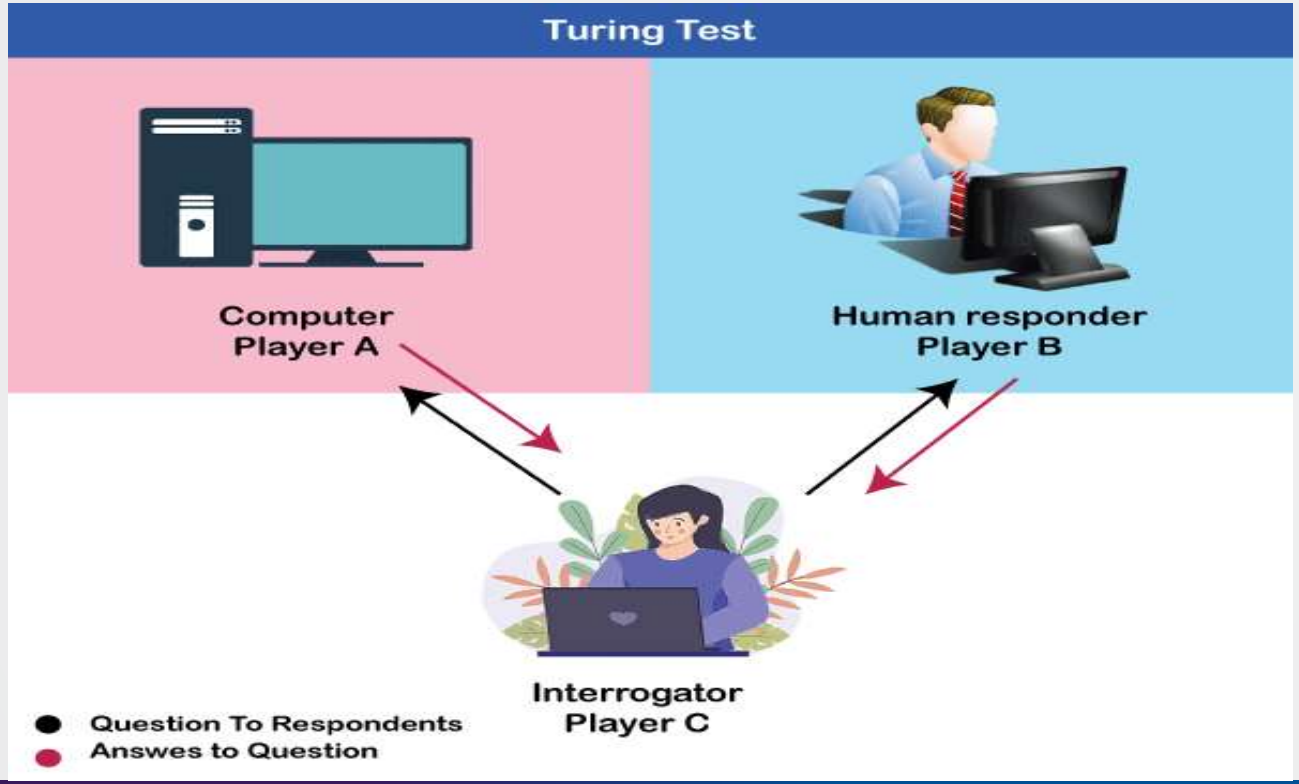
Views of AI fall into four categories:

1. Acting Humanly (The Turing Test approach)
2. Thinking Humanly (The Cognitive modelling approach)
3. Thinking Rationally (The “Laws of Thoughts” approach)
4. Acting Rationally (The Rational Agent approach)

1. Systems that act like humans (Turing Test Approach)

- If an intelligent machine act like human then it is called as acting humanly.
- The **Turing Test** was designed to provide a satisfactory operational definition of intelligence and **proposed by Alan Turing (Turing 1950).**

1. Systems that act like humans (Turing Test Approach)-Contd….



1. Systems that act like humans (Turing Test Approach)-Contd….

- The Turing Test involves three players:
  - ***a computer,***
  - ***a human respondent and***
  - ***a human interrogator.***
- All three are placed in separate rooms or in the same room but physically separated by terminals.
- The interrogator asks both players a series of questions and, after a period, tries to determine which player is the human and which is the computer.

1. Systems that act like humans (Turing Test Approach)-Contd….

- ***If the interrogator fails to determine which player is which***, the computer is declared the winner and the machine is described as being able to think.

1. Systems that act like humans (Turing Test Approach)-Contd….

Qualities of Acting Humanly:

- Natural language processing
  - (*for communication with human*)
- Knowledge representation
  - (*to store information effectively & efficiently*)
- Automated reasoning
  - (*to retrieve & answer questions using the stored information*)
- Machine learning
  - (*to adapt to new circumstances*)
- Computer vision
  - (*to perceive objects (seeing))*
- Robotics
  - (*to move objects (acting))*

2. Systems that think like humans (Cognitive Modelling Approach)

- Thinking humanly means trying to understand and model how the human mind works. The three ways are:
  - ***Through introspection*** — trying to catch our own thoughts as they go by;

  - ***Through psychological experiments*** — observing a person in action;

  - ***Through brain imaging*** — observing the brain in action.

2. Systems that think like humans (Cognitive Modelling Approach)- Contd..

- ***General Problem Solver(GPS)*** was an early computer program that attempted to model human thinking.

3. Systems that Think Rationally (The “Laws of Thoughts” approach)

- In AI, thinking rationally means **thinking rightly.**
- **Ex**: if something is true that should be true or that must be true or it can’t be false.
- If someone thinking rightly always in a given circumstance in a given amount of information then we can call it as **laws of thought approach.**

3. Systems that Think Rationally (The "Laws of Thoughts" approach)- Contd..

- Think rationally is the ***ability to think with reason and draw sensible conclusions from facts, logic and data.***
- It could be defined as ***thoughts based on facts*** and not emotions.
- The **Greek philosopher Aristotle** was one of the first to attempt to codify " **Right Thinking**" for structured argument. He always yielded a correct conclusion when given correct premises.
- Ex:" *All men have brains, All humans have brains therefore all humans are men*."

3. Systems that Think Rationally (The "Laws of Thoughts" approach)- Contd..

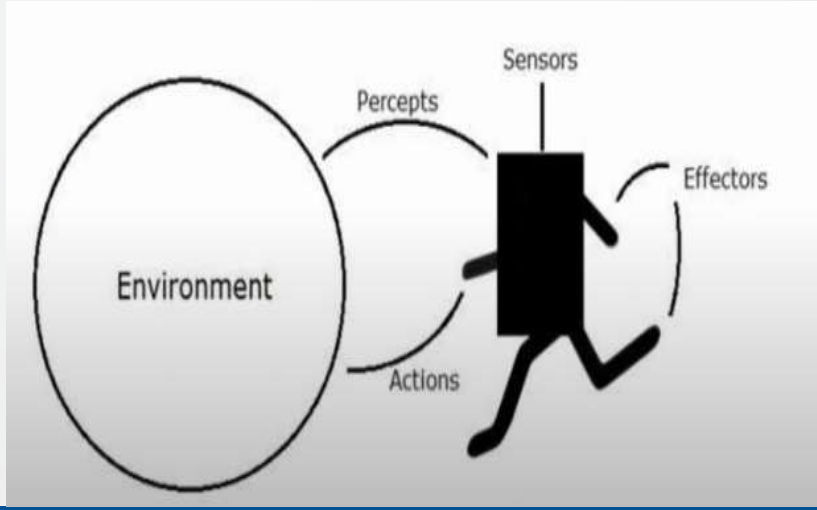
- There are **two main obstacles exist** to implement this approach:
  - This approach needed 100% knowledge.
  - Too many computations required.

4. Systems that Act Rationally (The rational agent approach)

- **Doing or behaving rightly.**
- Generalized approach.
- Rational agent acts to achieve high value and brings the best possible outcome for any given task.

4. Systems that Act Rationally (The rational agent approach) – Contd..

- In terms of Artificial Intelligence, agent is anything that perceives its environment through **sensor** and acts upon that environment through **effectors.**



4. Systems that Act Rationally (The rational agent approach) – Contd..

- **A Human agent**
  - *Sensors*: has sensory organs such as eyes, ears, nose, tongue and skin.
  - *Effectors*: hands, legs, mouths.

4. Systems that Act Rationally (The rational agent approach) – Contd..

- **A Robotic Agent**
  - *Sensors*: cameras, infrared range finders
  - *Effectors*: motors, actuators..etc.

4. Systems that Act Rationally (The rational agent approach) – Contd..

- **A Software Agent**
  - *Sensors*: keystroke, file content, received network packages.
  - *Effectors*: display screen, sent network packets.

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Introduction to Artificial Intelligence

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 04
Presentation Date -

Course Outcome

At the end of the course, students should be able to:

CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand the key concepts, techniques, and applications of artificial intelligence to analyze, design, and implement AI-driven solutions across various domains.

Contents to be Covered

- Definition of AI
- Types of AI

Definition of Artificial Intelligence

Definition of Artificial Intelligence

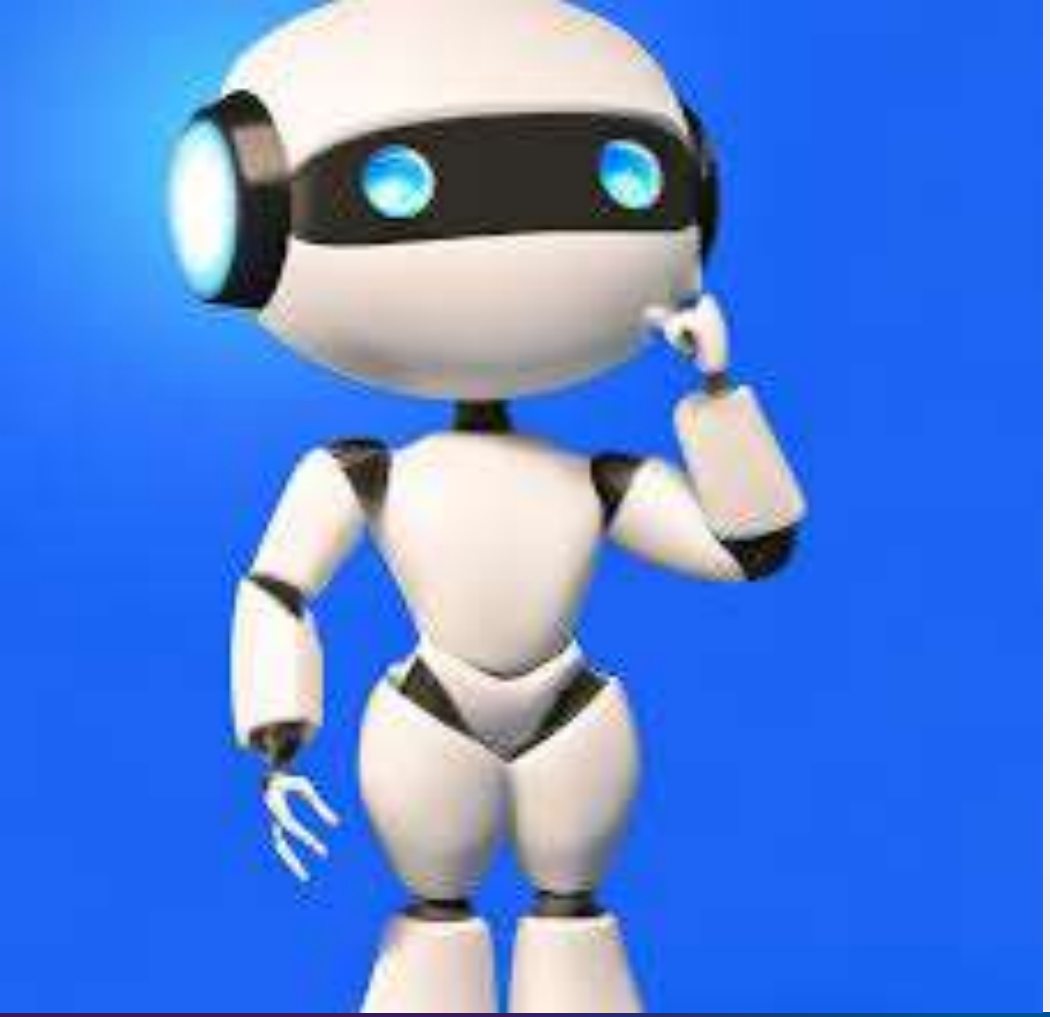
(AI) is a branch of computer science that focuses on the creation of intelligent machines that can think and learn like humans.

AI technology **enables machines to mimic human intelligence** and also improve the capabilities of the human mind.

AI systems have the **ability to process data, interpret speech, analyse patterns, identify objects, and make decisions on their own**.

Examples of Artificial Intelligence

- Robotic assistants
- Self-driving cars
- Virtual chatbots
- Facial recognition
- Auto correction or text editors
- Personal recommendations for shopping
- Surgical Robots
- Virtual travel booking assistants
- Social media monitoring



Types of Artificial Intelligence

Types of Artificial Intelligence

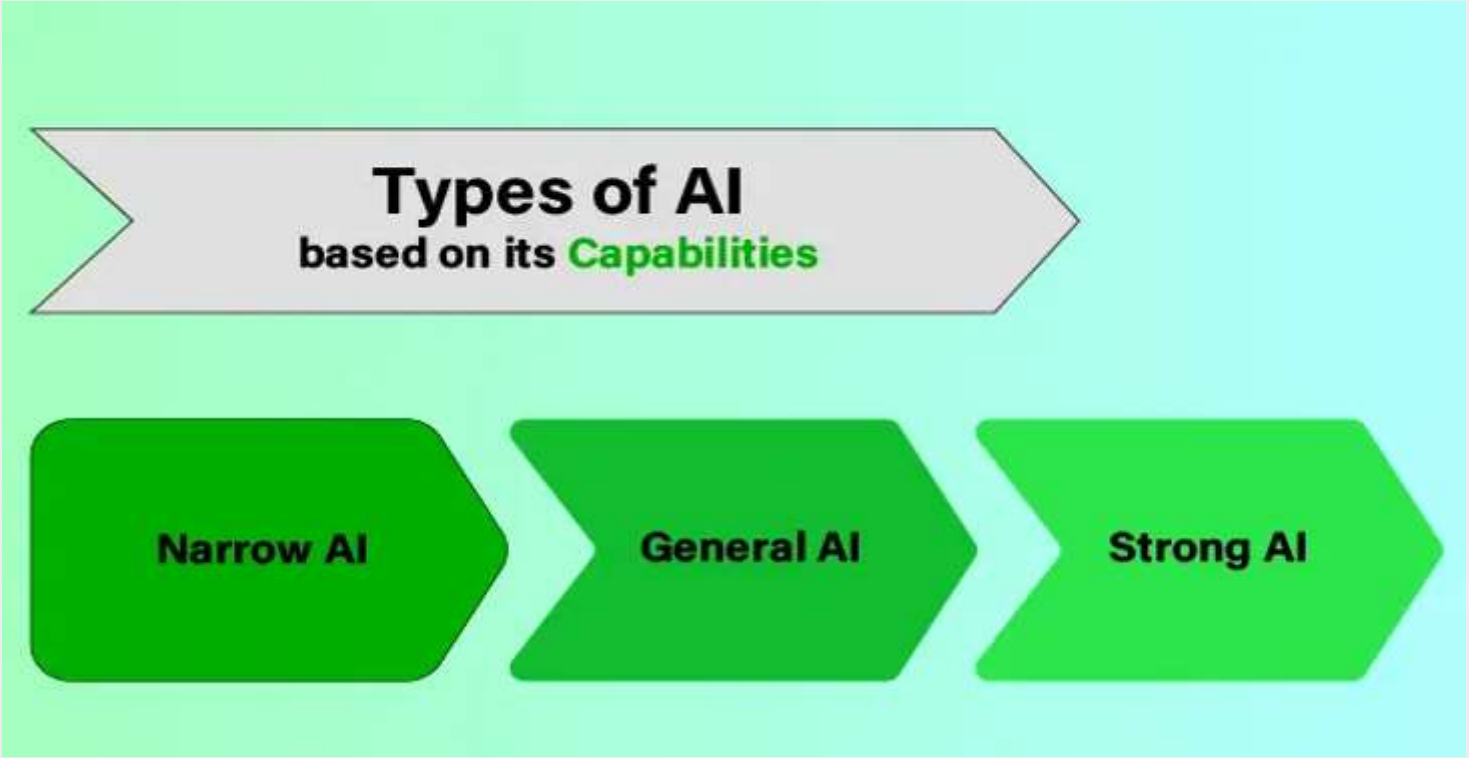
Artificial Intelligence can be broadly classified into several types based on capabilities, functionalities, and technologies**.**

1. **Based on capabilities** (Narrow/Weak AI, General/Strong AI, Superintelligent AI)

2. Based on functionalities (Reactive machines, Limited memory, Theory of mind, Self-aware AI)

3. Based on Technologies (Machine learning, Deep learning, Natural language processing, Robotics, Computer vision, Expert systems, Fuzzy logic)

1. AI Based on Capabilities



a. Narrow / Weak AI

- Able to **perform a dedicated task** with intelligence.
- Most **common and currently available** AI.
- Designed to perform a narrow task. (e.g., facial recognition, internet searches, or driving a car).
- Cannot perform beyond its field or limitations. (as it is only trained for one specific task.)

a. Narrow / Weak AI (Contd..)

- **Ex:**
  - Virtual assistants like Siri by Apple, Alexa by Amazon, IBM's Watson supercomputer
  - Playing chess
  - Purchasing suggestions on e-commerce site
  - Self-driving cars
  - Speech recognition
  - Image or facial recognition software

b. General / Strong AI

- Able to ***perform any intellectual task with efficiency like a human*.**
- ***Smarter and think like a human*** by its own.
- It has the ***ability to learn, reason, and make decisions*** in a wide variety of contexts.
- Systems with general AI are ***still under research.***
- Will take lots of efforts and time to develop such systems.

b. General / Strong AI (Contd..)

- **Ex:**
  - NLP (natural language processing)
  - Image recognition
  - Robotics
  - Automate complex tasks

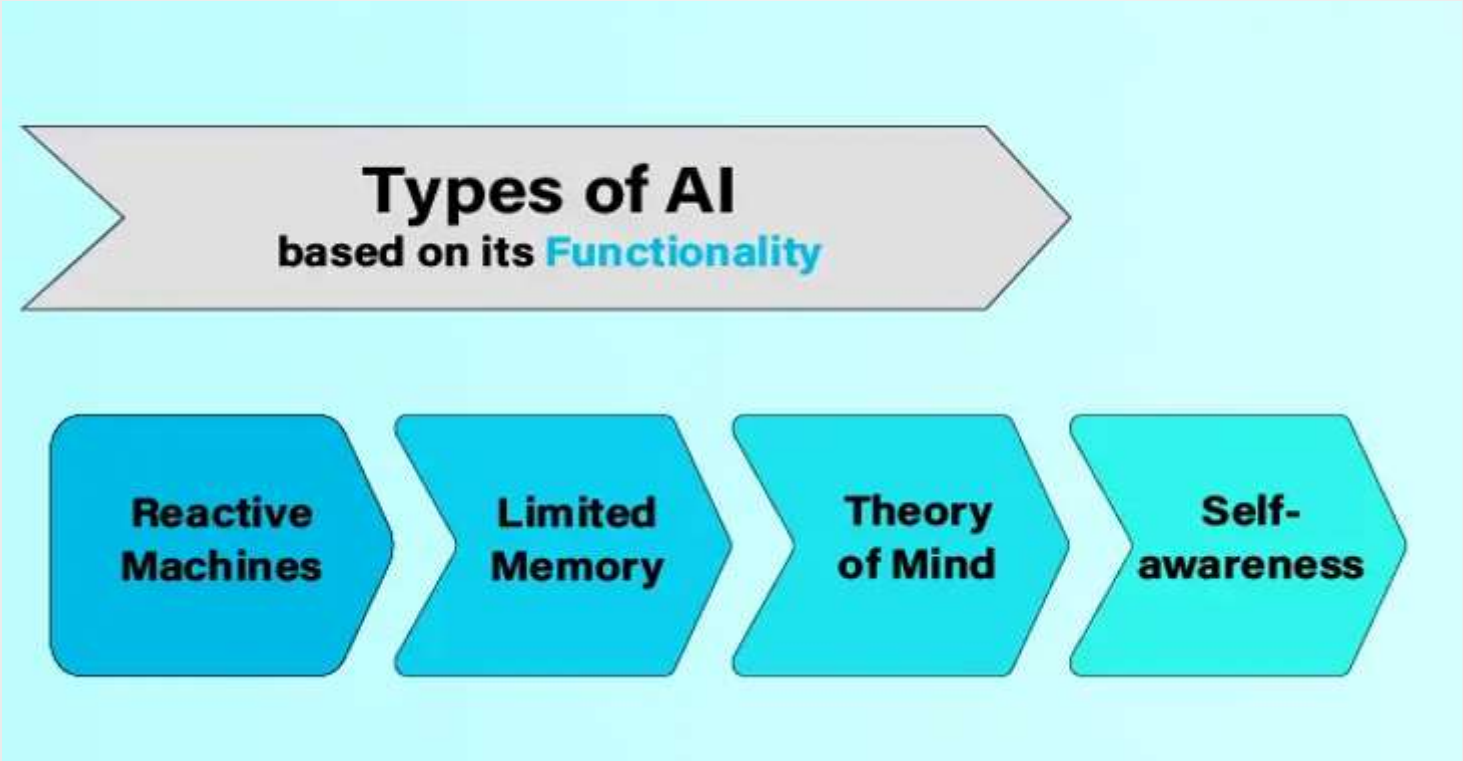
c. Superintelligent AI

- It is an ***outcome of general AI.***
- Self-aware and expected to surpass human intelligence.
- Can ***perform any task better than humans***.
- Artificial superintelligence (ASI) is considered the most ***advanced and powerful type of AI.***
- ASI can also ***interpret human emotions and experiences.***

c. Superintelligent AI

- **Ex:**
  - Problem-solving
  - Thinking
  - Decision-making
  - Ability to think
  - Reasoning
  - Solve the puzzle
  - Make judgments, plan, learn, and communicate by its own.

2. AI Based on Functionalities



a. Reactive Machines

- The ***oldest and the most basic*** forms of AI.
- ***Purely reactive*** machines are the most basic types of Artificial Intelligence.
- Such AI systems ***do not store memories or past experiences*** for future actions.
- These machines only ***focus on current scenarios and react on it as per possible best action.***
- Ex: IBM's Deep Blue system, Google's AlphaGo

b. Limited Memory

- Possess the capabilities of reactive machines.
- Capable of ***learning from past experiences*** and using that data to make decisions.
- Can ***use stored data for a limited time period only***.

b. Limited Memory (Contd..)

- **Ex:**
  - ***Self-driving cars*** are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.
  - Most present-day AI applications, from ***chatbots*** and ***virtual assistants*** fall into this category.

c. Theory of mind

- ***More advanced type*** of AI that researchers are still working on.
- ***Understand the human emotions, people, beliefs***, and be able to interact socially like humans.
- ***Still not developed.***
- Plays a crucial role in psychology as they will ***focus on emotional intelligence.*** (needs a clear understanding of human feelings and behaviour within an environment.)

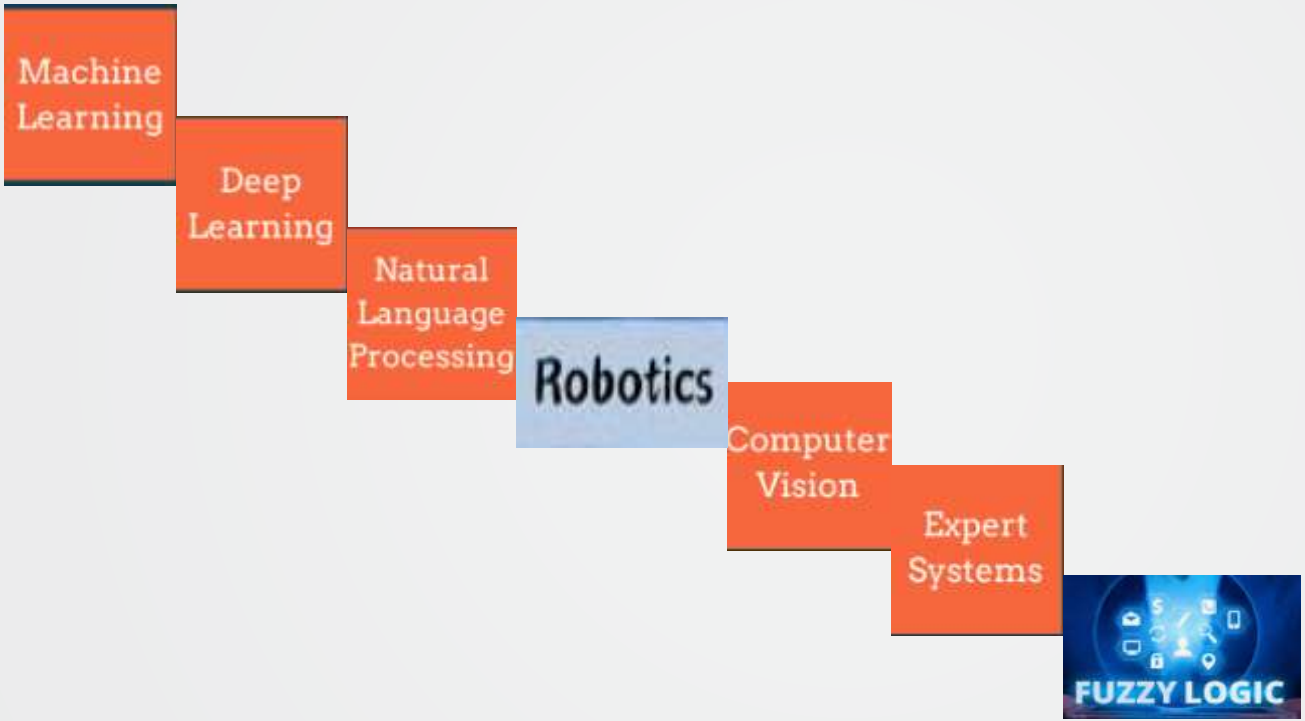
c. Theory of mind (Contd..)

- **Ex:**
  - ***Robots Kismet*** (a robot developed in the 1990s, was capable of recognizing human facial emotions and could replicate those emotions with its facial features, eyes, lips, ears, eyebrows, and eyelids.)
  - ***Robot Sophia*** (is a humanoid robot developed in the 2016 and is known for its prominent human-like appearance, facial expressions, and behaviour as compared to previous variants.)

d. Self Aware AI

- ***Represents the future of AI.***
- Will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines ***will be smarter than human mind***.
- ***Does not exist in reality*** still and it is a hypothetical concept.

3. AI Based on Technologies



a. Machine Learning (ML)

- ***Subset of AI***.
- Involves ***developing algorithms*** to interpret, process, and analyse data to solve various real-world problems.
- These programs or algorithms are designed such that they learn and improve over time when exposed to new data.

b. Deep Learning (DL)

- ***Subset of ML*** involving ***many layers*** of neural networks.
- Makes ***use of artificial neural networks*** to gain insights from data and solve more advanced problems.
- The deep learning algorithm is the logic behind facial & speech recognition, virtual assistants like Alexa & Siri, self-driving cars, and much more.

c. Natural Language Processing (NLP)

- It deals with the ***interaction between computers and human language.***
- NLP is used to process & interpret human language which is useful in many applications like speech recognition, text analysis, translation, etc.

d. Robotics

- It is a branch of artificial intelligence that deals with the ***design and development of robots.***
- AI robots can be used to automate different tasks in multiple industries like *healthcare, manufacturing, logistics,* etc.
- They can ***learn from experience and work collaboratively with humans*.**

e. Computer Vision

- This technology allows machines to ***interpret the world visually.***
- it's used in various applications such as *medical image analysis, surveillance, and manufacturing.*

f. Expert Systems

- These AI systems ***answer questions*** and ***solve problems in a specific domain of expertise*** using rule-based systems.
- Expert systems are ***AI-based computer programs designed to mimic the reasoning and decision-making abilities of a human expert.***
- They are useful in many applications like *financial planning, customer service, medical diagnosis, virus detection*, and so on.

g. Fuzzy Logic

- Fuzzy logic is a computing approach that ***resembles human reasoning.***
- FL is based on the principles of "***degrees of truth***" instead of the modern computer logic i.e. Boolean in nature.
- It can be ***implemented in hardware, software, or a combination of both***.

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
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Topic Title – Introduction to Artificial Intelligence

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 05
Presentation Date – 28/08/2024

Course Outcome

At the end of the course, students should be able to:

CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand the key concepts, techniques, and applications of artificial intelligence to analyze, design, and implement AI-driven solutions across various domains.

Applications / Future of Artificial Intelligence

AI Applications / Future

Many thousands of AI applications are deeply embedded in the infrastructure of every industry and it will continue for future.

AI Applications / Future

- AI in Games
- AI in healthcare
- AI in Software Engineering
- AI in Agriculture
- AI in Finance
- AI in Automobiles
- AI in Space exploration
- Expert Systems
- Robotics
- Autonomous planning and scheduling
- Natural Language Processing
- Language understanding and problem solving
- Machine Translation
- Computer Vision
- E-commerce
- Heuristic Classification

1. AI in Games

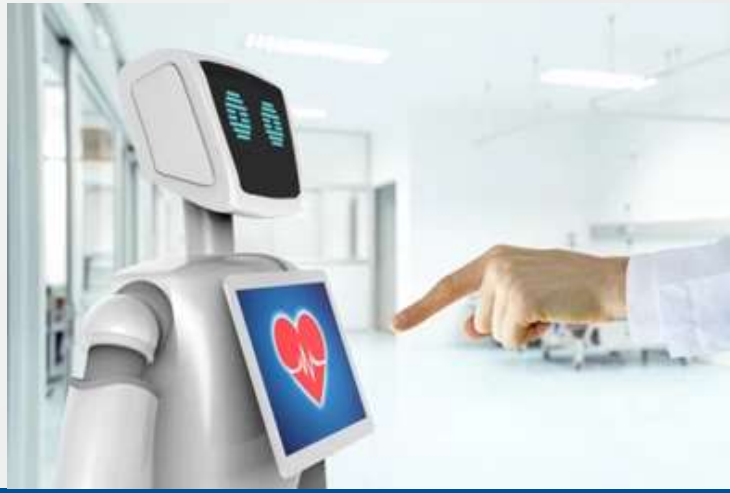
- Nowadays there are different ***gaming bots*** are introduced. Bot are developed who will play with you, such as **checkers, chess, and the 15-puzzle.**
- **Deep Blue** became the first computer chess-playing system to beat a reigning world chess champion, Garry Kasparov, on 11 May 1997.

1. AI in Games (Contd..)

- **AlphaGo**, a Go-playing computer program developed by Google and **DeepMind**, In March 2015 became the first computer Go program to beat a professional ***human player.***
- **First encounter Assault Recon F.E.A.R** first-person shooter survival video game.

2. AI in Healthcare

- In Medical Science AI is used to create **virtual personal health care assistant**.
- A medical clinic can use artificial intelligence systems **to organize bed schedules, make a staff rotation, and provide medical information** and other important tasks.



2. AI in Healthcare (Contd..)

- AI has also applications in field of cardiology(CRG),Neurology(MRI),Embryology(sonography), complex operations of internal organs etc.
- **Virtual nursing assistants** (These virtual nurses are available 24/7 and can respond to queries as well as examine patients and provide instant solutions.)
- **MYCIN** expert systems which diagnosed bacterial infections of the blood and suggested treatments.
- **Buoy Health** is an AI-based symptom and cure checker that uses algorithms to diagnose and treat illness.

3. AI in Software Engineering

- Taking over automated routines.
- Contributes to reduce development time.
- Increases market success of software development companies.

4. AI in Agriculture

- Analysing crop health by drones.
- Precision Farming and Predictive Analytics.
- Agricultural Robotics.

5. AI in Finance

- Artificial intelligence in finance encompasses everything from **chatbot assistants** to **fraud detection and task automation.**
- Some ways of how AI transformed financial industry:
  - Risk Assessment
  - Fraud Detection And Management
  - Trading
  - Managing Finance

6. AI in Automobiles

- Car manufacturers all over the globe are using AI in just about every facet of the car making process.
- **Autonomous driving** is one of the key application areas of artificial intelligence (AI).
- Ex: **AUTOX** which is a Self-Driving grocery delivery.

7. AI in Space Exploration

- NASA installed a new AI system called **AEGIS** on its current rovers which autonomously choose targets *for its laser detection system.*
- Artificial Intelligence, NASA Data Used to Discover Eighth Planet Circling Distant Star.
- ISRO's AI powered **Vyommitra.**

8. Expert Systems

- It is a computer system that *emulates the decision making ability of a human expert in a specific domain.*
- First expert systems was **MYCIN** in 1974, which diagnosed bacterial infections of the blood and suggested treatments.
- It did better than medical students or practicing doctors, provided its limitations were observed.

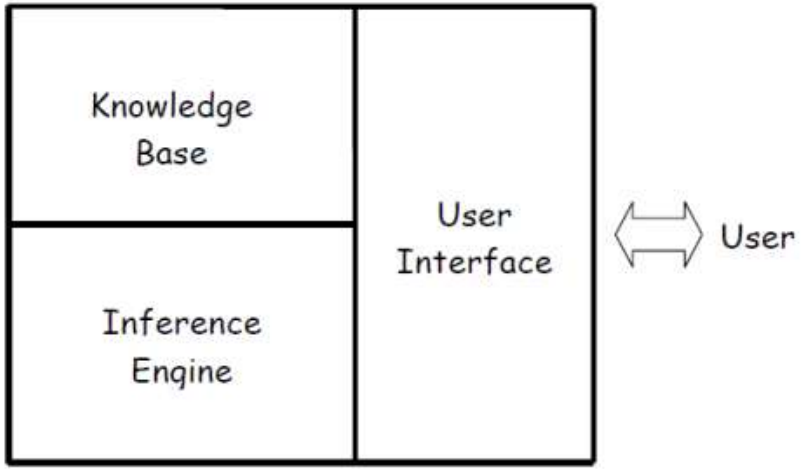


Fig: Block Diagram of expert system

9. Robotics

- Robotics is a branch of engineering devoted to the creation and training of robots.
- Roboticists works within a wide range of fields, such as mechanical and electronic engineering, cybernetics, bionics and AI.
- Generally a robot consists of 5 basic components:

  1.Controller 2.Arm 3.Drive 4.End-Effector 5.Sensor

10. Autonomous Planning and Scheduling

Also called as **AI planning**, is a branch of AI that concerns the realization of strategies or action sequences, typically for execution by intelligent agents, autonomous robots and unmanned vehicles.

Telescope Scheduling

11. Natural Language Processing (NLP)

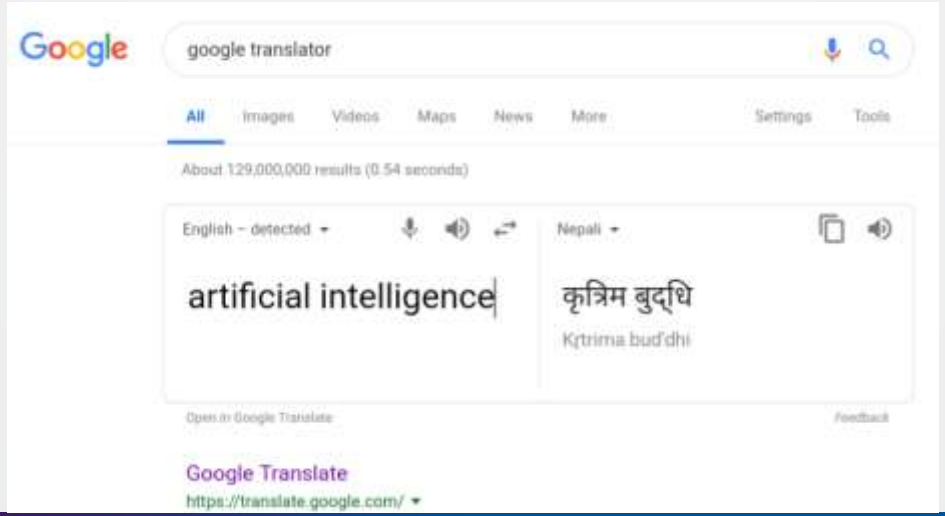
- Natural Language Processing(NLP) is a technology which involves converting spoken or written human language into a form which can be processed by computers, and vice versa.
- **Applications of NLP includes:**
  - *Voice recognition software* (Ex: Google assistant, window speech recognition etc)
  - *Text-to-speech synthesizers* (Ex: reads document by Microsoft Edge browser)
  - *Grammar and style checkers* (Ex: used in documenting computer)
  - *Machine translation systems* (Ex: google translator)

12. Language Understanding and Problem Solving

- The AI helps the computer to understand our natural language like English, Telugu etc, so that we can communicate with computer like a human being.
- Major issue involved in understanding language:
  - A **large amount of human knowledge is assumed**.

13. Machine Translation

- The term *machine translation* (MT) is used in the sense of translation of one language to another.
- The ideal aim of machine translation systems is to produce the best possible translation without human assistance.



14. Computer Vision

- AI can be **used to improve the vision of the real world object** on computer **so that we can view it with 3-Dimension**.

- Computer vision is a field that **includes methods for acquiring, processing, analysing, and understanding images** and, in general, **high dimensional data from the real world in order to produce numerical or symbolic information**.

15. E- Commerce

- Major e-commerce companies have been using the advanced technology like AI or machine learning.
- Companies are using the **AI as Chabot's, AI assistants, Smart logistics**, using algorithms *to predict and analyze customer's behaviours.*
- The ultimate aim is to **reduce shipping costs**.
- Machine learning helps companies in **demand forecasting, product search ranking, product and deals recommendations, merchandising placements, fraud detection, translations** and much more.

16. Heuristic Classification

- Given knowledge of AI is to put some information in one of a fixed set of categories using several sources of information.
- **Example**: information is available about the owner of the credit card, his record of payment, also about the item he is buying.

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
- NPTEL

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Introduction to Artificial Intelligence

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 06
Presentation Date – 28/08/2024

Course Outcome

At the end of the course, students should be able to:

CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand the key concepts, techniques, and applications of artificial intelligence to analyze, design, and implement AI-driven solutions across various domains.

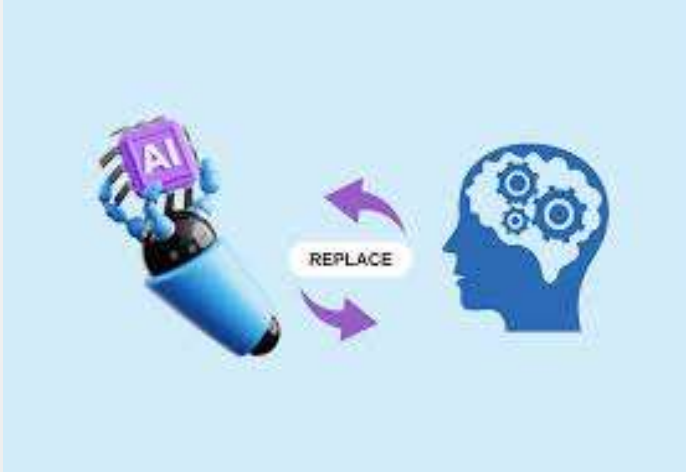
Pros and Cons of Artificial Intelligence

Common Questions Raised Regarding AI

- **Can AI replace human intelligence?**
- **What is the biggest threat of AI?**

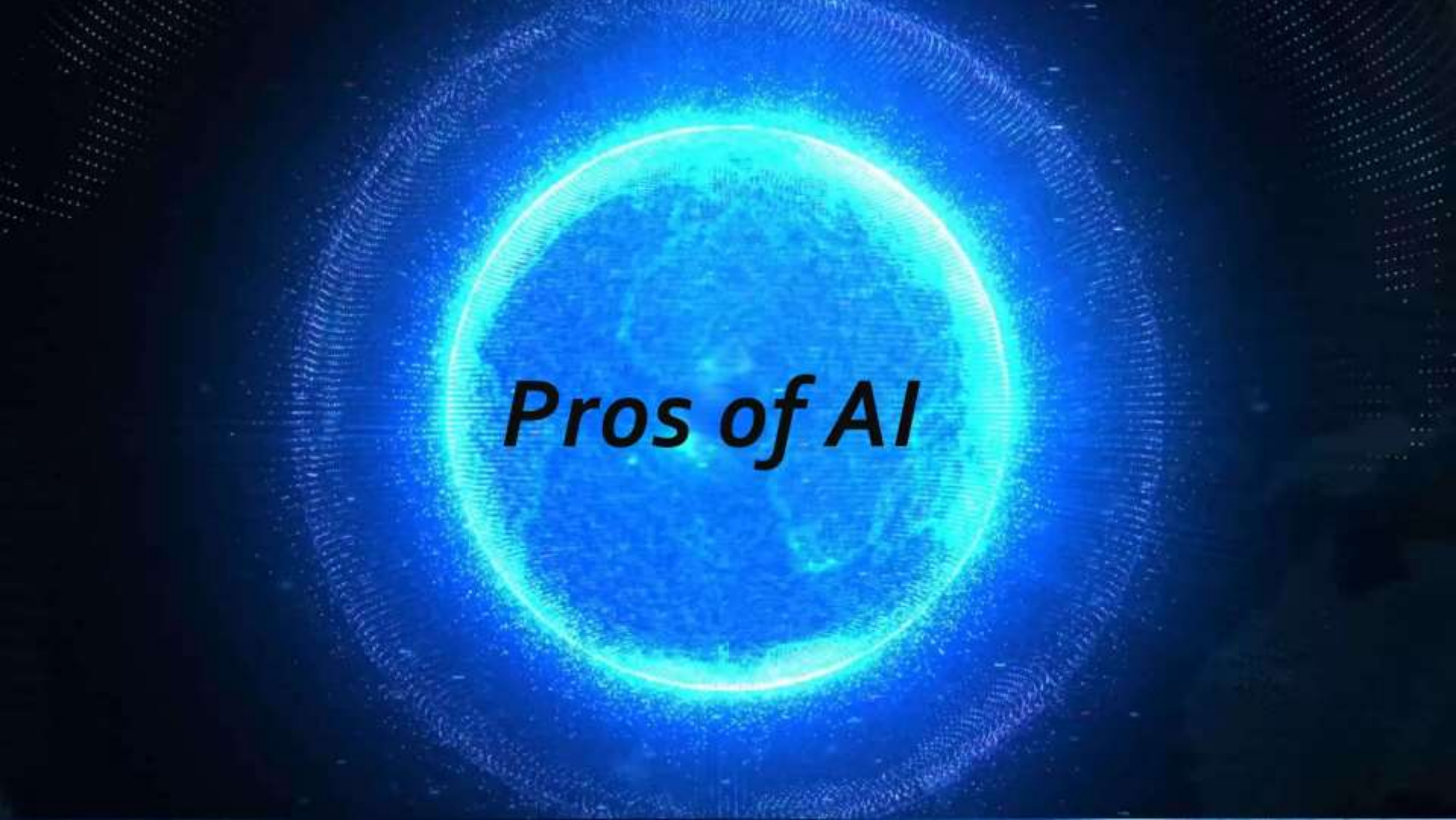
Can AI replace human intelligence?

- AI is the best suited for ***handling repetitive, data driven tasks and making data driven decisions.***
- However human skills such as ***creativity, critical thinking, emotional intelligence and complex problem solving skill need to be more valuable*** and easily replicated by AI.



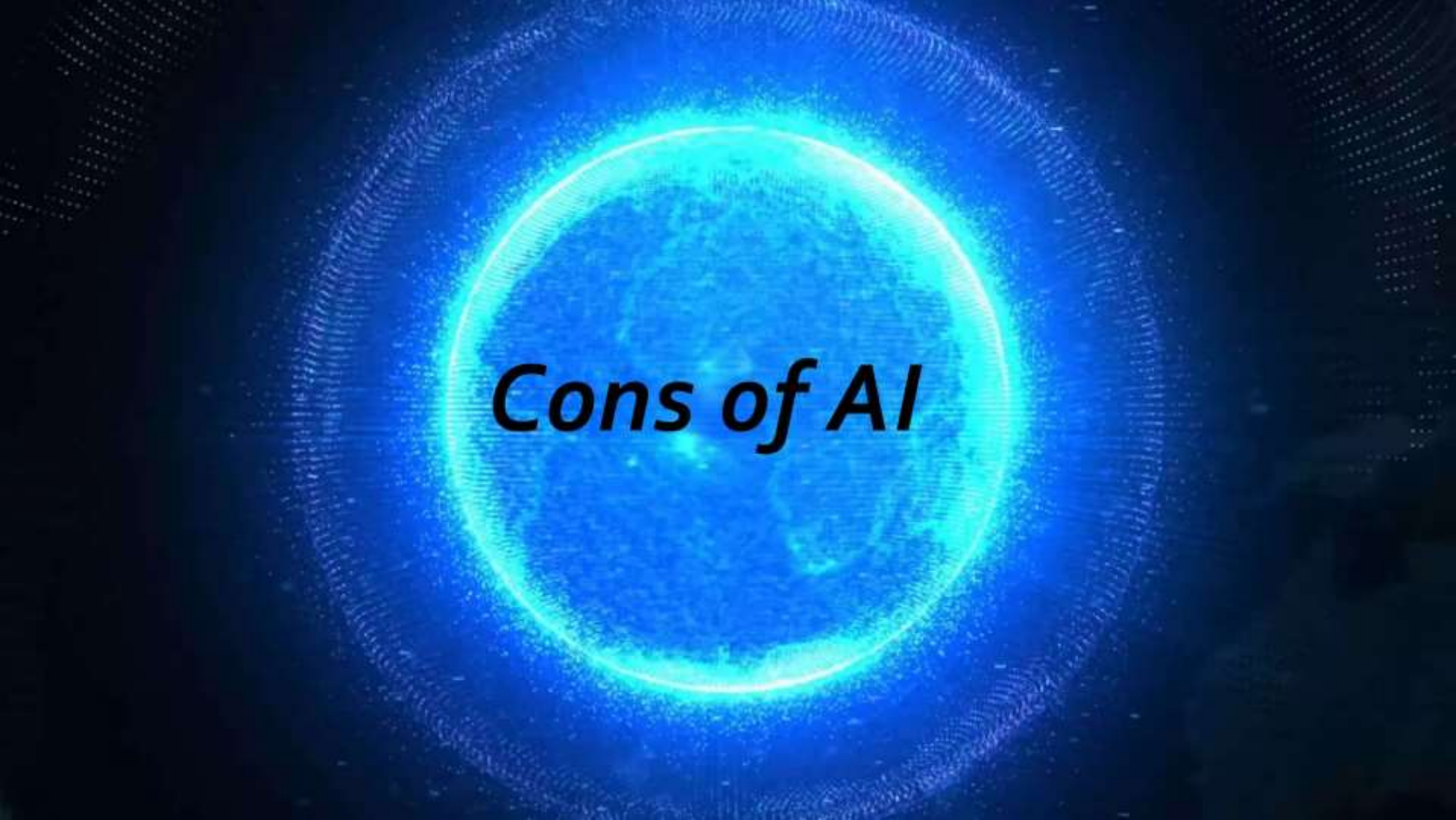
What is the biggest threat of AI?

- Job Displacement
- Economic Inequality (uneven distribution of income and job)
- Legal and Regulatory Challenges
- AI Arms Race (competition for superior AI)
- Loss of Human Connection etc..


Pros of AI

Pros of AI

- **Error-free Processing**: The execution of tasks by humans is more prone to make errors.
- **Helps in Repetitive Jobs:** Automate repetitive tasks such as data entry, report generation, and customer service inquiries.
- **24/7 Availability**: AI can be accessed at any time.
- **Right and Faster Decision-Making**: takes quick and correct decisions.
- **Digital Assistance**: Assists the user in many ways.


Cons of AI

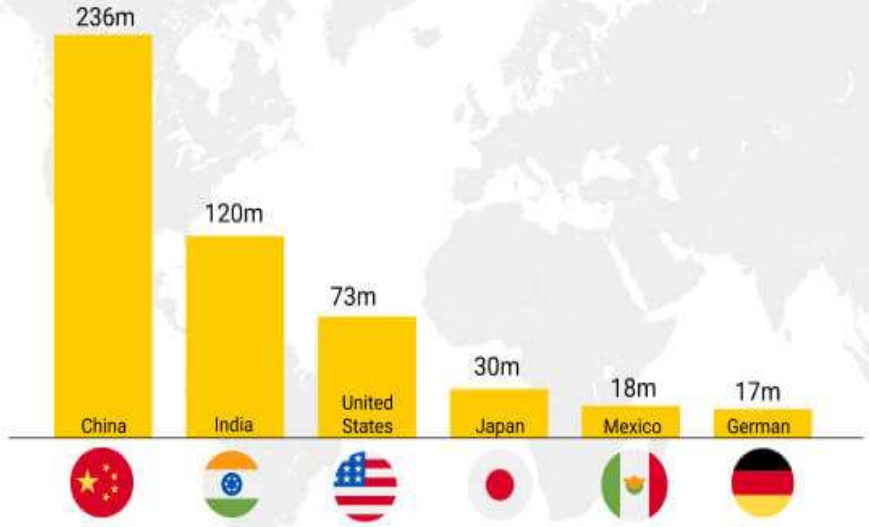
Cons of AI

- **High Costs.** The ability to create a machine that can simulate human intelligence is no small feat.
- **No Creativity**. A big disadvantage of AI is that it cannot learn to think outside the box.
- **Unemployment**
- **Make Humans Lazy.**

Impact of AI in the modern world

- AI has become increasingly important in today's world as it has the potential to revolutionize many industries, including healthcare, finance, education, and more.
- The use of AI has ***already improved efficiency, reduced costs, and increased accuracy in various fields.***

Impact of AI in employment



BY 2030, AUTOMATION COULD ELIMINATE 73 MILLION JOBS IN THE U.S.

Number of jobs at risk of being displaced by automation by 2030

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
- NPTEL

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Intelligent Agent and It's Characteristics

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 07
Presentation Date – 29/08/2024

Course Outcome

At the end of the course, students should be able to:

CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Understand an intelligent agent how it observes its environment, processes information, and takes actions autonomously to achieve specific goals.

Introduction to Intelligent Agents

Introduction to Agent

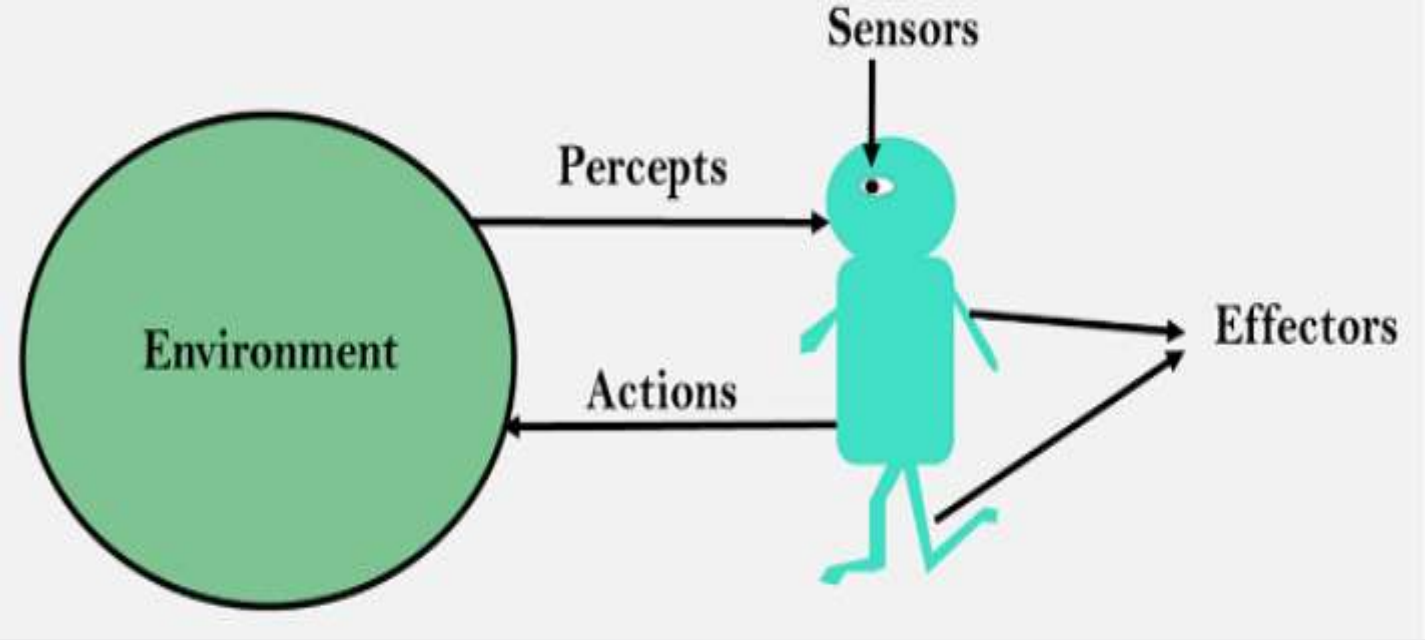
- Responsible for any work output obtained from system.
- An ***agent*** can be anything that ***perceive its environment*** through ***sensors*** and act upon that environment through ***actuators.***
- An Agent runs in the cycle of ***perceiving (information gathering), thinking, and acting.***
- **Ex: S**ometime when you are leaving, experience humidity and see the sky full of clouds. You anticipate that it might rain. So, you go back to your house and pick up the umbrella.

An Agent can be:

- ***Human Agent***
  - ***Sensors:*** eyes, ears, skin, taste buds etc.
  - ***Effectors:*** hands, fingers, legs, mouth etc.
- ***Robots Agent***
  - ***Sensors:*** camera, infrared range finders, bumper etc.
  - ***Effectors:*** grippers, wheels, lights, speakers etc.
- ***Software Agents***
  - ***Sensors:*** scanners, keyboard, mouse, readers etc.
  - ***Effectors:*** monitors, speakers, printers, and files etc.

Agent and Environment

An agent is composed of 2 things: ***an agent*** and ***an environment.***



Agent and Environment

- **Sensor**: Sensor is a device which detects the change in the environment and sends the information to other electronic devices. **An *agent observes its environment through sensors.***
- **Actuators**: An actuator is the actual mechanism that enables the effector to execute an action. The ***actuators are only responsible for moving and controlling a system***. An actuator can be an electric motor, gears, rails, etc.
- **Effectors:** An effector is any device ***that affects the physical environment.*** Effectors can be legs, wheels, arms, fingers, wings, fins, and display screen.

Intelligent Agent

Intelligent Agent

- An intelligent agent is an ***autonomous entity*** which act upon an environment using sensors and actuators for achieving goals.
- An intelligent agent may learn from the environment ***to achieve their goals.***
- A ***thermostat*** is an example of an intelligent agent.

Intelligent Agent

Following are the ***main four rules for an AI agent***:

- **Rule 1**: An AI agent must have the ability to perceive the environment.
- **Rule 2**: The observation must be used to make decisions.
- **Rule 3**: Decision should result in an action.
- **Rule 4**: The action taken by an AI agent must be a rational action.

Structure of AI agent

Structure of AI agent

- The task of AI is to design an ***agent program*** which implements the ***agent function.***
- The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as:

Agent = Architecture + Agent program

Structure of AI agent

- Following are the *main three terms* involved in the structure of an AI agent:
  - **Architecture**: Architecture is machinery that an AI agent executes on.
  - **Agent Function**: Agent function is used to map a percept to an action. $\mathbf{f:P^* \rightarrow A}$
  - **Agent program**: Agent program is an implementation of agent function. An agent program executes on the physical architecture to produce function f.

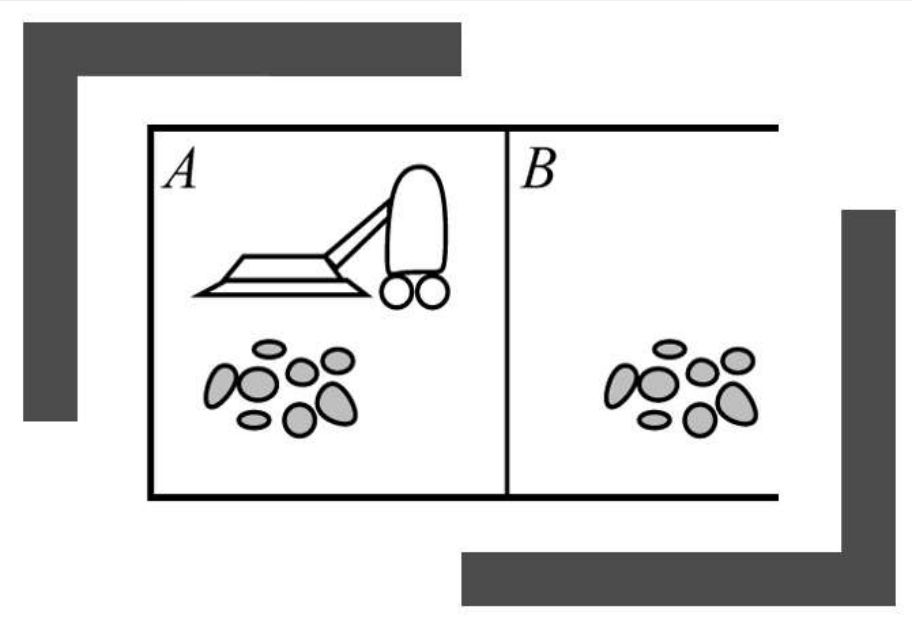
Goals of Agents

Goals of Agents

- **High performance***: performance should be at max.*
- **Optimized result***: correct and short procedure.*
- **Rational action***: right action should be performed.*

Examples of Agents

Example-1: A Vacuum Cleaner agent



- **Percept:** location and contents,

  e.g., [A, Dirty]

- **Actions**: *Left, Right, Suck, NoOp*

Example-1: A Vacuum Cleaner agent (Contd..)

- This particular world has just two locations: squares A and B.
- The vacuum agent **perceives** which square it is in and whether there is dirt in the square.
- It can choose to move left, move right, suck up the dirt, or do nothing.
- One very simple **agent function** is the following:
  - if the current square is dirty, then suck, otherwise,
  - it move to the other square.

Example-1: A Vacuum Cleaner agent (Contd..)

Agent Function:

Percept sequence	Action
$[A, Clean]$	$Right$
$[A, Dirty]$	$Suck$
$[B, Clean]$	$Left$
$[B, Dirty]$	$Suck$
$[A, Clean], [A, Clean]$	$Right$
$[A, Clean], [A, Dirty]$	$Suck$
⋮	⋮

Agent Program:

```
function REFLEX-VACUUM-AGENT([location,status]) returns an action
    if status = Dirty then return Suck
    else if location = A then return Right
    else if location = B then return Left
```

Example-2: Collision Avoidance Agent (CAA)

- **Goals:** Avoid running into obstacles
- **Percepts:** Obstacle distance, velocity, trajectory
- **Sensors:** Vision, proximity sensing
- **Effectors**: Steering Wheel, Accelerator, Brakes, Horn, Headlights
- **Actions:** Steer, speed up, brake, blow horn, signal (headlights)
- **Environment**: Highway

Example-3: Lane Keeping Agent (LKA)

- **Goals:** Stay in current lane
- **Percepts:** Lane center, lane boundaries
- **Sensors:** Vision
- **Effectors:** Steering Wheel, Accelerator, Brakes
- **Actions:** Steer, speed up, brake
- **Environment:** Freeway

Good Behaviour
of
An Intelligent Agent

Good Behaviour : The Concept of Autonomy

- The autonomy of an agent is ***the extent to which its behaviour is determined by its own experience*** (***with ability to learn and adapt***)
- Example: baby learning to crawl

Good Behaviour : The Concept of Rationality

- A ***rational agent*** is one that ***does the right thing.***

- Conceptually speaking; every entry in the table for the agent function is filled out correctly.

- The right action is the one that will cause the agent to be most successful.

- A rational agent is one that does the "right thing", which depends on the ***performance measure. (how the agents should behave).***

Good Behaviour : The Concept of Rationality (Contd..)

- What is rational at any given time depends on four things:

  - The ***performance measure*** that defines the criterion of success.
  - The agent's ***prior knowledge*** of the environment.
  - The ***actions*** that the agent can perform.
  - The agent's ***percept*** sequence to date.

Nature
of
Environment
(Task Environment – PEAS Representation)

Nature of Environments

- PEAS is a ***type of model*** on which ***an AI agent works upon***. When we define an AI agent or rational agent, then we can group its properties under PEAS representation model. It is made up of *four words:*
  - ***P: performance measure***
  - ***E: environment***
  - ***A: agent's actuators***
  - ***S: agent's sensors***
- Must first specify the setting for intelligent agent design.

Nature of Environments (PEAS)

- Performance: ***Output*** which we get from the agents after processing.
- Environment: All ***surrounding*** things and conditions.
- Actuators: Hardware or software devices through which ***agent performs.***
- Sensors: Devices through which agent ***observes and perceives*** its environment.

PEAS Example-1 (*Self Driven Car*)

- **Performance**: *Speed, Safety of car and passengers, time taken and comfort of user.*
- **Environment**: *Roads, Pedestrians, Crossings, Traffic signals etc.*
- **Actuators**: *Steering, Accelerators, Breaks, Horns, Music systems etc.*
- **Sensors:** *Camera, Speedometer, GPS, Odometer, Sonar etc.*

PEAS Example-2 (Medical Diagnosis System)

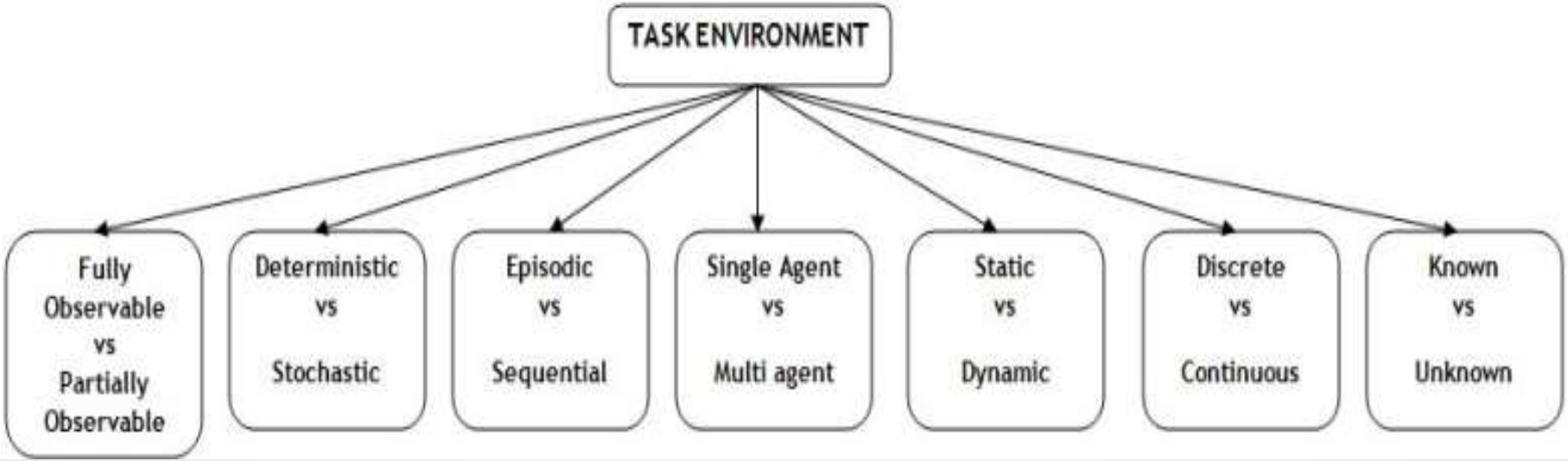
- **Performance**: *Healthy patient, reduced costs*
- **Environment**: *Patient, hospital, staff*
- **Actuators**: *Screen display (questions, tests, diagnoses, treatments, referrals)*
- **Sensors:** *Keyboard (entry of symptoms, findings, patient's answers)*

PEAS Example-3 (Interactive English Tutor)

- **Performance**: *Maximize student's score on test*
- **Environment**: *Set of students*
- **Actuators**: *Screen display (exercises, suggestions, corrections)*
- **Sensors:** *Keyboard entry*

Properties of Task Environment

Types / Properties of Task Environment



Types / Properties of Task Environment

Environment is a part of the universe that surrounds intelligent system.

- ***Fully observable vs. partially observable***
- ***Deterministic vs. stochastic***
- ***Episodic vs. sequential***
- ***Single agent vs. multiagent***
- ***Static vs. Dynamic***
- ***Discrete vs. continuous***
- ***Known vs. Unknown***

Properties of Task Environment (Contd..)

Fully observable vs. partially observable.

- **Fully Observable**: : An agent can sense or access the complete environment.

  Ex: Chess

- **Partially Observable**: An agent can sense or access only a part of the environment

  Ex: Cards

Properties of Task Environment (Contd..)

Deterministic vs. stochastic.

- ***Deterministic:*** Agent's current state completely determines the next state of the agent.

  Ex: Tic Tac Toe

- ***Stochastic***: The state of the agent is random in nature and cannot be completely determined by the agent.

  Ex: Ludo

Properties of Task Environment (Contd..)

Episodic vs. sequential

- **Episodic** : Agent's action is divided into atomic incidents i.e. No dependency between current and previous incidents.

  Ex: Part Picking Robot

- **Sequential**: Agent's previous actions affect all future decisions.

  Ex: Chess

Properties of Task Environment (Contd..)

Single agent vs. multiagent

- **Single Agent**: The environment involves only one agent.

  Ex: Maze

- **Multi Agent**: The environment involves multiple agents.

  Ex: Cricket

Properties of Task Environment (Contd..)

Static vs. Dynamic

- **Static :** The environment does not change while the agent is acting.

  Ex: Crossword Puzzle

- **Dynamic** : The environment keeps on changing while the agent is acting.

  Ex: Taxi Driving

Properties of Task Environment (Contd..)

Discrete vs. continuous

- **Discrete** : The environment consists of finite number of percepts and actions.

  Ex: Chess

- **Continuous** : The environment in which the actions are performed cannot be numbered.

  Ex: Self Driving Cars

Properties of Task Environment (Contd..)

Known vs. Unknown

- **Known :** The result for all actions are known.

  Example: Cards

- **Unknown**: The agent make a decision and act by learning how it works.

  Example: Video Games.

Characteristics of Intelligent Agents

Characteristics of Intelligent Agents

- **Autonomy:** An AI virtual agent is capable of *performing tasks independently without requiring constant human intervention* or input.

- **Perception:** The agent function *senses and interprets the environment they operate in through various sensors*, such as cameras or microphones.

- **Reactivity:** An AI agent can *assess the environment and respond accordingly to achieve its goals.*

Characteristics of Intelligent Agents (Contd..)

- **Reasoning and decision-making:** AI agents are intelligent tools that *can analyze data and make decisions to achieve goals*. They use reasoning techniques and algorithms to process information and take appropriate actions.

- **Learning:** They *can learn and enhance their performance through machine, deep, and reinforcement learning elements and techniques.*

- **Flexibility:** They *can adapt to changing circumstances and requirements.*

Characteristics of Intelligent Agents (Contd..)

- **Communication:** AI agents *can communicate with other agents or humans using different methods*, like understanding and responding to natural language, recognizing speech, and exchanging messages through text.

- **Goal-oriented:** They are *designed to achieve specific goals*, *which can be pre-defined or learned* through interactions with the environment.

Capabilities, Advantages and Disadvantages of Intelligent Agents

Capabilities of Intelligent Agents

- Interact with user in real world
- Find specific information
- Solve problems
- Make Decisions
- Summarize Complex Data
- Perform Repetitive Tasks
- Handling Multiple tasks
- Mobile

Advantages of Intelligent Agents

- **Increased efficiency**: Automate repetitive tasks, allows employees to focus on more business-critical tasks.
- **Better decision making**: Analyze large amounts of data, identify patterns, trends, and correlations, provide valuable insights to support decision-making processes.
- **Improved customer experience**: Provide personalized and timely interactions with customers, offer instant support, answer queries, and provide recommendations, leading to increased customer satisfaction and loyalty.
- **Cost savings** : Reduce the need for human resources.

Disadvantages of Intelligent Agents

- **Data bias**: Agent program relies heavily on data to make decisions. If the data they use is biased, it can lead to unfair or discriminatory outcomes.
- **Lack of accountability**: *Proactive agents can make decisions without human intervention,* so holding them accountable for their actions can be difficult.
- **Lack of transparency**: The *decision-making processes of a learning agent can be complex and opaque*, making it difficult to understand how they arrive at certain decisions.

Disadvantages of Intelligent Agents (Contd..)

- **Security risks:** Software agents can be vulnerable to cyber attacks, compromising their decision-making processes or leading to data breaches.
- **Lack of adaptability:** *Autonomous AI agents act according to their training data, which means they can struggle to adapt to new situations or contexts.*

References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
- NPTEL

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Typical Intelligent Agent

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 08
Presentation Date – 03/09/2024

Course Outcome

At the end of the course, students should be able to:

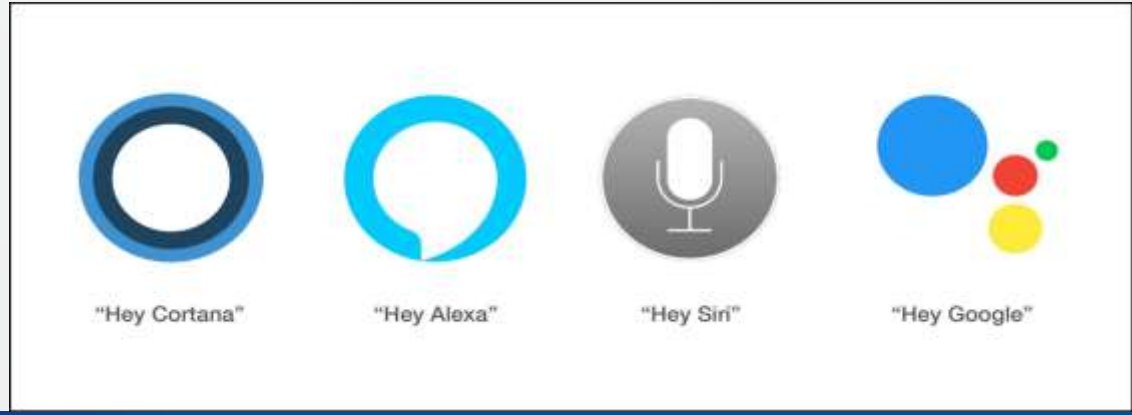
CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Illustrate various agent architectures and their influence for decision making process.

Intelligent Agents

- Must sense
- Must act
- Must autonomous (to some extend)
- Must rational



Types / Classes of Intelligent Agents (Typical Intelligent Agent)

The Structure of Intelligent Agents

- Agent's structure can be viewed as

  Agent = Architecture + Agent Program

- Architecture = the machinery that an agent executes on.
- Agent Program = an implementation of an agent function.

Classes of Intelligent Agents

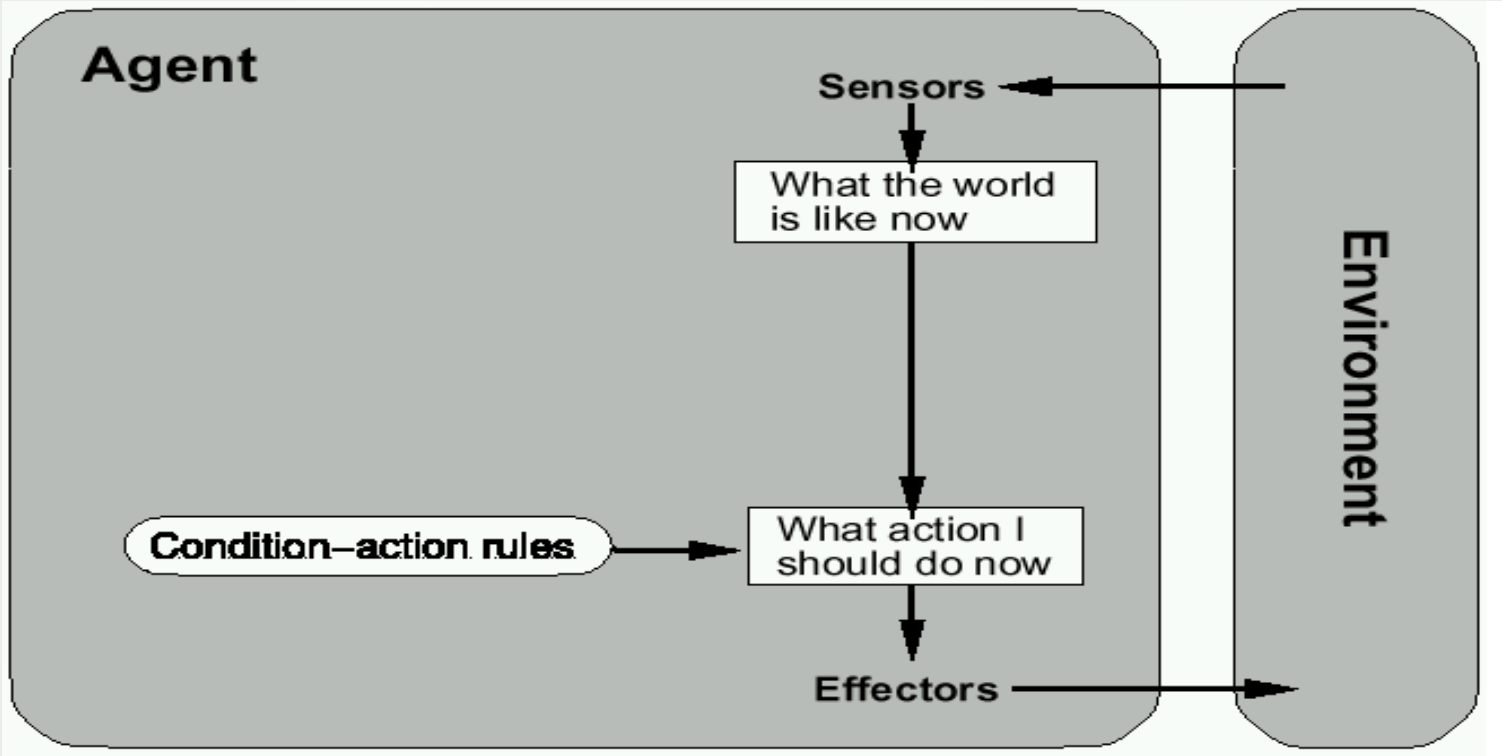
Agents are classified into 5 classes, based on their degree of perceived intelligence and capacity. Such as:

1. Simple reflex agents
2. Model-based reflex agents
3. Goal-based agents
4. Utility-based agents
5. Learning Agents

1. Simple Reflex (SR) Agents

- Simple reflex agents act only on the basis of the ***current percept***, ignoring rest of the percept history.
- The agent function is based on the ***condition-action rule*** : If the condition is true, the action is taken else not.
- Succeeds when the environment is ***fully observable and limited knowledge is required.***
- Works on if then condition like: ***game playing i.e, Tic tac toe, Chess, vacuum cleaner agent etc.***

1. Simple Reflex (SR) Agents (Contd..)



1. Simple Reflex (SR) Agents (Contd..)

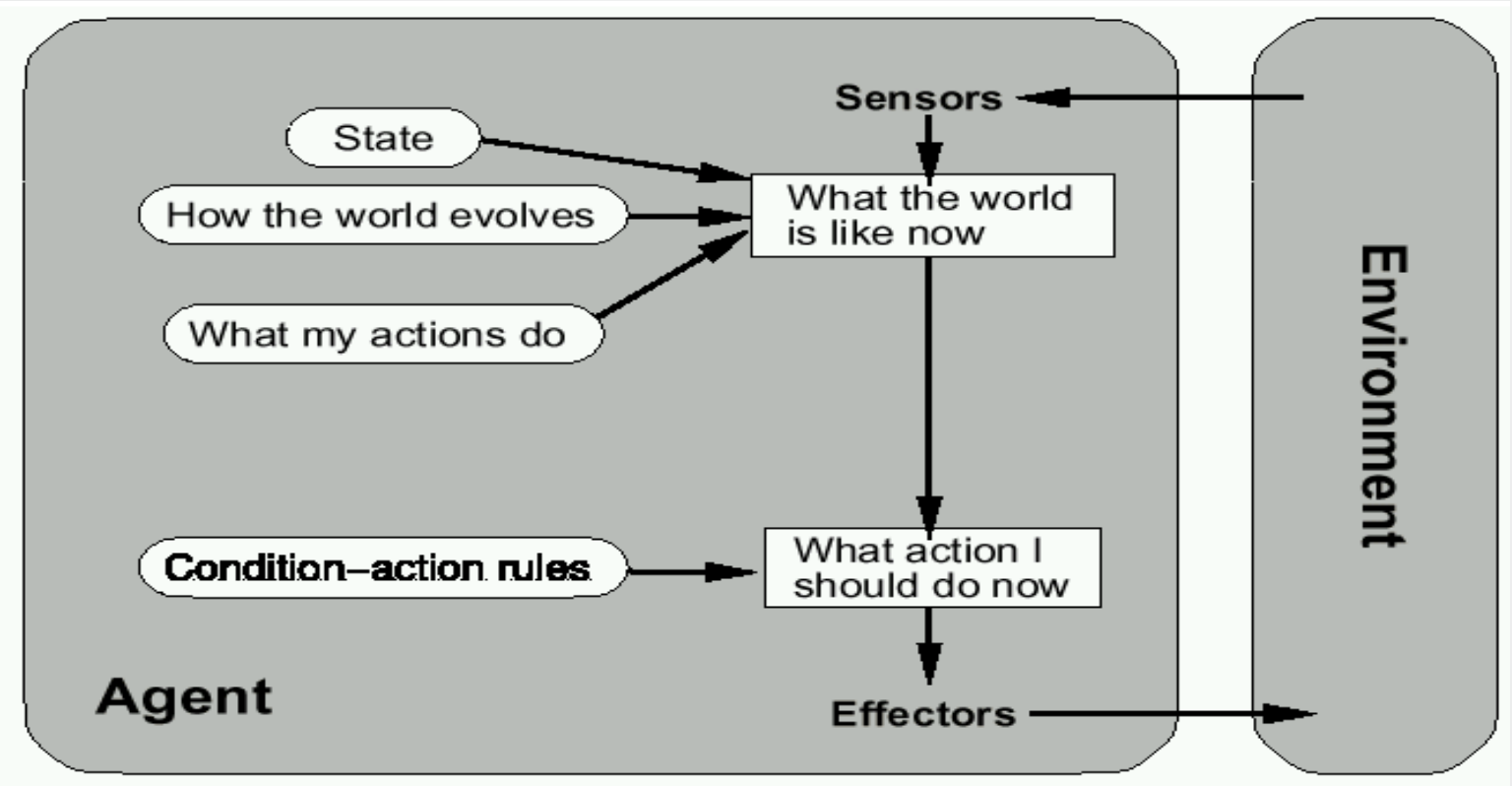
Limitations:

- Very limited intelligence.
- Not flexible, *need to update the rules if any change occurs in environment.*

2. Model Based Reflex Agents

- It ***works by finding a rule whose condition matches the current situation.***
- Handle ***partially observable environments*** by using model.
- The agent has ***internal state***, adjusted by each percept and that depends on the percept history.
- ***Current state*** stored inside the agents, describing the part of the world which cannot be seen. **Ex**: self driving cars
- ***Updating the state requires information about :***
  - *how the world evolves in-dependently from the agent, and*
  - *how the agent actions affects the world.*

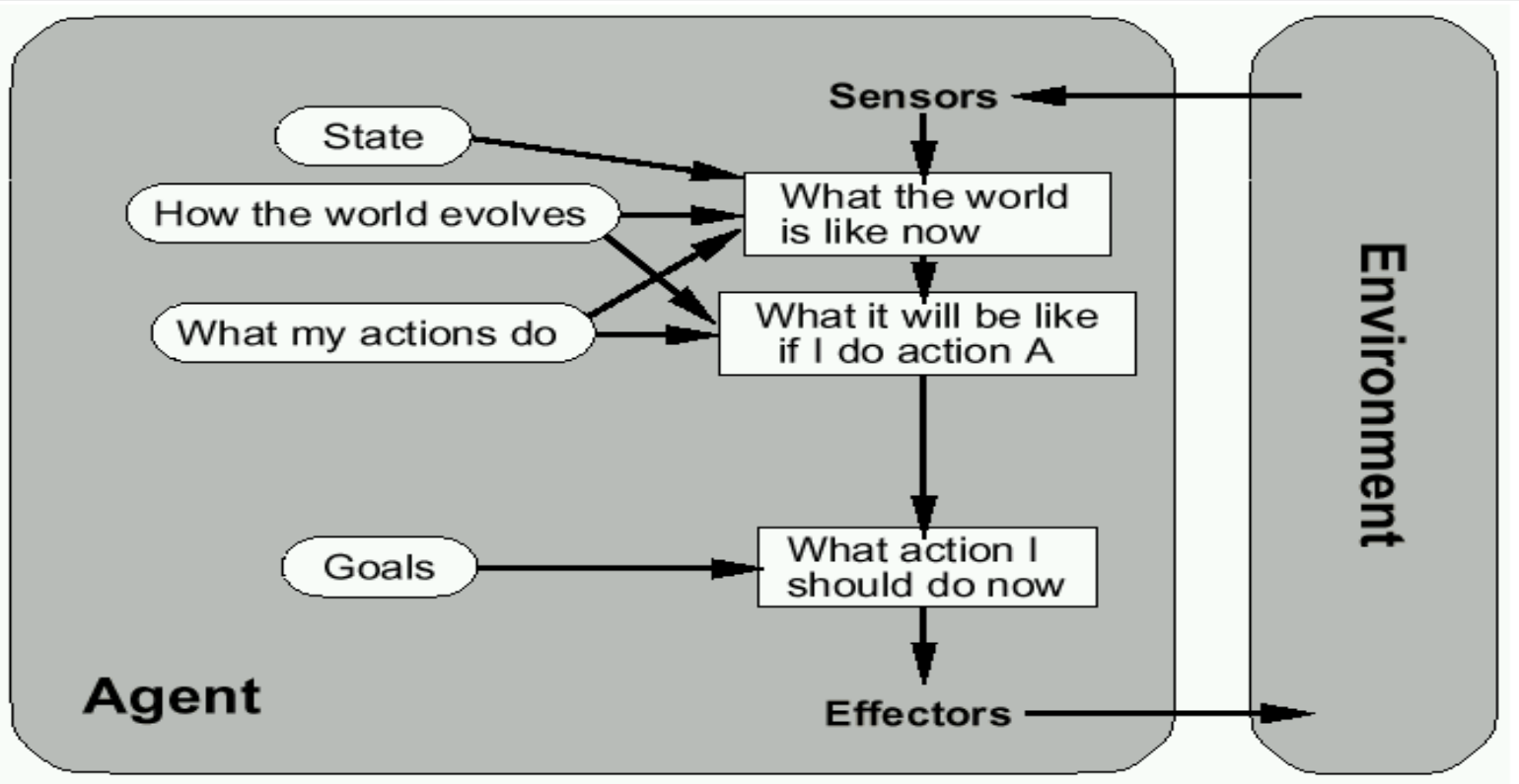
2. Model Based Reflex Agents (Contd..)



3. Goal Based Agents

- ***Extension of model based agents.***
- Take decision based on ***how far they are currently from their goal.***
- Every action is ***intended to reduce its distance from the goal***.
- Agent choose a way among multiple possibilities, selecting the one which ***reaches a goal state. Ex:*** *Shopping list, google map*
- ***Searching and planning*** are considered for finding appropriate action sequences that achieve the agent's goal.
- Agent needs some sort of ***looking into future.***

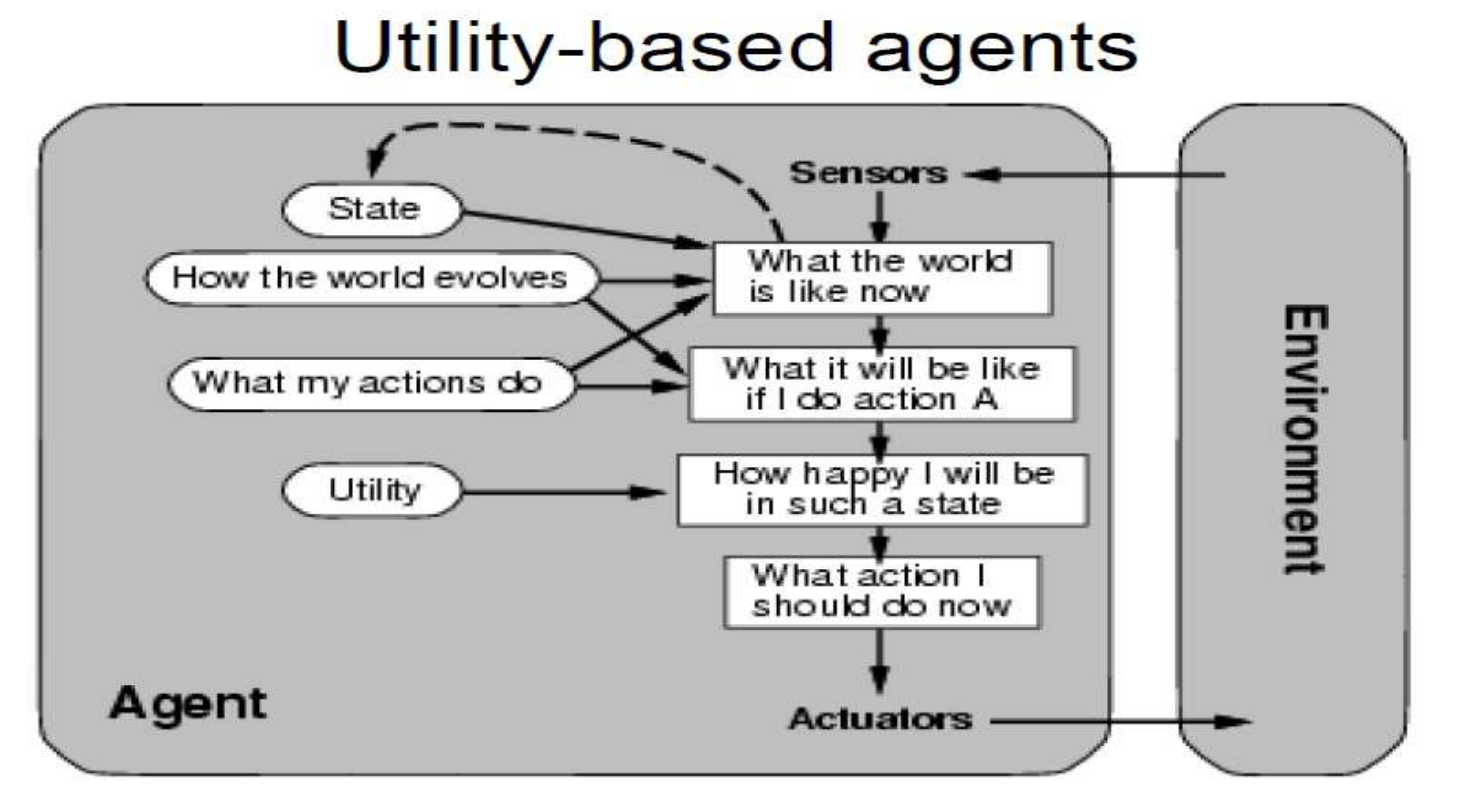
3. Goal Based Agents (Contd..)



4. Utility Based Agents

- ***Similar to the goal based agent.***
- Agents are more ***concerned about the utility (preference)*** for each state.
- Act *based on* not only on goals but also ***the best way to achieve goals. (i.e,*** Utility describes how happy the agent is.)
- ***Used when there are multiple possible alternatives.***
- Agent ***chooses the action that maximize utility.***
- ***Ex:*** *A self-driving car* has many goals considering when heading toward its destination: choosing the quickest route, ensuring the safety of its passengers, avoiding road closures or traffic jams, among others.

4. Utility Based Agents (Contd..)



5. Learning Agents

- Learn from ***past experiences or it has a learning capabilities.***
- It start with ***basic knowledge*** then able to ***act and adapt automatically through learning.***
- ***Ex:*** *A human*

5. Learning Agents (Contd..)

It has 4 components:

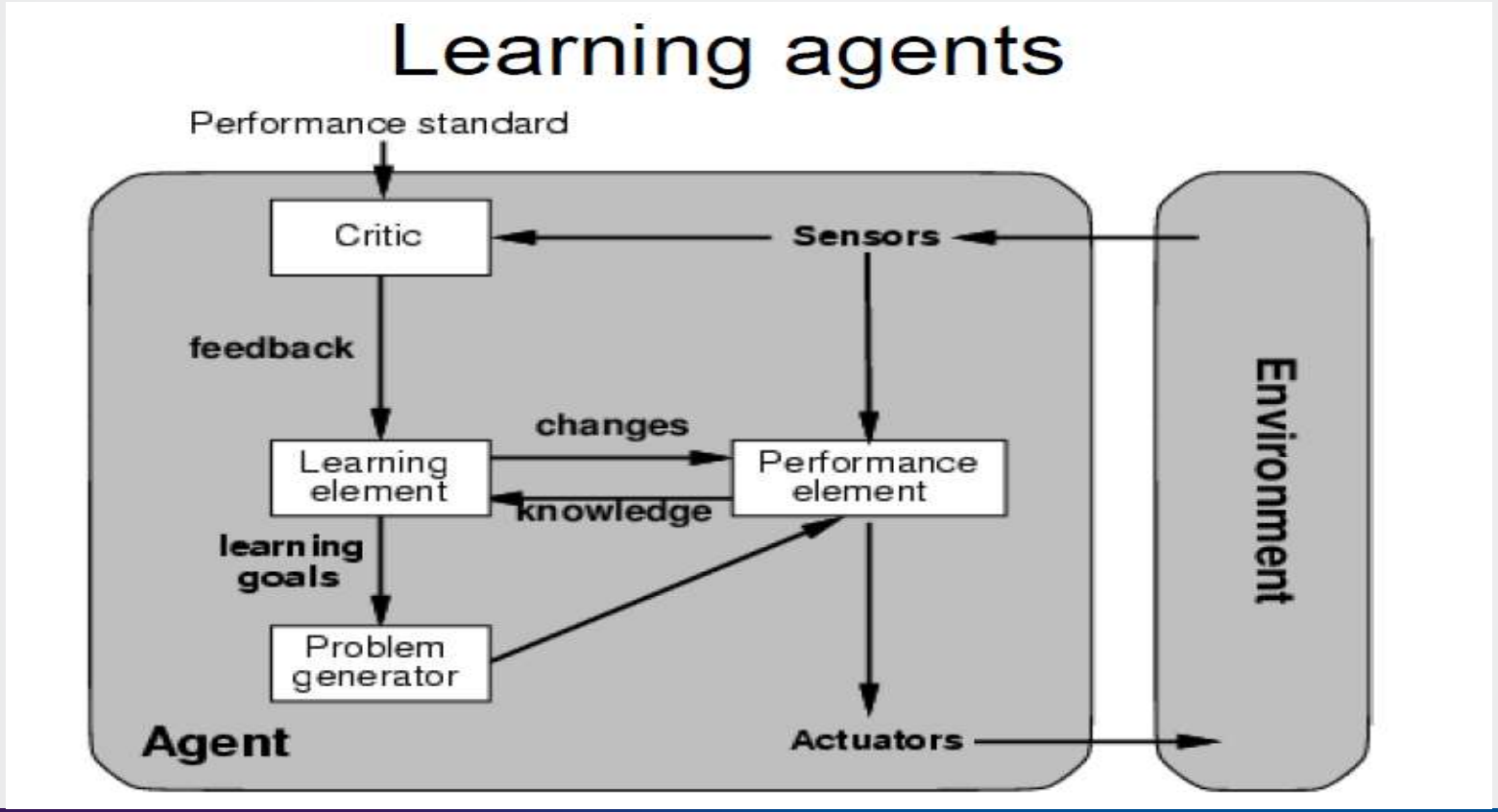
I. **Learning element**: It is responsible for making improvements by learning from the environment.

II. **Critic:** Learning element takes feedback from critic which describes how well the agent is doing with respect to a **fixed performance standard.**

III. **Performance element:** Responsible for ***selecting external action***, based on percept and feedback from learning element

IV. **Problem Generator: *Suggest actions*** that will lead to new and informative experiences.

5. Learning Agents (Contd..)



References

- Stuart Russell and Peter Norvig, “Artificial Intelligence”, 2nd edition, Pearson Education, 2003.
- Saroj Koushik, “Artificial intelligence”.
- NPTEL

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Course Title - Logic Programming for Artificial Intelligence

Topic Title – Problem Solving Approach to Typical AI Problem

Presenter's Name – Ms. Bidyutlata Sahoo
Presenter's ID – IARE11028
Department Name – CSE (AI & ML)
Lecture Number - 09
Presentation Date – 03/09/2024

Course Outcome

At the end of the course, students should be able to:

CO1: Illustrate the ability to design a plan for the real-world problems and mapping it to the digital world.

Topic Learning Outcome

Develop the ability to identify appropriate AI techniques for solving specific types of problems.

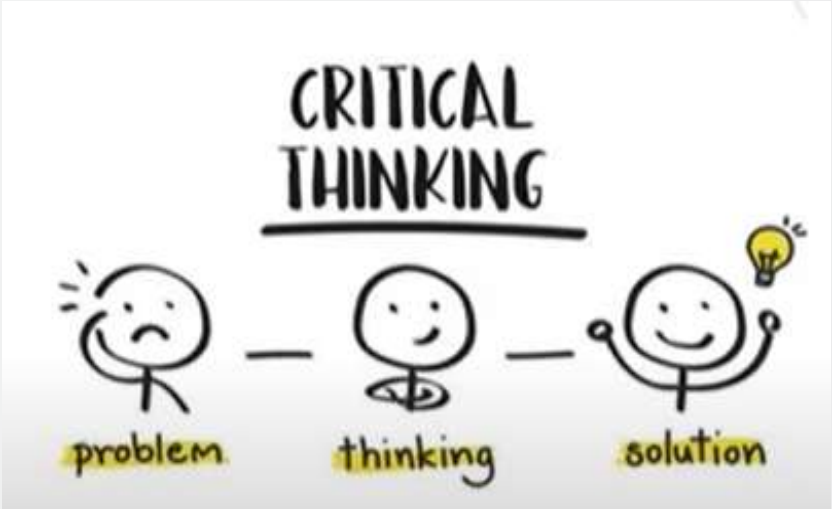
Problem Solving Approach To Typical AI Problems

Problem Solving Approach to Typical AI Problems

- ***Problems*** are the issues which comes across any system.
- A ***solution*** is needed to solve that particular problem.
- ***Strong intelligence*** is required to solve such problems.

Problem Solving Approach to Typical AI Problems (Contd..)

- Traditionally people think that the ***person who is able to solve more and more problems is more intelligent than others.***



Problem Solving Approach to Typical AI Problems (Contd..)

- It is always said that ***problem solving skills demonstrates intelligence*** hence it becomes a major aspect in artificial intelligence to solve the problems.

Classical Approach To Solve Problem

- The classical approach to solve a problem is quite simple in which, given a problem at hand ***hit and trial method is used*** to check for various solutions to that problem.
- This hit and trial approach usually ***works well for trivial problems*** and is referred to as the classical approach to problem solving.

Classical Approach To Solve Problem (Generate and Test)

- This is a ***technical name*** given to the ***classical way of solving problems*** where ***different combinations are generated to solve the problems***, and the one which solves the problem is taken as the correct solution.
- The rest of the combinations that are considered as incorrect solution are destroyed.

AI Components that are required to Solve Problem

AI Components That are required to Solve problem

- There are **six major components** of an artificial intelligence system. They are solely responsible for generating desired results for particular problem. These components are as follows,
  - ***Knowledge Representation***
  - ***Heuristic Searching Techniques***
  - ***Artificial Intelligence Hardware***
  - ***Computer Vision and Pattern Recognition***
  - ***Natural Language Processing***
  - ***Artificial Intelligence Language and Support Tools***

AI Components That are required to Solve problem (Contd..)

Knowledge Representation:

- It is the major foundation of an artificial intelligence system.
- It is *used for* ***representing necessary knowledge*** so as ***to generate knowledge base*** with the help of which AI system can perform tasks and generate results.

AI Components That are required to Solve problem (Contd..)

Heuristic Searching Techniques

- Usually while dealing with the ***problems the knowledge base keeps on growing and growing making it difficult to search*** in that knowledge base.
- To tackle with this challenge, ***heuristic searching techniques can be used which can provide results*** (because of certain criteria) ***efficiently in terms of time and memory usage***.

AI Components That are required to Solve problem (Contd..)

Artificial Intelligence Hardware

- Hardware compatibility is major concern when it comes to deploy software on machines.
- Hardware must be efficient to accommodate and produce desire results.
- ***AI systems incomplete without AI hardware***.

AI Components That are required to Solve problem (Contd..)

Computer Vision and Pattern Recognition

- AI programs ***capture the inputs on their own by generating a real world scenario*** with the help of this component.
- Sufficient and compatible hardware enables better patterns gathering that makes a useful knowledge base.

AI Components That are required to Solve problem (Contd..)

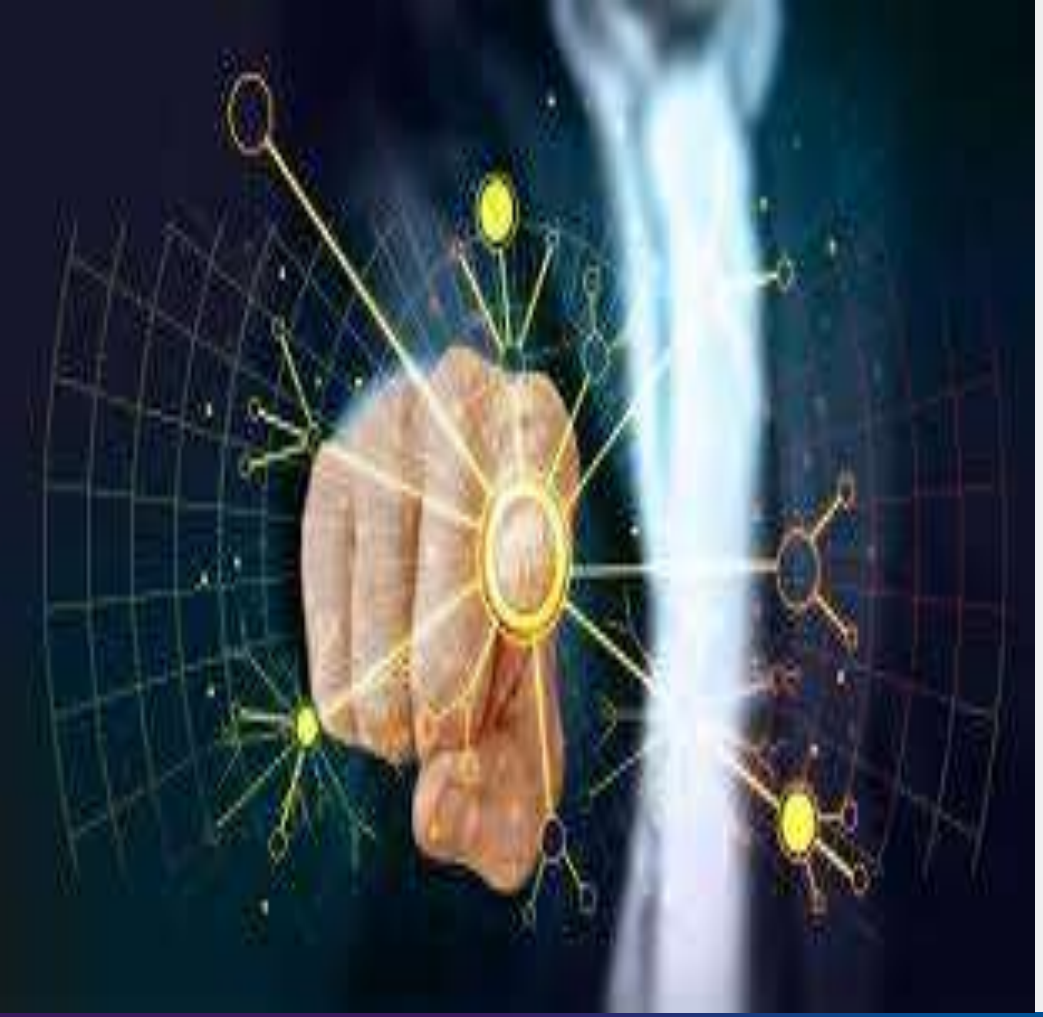
Natural Language Processing

- This component ***processes or analyses written or spoken languages.***
- Natural Language processing plays vital role in understanding of domain of text to AI systems.

AI Components That are required to Solve problem (Contd..)

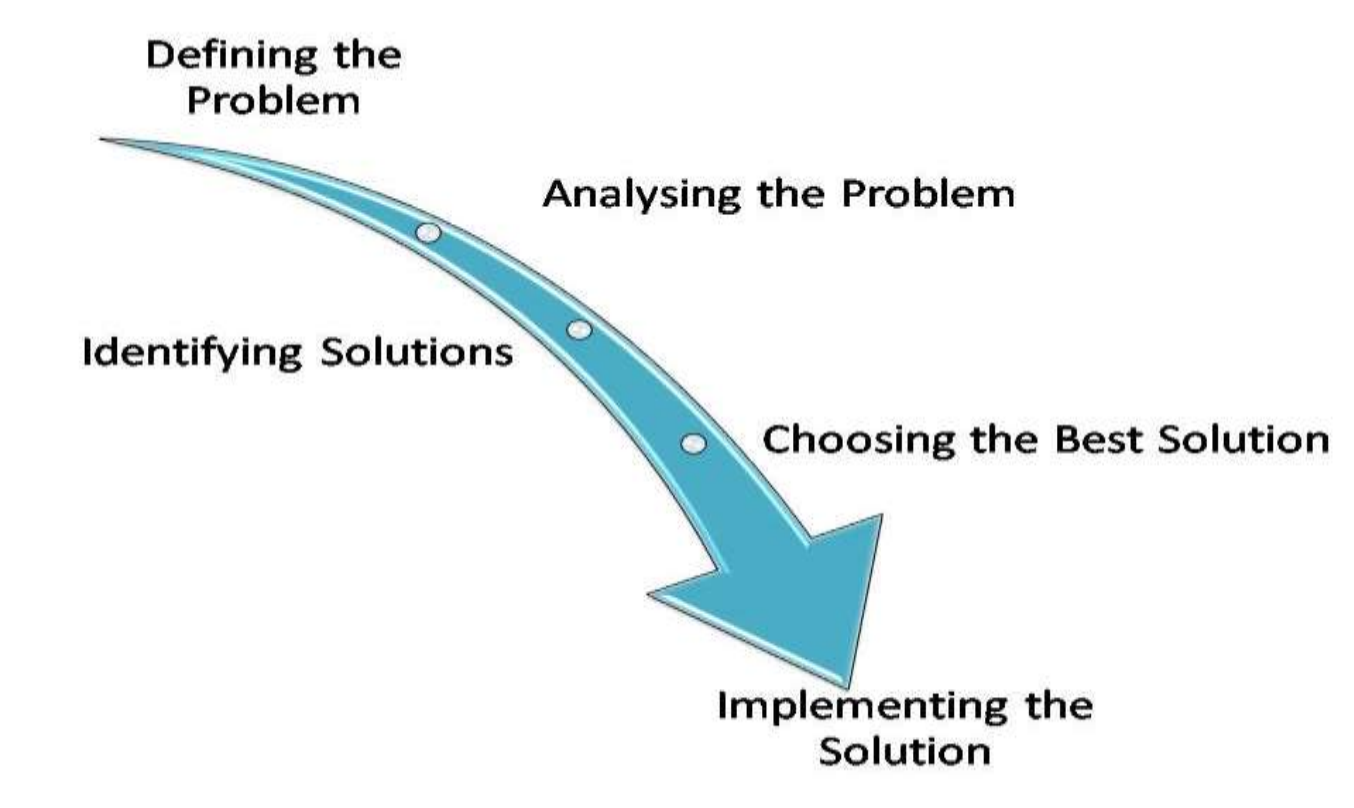
Artificial Intelligence Language and Support Tools

- Artificial Intelligence languages are almost similar to traditional software development programming languages ***with additional feature to capture human brain processes and logic*** as much as possible.



Steps To Solve A Problem Using AI

Steps to Solve a Problem Using AI (5 steps)



Steps to Solve a Problem Using AI (Contd..)

Defining the Problem

- The definition of the problem must be included precisely. It should *contain the possible initial as well as final situations* which should result in acceptable solution.

Analysing the problem

- Analysing the problem and its requirement must be done as few features can have immense impact on the resulting solution.

Steps to Solve a Problem Using AI (Contd..)

Identifying Solutions

- This phase *generates reasonable amount of solutions* to the given problem in a particular range.

Choosing the Best Solution

- From all the identified solutions, the *best solution is chosen on the basis of the results produced* by respective solutions.

Steps to Solve a Problem Using AI (Contd..)

Implementing the Solution

- After choosing the best solution, *its implementation is done*.

Problem Solving Agent and Steps Performed by Problem Solving Agent

Problem Solving Agent

- The problem-solving agent performs precisely by defining problems and its several solutions.
- A problem-solving agent is a ***goal-driven agent*** and focuses on satisfying the goal.

Steps Performed by Problem Solving Agent

1. **Goal Formulation:**
   - It is the first and simplest step in problem-solving.
   - It ***organizes the steps/sequence required to formulate one goal out of multiple goals*** as well as ***actions to achieve that goal.***
   - Goal formulation is ***based on the current situation and the agent's performance measure.***

Steps Performed by Problem Solving Agent

2. <u>Problem Formulation:</u>

- It is the most important step of problem-solving which decides ***what actions should be taken to achieve the formulated goal***.

Steps Performed by Problem Solving Agent

2. <u>Problem Formulation:</u>

- There are following ***five components*** involved in problem formulation:
  - ✓ ***Initial State*** : It is the starting *state or initial step* of the agent towards its goal.
  - ✓ ***Action*** : It is the description of the *possible actions* available to the agent.
  - ✓ ***Transition model*** : It describes *what each action does*.
  - ✓ ***Goal test*** : It determines if the given state is a goal state.

Steps Performed by Problem Solving Agent

2. <u>Problem Formulation:</u>

- ✓ ***Path Cost***: It *assigns a numeric cost to each path that follows the goal.* The problem-solving agent selects a cost function, which reflects its performance measure. ***Remember, an optimal solution has the lowest path cost among all the solutions.***

Steps Performed by Problem Solving Agent

3. <u>State Space</u>

- ***Initial state, actions, and transition model together*** define the state-space of the problem implicitly.
- State-space of a problem is a ***set of all states*** which can be reached from the initial state followed by any sequence of actions.
- The state-space forms a ***directed map or graph*** where nodes are the states, links between the nodes are actions, and the path is a sequence of states connected by the sequence of actions.

Steps Performed by Problem Solving Agent

4. <u>Search</u>

- It identifies ***all the best possible sequence of actions to reach the goal state from the current state***.
- It takes a problem as an input and returns solution as its output.

Steps Performed by Problem Solving Agent

5. Solution

- It ***finds the best algorithm out of various algorithms***, which may be proven as the best optimal solution.

6. Execution

- It ***executes the best optimal solution*** from the searching algorithms to reach the goal state from the current state.

Example

Tic Tac Toe Game

- Board Position : {1,2,3,4,5,6,7,8,9}
- An element contains the value 0, if the corresponding square is blank; 1, if it is filled with “O” and 2, if it is filled with “X”.
- Hence starting state is {0,0,0,0,0,0,0,0,0}
- The goal state or the ***winning combination*** will be board position having “O” or “X” separately in the combination of ({1,2,3},{4,5,6},{7,8,9},{1,4,7},{2,5,8},{3,6,9},{1,5,9},{3,5,7} element values.

Tic Tac Toe Game

- Hence two goal state can be {2,0,1,1,2,0,0,0,2} and {2,2,2, 0,1,0, 1,0,0}. These values corresponds to the goal states.
- In this game, valid transition table will be a vector (having 3^9 entries.) , having 9 elements in each.

Start State Goal State-1 Goal State-2

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