Artificial Intelligence
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Class Discussion Topic

Textbook:

1.Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, 3rd ed. New Delhi: Tata McGraw-Hill, 2012.

Class Discussion Topic(CDT):

Review of AI Problems, Underlying assumption of AI, Historical perspectives of AI , What is Intelligence?, Level of the Model, Criteria for Success

Lecture Level Learning Outcome

Upon completion of this course, students will be able to …

- apply ”Search” techniques to solve different AI problems.
- Explain various assumptions and AI technique.
- Discuss about the level of the model and Criteria for success.

AI Definitions

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

(or)

- AI is the study of how to make programs/computers do things that people do better

(or)

- The study of how to make computers solve problems which require knowledge and intelligence

AI Problems

Problems in Artificial Intelligence (AI) comes in different forms, each with its own set of challenges and potential for innovation. From image recognition to natural language processing, AI problems exhibit distinct characteristics that shape the strategies and techniques used to tackle them effectively.

Characteristics of Artificial Intelligence Problems

- Learning and adaptation:
- AI systems should be capable of learning from data or experiences and adapting their behavior accordingly. This enables them to improve performance over time and handle new situations more effectively.

AI Problems

Interactivity:

- Many AI applications involve interaction with users or other agents. Effective AI systems should be able to perceive, interpret, and respond to these interactions in a meaningful way.

Context dependence:

- The behavior or performance of AI systems may depend on the context in which they operate. Understanding and appropriately responding to different contexts is essential for achieving desired outcomes.

AI Problems

Multi-disciplinary:

- AI problems often require knowledge and techniques from multiple disciplines, including computer science, mathematics, statistics, psychology, and more.Integrating insights from these diverse fields is necessary for developing effective AI solutions.

Complexity:

- AI problems often involve dealing with complex systems or large amounts of data. AI systems must be able to handle this complexity efficiently to produce meaningful results.

AI Problems

Uncertainty:

- AI systems frequently operate in environments where outcomes are uncertain or incomplete information is available. They must be equipped to make decisions or predictions under such conditions.

Dynamism:

- Environments in which AI systems operate can change over time. These changes may occur unpredictably or according to specific rules, requiring AI systems to continually adjust their strategies or models.

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AI systems are typically designed to achieve specific objectives or goals. Designing AI systems with clear objectives in mind helps guide the development process and ensures that the resulting systems are focused on achieving meaningful outcomes.

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- These characteristics collectively shape the challenges and opportunities involved in developing and deploying AI systems across various domains and applications.

What are the Underlying Assumptions in AI?

- The Underlying assumptions in AI revolve around the idea of attempting the simulations of intelligence in machines like humans. It also states that algorithms can help the machine learn from the data.
- The data used to train the algorithm can provide real-time insights and patterns that help them promote human-like cognition thinking in machines.
- This assumes that machines can understand human thoughts, use the data to learn things, and apply logic and reasoning to solve problems like humans do.
- The machine can also learn from their past experiences and receive feedback on the areas to improve. The machines can make their own decisions and make predictions unexpectedly or unpredictably.

Historical perspectives of AI

- The history of artificial intelligence begins with a lot of assumptions, myths, and confusion. The idea of artificial intelligence emerged when philosophers tried to describe human cognition as a mechanical manipulation.
- Later in the 1940s, a programmable digital computer was invented and this technology provided a practical demonstration of mathematical reasoning proving the point of the philosophers.

Historical perspectives of AI

- This device leads to the inspiration to build an “electronic brain” i.e. software that can think like humans. Then further workshop was held at Dartmouth College in the USA in 1956.
- Many researchers believed that there would be computer systems that would be as intelligent as human beings and funds were provided.
- Later, the researchers discovered the difficulty of the project. In 1974, due to huge criticism and pressure, the funds were stopped.

Historical perspectives of AI

- The theories based on artificial intelligence state that “The best model of intelligence is the human brain itself”. That is the human brain can be a perfect example to build AI systems.

- The idea of artificial intelligence was based on the assumption that the cognition thinking of humans can be mechanized.

- This assumption underlying AI is that human thoughts can be mechanized. This idea led back to exploring the formal methods of reasoning such as deductions made by ancient philosophers.

Historical perspectives of AI

- The main challenge for building AI systems is that thinking can be put into mathematical rules and how math is used to reason logically. Boole and Frege showed how math can be used in logical reasoning in the 1900s.
- Later it was found that math has its limits and there are few things that math can’t be used in. That’s when the truing machines came into the picture and showed that any kind of math reasoning can be done by following a set of rules.

Historical perspectives of AI

- Further, when researchers started to study they found that the brain was a network of neurons that network was an electrical network and this led to thinking that the construction of an electronic brain was possible.
- Later the scientist Alan Turing proved that any computation can be described digitally and circulated a paper on machine intelligence. In 1950 Turing published a paper named " Computing Machinery and Intelligence" which specified the possibility of creating machines that can think and also introduced a concept called the "Turing test".

Historical perspectives of AI

- The Turing test is a test conducted between a human and a machine where the machine and humans are placed in different rooms and they are examined, if the machine's answer is similar to the answer of the human being.
- This test was the first serious step in the philosophy of artificial intelligence and is widely accepted. In 1943, Walter Pitts and Warren McCulloch showed how the network of an idealized artificial neural network can be used to perform simple logical functions.

What is Intelligence?

✓Is there a “holistic” definition for intelligence?

Here are some definitions:

- the ability to comprehend; to understand and profit from experience
- a general mental capability that involves the ability to reason, plan, solve problems, think abstractly, comprehend ideas and language, and learn
- is effectively perceiving, interpreting and responding to the environment

Level of the Model

- It is a good idea to decide exactly what we are trying to do. So we must ask ourselves, “What is our goal in trying to produce programs that do the intelligent things that people do?”

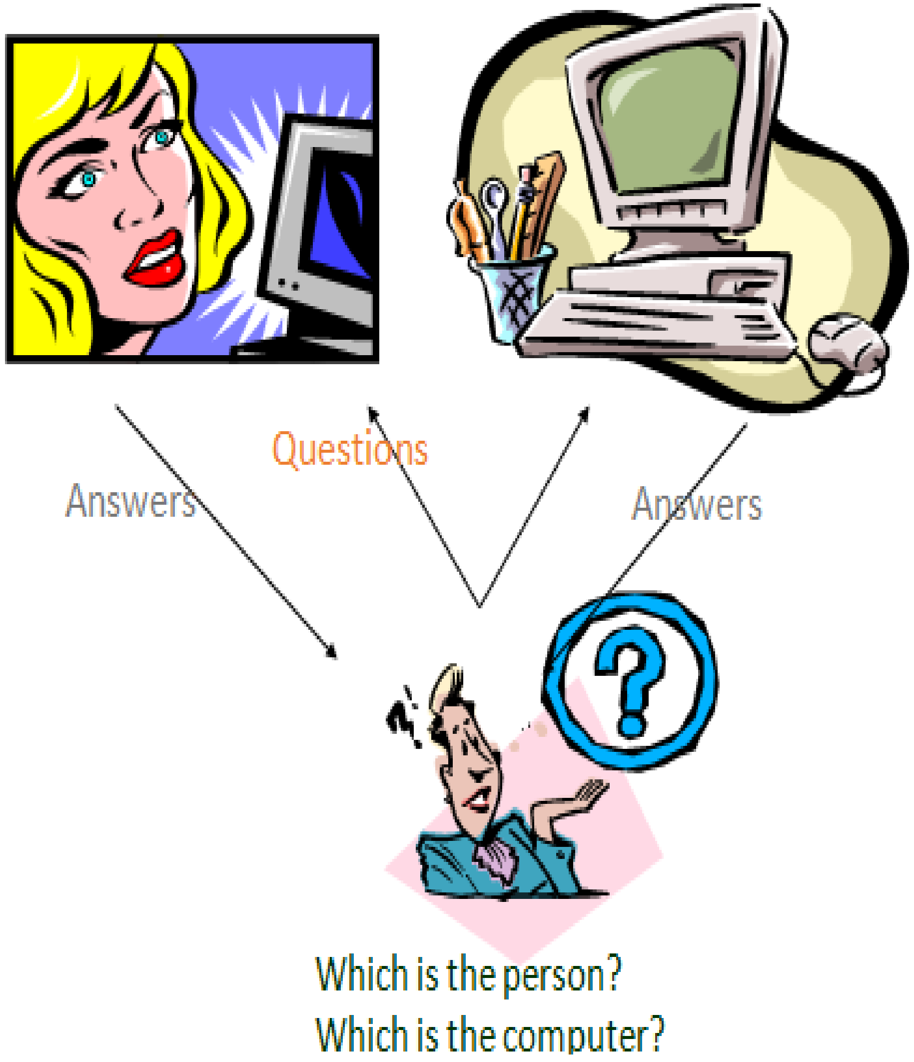
1. Are we trying to produce programs that do the tasks the same way people do?

OR

1. Are we attempting to produce programs that simply do the tasks in what ever the way it is easiest.

The Turing Test : Criteria for Success

- 1950 – Alan Turing devised a test for intelligence called the Imitation Game
- Ask questions of two entities, receive answers from both
- If you can't tell which of the entities is human and which is a computer program, then you are fooled and we should therefore consider the computer to be intelligent



Problem-Solving Agents

Intelligent agents can solve problems by searching a state-space.

Key element of problem solving

State: A state is a representation of problem at a given moment.

State space: Contains all the possible states for a given problem.

Initial state: position from which the problem-solving process may start.

Goal state: solution to the problem.

- ✓ Operators (actions, successor function)
- ✓ operators are legal actions which the agent can take to move from one state to another
- ✓ A solution is a sequence of actions leading from the initial state to a goal state2

State-Space Problem Formulation

- Before a solution can be found, the prime condition is that the problem must be very precisely defined. By defining it properly, one converts the abstract problem into real workable states that are really understood.
- A set of all possible states for a given problem is known as the state space of the problem. State space representations are highly beneficial in AI because they provide all possible states, operations and goals.

State-Space Problem Formulation

- If the entire state space representations for a problem is given, it is possible to trace the path from the initial state to the goal state and identify the sequence of operators necessary for doing it.

- The major deficiency of this method is that it is not possible to visualize all states for a given problem. Moreover, the resources of the computer system are limited to handle huge state-space representation

Puzzle-Solving as Search

A Water Jug Problem:

- You have a 4-gallon and a 3-gallon water jugs without any measuring marks.
- You have a tap with an unlimited amount of water.
- You need to get exactly 2 gallons of water in 4-gallon jug.
- State space representation: (x, y)
- x: Contents of water in four gallon jug
- y: Contents of water in three gallon jug

Puzzle-Solving as Search

- **Start state: (0, 0)**
- **Goal state: (2, n)**
- **Operators**
  - Fill 3-gallon from faucet, fill 4-gallon from faucet
  - Fill 3-gallon from 4-gallon , fill 4-gallon from 3-gallon
  - Empty 3-gallon into 4-gallon, empty 4-gallon into 3-gallon
  - Dump 3-gallon down drain, dump 4-gallon down drain

Production Rules for the Water Jug Problem

1 $(x,y) \rightarrow (4,y)$ if $x < 4$	Fill the 4-gallon jug
2 $(x,y) \rightarrow (x,3)$ if $y < 3$	Fill the 3-gallon jug
3 $(x,y) \rightarrow (x-d,y)$ if $x > 0$	Pour some water out of the 4-gallon jug
4 $(x,y) \rightarrow (x,y-d)$ if $x > 0$	Pour some water out of the 3-gallon jug
5 $(x,y) \rightarrow (0,y)$ if $x > 0$	Empty the 4-gallon jug on the ground
6 $(x,y) \rightarrow (x,0)$ if $y > 0$	Empty the 3-gallon jug on the ground
7 $(x,y) \rightarrow (4,y-(4-x))$ if $x + y \geq 4$ and $y > 0$	Pour water from the 3-gallon jug into the 4-gallon jug until the 4-gallon jug is full

Production Rules for the Water Jug Problem

8 $(x,y) \rightarrow (x-(3-y),3)$ if $x+y \geq 3$ and $x>0$	Pour water from the 4-gallon jug into the 3-gallon jug until the 3-gallon jug is full
9 $(x,y) \rightarrow (x+y, 0)$ if $x+y \leq 4$ and $y>0$	Pour all the water from the 3-gallon jug into the 4-gallon jug
10 $(x,y) \rightarrow (0, x+y)$ if $x+y \leq 3$ and $x>0$	Pour all the water from the 4-gallon jug into the 3-gallon jug
11 $(0,2) \rightarrow (2,0)$	Pour the 2 gallons from the 3-gallon jug into the 4-gallon jug
12 $(x,2) \rightarrow (0,2)$	Empty the 4-gallon jug on the ground

One Solution to the Water Jug Problem

Gallons in the 4-Gallon Jug	Gallons in the 3-Gallon Jug	Rule Applied
0	0	2
0	3	9
3	0	2
3	3	7
4	2	5 or 12
0	2	9 or 11
2	0	

State space of the 8 puzzle problem

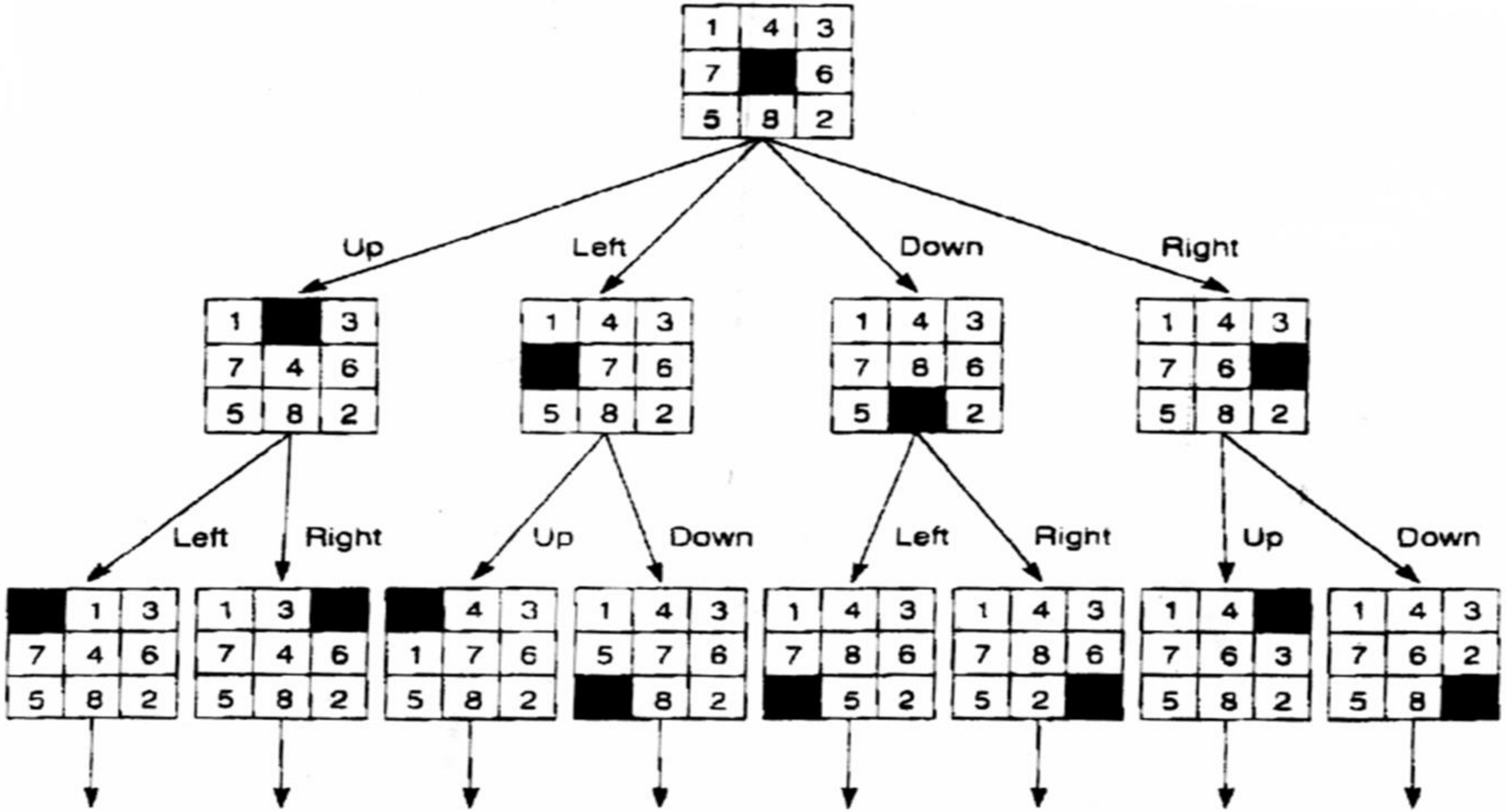


Figure 3.6 State space of the 8-puzzle generated by "move blank" operations.

Why Search can be difficult

- At the start of the search, the search algorithm does not know
  - the size of the tree
  - the shape of the tree
  - the depth of the goal states
  - How big can a search tree be?
  - say there is a constant branching factor b
  - and one goal exists at depth d
  - search tree which includes a goal can have

    b^d different branches in the tree (worst case)

  Examples:

  - b = 2, d = 10: $b^d = 2^{10} = 1024$
  - b = 10, d = 10: $b^d = 10^{10} = 10{,}000{,}000{,}000$

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Learning Outcomes(LOs)

Learning Outcomes of today’s session are …

- ➢Able to distinguish knowledge and intelligence
- ➢Know PSS & its hypothesis
- ➢Identify what is AI Technique
- ➢Know at what Level of detail we have to Model
- ➢Able to apply Turing test

Questions

1. Define Turing test?
2. List the Classes of Production Systems in Artificial Intelligence.
3. State space representations are highly beneficial in AI because they provide all possible states, operations and goals.Solve the water jug problem using the state space representation.
4. what is AI Techniques?
5. Explain the level of model

Thank you