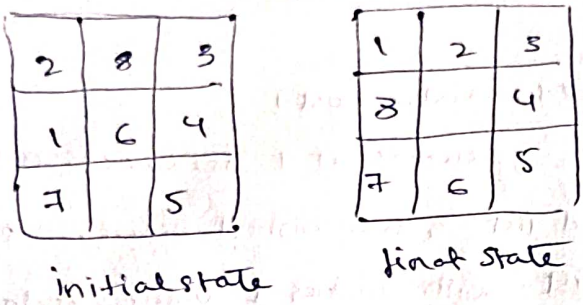
A.I. Assignment - I

K Dhanunjay
A22126552149
CSME

1) Explain about heuristic search techniques in A.I and describe the steps in A* algorithm with given example.

A1 Problem:-

Given an initial state of a 8-puzzle problem and final state to be reached.



initial state final state

Find the most cost effective path to reach the final state from initial state using A* algorithm.

Consider g(n) = Depth of node and h(n) = Number of misplaced tiles.

Heuristic search techniques in AI aim to solve problem faster and move efficiently by using heuristic to guide the search process. Heuristic are rules or methods that help in making decisions by estimating the best possible path towards a goal. In the context of AI, heuristic search algorithms, like the A* algorithm, are commonly used to find the most cost effective path from an initial state to goal state.

A* algorithm:-

The A* algorithm is a popular heuristic search technique that combines the best features of uniform-cost search and greedy best first search. It uses to main components

g(n): the cost to reach the current node from the start node (depth of node)

h(n): The estimated cost from the current node to goal (heuristic)

The A* algorithm evaluates nodes by combining two costs into a single function: $f(n) = g(n) + h(n)$

↓

total cost of the cheapest solution through node n

Steps of A* algorithm

1. Initialize open and closed list. The open list contains nodes to be evaluated starting with the initial state. The closed list contains nodes already evaluated.
2. Loop until the open list is empty.
   - select the node n from the open list with lowest f(n).
   - If n is goal node return the path from the start node to n.
   - Generate successors of n. For each successor
     i) calculate g(successor)
     ii) calculate h(successor) (heuristic cost)
     iii) calculate f(successor) = g(successor) + h(successor)
     iv) If successor is in closed list & has highest value, skip it.
     v) If successor is in open list with highest f value, update if cost and parent.
     vi) If successor is not in open list add it.
   - Move n to closed list.

To solve 8 puzzle problem.

1. 2 8 3 / 1 6 4 / 7 _ 5
   - g(n) = 0 (initial state)
   - h(n) = 3 (tiles 2, 8, 1 are misplaced)
   - f(n) = g(n) + h(n) = 0 + 3 = 3

2	8	3
1	6	4
7		5

2	8	3
1	6	4
	7	5

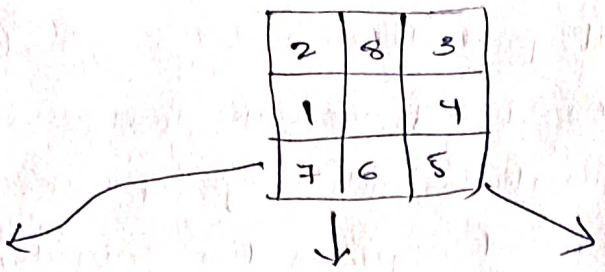
g = 1
H = 5
f = 1 + 3 = 6

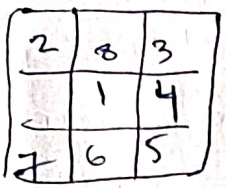
2	8	3
1		4
7	6	5

g = 1
H = 3
f = 1 + 3 = 4

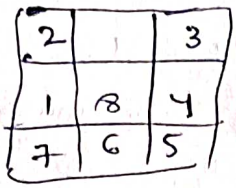
2		3
1	8	4
7	6	5

g = 1
H = 5
f = 1 + 5 = 6

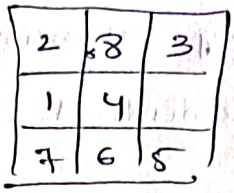




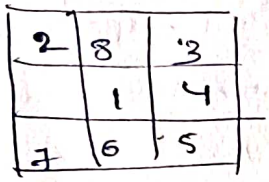
g 22
H 23
f = 2+3=5

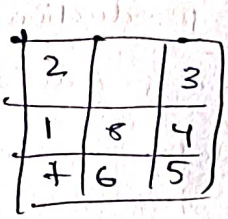


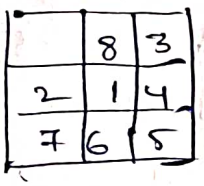
g 22
H 23
f = 2+3=5



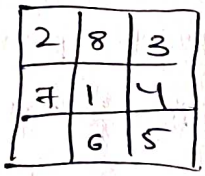
g 22
H 24
f = 6



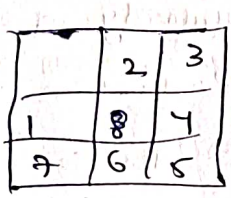




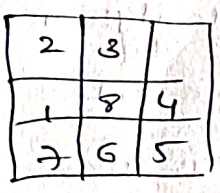
g 23
H 23
f = 6



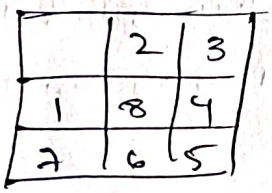
g 23
H 24
f = 7

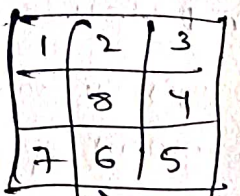


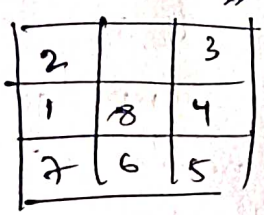
g 23
H 22
f = 5



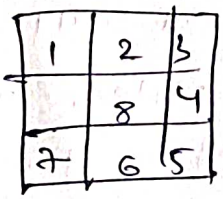
g = 3
H = 4
f = 7



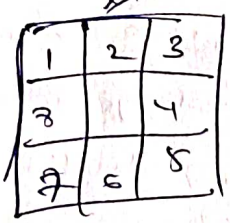




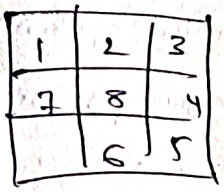
g 24
H = 5
f = 9



g 24
H 21
f = 5



g = 5
H 20
f 20



g = 5
H = 2
f 27

2) Give a detailed note about production system characteristics.

A) A production system in AI is a framework that exists in developing computer programs to automate a wide range of tasks. It significantly impacts the creation of AI based systems like computer software, mobile applications. By establishing rules, a production system empowers machine to demonstrate particular behaviours and adopt to their surroundings.

Production system characteristics

- Simplicity
- modifiability
- modularity
- knowledge-intensive.

Simplicity:- The production rule in AI is in the form of an 'IF-THEN' statement. Every rule in the production system has a unique structure. It helps represe-ntation knowledge and reasoning in the simplest way possible to solve real world problems.

Modularity:- The modularity of a production rule helps in its incremental improvement as the production rule can be in discrete parts. The production rule is made from collection of information and facts that may not have dependencies unless there is a rule connecting them together.

Modifiability:- This feature helps after the rules as per requirements, skeletal form of production system is created. We then gather the requirements and make changes in raw structure of production system. This helps in iterative improvement of production system.

Knowledge-intensive:- production system contains knowledge in the form of human spoken language i.e. English. It is not built using any programming languages. The knowledge is represented in plain english sentence production rules help make productive conclusions from these sentences.

3) Differentiate between procedural vs Declarative knowledge with examples

S.No	procedural knowledge	Declarative knowledge
1.	It is also known as 'interpretive knowledge'	It is also known as Descriptive knowledge.
2.	It emphasize how to do something to solve a problem	It emphasize what to do something to solve a problem.
3.	procedural knowledge is not popular	Declarative knowledge is popular.
4.	procedural knowledge can be easily communicate.	Declarative knowledge is data oriented in nature
5.	General process oriented in nature.	Data oriented in nature.
6.	Debugging and 'validation' is not easy	Debugging & validation is easy.
7.	Less effective in competitive programming	more effective in competitive programming.
8.	ex: var a = [1,2,3,4,5] var b = [] for(var i=0; i<a.length; i++){ b.push(a[i]); } console.log(b) o/p → [1,2,3,4,5]	ex: var a = [1,2,3,4,5]. var b = a.map(function(number){ return number*3}); Console.log(b). o/p [1,2,3,4,5]

4) what is semantic networks in AI. Explain with example.

A) Semantic networks are a way of representing relationships between objects and ideas.

Semantic network are alternative of predicate logic for knowledge representation. In semantic networks, we can represent our knowledge in the form of graphical networks. This network consist of nodes representing objects and arcs which describe the relationship between those objects. Semantic networks can categorize the object in different forms and can also link those objects. Semantic networks are easily

to understand and can be easily extended.

→ Two types of relations.

Is-A relation (Inheritance)

kind-of-relation.

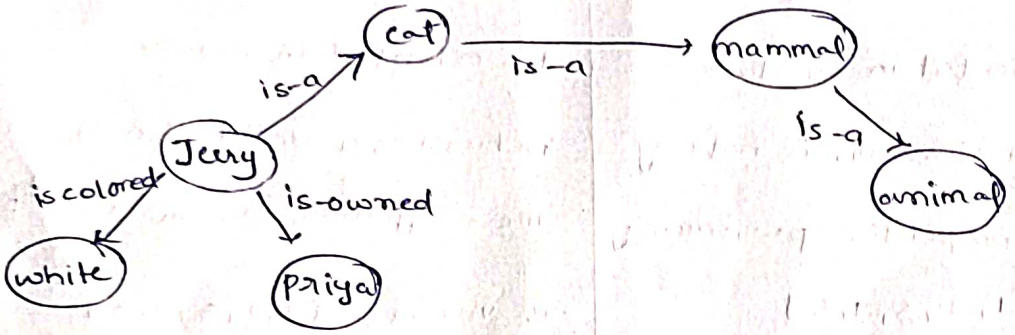
Ex:- Jerry is a cat.

Jerry is a mammal.

Jerry is owned by priya.

Jerry is brown colored.

All Mammals are animal.



Advantages

- Natural representation of knowledge.
- Convey meaning in a transparent manner.
- simple and easily understandable.

Disadvantages

- Not intelligent depends on creator
- Not having standard definition for link names.
- Not possible to built such a vast semantic network.
- More computational time.