Problem Solving in AI

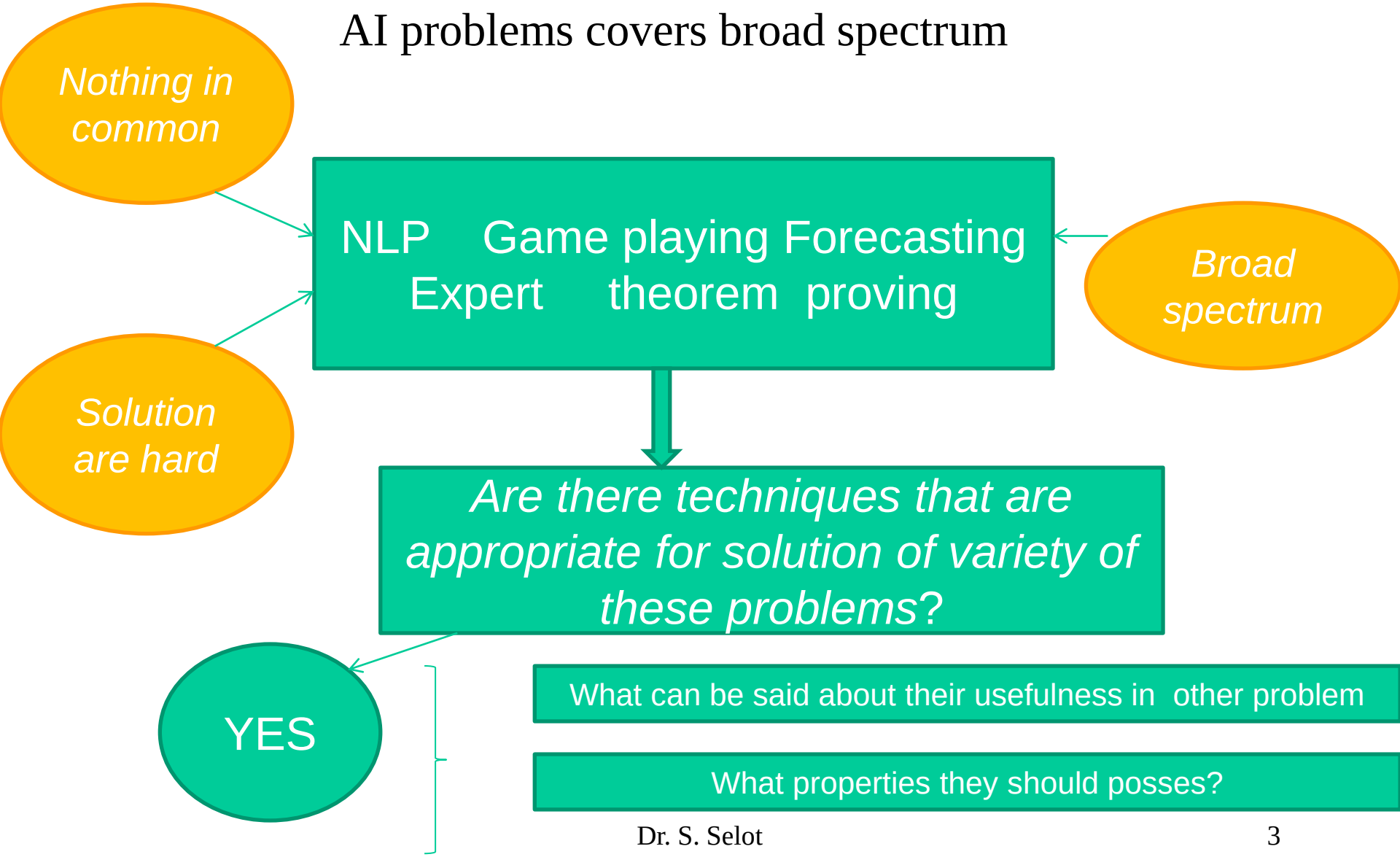
MCA II Semester

Outline

- AI technique
- Characteristics of AI
- Problem Solving
- Water Jug Problem

AI Technique

AI problems covers broad spectrum



AI Technique

- Intelligence requires Knowledge
- Knowledge possesses less desirable properties such as:
  - Voluminous
  - Hard to characterize accurately
  - Constantly changing
  - Differs from data that can be used
- AI technique is a method that exploits knowledge that should be represented in such a way that:
  - Knowledge captures generalization
  - It can be understood by people who must provide it
  - It can be easily modified to correct errors.
  - It can be used in variety of situations

Knowledge and Intelligence

- AI requires knowledge
- Knowledge-” Body of facts and principles accumulated by the human-kind or the act, fact or state of knowing”
- Intelligence-” Ability to reason to trigger new thought , to perceive and to learn is intelligence”
- John Mcarthy definition ”Developing computer program to solve complex problem by application of processes that are analogous to human reasoning processes

Characteristics of AI

- The problems of AI have **combinatorial explosion**
- AI programs **manipulate symbolic information** as compared to conventional programming which deal with numeric processing
- Uses **heuristics** to solve problem and prune the search tree
- For classification of AI it must have **large quantity of knowledge** and it must be represented in a form that system working on it can easily manipulate it.
- AI deals with **real life problem** to large extent and asserts in decision making
- AI systems have **ability to learn new** concept and draw conclusion from the facts

Difference with conventional system

Parameter	**AI**	**Conventional**
Processing type	Symbolic	Numeric
Technology	Heuristic	Non heuristic
Solution step	Not explicit	Precise
Answer sought	Satisfactory	Optimal
Knowledge	Imprecise	Precise
Modification	Frequent	Rare
Process	Inferential	Repetitive
Uncertainity	More	Less

Problem Solving

- Is a method of *deriving solution* steps beginning from initial description to desired solution.
- Problem is solved by *series of action* that minimizes the gap between the *initial and final state*
- In AI, problems are modeled as *state space representation* where state space is set as all possible states from start to goal state.
- Set of states form a *graph or tree* where two states are linked is there is operation that transforms the given state to the new state
- While solving the problem state space is generated in process of searching the solution

Problem Solving

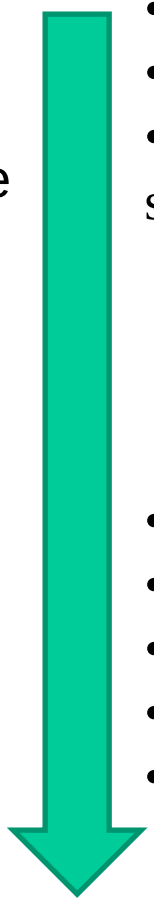
- Typical state space is too large to be stored in the memory
- Two types of problem solving are
  - general –purpose method : generate the solution and test it
  - Special-purpose method : tailored for specific type of problems
- For generating a new state an *action/operator/rule* is applied
- If the state is not the goal state procedure is repeated
- Order of applications of rule to current state is called *control strategy*

Problems , Problem Spaces and Search

- To build a system to solve a particular problem , we need four things
  - **Define the problem precisely**: must include definition of initial and final situation-*state space representation*
  - **Analyze the problem** : Few parameters can have immense impact on appropriateness of various possible techniques.
  - **Isolate and represent the task knowledge**
  - **Choose the best** problem solving technique and apply it.

Problem solving

- Simple
  - Structured, well defined procedure
  - certainty
- Complex
  - unstructured and not well defined procedure
  - uncertainty



•Roots of quadratic equation
•Calculating income tax
• inventory management system

•Game playing
•Solving puzzle
•Question-answer system
•Medical diagnosis system
•Weather forecasting system

Simple programs and database

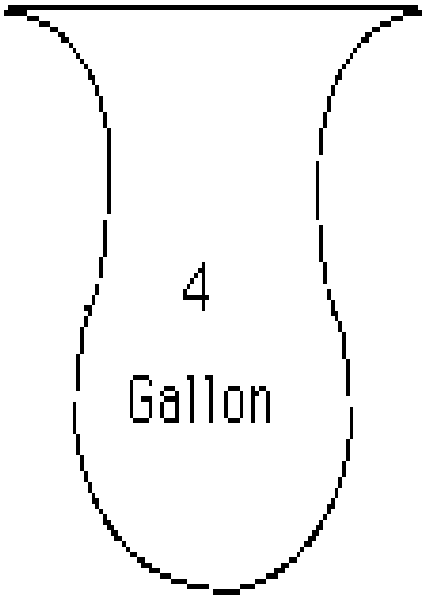
Algorithms which will search for a goal in state space

Pattern classification , Neural Network and fuzzy

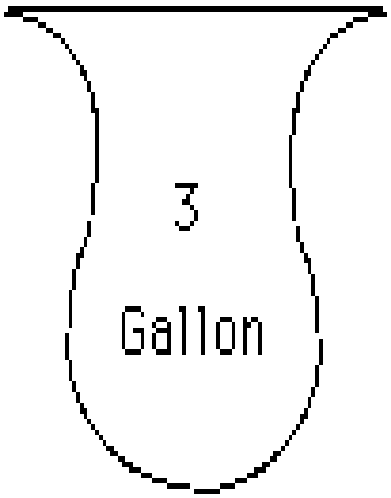
Water Jug problem

- Given two jugs a 4 gallon and a 3 gallon
- No measuring marks on it
- Pump is used to fill jug with water
- How to get exactly 2 gallon of water in 4 gallon jug
- State space representation *Formal Description*
  - Is described by 2 variables (x,y)
  - x= 0,1,2,3,4 y=0,1,2,3
  - x=number of gallons in 4 gallon jug
  - y=number of gallon in 3 gallon jug
  - Initial state (0,0) Final State=(2,n)

Water Jug Problem



x = 0,1,2,3,4



y = 0,1,2,3

State Representation - S(x y)

x,y =
integer gallons of water in
4 and 3 gal. containers,
respectively.

Start State: (S 0 0)
Goal State: (S 2 y)

Water Jug problem

- Operators(in form of rules) are as follows

1. Fill the 4 gallon jug — if (x<4) →(4,y)
2. Fill the 3 gallon jug — if y<3} → (x,3)
3. Pour some water(d) out of 4 gallon jug — if (x>0)→ (x-d,y)
4. Pour some water out of 3gallon jug — if (y>0)→ (x,y-d)
5. Empty 4 gallon jug on ground — if (x>0)→ (0,y)
6. Empty 3 gallon jug on ground — if (y>0)→ (x,0)
7. Pour water from 3G into 4G till 4G jug is full
   if (x+y >=4 and y>0)→(4,y-(4-x))
8. Pour water from 4G into 3G till 3G jug is full
   if (x+y >=3 and x>0)→(x-(3-y),3)
9. Pour all water from 3G jug into 4G jug — if (x+y <4 and y>0)→(x+y,0)
10. Pour all water from 4G jug into 3G jug — if (x+y <3 and x>0)→(0,x+y)
11. Pour 2G water from 3G jug to 4G jug — (0,2) →(2,0)

Solution

Rule /operator applied	Change in state	
	x	Y
2	0	0 Initial state
9	0	3
2	3	0
7	3	3
5	4	2
9	0	2
	2	0 goal state