Artificial Intelligence

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Artificial Intelligence and KBS

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MSC IT II Semester

COURSE Code: PS02CINT33

Course Title: Artificial Intelligence

Unit 1: Artificial Intelligence (AI) and Knowledge Based Systems (KBS)

- Natural and Artificial Intelligence
- Testing Intelligence with Turing Test, and Chinese Room Experiment, Application Areas of Artificial Intelligence, Data pyramid
- Production systems and AI Based Searches like Hill Climbing and Heuristic Search
- KBS Structure, Components of KBS, Categories of KBS, Knowledge-Based Shell, Advantages, Limitations and Applications of KBS
- Knowledge Acquisition, Knowledge Update
- Factual and Procedural Knowledge Representations
- Knowledge Based Systems Development Model

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Natural Intelligence

- Responds to situations **flexibly**.
- **Makes sense of** ambiguous or erroneous messages.
- Assigns **relative importance** to elements of a situation.
- **Finds similarities** even though the situations might be different.
- **Draws distinctions** between situations even though there may be many similarities between them.

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"Artificial Intelligence(AI) is the study of how to make **computers do things** at which, at the moment, **people are better**"

- Elaine Rich, Artificial Intelligence, McGraw Hill Publications, 1986

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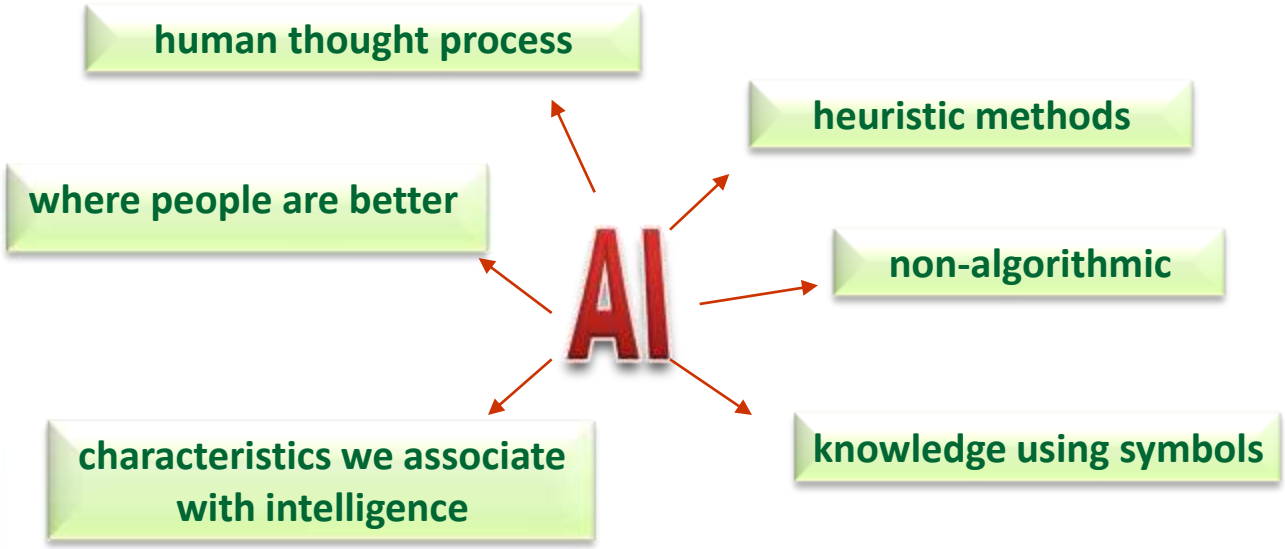
Artificial Intelligence



Constituents of artificial intelligence

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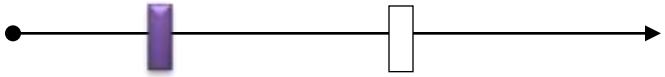
Acceptable solution in acceptable time

Extreme solution, either best or worst taking ∞ (infinite) time



Nature of AI solutions

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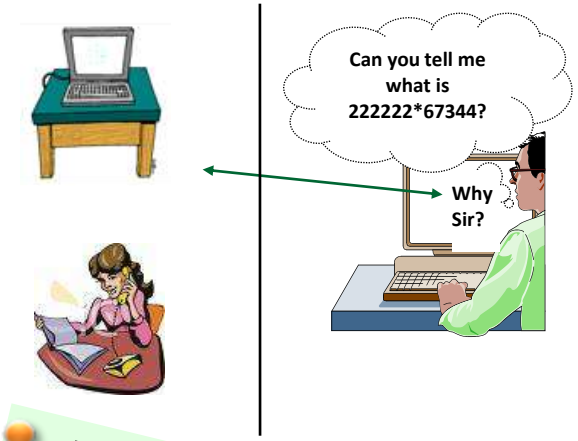

The Boss could not judge who was replying, thus the machine is as intelligent as the secretary.

Turing test will fail to test for intelligence in two circumstances;

1. A machine may well be **intelligent without being able to chat** *exactly* like a human; and;
2. The test fails to capture the *general* properties of intelligence, such as the ability to solve difficult problems or come up with original insights. If a machine can **solve a difficult problem that no person could solve**, it would, in principle, fail the test.

The Turing test

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Chinese Room Test

- The Chinese room argument holds that a digital computer executing a program **cannot** be shown to **have a "mind",** "understanding" or "consciousness", regardless of how intelligently or human-like the program may make the computer behave. (Even if the prog passes the Turing test!)
- The argument was first presented by philosopher John Searle in his paper, "Minds, Brains, and Programs", published in Behavioral and Brain Sciences in 1980.

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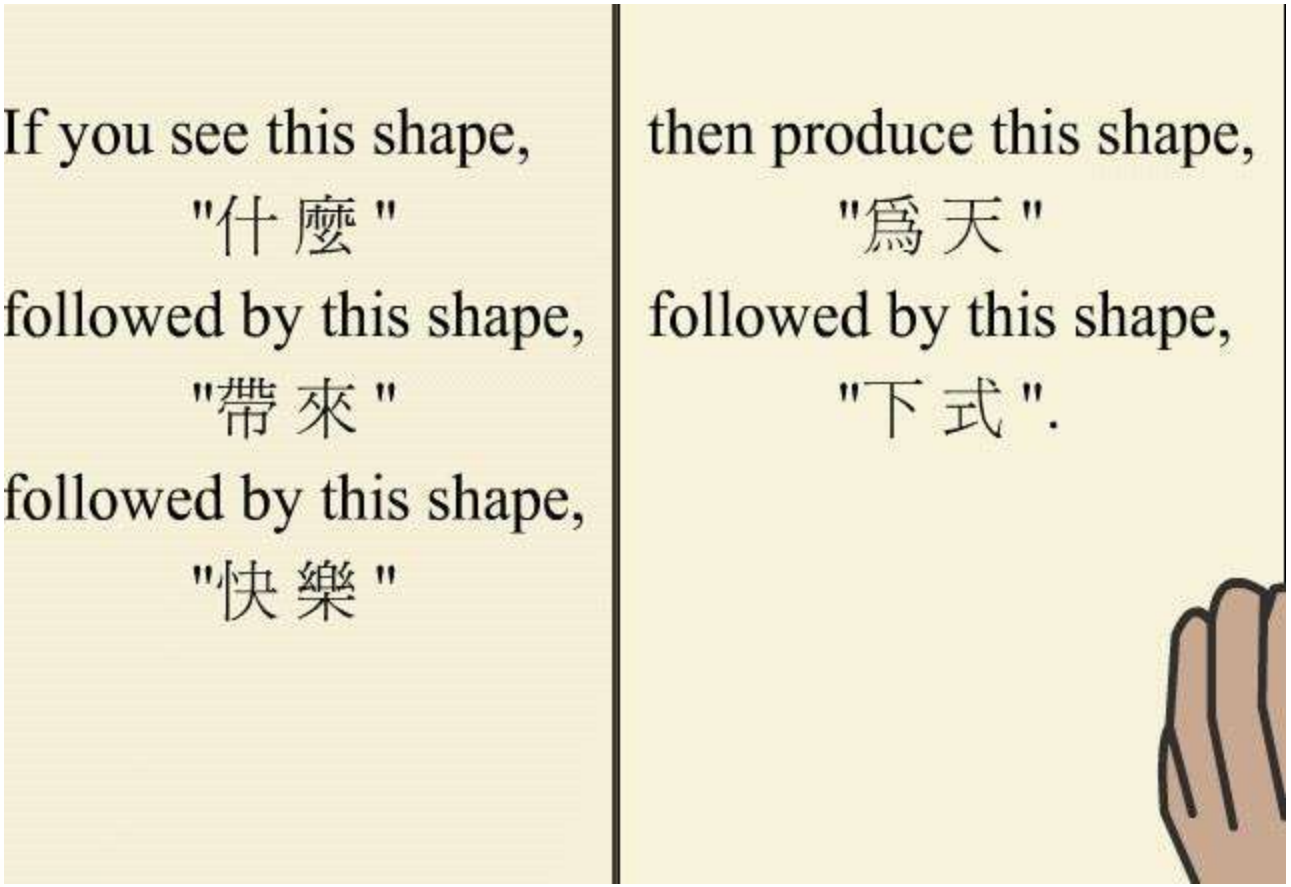

https://mind.ilstu.edu/

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Rich & Knight (1991) classified and described the different areas that Artificial Intelligence techniques have been applied to as follows:

Mundane Tasks

- Perception - vision and speech
- Natural language understanding, generation, and translation
- Commonsense reasoning
- Robot control

Expert Tasks

- Engineering - design, fault finding, manufacturing planning, etc.
- Scientific analysis
- Medical diagnosis
- Financial analysis

Formal Tasks

- Games - chess, backgammon, checkers, etc.
- Mathematics- geometry, logic, integral calculus, theorem proving, etc.

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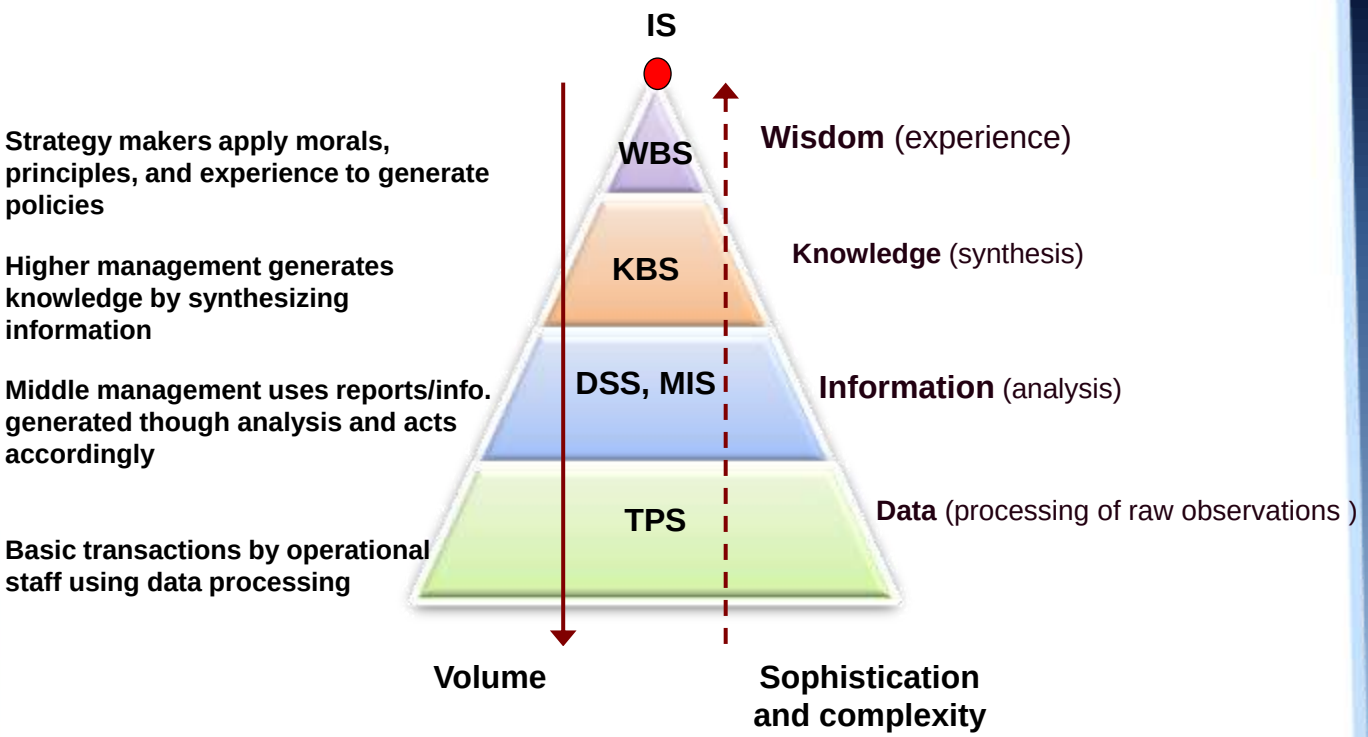

Data Pyramid

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Water Jug Problem in Artificial Intelligence

- Consider two jugs: one having the capacity to hold **3 gallons** of water and the other has the capacity to hold **4 gallons** of water.
- There is **no other measuring equipment** available and the jugs also do not have any kind of marking on them.
- The task is to **fill the 4-gallon jug with 2 gallons of water** by using only these two jugs and no other material.
- Initially, both our jugs are empty.

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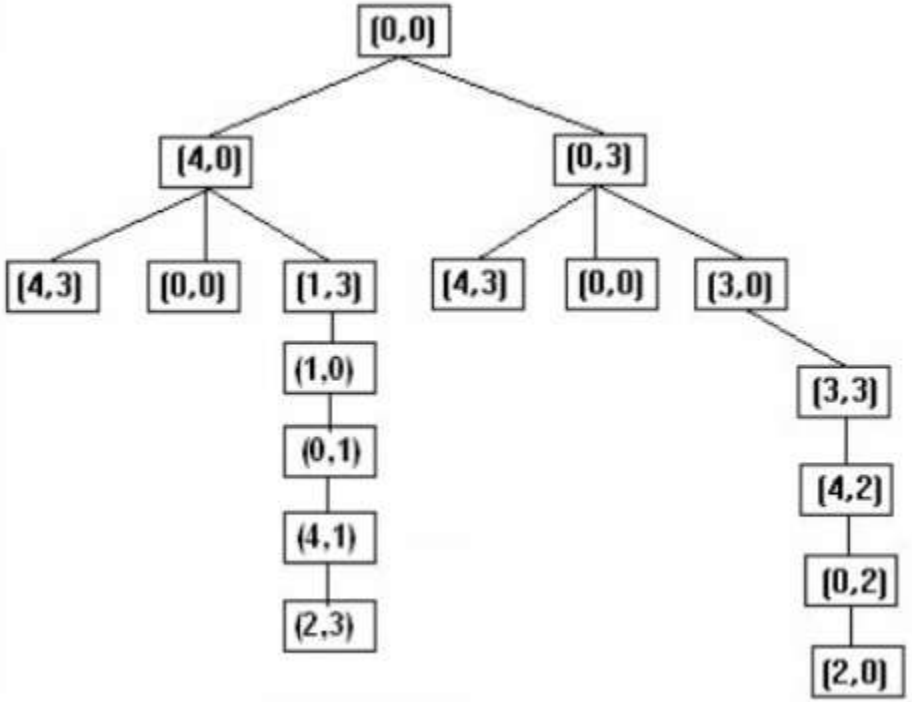
Water Jug problem in Artificial Intelligence



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Water Jug problem in Artificial Intelligence

1.	(X, Y) if	$X < 4 \rightarrow (4, Y)$	Fill the 4-gallon jug
2.	(X, Y) if	$Y < 3 \rightarrow (X, 3)$	Fill the 3-gallon jug
3.	(X, Y) if	$X = d \ \& \ d > 0 \rightarrow (X\text{-}d, Y)$	Pour some water out of the 4-gallon jug
4.	(X, Y) if	$Y = d \ \& \ d > 0 \rightarrow (X, Y - d)$	Pour some water out of 3-gallon jug
5.	(X, Y) if	$X > 0 \rightarrow (0, Y)$	Empty the 4-gallon jug on the ground
6.	(X, Y) if	$Y > 0 \rightarrow (X, 0)$	Empty the 3-gallon jug on the ground
7.	(X, Y) if	$X + Y \leq 4$ and	Pour water from the 3-gallon jug into the
	$Y > 0$	$\rightarrow 4, (Y - (4 - X))$	4-gallon jug until the gallon jug is full.
8.	(X, Y) if	$X + Y \geq 3$ and	Pour water from the 4-gallon jug into the
	$X > 0$	$\rightarrow (X - (3 - Y), 3))$	3-gallon jug until the 3-gallon jug is full.
9.	(X, Y) if	$X + Y \leq 4$ and	Pour all the water from the 3-gallon jug
	$Y > 0$	$\rightarrow (X + Y, 0)$	into the 4-gallon jug
10.	(X, Y) if	$X + Y \leq 3$ and	Pour all the water from the 4-gallon jug
	$X > 0$	$\rightarrow (0, X + Y)$	into the 3-gallon jug
11.	$(0, 2)$	$\rightarrow (2, 0)$	Pour the 2-gallons water from 3-gallon jug into the 4;gallon jug
12.	$(2, Y)$	$\rightarrow (0, Y)$	Empty the 2-gallons in the 4-gallon jug on the ground.

Fig. 2.3. *Production rules (operators) for the water jug problem.*

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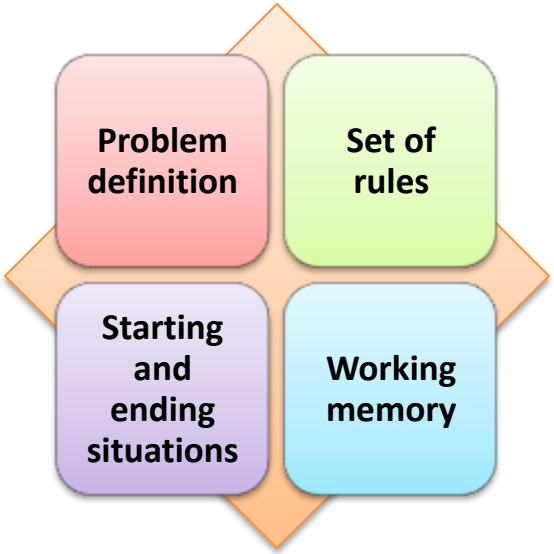
A **production system** (or production rule system) is a computer program which consists of a

- Problem definition
- Set of rules
- Starting and ending situations
- Working memory



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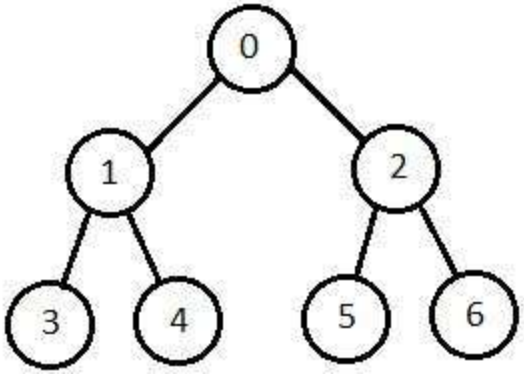
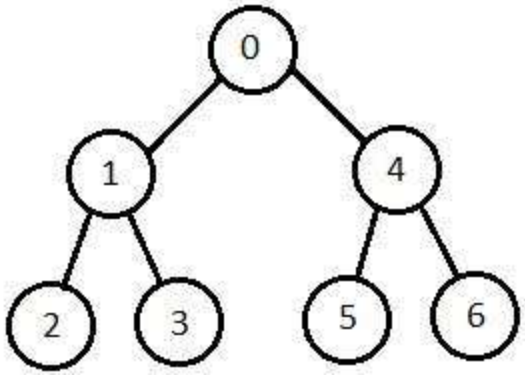


Breadth First Search



Depth First Search

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Hill Climbing Search

- Hill climbing is an **AI based** local search algorithm. Also known as **weak search**, instead of blind search.
- Control continuously moves in the direction of increasing elevation/value **to find the peak of the mountain** or best solution to the problem. It is **heuristic based search**.
- It terminates when it reaches a peak value where no neighbor has a higher value.
- It is also called **greedy local search** as it only looks to its good immediate neighbor state and not beyond that.

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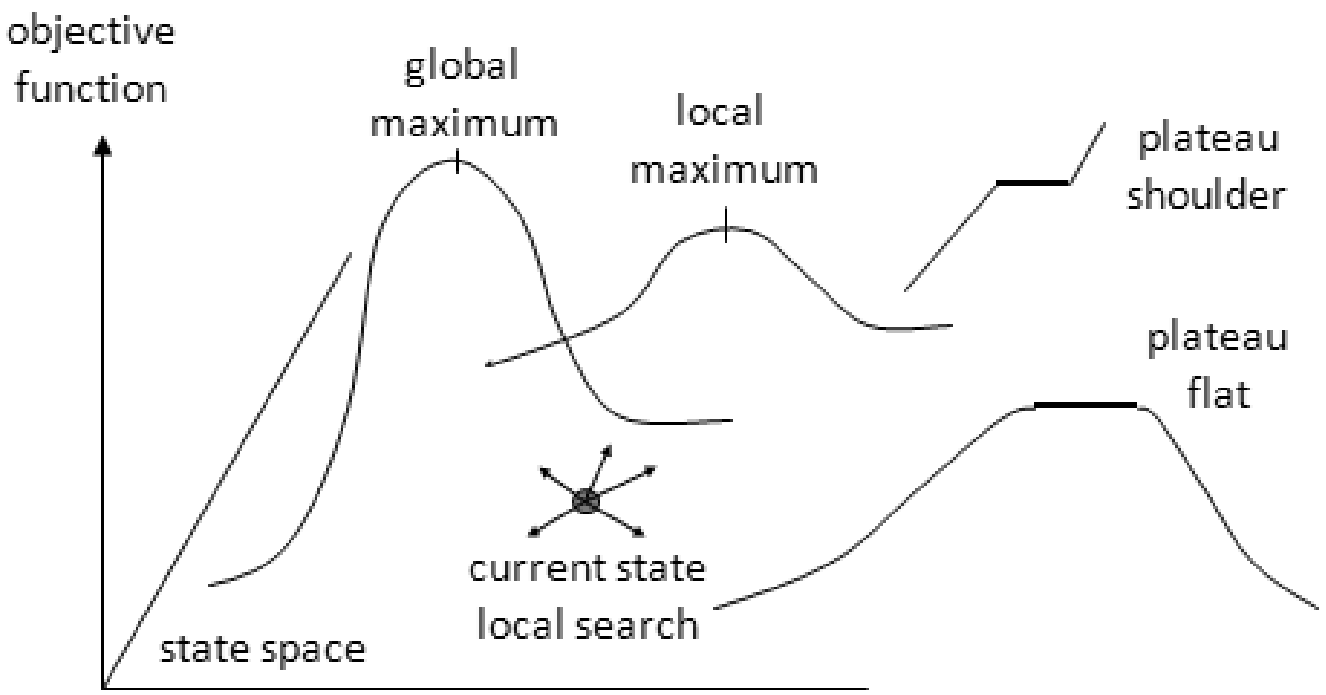
Hill Climbing Search



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Algorithm for Simple Hill Climbing:

Step 1: Evaluate the initial state, if it is goal state then return success and Stop.

Step 2: Loop Until a solution is found or there is no new operator left to apply.

Step 3: Select and apply an operator to the current state.

Step 4: Check new state:

If it is goal state, then return success and quit.
Else if it is **better** than the current state then assign new state as a current state.
Else if **not better than** the current state, then return to step2.

Step 5: Exit.

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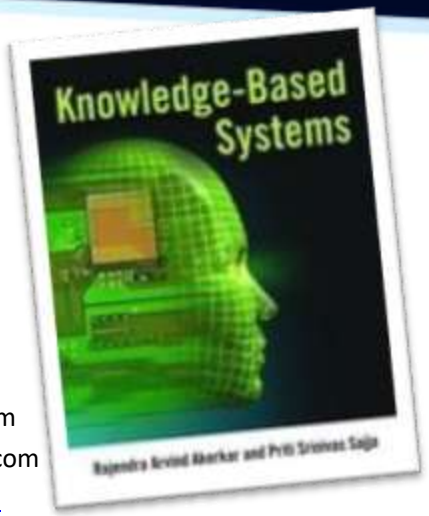

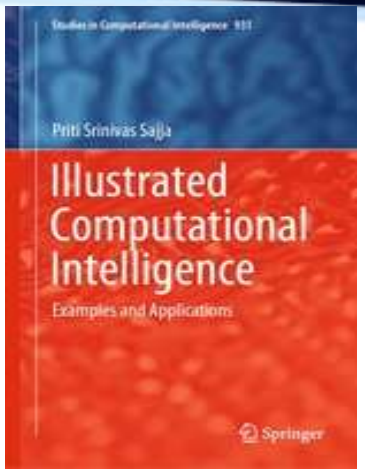

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