

Questions 4: Search

Roman Belavkin

Middlesex University

Question 1

Briefly describe what is uninformed and informed search? Name examples of uninformed and informed search strategies in lists and trees.

Answer:

Uninformed search uses some fixed strategy that does not use any knowledge about the problem. The advantage of such algorithms is that they can be applied to many problems, but the complexity of the problem can be too high. Examples include linear and binary search for lists and breadth-first and depth-first search for trees.

Informed search uses a heuristic based on the knowledge of a specific problem type. Heuristic can reduce the search space and complexity of the problem. Examples include best-first search, A^* and Dijkstra's algorithms.

Question 2

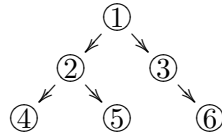
a) Briefly describe the breadth-first and the depth-first search for trees.

Answer:

Breadth-first : first, check all nodes on the same depth. In other words, visit all the nearest neighbours of the current root nodes; then move to the next depth level by considering the new visited nodes as the root nodes.

Depth-first : First, check all nodes in the same branch. In other words, visit each neighbour of the most recently visited node.

b) Consider the following graph:



Starting at root node 1, give the order in which the nodes will be visited by the breadth-first and depth-first algorithms.

Answer:

Breadth-first : 1 → 2 → 3 → 4 → 5 → 6

Depth-first : 1 → 2 → 4 → 5 → 3 → 6

Question 3

What is conflict resolution in expert systems? What conflict resolution methods are used? Give their brief descriptions.

Answer: *Conflict resolution is a process (strategy, algorithm) of selecting which rule to use when more than one rule matches the current working memory state.*

There are several strategies for conflict resolution:

Refractory : *once the rule has fired, it is not used again.*

Recency : *use the rule that has been successfully used most recently in a similar situation.*

Specificity : *use the rule with the most specific conditions (more facts).*

Priority : *assign priority to rules (on the basis of rank, utility, probability, cost, etc) and choose the one with the highest priority.*

Parallel : *fire all eligible rules using separate lines of reasoning.*

Question 4

Consider the following familiar set of rules:

1		IF	<i>green</i>		THEN	<i>walk</i>
2		IF	<i>red</i>		THEN	<i>wait</i>
3		IF	<i>green AND blinking</i>		THEN	<i>hurry</i>
4		IF	<i>red OR green</i>		THEN	<i>traffic light works</i>

a) Which of the above rules will be put into a conflict set by the system if the working memory contains two facts: *green, blinking*? Explain why each rule is selected or not.

Answer: The conflict set will contain three rules: 1, 3 and 4. Rule 1 matches the fact green in the working memory (WM). Rule 2 does not match because there is no fact red in WM. Rule 3 uses AND (conjunctive), so both facts should be in WM, which is exactly the case. So, rule 3 is selected. Finally, rule 4 uses OR (disjunctive), which means that it is sufficient for only one of the facts to be in WM. In this case fact green is in WM, so rule 4 is selected.

- b) Which of the rules would fire if we used the specificity conflict resolution strategy? Explain why.

Answer: Specificity strategy states that a rule with a greater number of conditions (more specific) should be given the priority. Rules 1 and 4 satisfy only one fact in WM, while rule 3 uses two facts. Thus, it is more specific for the situation, and rule 3 will be selected by the conflict resolution.

Question 5

Consider the following set of rules:

1	IF	<i>cyclone</i>	THEN	<i>clouds</i>
2	IF	<i>anticyclone</i>	THEN	<i>clear sky</i>
3	IF	<i>pressure is low</i>	THEN	<i>cyclone</i>
4	IF	<i>pressure is high</i>	THEN	<i>anticyclone</i>
5	IF	<i>arrow is down</i>	THEN	<i>pressure is low</i>
6	IF	<i>arrow is up</i>	THEN	<i>pressure is high</i>

Use backward chaining to reason about the weather if the working memory contains the fact: *clouds*. Show your answer in a table listing the rules matching the working memory (conflict set), which rule you apply, and changes to the working memory contents:

Cycle	Working Memory	Conflict set	Rule fired
⋮	⋮	⋮	⋮

Answer:

Cycle	Working Memory	Conflict set	Rule fired
0	clouds	1	1
1	clouds, cyclone	1, 3	3
2	clouds, cyclone, pressure is low	1, 3, 5	5
3	clouds, cyclone, pressure is low, arrow is down	1, 3, 5	Halt

Question 6

What reasoning direction is a more suitable heuristic in the game of Chess — forward or backward? What about the Rubik's cube puzzle? Justify your answers by referring to properties of the search space in each case.

Answer: *Forward for Chess and backward for Rubik's cube. One has to compare the numbers of initial states and the goal states in each problem. There is always one initial state in Chess, but many possible states to finish the game. Thus, because the number of states is generally increasing in Chess, forward reasoning is preferred. Conversely, there is one goal state in Rubik's cube puzzle, but many initial states, and therefore backward reasoning is preferred.*