Questions 7

Dr. Roman Belavkin

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Question 1

Consider the following production rule:

IF *green* THEN *walk*

a) What is the antecedent of this rule?

Answer: *Antecedent is the left–hand–side of the rule*: IF *green*.

b) What is the consequent of this rule?

Answer: *Consequent is the right–hand–side of the rule*: THEN *walk*.

c) Which part of the rule will be matched against the working memory in case of forward chaining?

Answer: *Left–hand–side*

d) And in case of backward chaining?

Answer: *Right–hand–side*

Question 2

The following is the rule set of a simple weather forecast expert system:

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

a) Use forward chaining to reason about the weather if the working memory contains the fact: *arrow is down*. Show your answer in a table naming the rules matching the current working memory (conflict set), which rule you apply, and how the working memory contents changes on the next cycle after a rule has fired:

Cycle	Working Memory	Conflict set	Rule fired
⋮	⋮	⋮	⋮

Answer:

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

b) Use backward chaining to reason about the weather if the working memory contains the fact: *clouds*. Show your answer in a similar table.

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

c) Suppose that the user interface of our ES allows the system to ask a user about the facts whether they are true or false. What question (or questions) the system should ask the user in order to conclude that the sky is clear? What will the user answer? Which rule will require the clarification from the user?

Answer: *The system should ask something like:*

Is the arrow up? (Yes/No)

And the user will answer 'Yes'. The system will start from the goal clear sky, *and then, in order to prove it, the system will reason backwards using rules 2, 4 and 6 until it will need to clarify the condition of rule 6. That is whether the fact* arrow is up *is true or false. Thus, rule 6 will cause the clarification from a user.*

Question 3

Consider the following familiar set of rules:

1	IF	*green*	THEN	*walk*
2	IF	*red*	THEN	*wait*
3	IF	*green* AND *blinking*	THEN	*hurry*
4	IF	*red* OR *green*	THEN	*traffic light works*

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 4

Describe characteristics of problems in which it is better to use rule–based expert systems or problems where the case–based systems are more appropriate.

Answer: *Rule–based systems are better for problems*

- *With well–defined domain which can be easily represented.*
- *That do not change with time.*
- *Where explanation of the reasoning process is very important.*

Case–based systems are better for problems

- *Which are less understood.*
- *Which are dynamic (may change with time).*

Question 5

Briefly describe the cyclic process of CBR.

Answer: *The process can be summarised by four REs:*

a) *REtrieve the most similar case or cases.*

b) *REuse the case(s) to attempt to solve the problem.*

c) *REvise the proposed solution if necessary*

d) *REtain the new solution as a part of a new case*

A new problem is matched against cases in the case-base, and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused and tested for success. The solution will normally be revised, producing a new case that can be retained. This cycle rarely occurs without human intervention. For example, many CBR tools act primarily as case retrieval and reuse systems, case revision often being undertaken by users of the case-base.

Question 6

Briefly describe the nearest neighbour retrieval method used in CBR systems for case retrieval.

Answer: *Each case in a case base is represented by a number of features, some of which are used as indexes. A target case will be compare with all the source cases according to some similarity function shown below, such as Euclidean or a taxi-cab distance. Sometimes, weights can be used to make some features more important. The most similar case(s) is retrieved, and the solution for the retrieved case is adapted as the solution for the target case.*