Rule-Based Systems

Consider a system with the following rules.

Index	Antecedents	Consequents	
R1	X employs rhythmic language	X is a poem	
R2	X contains lines with a clear pattern	X is a poem	
R3	X employs rhythmic language		
	X is usually short	X is a poem	
	X often depicts a folklore		
R4	X is a poem	V is a connet	
	X is popular from the late Middle Ages on	A is a somet	
R5	X is a poem		
	X originates from Sicily	X is a sonnet	
	X often expresses romantic love		
R6	X is a poem	X is a sonnet	
	X originates from Sicily		
	X contains 14 lines		
R7	X is written by William Shakespeare	X is one of the best-known among the author's works	
	X is a typical English sonnet		
R8	X is printed on a paper with doodles	V is printed on a tattaned name	
	X is printed on a paper with tea stains	A is printed on a tallered paper	
R9	X is a sonnet	X is Sonnet 18	
	X is one of the best-known among the author's works		
	X is a must-read for high school students		
	X is printed on a tattered paper		

Suppose the following assertions about a book B are in the system's initial working memory:

- B often depicts a folklore
- B is usually short
- B employs rhythmic language
- B originates from Sicily
- B often expresses romantic love
- B is written by William Shakespeare
- B is a typical English sonnet
- B is a must-read for high school students
- B is printed on a tattered paper

The expert system evaluates the rules as follows:

- Conflicts are resolved based on rule ordering and antecedent ordering. In other words, when examining rules, the system always go from R1 to R9 sequentially; when examining antecedents in any rule, the system always follow the order as appeared in the table.
- A rule is never selected unless it adds a new assertion to the working memory.

Questions:

1. Simulate how the expert system interprets the working memory by making a table with the relevant rule indices (e.g., R4) and by indicating any new assertions added to the working memory. An example of your answer is given as follows.

Step	Rules ready to be instantiated	Rule selected	New assertion
1	R1, R3, R7	R1	B is a poem
2	R1, R3, R5, R7	R5	B is a sonnet
3	R1, R3, R5, R7	R7	B is one of the best-known among the author's works
4	R1, R3, R5, R7, R9	R9	B is Sonnet 18

2. The expert system uses backward chaining and starts with the hypothesis that book B is *Sonnet 18* but no initial assertions. The system asks the user questions to build the working memory and instantiate rules. The user answers "yes" to any question corresponding to an assertion on the list given in the initial working memory and "no" otherwise. In addition, the system can read a previously stored answer to a repeated question, so it never asks the same question twice.

It can be helpful to draw a diagram as in 1.

- (a) If the system follows in a depth-first way, list the questions in the order it asks. There should be 12 questions in total.
 - i. B is Sonnet 18?
 - ii. B is a sonnet?
 - iii. B is a poem?
 - iv. B employs rhythmic language?
 - v. B is popular from the late Middle Ages on?
 - vi. B originates from Sicily?
 - vii. B often expresses romantic love?
 - viii. B is one of the best-known among the author's works?
 - ix. B is written by William Shakespeare?
 - x. B is a typical English sonnet?
 - xi. B is a must-read for high school students?
 - xii. B is printed on a tattered paper?
- (b) If the system follows in a breadth-first way, list the questions in the order it asks. There should be 13 questions in total.
 - i. B is Sonnet 18?
 - ii. B is a sonnet?
 - iii. B is one of the best-known among the author's works?
 - iv. B is a must-read for high school students?
 - v. B is printed on a tattered paper?
 - vi. B is a poem?
 - vii. B is popular from the late Middle Ages on?
 - viii. B originates from Sicily?
 - ix. B often expresses romantic love?
 - x. B contains 14 lines?
 - xi. B is written by William Shakespeare?
 - xii. B is a typical English sonnet?
 - xiii. B employs rhythmic language?

Please be careful as an error in the middle of your answer means the portion after that is also incorrect.

- 3. Which of the two backward chaining versions of the expert system would be preferred? Choose each of the following that support your view.
 - (a) Depth-first, because questions tend to stay relevant to particular subproblems, rather than jumping around.
 - (b) Depth-first, because the answer will be produced more reliably.
 - (c) Breadth-first, because answers will be produced faster.
 - (d) Breadth-first, because questions tend to stay relevant to particular subproblems, rather than jumping around.



Figure 1: Backward chaining diagram