Question paper
+ answer

UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE

ARTIFICIAL INTELLIGENCE 3

Date: 7 September 1988 Time: 11.30 - 13.00

Examiners: Chairman - J.A.M. Howe
External - A.G. Cohn

KNOWLEDGE REPRESENTATION AND INFERENCE 2

INSTRUCTIONS TO CANDIDATES

1. Candidates *must* answer question 1, and *either* question 2 *or* question 3.

2. Each question is marked out of 100%. The marks at the side of the questions show how these are apportioned.

3. If more than two questions are attempted, candidates should cross out the answer which is **NOT** to be marked. Otherwise, the examiners will mark only the first two answers which appear in the script.

Question 1.

What is Brian Smith's Knowledge Representation Hypothesis, and how does it relate to the functioning of a knowledge-based system?

[100%]

Question 2.

What are the three levels Brachman and Levesque propose for the description of knowledge-based systems? Briefly explain each level, how they relate to each other, and what use they are in designing and building knowledge-based systems.

[100%]

Question 3.

(a) (i) The use of logic in knowledge representation systems has received a certain amount of criticism from people working in AI. Briefly describe three of the most common criticisms made.

[15%]

(ii) Suggest a misconception about the use of logic in knowledge representation that the criticisms referred to in (i) might be based upon, and briefly discuss whether this misconception invalidates the criticisms.

[15%]

(b) "Several authors have recently suggested that more exotic logics, especially *fuzzy logic*, are necessary in order to capture the essentially imprecise nature of human deduction. While agreeing that we have to look beyond first-order logic, I find the usual arguments advanced for the use of fuzzy logic most unconvincing."

Patrick Hayes - *Some Problems and Non-problems in Representation Theory*, 1974.

Briefly summarise the arguments Hayes presents to justify the above quote.

[30%]

(c) The basic formalism of the situational logic of Hayes and McCarthy is:

$$S' = result(E,S),$$

which asserts that S' is the situation that results when event E occurs in situation S. The axiom:

$$\forall XLS\ clear(top(X),S) \wedge clear(L,S) \wedge \neg tooHeavy(X) \rightarrow loc(X,result(move(X,L),S)) = L$$

asserts that moving an object X to a location L results in a new situation $result(move(X,L),S)$, in which X is at location L provided X is not too heavy and both its top and the location L are clear. Further, the axiom:

$$\forall XCS\ colour(X,result(paint(X,C),S)) = C$$

asserts that the result of painting an object X with paint of colour C results in it becoming the colour C.

These two axioms need to be accompanied by four *Frame axioms* which explicitly represent what changes when the actions *move* and *paint* are applied to blocks. Express these four axioms in the situational logic, and explain why situational logic proved to be impractical as a knowledge representation formalism.

[40%]