C331 Expert Systems 1997

Answer any THREE of the five questions in this paper.

1.(a) Explain the terms “conjunctive normal form”, “resolution” refutation”, and “unification”.

[8 marks]

(b) Consider the following assertions:

All humans are male and female

No human is both male and female

Archbishops are human

No archbishop is a female

Beckett is an archbishop

EITHER

Express these assertions in the First Order Predicate Calculus and prove, using resolution-refutation that Beckett is male and hence or otherwise show how it may be derived. [Note: the example has been constructed so that you may abbreviate terms by their first letters, i.e. human to h, and so on.]

[13 marks]

OR

Express the assertion in the form of a semantic net, and use it to show that Beckett is male.

[13 marks]

[Question 1 cont. over page]

TURN OVER

[Question 1, continued]

(c) Explain what is meant by the “closed-world assumption” and by “negation by failure”, and how the Prolog clause q :- p. differs from the logical implication p -> q.

Explain

i) the limitation in Prolog that does not allow one of the assertions in (b) to be expressed in Prolog,

ii) why the limitation exists, and

iii) how attempts to circumvent the limitation may not give quite the desired results.

[12 marks]

TURN OVER

2. (a) Explain the following terms with respect to the NEOMYCIN system:

structural knowledge

support knowledge

strategic knowledge

[7 marks]

(b) Describe the contexts in which an "explanation system" might be considered necessary. Compare the explanation systems of MYCIN and NEOMYCIN.

[13 marks]

(c) Explain what is meant by "shallow" or "compiled" knowledge.

Experts can solve common problems quickly, and unusual ones by reasoning "from first principles". Discuss the extent to which MYCIN and NEOMYCIN show expert behaviour in this respect.

[13 marks]

3. (a) Explain the terms "forward reasoning" and "backward reasoning".

Explain the difference between forward chaining and backward chaining. For each, give an example of a system that uses it as its primary mode of inferencing, explaining why it is an appropriate mode for the domain of the system and whether the reasoning is deductive or abductive.

[7 marks]

(b) Explain the term "abduction". Explain also how the use of abduction and deduction may be combined in reasoning.

[4 marks]

(c) For each of inheritance networks and frames,

i) indicate an example of their normal use to retrieve information, where this can be viewed as either abductive or deductive reasoning. Explain which form of reasoning it is.

ii) either give an example of how to use them that is at the same time an example of the other form of reasoning (i.e. the one that does not occur in your answer to (i)), or explain why the other form of reasoning is inappropriate for them.

[8 marks]

(d) Explain the terms "belief revision", "non-monotonic reasoning" and "truth maintenance system" (TMS).

[5 marks]

(e) For any two other knowledge representations apart from logics and rules, consider how the concepts in part (d) can apply or can assist in typical acts of reasoning with the representation, and either show why they contribute positively to this activity or explain why they have no relevance for that purpose.

[9 marks}

4. (a) Outline a typical lifecycle for the software produced in an expert system project.

[13 marks]

(b) Models for the lifecycle of conventional software, in software engineering, are different from those used for typical expert systems. Yet an expert system is a piece of software. So, why does the difference exist?

Divide your answer to this question into consideration of

i) the stages before substantial software design and development start.

ii) the period after (i) that extends as far as the time when the eventual users accept delivery of the required system.

iii) the rest of the lifecycle.

[11 marks]

(c) Suppose that you are in charge of the detailed planning and management of an expert system project, if the project itself is approved. State how you would deal with the issues of

i) assessing the idea for the project, and what time-scale, resources etc. are likely to be needed for it, in order either to establish an outline plan for the project or a report to say that the idea of doing the project ought to be abandoned.

ii) establishing further details for the time-scale and resources, to serve as the backbone for the detailed plan for the project.

iii) deciding when one stage in the lifecycle is clearly finished and that the project should move on to the next stage.

[9 marks]

5. (a) Artificial intelligence covers a wider range of topics and interest than "expert systems". Choose one area or topic in artificial intelligence that has not been treated in the course as a substantial component of the science and technology of expert systems, but that seems to you to be relevant to the near-future improvement of what expert systems can do. State your choice, and justify it.

Repeat this process for

i) One area or topic in artificial intelligence that may improve the capabilities of expert systems in the more distant future if it can be exploited, but where the details of this exploitation are not clear at present.

ii) One area or topic in artificial intelligence that seems to have nothing useful to contribute to expert systems.

[9 marks]

(b) Many instances of experience with expert system projects can be expressed in the form of "commandments" or short sayings that are easy to remember.

State 5 such commandments, and explain each one.

[15 marks]

(c) Suppose that you are approached by the owner of a company that specialises in providing users with automatic information-retrieval via the Internet, with automatic access to any sites and materials that may answer a client's needs. This company does not have anything that can be regarded as an expert system, but the owner has heard that expert systems are very "intelligent" and can do useful things,e.g. to extend the range or effectiveness of her company's services. The approach ends with the offer of support to specify and develop one expert system that will be of value to the company, in allowing it to perform services that rival companies can not, or in allowing it to perform those services better. You are also requested to select an example that will be simple enough that the technical staff of the company will be able to learn about expert systems by collaborating with you and by inspecting the expert system.

State what you would choose this expert system to do. Justify both the usefulness and the feasibility of your choice.

[9 marks]

END OF PAPER