UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1996

MSc Degree in Foundations of Advanced Information Technology
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Diploma of Membership of Imperial College

PAPER F4.94

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Thursday, May 16th 1996, 10.00 - 12.00

Answer THREE questions

For admin. only: paper contains
4 questions
2 pages (excluding cover page)

1a Explain what is an integrity constraint. How do integrity constraints differ from knowledge and belief? What role do integrity constraints play in abduction?

b Explain how integrity constraints which contain at least one abducible condition can be eliminated. Informally justify the elimination method.

c Explain the distinction between default and non-default abduction. Explain how and under what circumstances default abduction and integrity constraints can be eliminated. Informally justify the elimination method.

The three parts carry, respectively, 30%, 30% and 40% of the marks

2a Explain what is a condition-action production rule. Explain how condition-action rules are related to goal-subgoal reduction rules. Explain how condition-action rules are related to integrity constraints.

b Explain how condition-action rules can be used to simulate goal-subgoal reduction rules.

c Outline, informally, the top-most level of a condition-action rule interpreter.

d What does the term "conflict resolution" mean in relation to the execution of condition-action rules? What are the most commonly employed conflict resolution strategies?

The four parts carry, respectively, 30%, 20% , 20% and 30% of the marks.

3a What is the difference between a rational and a reactive agent?

b Outline informally the top-most level of an hybrid agent that combines rationality with reactivity by combining resource-bounded reasoning with assimilating observations and performing actions.

c Explain informally how observations affect an hybrid agent's goals and beliefs.

d Explain informally

i) when an hybrid agent decides to try to perform an action,

ii) how such an attempt affects the agent's beliefs and goals.

e Explain how, to an outside observer, an hybrid agent might seem to behave as though it were simply executing condition-action rules.

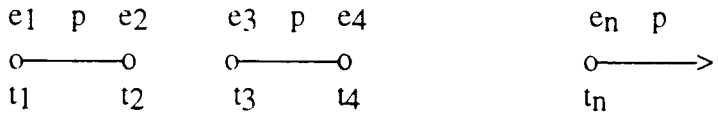
f Explain how an hybrid agent can be specialised to a pure condition-action rule interpreter.

g Explain how an hybrid agent can be specialised to a purely rational agent.

The seven parts carry, respectively, 20%, 20%, 10%, 20%, 10%, 10% and 10% of the marks.

4a What is the frame problem in the situation calculus and what can be done to lessen it?

b Assume that we are given a complete, finite history of all the events that initiate and terminate a given property p. Pictorially:



where for each i, $1 \leq i \leq n$, e_i happens at time t_i, $t_i \leq t_{i+1}$ and e_i initiates p if i is odd and terminates p if i is even. Assume n is odd and $n > 1$.

Show how to derive

$$\text{holds}(p,T) \Leftrightarrow [t_1 < T \leq t_2 \vee t_3 < T \leq t_4 \vee t_n < T]$$

using the event calculus in iff-form, an appropriate representation of the given assumptions and suitable properties of $<$ as a total ordering.

To what extent can the derived representation be said to solve the frame problem?

The two parts carry, respectively, 30% and 70% of the marks.

End of paper.