UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1996

MEng Honours Degrees in Computing Part IV
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
Associateship of the City and Guilds of London Institute

PAPER 4.98

NON-MONOTONIC AND META-LEVEL REASONING
Wednesday, May 15th 1996, 10.00 - 12.00

Answer THREE questions

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

1 It can be argued that the essence of non-monotonic reasoning is the appropriate representation of default rules, which in natural language have the form:

P unless Q can be shown.

a Explain why classical logic is inadequate for the representation of such rules. For each of Theorist, Circumscription, (normal) Logic Programming, Default Logic, Auto-epistemic Logic and Non-monotonic Modal Logic, explain how these logics represent such default rules. Indicate briefly how each of these logics overcomes the inadequacies of classical logic.

b For each of the formalisms, except classical logic and circumscription, mentioned in part (a), outline how it can be interpreted as an assumption-based framework in the spirit of Theorist.

The two parts carry, respectively, 60% and 40% of the marks.

2a Show formally that, for any assumption-based framework, any stable extension is an admissible extension. Give an example where the two semantics give different results, and explain why one semantics gives results which are intuitively more correct for this example.

b Show formally that, for any assumption-based framework, any stable extension is an acceptable extension. Give two examples where the two semantics give different results, and explain why one semantics gives results which are intuitively more correct for one example and the other semantics gives results which are intuitively more correct for the other example.

The two parts carry equal marks.

3 Reiter conjectured that normal default rules are adequate for default reasoning.

a What is the form of normal default rules in default logic? Give a counter-example to Reiter's conjecture and explain why it is a counterexample. Explain how the counter-example can be avoided in default logic.

b Show how Theorist can be simulated in default logic, using normal default rules.

c Outline a proof that, under this simulation, extensions in Theorist coincide with extensions in default logic. (You may quote without proof any relevant theorems presented in the lecture course.)

d Show how normal logic programs can be simulated in default logic, using non-normal default rules. State without proof the relationship between the semantics of the normal logic program and the semantics of the default logic simulation.

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

4a Represent the following sentences in normal logic programming form:

r1: Except as provided for by r2, all thieves should be punished.

r2: Except as provided for by r3, thieves who are minors should be rehabilitated and not punished.

r3: Any thief who is violent should be punished.

John is a thief, who is a minor and violent.

What are all the stable extensions of this representation?

b Represent the sentences in part a above in Theorist. What are all the acceptable extensions of this representation?

c Suppose the statement in part a that John is violent is withdrawn.

i) What are all the stable extensions of the resulting logic programming representation?

ii) What are all the acceptable extensions of the resulting Theorist representation?

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

End of paper