UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1998

MSc Degree in Advanced Computing
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 A4.94

ARTIFICIAL INTELLIGENCE

Friday, May 1st 1998, 2.30 - 4.30

Answer THREE questions

For admin. only: paper contains 4 questions

1a Represent the following narrative as a semantic network:

> Bob gives Mary a book, after which
> Mary gives the book to John.

b Translate the semantic network of part a into a logical form having the same meaning.

c Represent in logical form any sentences additional to those in part b needed to conclude that John has the book and Mary no longer has the book after Mary gives the book to John.

d Explain in what sense the sentences in part c can be said to formalise a case of default reasoning. Explain in what sense such reasoning is non-monotonic.

The four parts carry, respectively, 20%, 20%, 40%, 20% of the marks.

2a Assume that initially Mary is at home and possesses a book. Assume, moreover, that the following sequence of events then takes place:

> Mary travels from home to work,
> immediately after which,
> Mary gives the book to John.

Use the situation calculus to represent these assumptions and the problem of showing that

> immediately after Mary gives the book to John,
> Mary is at work and John possesses the book.

Give the general situation calculus axioms, as well as any domain-specific axioms, needed to solve the problem.

b In addition to the assumptions of part a, assume that initially Mary is carrying the book. Assume also that, if a person carries an object, then the object is at the same location as the person. Use these assumptions, formalised in situation calculus notation, in addition to the assumptions and axioms formalised in part a, to show that

> immediately after Mary travels from home to work,
> the book is at work.

The two parts carry equal weight.

3a i) Describe the main steps in a general graph-searching procedure. Include the role of the OPEN and CLOSED lists of nodes.

ii) What is an A* graph-searching algorithm and what result does it guarantee?

b A well-known puzzle involves four counters: two black and two white. Initially, they are laid out in a row, the black ones on the left, the white ones on the right and a gap in the middle:

The aim is to move the counters into a goal position in which both white counters are to the left of both black counters, irrespective of the final postion of the gap.

A counter can be slid into an adjacent gap, with cost 1. Alternatively, a counter can jump over one or two counters of the ***opposite*** colour into the gap, in which case the cost is equal to the number of counters jumped over. Black counters can only move to the right and white counters only to the left.

i) Propose and justify an effective heuristic evaluation function that can be employed by an A* algorithm to solve this puzzle.

ii) Draw that part of the search space explored when your A* algorithm is applied to the puzzle. What solution does the algorithm discover?

It may be easier for you (and the marker) if you lay out your answer to subpart b ii) in "landscape" mode.

The four subparts carry, respectively, 30%, 20%, 25%, 25% of the marks.

Turn over ...

4 a i) Compare and contrast the concepts of supervised and unsupervised learning.

ii) Describe briefly the following algorithms for supervised learning : decision tree learning, neural networks and genetic algorithms

b Given the following set of training examples:

Instance	A1	A2	Class Value
1	T	N	1
2	T	O	0
3	F	N	1
4	T	N	0
5	F	N	1
6	T	O	1
7	F	O	0

i) What is the entropy of this collection of training examples with respect to the target classification ?

ii) Compute the information gain of A2 relative to the set of training examples

iii) Apply the naïve Bayes classifier method to determine the class value of the

data: <A1: F, A2: O>

The two parts carry, respectively, 25%, 75% (25% each subparts) of the marks.

End of paper