UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1996

BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
BSc Honours Degree in Mathematics and Computer Science Part III
MSc Degree in Computing Science
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
Associateship of the Royal College of Science

PAPER I3.22 / M326

ARTIFICIAL INTELLIGENCE

Wednesday, May 15th 1996, 10.00 - 12.00

Answer THREE questions

For admin. only: paper contains
5 questions
3 pages (excluding cover page)

1 A game is played with a pile of 5 gold coins. Two players A and B take it in turns to remove 1, 2 or 3 coins from the pile. When all the coins are finally taken each player must discard all complete sets of three coins they hold. If both players are left with one coin then the game is a draw. Otherwise the player holding a non zero number of coins wins all the coins.

a i) For this two person game explain what is meant by the terms *Game Tree*, *backed up values* and *forcing tree*.

ii) What information must be held for each position in this game?

b Draw the game-tree for this game and compute the expected outcome using the mini-max procedure. Place moves in your tree in the order *take 1*, *take 2* or *take 3 coins* .

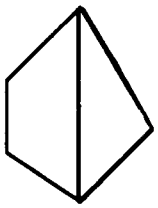
c Show carefully on your game tree how Alpha-Beta cutoff can be used to reduce the number of nodes that need to be expanded.

How many nodes can be pruned in this example?

2a Briefly explain the principles behind the line labelling approach to scene recognition.

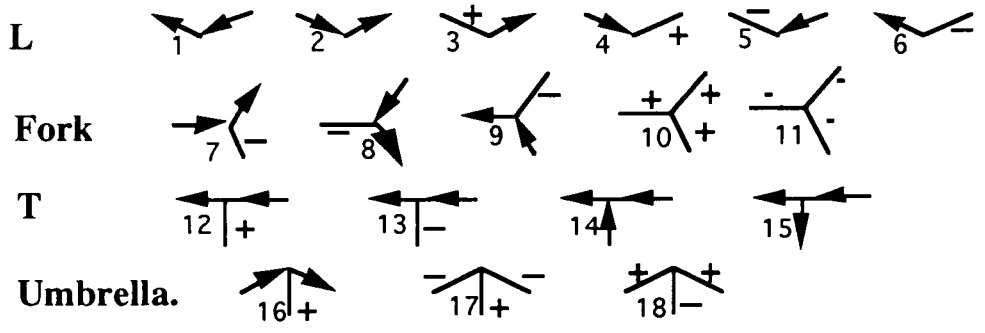
What assumptions are usually made about a scene to assist the interpretation process and how do they help?

b Describe carefully the WALTZ algorithm and use it to find all the consistent trihedral world labellings of the following scene. Give physical interpretations of the labellings, if possible.



c Outline what extra factors must be taken into account to allow more realistic scenes to be analysed. Indicate what problems remain with this labelling approach, even with these extensions, and suggest briefly how they might be tackled.

For reference the possible labellings of vertices are:-



The three parts carry, respectively, 25%, 50% and 25% of the marks.

3 A possible definition of learning is "Learning is the ability to improve performance as the result of practical personal experience."

a Explain the principles of Rote Learning and describe two distinct applications of the technique (one to a game playing and the second to a non game playing situation). Briefly outline Rote Learning's benefits and limitations suggesting ways of minimising the latter.

b Describe carefully a second method of learning applicable to games such as Chess. Explain the Credit Assignment problem in this context and suggest how this might be overcome.

c One difficulty for a beginner is how to decide what moves are good. Outline ways in which a novice human chess player could learn good play and briefly discuss machine analogues of two of these (including at least one not mentioned in section b). In what way might the above definition have to be modified in the light of this?

4 AI could be defined as "the pursuit of Intelligence".

a In the light of this briefly explain the two main streams of AI research.

Describe one program from each stream which might be considered a "success" of that line of research and comment on the quality of "Intelligence" exhibited by each.

b Lenat's Automated Mathematician program (AM) is claimed to have discovered non trivial results in number theory. Sketch out the structure and operation of the AM program, briefly outlining some of its achievements and limitations.

c Outline two other factors which you feel characterise "intelligent behaviour" and suggest some ways in which this behaviour could be exhibited by a program. Suggest some human characteristics which you feel would be very difficult or impossible for a computer program to simulate, indicate briefly why you think they are so problematic.

Turn over ...

5a. Briefly explain Schank's aims in developing Conceptual Dependency (CD) Theory. State his three basic design principles.
Describe the basic components of an event in CD, giving examples of each.

b Outline a CD representation for the following short story, showing how the meaning of each sentence can be expressed in CD.

> Mary drove to the supermarket.
> She bought a pack of sandwiches.
> It dropped on the floor. So Mary picked it up and put it in her bag.
> Later she ate them.

c Suggest how the CD representation could be used as a basis for answering questions such as the following:-
i) How did Mary get to the supermarket?
ii) Did Mary pay for the sandwiches?
iii) What made the sandwiches fall to the floor?
iv) Where are the sandwiches at the end of the story?

d Briefly discuss why the CD answer to question c/iii) above is likely to differ from that given by a human. Indicate what information is present in or can be inferred from the CD representations that is not explicit in the original sentences.

End of paper