UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1999

BSc Honours Degree in Mathematics and Computer Science Part III
MSci 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 Royal College of Science

PAPER M 3.26

ARTIFICIAL INTELLIGENCE

Thursday, May 13th 1999, 2.00 – 4.00

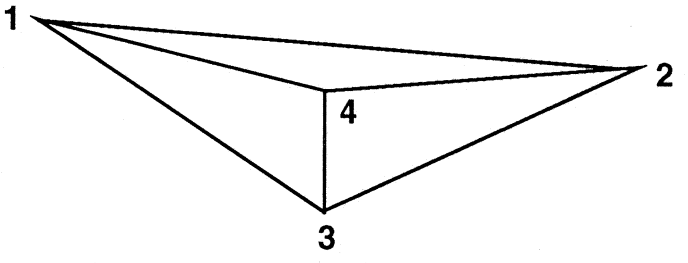
Answer THREE questions

For admin. only:
paper contains 4 questions

1a Briefly explain the principles behind the line labelling approach to scene recognition.

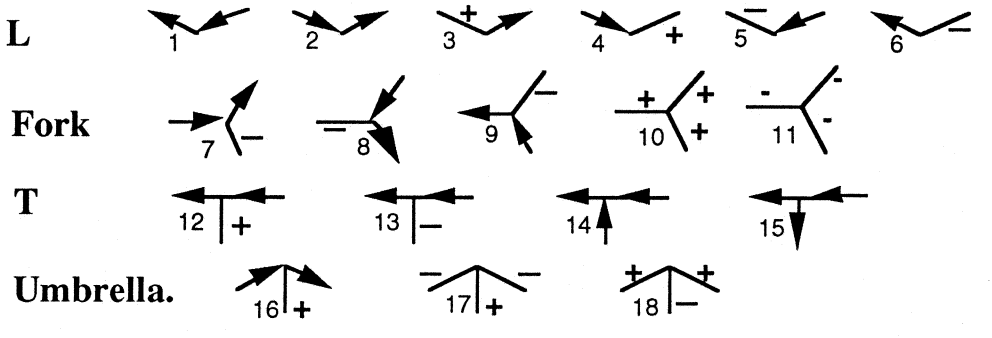
What assumptions are usually made about a scene to assist the interpretation process and how do they help?

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 the extra factors that 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.
Suggest briefly some alternatives to the Waltz approach which might overcome some of the problems.

For your reference the possible labellings of vertices are:-



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

2a What is meant by *hill climbing* as a method of search and by *signature tables* in learning?

b Explain with diagrams the major and one minor problem with *hill climbing* as a search method and suggest a way of solving each.

c Describe carefully how you would apply *hill climbing* and *learning by search* to the game of Hexapawn on a 6 wide x 4 high board which is too large for easy exhaustive analysis. Suggest how you would overcome the training problem in this case.

d Briefly discuss two further problems with *linear evaluation functions* which limit the effectiveness of learning by search and outline possible solutions.

e In what situations might a *linear evaluation function* not be effective? Suggest a possible alternative approach to learning in this case.

The five parts carry, respectively, 15%, 20%, 25% 25% and 15% of the marks.

3a State the three design principles behind Schank's Conceptual Dependency theory (CD).

b Describe the basic components of an event in CD and the two types of basic primitive, giving examples of each.

c The events described by the sentences below have a common CD action. Outline a CD representation for each one, showing how the meaning of each sentence is distinguished in CD even though a common action is used.

The buttered toast fell from the table onto the floor.
A stone hit the window.
The yacht sailed out of the harbour.
Lunar explorer-V took off yesterday.
The old car struggled up the hill.

d Indicate what elements need to be present in the CD representations that are not explicit in the sentences in part c.

Suggest an inference which could be associated with the common primitive action used above and state some of the conclusions that might be drawn from the examples in part c using it.

e Briefly discuss the benefits we hope to gain by expressing natural language information in CD or similar form.

The five parts carry, respectively, 20%, 20%, 25%, 20% and 15% of the marks.

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

a Briefly explain the two main streams of AI research from this viewpoint.

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. Discuss the aspects of its operation which contributed to its successes and failures. Suggest your own design for a learning program which might overcome some of its problems.

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.

d Give 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 and suggest ways in which they might be dealt with in a computer program.

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

End of paper