UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2003

BEng Honours Degree in Computing Part II
MEng Honours Degrees in Computing Part II
MSc in Computing Science
BSc Honours Degree in Mathematics and Computer Science Part II
MSci Honours Degree in Mathematics and Computer Science Part II
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute
This paper is also taken for the relevant examinations for the Associateship of the Royal College of Science

PAPER C231=MC231

ARTIFICIAL INTELLIGENCE I

Friday 9 May 2003, 14:30
Duration: 120 minutes

Answer THREE questions

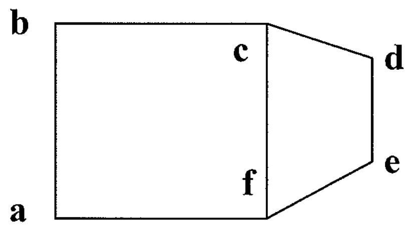
Paper contains 4 questions
Calculators not required

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?

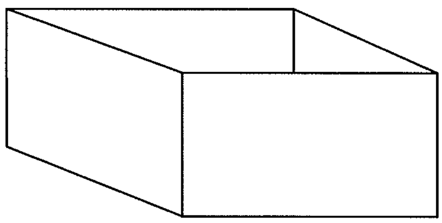
b i Apply the WALTZ to find all the consistent ***Trihedral World*** labellings of the following scene, carefully describing the essential steps. (You should visit the vertices in the order **a** to **f)**

ii Give physical interpretations of each consistent set of labellings, if possible. Comment on what it means if a consistent labelling is physically impossible?

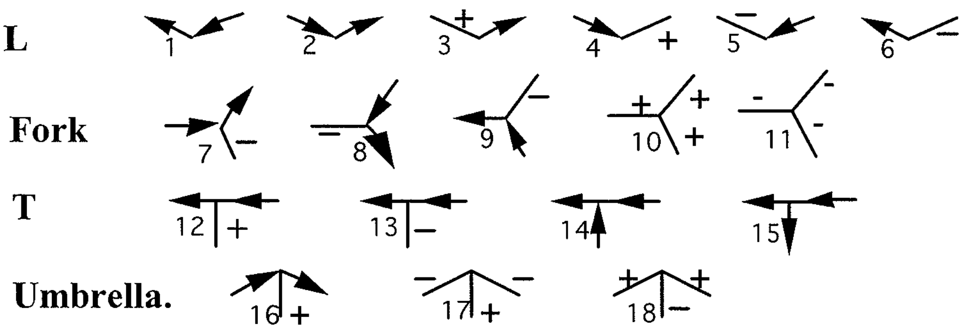


c ***Origami World***. We wish to extend our recognition to allow Origami type objects (ie ones made with thin paper like the paper box below.)

Draw out ***three new*** physically possible vertex labels which we would have to add to our list in order to recognise the scene below. Mark them on a copy of the scene. Note there are in fact four new labels in the scene.



For your reference the possible labellings for vertices are:-



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

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

b Explain with diagrams the major and one minor problem with *hill climbing* as a search method and suggest ways 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.

Each part carries equal marks.

3 AI could be defined as "the pursuit of I ntelligence".

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 and in view of these sketch your own design for a learning program which might overcome some of its problems.

c Give some important 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.

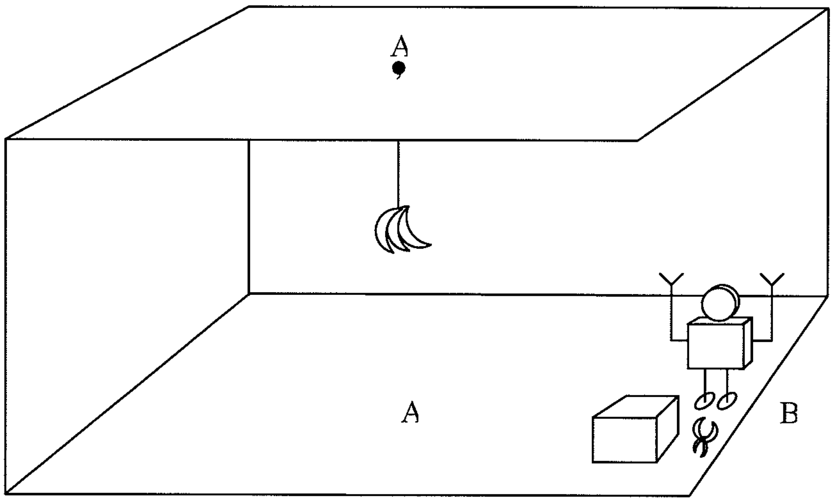
Each part carries equal marks.

4a In the context of planning explain what is meant by *linearly separable problems* and why *Frame Axioms* are needed.

What method did Newell's General Problem Solver (GPS) use to guide its search?

b A robot is at position B beside a box on which are some cutters. Suspended by a thick rope in the middle of the room is a bunch of bananas, just out of reach of the robot when standing on the floor. The robot can get the bananas provided it-is-on-the-box-at A and the robot-is-holding the cutters.

The robot can move itself and the box from place to place. It can also pick up and put down the cutters. However the robot cannot push the box and carry the cutters at the same time. The robot can climb onto the box in a given position X.



Describe what information a linear STRIPS-like planner needs about this problem and outline how it would go about generating a plan to to get the bananas for its human master.

ie to achieve the goals robot-on-box(A) & robot-holding(cutters).

c Show how the above task creates an example of Sussman's anomaly and explain the implications of this. Suggest two ways in which a linear planner could be modified to get efficient plans for such anomalous situations.

d STRIPS and similar planners have many other limitations. Discuss the difficulties this type of planner has compared with a human when given Michie's "Keys and Boxes" problem to solve and suggest possible ways of overcoming them

Each part carries equal marks.

End of paper

