UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2002

BEng Honours Degree in Computing Part II
MEng Honours Degrees in Computing Part II
BSc Honours Degree in Mathematics and Computer Science Part II
MSci Honours Degree in Mathematics and Computer Science Part II
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
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

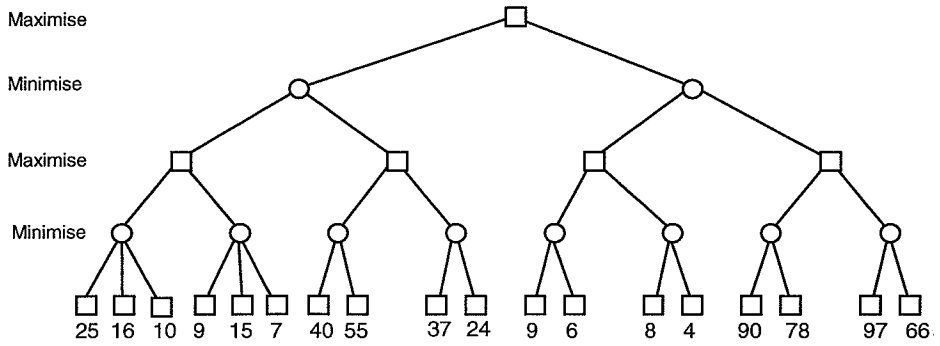
Tuesday 23 April 2002, 14:00
Duration: 90 minutes
(Reading time 5 minutes)

Answer THREE questions

Paper contains 4 questions
Calculators not required

1a Define the terms *Static Evaluation function*, *Quiescence* and *Horizon Effect* giving examples of each.

b Explain the motivation and working of the Mini-Max procedure using the following Game tree.



c Show carefully, using your tree, how Alpha-Beta pruning can reduce the number of nodes which need to be evaluated indicating which nodes or subtrees can be pruned and why.

d Give one other method of improving the search and discuss the factors which influence the effectiveness of any search methods chosen.

e What critical assumption does the Mini-max procedure make when choosing the "best" move?

Briefly explain why a program using the minimax procedure **cannot** play against a novice as effectively as an experienced human player . Outline how this could be remedied.

Each part carries approximately equal marks.

2a. 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 possible representation for the following short story in CD, showing how the meaning of each sentence can be expressed in terms of the CD primitives.

> 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.

Each part carries approximately equal marks.

3 Charles Dodgson (better known as Lewis Carroll) proposed the following Word Chain problem:

Given two N letter words, form a chain between them by changing a single letter at a time, but ensuring that each intermediate string is a valid word.

For example **HORSE** could be transformed to **MOOSE** by the (not necessarily shortest) chain of words:

HORSE - HOUSE - MOUSE - MOOSE

a Specify carefully what is meant by the *State Space* and *branching Factor* of any problem.

b Work out the theoretical maximum number of possible states for an N letter word chain problem?

What is the theoretical (worst case) branching factor for naive breadth first search on the N letter word problem and how many states are theoretically reachable in **S** steps of a breadth first search?

Explain why the **real** branching factor is very much less than this.

c Consider the Word Chain problem of changing **SAD** into **JOY:**

Generate part of the **actual** *State Space* for this problem. Include at least 10 words and at least two solution paths.

Given any two N letter words, what is the theoretically shortest possible chain length between them? Justify your answer in the general case.

In view of this, suggest a simple heuristic to select the best change (move) to make at each step and show how it would work on your *State Space* above.

d Outline the design for a program to match human performance in this *mind game*

What kind of resources would it need and what is its likelihood of success?

Each part carries approximately equal marks.

4a Define what is meant by the *Frame Axiom* in a planning context and explain its importance. Give a situation when it might fail and suggest the implications of this.

Goldilocks wants some breakfast. She finds three unattended bowls of porridge on a table in the three bears' cottage. The largest bowl has a large spoon and the porridge is very hot. The second bowl has a medium sized spoon and the porridge is very sweet. The third bowl has a small spoon and the porridge is just right.

Goldilocks can eat porridge if:
1/ the spoon is not large
and 2/ the porridge is not very hot and not very sweet.

b Express Goldilock's breakfast problem in simple Linear planner style, showing what information is needed and how it is represented.

c Carefully describe how such a planner can generate a plan for the above problem.

d Outline how the planning mechanism could also be used to generate a reasonably coherent story from the example in a manner similar to the TALESPIN program.

Each part carries approximately equal marks.

End of paper