NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
DECEMBER EXAMINATIONS 2001

SUBJECT: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
CODE: SCS 5203

INSTRUCTION TO CANDIDATES

This question consists of seven questions
Answer any five (5) questions

Time: 3 hours

QUESTION ONE

a) Define the term forward-chaining reasoning. [5]

b) State what is meant by Conflict Resolution in a Production system, and describe three possible Conflict Resolution Strategies. Explain why more than one conflict resolution strategy is usually needed. [10]

c) What would be the result of the following Prolog query?

?-[Head/Tail]=[tom,sue,joe,mary]. [5]

QUESTION TWO

a) What problem-solving skills of a human expert may be implemented in an expert system? [10]

b) The following Prolog program says that two people are relatives if:

i) one is a predecessor of the other, or
ii) they have a common predecessor, or
iii) they have a common successor:

```
relatives (x,y):-
        predecessor (x,y).

relatives (x,y):-
        predecessor (y,x).
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```
relatives (x,y):-
        predecessor (z,x),
        predecessor (z,y).

relatives (x,y):-
        successor (x,z),
        successor (y,z).
```

Shorten this program by using the semicolon. [5]

c) Define two predicates;

evenlength (List) and oddlength(List).

So that they are true if argument is a list of even or cdd length respectively. For example, the list [a,b,c,d] is even length and [a,b,c] is odd length [5]

QUESTION THREE

a) State the potential benefits of expert systems in a commercial environment. [10]

b) Given the production rules:

Rule 1: **if associated (disease, Sign)**
and has-symptom (Patient, Sign)
then add investigate (Patient,Disease).

Rule 2: **if test-for (disease, Test)**
and investigate (Patient,Disease)
then add request-test (Patient,Test).

and these initial facts in working memory (most recently added facts are at the top):

associated (malaria,jaundice).
associated (hepatitis, nausea).
associated (hepatitis, jaundice).
test for (hepatitis, liver-function).
test for (malaria, microscopy).
has-symptom (moyo, nausea).
has-symptom (moyo, jaundice).

Show the conflicts sets and changes to working memory for 4 cycles of forward-chaining, using conflict resolution strategies (in order of priority): [recency, rule order] [10]

QUESTION FOUR

a) Sketch the components of an Expert system. [5]

b) State what is meant by the "Fundamental Tradeoff" in Knowledge Representation and Inference. [5]

c) A program incorporates use menus, where the user selects an option by entering a number. A menu is represented as a list of text strings, such as
["Update customer account", "View customer details", "Add new customer", ---].

Write a predicate display-menu, which takes such a list as argument and displays the menu options, numbered, on successive lines, for example:

i) Update customer account
ii) View customer details
iii) Add new customer
etc---- [10]

QUESTION FIVE

a) Describe briefly two alternative techniques for Knowledge representation. [8]

b) How would you assess whether a proposed problem is suitable for the application of an Expert system solution? [8]

c) Write a depth-first search procedure (with cycle detection)
depthfirst1 (candidatePath, Solution).

to find a solution path solution as an extension of CandidatePath. Let both paths be represented as lists of nodes in the inverse order, so that the goal node is the head of solution. [4]

QUESTION SIX

a) State two kinds of questions that the explanation facility of an Expert System should be able to answer. [4]

b) Describe how such explanations can be generated in a rule-based system. [10]

c) Define the procedure

add (item, list)

to store a new element into a list. Assume that all of the elements that can be stored are atoms. List contains all stored elements followed by a tail that is not instantiated and can thus accommodate new elements. For example, let the existing elements stored be a.b.c. Then

List = [a,b,c|Tail].

where tail is a variable. The goal

add (d,List).

will cause the instantiation

tail = [d/New Tail] and List = [a,b,c,d/New tail]. [6]

QUESTION SEVEN

a) What are the differences between monotonic and non-monotonic logics (reasoning)? [8]

b) Describe one alternative technique for dealing with uncertainty. [8]

d) Consider the following statements about an elephant:

- A mammal is a king of animal
- Walking is the normal moving method of mammals
- An elephant is a mammal
- Horatio is an elephant
- An elephant has a task, and so does horatio.

Represent these as a semantic network, with ***isa*** and ***ako*** relationships.

END OF QUESTION PAPER

GOOD LUCK!