NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
DECEMBER EXAMINATIONS 2004

SUBJECT: ARTIFICIAL INTELLIGENCE
CODE: SCS4101

<u>INSTRUCTION TO CANDIDATES</u>

Answer any five questions
Each question carries 20 marks

Time: 3 hours

QUESTION ONE

a)   How is a knowledge base different from a database?   [2]

b)   Discuss the limitations of rules in knowledge representation as compared to frames.   [8]

c)   Explain the difference between Backward chaining and Forward chaining.
                                                                      [10]

QUESTION TWO

Explain the following terms fully with the aid of diagrams and mention how they are used in natural language processing:

i)   augmented transition network   [10]
ii)   parse trees   [10]

QUESTION THREE

Consider a production system that might be used to identify food items. The context data structure is a simple list of symbols called a context list (CL).
"On – CL X" means that the symbol X is currently in the context. The system has the following rule base and interpreter.

Productions:

P1	IF On-CL green THEN Put-On-CL produce
P2	IF On-CL packed in small container THEN Put-On-CL delicacy
P3	IF On-CL refrigerated OR On-CL produce THEN Put-On-CL perishable
P4	IF On-CL weighs 15 1bs AND On-CL inexpensive AND NOT On-CL perishable THEN PUT-On-CL Staple
P5	IF On-CL perishable AND On-CL weighs 15 lbs THEN Put-On-CL turkey
P6	IF On-CL weighs 15 lbs AND On-CL produce THEN Put-On-CL watermelon.

Interpreter:

1. Find all productions whose conditions parts are TRUE and make them applicable.

2. If more than one production is applicable then deactivate any production whose action adds a duplicate symbol to the CL.

3. Execute the action of the lowest numbered (or only) applicable production. If no productions are applicable, then quit.

4. Reset the applicability of all productions and return to 1.

Suppose the original knowledge about the mystery food item is that it is green and weighs 15 lbs. Describe and explain all the cycles and steps that the production system will go through until the interpreter finally quits. Show all changes to the context list through out this procedure.   [10]

b)   A science consists of a body of proved principles that have been abstracted from nature through processes of empirical inquiry and logical deduction. An art can be regarded as a collection of techniques developed pragmatically to a sophisticated level but not necessarily in a logical way. Discuss whether Artificial Intelligence is an Art or a Science.
                                                                                [10]

QUESTION FOUR

a)   i)   Give a formal definition of a prolog predicate.   [2]

      ii)   Give the meaning of the rule:

            Grandfather (X,Z) :- parent (X,Y), male (X)   [3]

b) A customer approaches you with a proposal for a possible expert system application. What questions to assess the suitability of an expert systems for the applications would you ask and why? [5]

c) A pocket calculator has a stack on which it pushes numbers typed in. When one of the keys , +, *, - or / is pressed this operation is applied to the top two elements of the stack. Thus if I type 1 2 then the stack contains 1 then 2. If I now press + then the stack simply contains 3. If I then press 4 5 * - then the stack has

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3    4
3    4    5
3    20
-17
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at successive presses. Pressing C clears the stack.

i) Write a specification for a relation calc (Input, Stack) that says 'Stack is the state of the stack after the input of the list of items Input'. Implement Input as a reverse list of integers and the objects +, -, *, / and C (for clearing the stack), and implement the stack as a list with the top element at the front. [5]

ii) Demonstrate how the above example works using your solution, that is, that

Calc ([-, *, 5, 4, +, 2, 1], [-17]) can be proved. [5]

QUESTION FIVE

a) You are given a list of intervals that restrict an algebraic variable X to an integer range, all of the form

[min,I]   [I,J]   or   [j, max]

where I and J are integers. The ranges are inclusive,

[min, I] denotes all integers less than I, [j, max] all integers greater than J. Such a list is called a cover of integers if every integer belongs to at least one of the intervals. So [[3, max], [min,0], [-2, 7]] is a cover but [[3, max], [min, 0]] is not. Write an extended Prolog specification that is true if a given list is a cover. [10]

b)   Within the context of A1 what is a conflict resolution and what are some of the resolution strategies?   [4]

c)   Describe the various methods of knowledge elicitation.   [6]

QUESTION SIX

a)   Describe how knowledge may be represented in each of the 3 parts of a production system.   [10]

b)   Write a specification of a relation that accepts two lists, A and B and is true if B is A in reverse order. The relation should behave symmetrically thus

?- reverse ([1, 2, 3, 4], X).

will give the solution X = [4, 3, 2, 1] and so will
? – reverse (x, [1, 2, 3, 4]).   [10]

END OF QUESTION PAPER

GOOD LUCK!