UNIVERSITY OF BUEA

FACULTY OF ENGINEERING

END-OF-SEMESTER EXAMINATIONS

DEPARTMENT: Computer Engineering

MONTH: March

YEAR: 2014

DATE: 05/03/2014 TIME: 08:00-11:00

TIME ALLOWED: 3 hours

COURSE INSTRUCTOR: Mr. Nyanga B.

COURSE CODE & NUMBER: CEF409

COURSE TITLE: Fundamentals of Artificial Intelligence.

CREDIT VALUE: 4

INSTRUCTIONS: **Read through EACH question before you answer it. Follow instructions for EACH Section. Time is allocated for a MAXIMUM POSSIBLE MARK of 70. Programs assumed to be in Standard Prolog. State any assumptions made. Penalty for poor English or poor presentation of work.**

ATTEMPT ALL QUESTIONS FOR AT MOST 70 MARKS

Q1) **(12 = ([3+3+2+4]) Marks)**

Translate the following statements into Prolog rules:

a) Everybody who has a child is happy (introduce a one-argument relation happy).

b) For all X, if X has a child who has a sister, then X has two children (introduce new relation hastwochildren).

c) Define the relation grandchild using the parent relation. (Hint: It will be similar to the grandfather relation!!)

d) Define the relation aunt(X, Y) in terms of the relations parent and sister. (As an aid, you can first draw a diagram).

Q2) **(20 = 4, [16 = (1+2+1)*4]) Marks)**

i) Given some of the problems in defining Artificial Intelligence (AI), four views (inter alia) of AI have been considered in relation to human intelligence, viz: (*a*) acting humanly, (*b*) thinking humanly, (*c*) thinking rationally, and (*d*) acting rationally. State (IN <= TWO LINES) what these views means.

ii) For each of the FOUR views in (ii), give one example problem (OR application area) that has become a subfield (or area of study) in AI. Example problems/areas must be distinct. For each example:

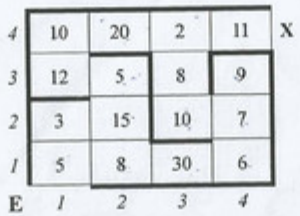
a. State and briefly explain what the subfield is;

b. Highlight a main issue in the subfield and a possible (or current) AI solution;

c. Show clearly how the subfield derives from one of the views of AI given in (ii).

Q3) **(22 = 8, 6, 5, 3 Marks)**

In Artificial Intelligence (AI), a problem is a goal and a means for achieving that goal; its solution is a sequence of actions applied to an initial state so as to attain the goal state.



Suppose a maze is as given in the figure adjacent where one gets in at the entrance **E** and exits to **X**. (The positions of **E** and **X** may change for different mazes.) An agent can only move horizontally or vertically to an adjacent cell, unless there is a wall (thick line). That is, it can only Move Left, Move Right, Move Up, or Move Down. Cells are identified by their horizontal and vertical grid positions, e.g. (1,4) for the top-left corner. The value in each square indicates a cost to the agent each time the agent enters the cell. There is no additional cost from that cell on exit or when the agent remains in the square.

The idea is that one want to go through the maze at a minimum cost.

i) Formulate this maze traversal as a search space problem. Assume the agent is initially at entry point **E**, and can only Move Up. **[Hint**: Aim for the least path cost through the maze to position **X**.]

ii) Give a diagrammatic representation of the FIRST THREE LEVELS of the search tree for the problem formulated in (i); label nodes with the distance covered so far.

iii) Take one of the leaf nodes in (ii), generate its successor nodes (expanding states) and compute the total distance travelled by the agent so far.

iv) Define, IN WORDS ONLY, a suitable heuristic that could be used, for example, in Greedy search or A* search. Why do you think it is a suitable heuristic? **[Hint**: A good heuristic is the solution to a simplified form of the problem. Also, your heuristic should work, even if the positions of **E** and **X** change.]

Q4) **(20 = [8=2+2+2+2] + [4.5=1.5+1.5+1.5] + [7.5=2.5+2.5+2.5] Marks)**

i) Search algorithms are measured by their: (a) completeness; (b) time complexity; (c) Space complexity; and (d) optimality. Explain IN AT MOST THREE LINES EACH what these concepts mean.

ii) Briefly express the key ideas in the following algorithms, and therefore explain how they work: (*a*) breadth-first search; (*b*) depth-first search; (*c*) best-first search. Please do NOT give the actual algorithms.

Briefly explain how: (a) Depth Limiting Search (DLS) improves on depth-first search; (b) A* search improves on Greedy search; and (c) alpha-beta pruning improves on minimax. Note that from your answer, we must know how the improved algorithms work *and* the improvements they make.

ALL THE BEST!

THE END