



UNIVERSITI KUALA LUMPUR  
MALAYSIAN INSTITUTE OF INFORMATION TECHNOLOGY

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**FINAL EXAMINATION**  
**JANUARY 2016 SEMESTER**

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**SUBJECT CODE** : IBB 31103  
**SUBJECT TITLE** : INTRODUCTION TO ARTIFICIAL INTELLIGENCE  
**LEVEL** : BACHELOR  
**TIME / DURATION** : 9.00 am – 11:30 am  
( 2 1/2 HOURS )  
**DATE** : 26 MAY 2016

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**INSTRUCTIONS TO CANDIDATES**

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1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of ONE (1) section. Section A.
4. Answer only FOUR (4) questions in Section A.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English.

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THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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SECTION A (Total: 100 marks)

INSTRUCTION: Answer FOUR questions only

Please use the answer booklet provided.

Question 1

(a) The Wumpus world is a cave consisting of rooms connected by passageways (See figure 1-a below). Lurking somewhere in the cave is the terrible Wumpus, a beast that eats anyone who enters its room. The Wumpus can shot by an agent, but the agent has only one arrow. Some rooms contain bottomless pits that will trap anyone who wanders into these rooms. The agent has five sensors as below:

- If the square contains Wumpus, the agent will perceive a stench in the adjacent Squares
- In the Squares directly adjacent to a pit, the agent will perceive a Breezy
- In the square where the gold is, the agent will perceive Glitter

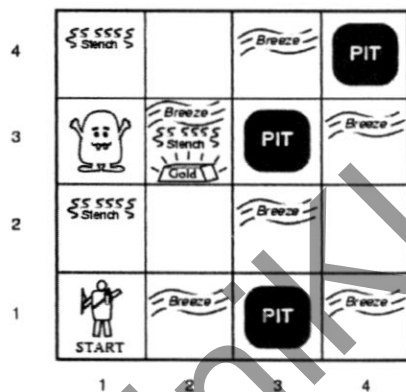


Figure 1-a

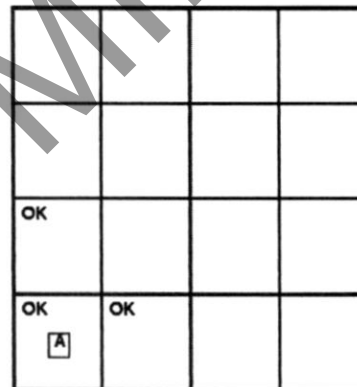


Figure 1-b

Assuming that the agent is at square [1,1] as seen in figure 1-b, Perform a search in order to find the solution to the above problem. The solution in the Wumpus problem is "reaching gold".

- Explain how square [1,1] is a **safe square**
- What **squares** that the agent infers and marks as **Safe Square**?
- Repeat drawing the figure 1-b with all **inference** that the agent will make. You may use B for Breezy; S for Stench; P for Pits, W for Wumpus; OK for safe squares and A for agent.

(8 marks)

- (b) Explain the Bi-Directional search strategy in AI. What is its space complexity?  
(4 marks)
- (c) Define the concept of *Unification* in Prolog. How do two terms unify in Prolog?  
(4 marks)
- (d) Use truth tables to show that the following **WFF** are always true in Propositional Logic
- (i).  $P \wedge (Q \vee R) \Leftrightarrow (P \wedge Q) \vee (P \wedge R)$
  - (ii).  $\sim(P \wedge Q) \Leftrightarrow (\sim P \vee \sim Q)$
  - (iii).  $(P \Rightarrow Q) \Leftrightarrow (\sim P \vee Q)$
- (6 marks)
- (e) What is the difference between Valid and Satisfiable statements in Propositional Logic?  
(3 marks)

**Question 2**

- (a) Discuss the Model based Reflex Agent? Show, by using a diagram, the interaction between the agent and its environment  
(7 marks)
- (b) What do we mean by Autonomous Agent?  
(3 marks)
- (c) Identify the Performance measure, Environment, Actuator and Sensors for the following agents:
- (i). Part-picking robot
  - (ii). Automated Taxi Driver
- (8 marks)
- (d) What is the output of the following Prolog queries?
- (i). ?- k(s(g),Y) = k(X,t(k)).
  - (ii). ?- loves(X,X) = loves(marsellus,mia).
  - (iii). ?- k(s(g),t(k)) = k(X,t(Y)).
  - (iv). ?- [a] = [H|T].
- (4 marks)

(e) How do we read the following statements written in First Order Logic:

(i).  $\forall x \text{ Red}(x)$

(1 mark)

(ii).  $\forall x \text{ Likes}(x, \text{AI})$

(1 mark)

(iii).  $\forall x \text{ Study}(x, \text{AI}) \Rightarrow \text{Smart}(x)$

(1 mark)

**Question 3**

(a) In cats and mice puzzle, three cats and three mice come to a crocodile infested river. There is a boat on their side that can be used by one or two "persons". If cats outnumber the mice at any time, the cats eat mice.

(i). How can we represent the (The initial state, the goal state and the operators)

(3 marks)

(ii). Suppose the agent move from state (1, 1, RIGHT, 2, 2) to a new state (1, 3, LEFT, 2, 0), Identify the preconditions of this operator

(4 marks)

(iii). List all the preconditions and provide the output state for each of below operators assuming the predecessor state is (***cleft, mleft, boatpos, cright, mright***):

Move-1m1c-lr,

Move-2c-rl

(6 marks)

(b) In *Breadth First Search*, Suppose  $b = 10$ , the processing speed is 1000 node/sec and each node needs 100 byte of storage, Determine the required time and space by filling the below table:

Depth	Nodes	Time	Memory
0			
2			
4			
6			
8			
10			

(8 marks)

(c) Based on **Modus Ponens** which is defined as  $\frac{\alpha \Rightarrow \beta, \alpha}{\beta}$ , What can be inferred from the below sentences:

- a.  $(Hungry \wedge FoodisAvailable) \Rightarrow Eat$  and  $(Hungry \wedge FoodisAvailable)$
- b.  $(WampusAhead \wedge WampusAlive) \Rightarrow Shoot$  and  $(WampusAhead \wedge WampusAlive)$

(4 marks)

**Question 4**

(a) Identify the Head and the Tail in the following Prolog List

`[[ ], dead(z), [2, [b,c]], [ ], Z, [2, [b,c]]]`

(2 marks)

(b) To facilitate a search algorithm, a data structure is needed for each node to maintain housekeeping information to be used during search. What are the information that are kept in the data structure?

(5 marks)

(c) What is the special case that makes the Breadth First Search and Uniform Cost Search same?

(3 marks)

(d) What is the Space Complexity of Uniform Cost Search if we assume  $C^*$  is cost of optimal solution and every action costs at least  $\epsilon$  ?

(3 marks)

(e) Consider the following Route finding in Romania problem (not drawn to scale).

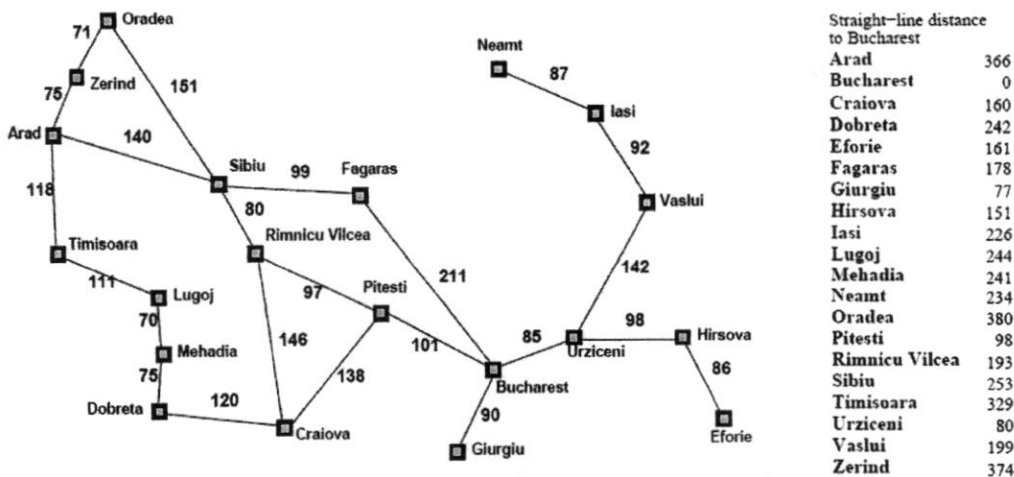


Figure 2

Using the *Greedy Search algorithm*, **find the solution** of the above problem assuming that Arad is the initial state and Bucharest is the Goal State if the heuristic function used is the straight line Distance between any town and Bucharest as given in the table above.

**Provide the search tree for your solution, showing the order in which the nodes were expanded and cost at each node.** Finally, state the route you would take and the cost of that route.

(6marks)

- (f) Write a Prolog program to define an append clause where append (L1,L2,L3) is true if list L3 is the result of concatenating the lists L1 and L2 together

(6 marks)

**Question 5**

- (a) Suppose we have the following facts and rules in our knowledge base.

`loves(vincent,mia).`

`loves(marsellus,mia).`

`jealous(A,B):- loves(A,C),loves(B,C).`

Explain how unification is done by drawing a search tree of the above knowledge if the following query is being asked

?- `jealous(X,Y).`

(6 marks)

- (b) What are the outputs of the following Prolog code?

?- `X=2,Y=3, Z is X+Y.`

?- `X=20,Y=13, Z is X*Y.`

?- `A=(20+40) / 6 , B is (A*A) +4.`

?- `[a|[b|[c|[]]]]= List.`

(6 marks)

(c) Write a Prolog program to sum elements of a list of numbers

(6 marks)

(d) Represent the following statements in First Order Logic:

- a. The wumpus is smelly
- b. Elvis is dead
- c. Income is inadequate
- d. John plays football on Tuesday
- e. Somebody likes Mary
- f. There is a breeze in some square
- g. Richard is John's brother

(7 marks)

END OF EXAMINATION PAPER

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