# KABARAK UNIVERSITY

## UNIVERSITY EXAMINATIONS

## 2008/2009 ACADEMIC YEAR

## FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCINCE

**COURSE CODE: COMP 413**

**COURSE TITLE: ARTIFICIAL INTELLIGENCE**

**STREAM: Y4S1**

**DAY: MONDAY**

**TIME: 2.00 – 4.00 P.M.**

**DATE: 10/08/2009**

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**INSTRUCTIONS:**

**Answer The First Question and any Other Two Questions.**

**PLEASE TURN OVER**

**QUESTION 1 (30 MARKS)**

(a). (i). Assume a computer game. For the computer to satisfy the Turing test in the game, explain two behaviors you think it should exhibit. **(2 Marks)**

(ii). Give two characteristics of an intelligent agent. **(1 Marks)**

(b). Describe the following AI research areas showing a description of what each area is aimed at, an application of the area, and a main challenge involved.
(i). ICAI (ii). NLP (iii). Computer graphics **(12 Marks)**

(c). Briefly explain the meanings of the following Artificial Intelligence terms. Give examples.
(i). Heuristics (ii). Tree pruning (iii). Backtracking **(3 Marks)**

(d). Using truth table, proof that;
( A Or ( B And C ) ) <=> ( ( A Or B ) And ( A Or C ) ) **(3 Marks)**

(e). Assume two existing predicates **person (A)** that shows that **A** is a person, and **richer(A, B)** that shows that person **A** is richer that person **B**.
Symbolize the following sentences in predicate logic using the above predicates.

(i). There is a person who is richer than Tom.
(ii). If a person is richer than Tom, then he is a billionaire.
(iii). Jack is the richest person. **(3 Marks)**

(f). Write down the output of the following Prolog program (when the user types the command go).

```
go:-calculate(10,3).
calculate(A,B):-compute(A,B,B,0).
compute(A,A,C,D):-X is D+1,show(X).
compute(A,B,C,D):-(A>B;show(D)),(A<B;T is B+C),E is D+1,
(A<B;compute(A,T,C,E)).
show(X):-write(X).
```

**(6 Marks)**

**QUESTION 2 (20 MARKS)**

(a). Describe how the following tools are used in searching in AI.
(i). Search tree (ii). A* search strategy. **(4 Marks)**

(b). Describe a scenario whereby the A* strategy could be more efficient than the greedy Best FS strategy. **(3 Marks)**

(c). Learning is a key feature of AI research. Explain how learning can be useful in the area of computer games. **(2 Marks)**

(d). Consider a 6-puzzle problem described below.
The puzzle consists of six 'tiles' whereby four of them have numbers, and the value inside a tile can be slid into an adjacent tile (on its left, right, top, or down) that has no number. The problem is to reach the goal state from the initial state, both of which are as shown below. Note also that each step costs value 1.

**Initial State**

| | |
|---|---|
| 8 | 5 |
| | 6 |
| | 7 |

**Goal state**

| | |
|---|---|
| 5 | 6 |
| 8 | 7 |
| | |

**Required**: Using the heuristic function **f(n)=g(n)=** the number of tiles of node **n** that are in the wrong position (compared to the goal), find the best steps to reach the goal (show the tree). **(5 marks)**

(e). (i). Write a Prolog program (named **compute**) that receives two parameters and returns a third value as follows.
- If the first parameter is 1, then it returns the square of the second parameter.
- If the first parameter is 2, then it returns the cube of the second parameter.
- For any other value of the first parameter, it returns 0. **(3 Marks)**

(ii). Write the output of the following queries base on the above program

(I). compute(2, 4, R). (II). compute(2, 3, 27).
(III). compute(1, 3, E). (IV). compute(1, 4, b).
(V). compute(3, 2, T). (VI). compute(4, 0, 0). **(3 Marks)**

**QUESTION 3 (20 MARKS)**

(a). Expert systems are designed to give expertise advise in various areas of applications. Describe the following areas showing an expertise that is being computerized.
(i). Vehicle diagnostic systems (ii). Economic forecasting systems **(5 Marks)**

(b). Speech recognition is a core area of research of artificial intelligence. Give four main areas of applications of speech recognition. **(2 Marks)**

(c). Fuzzy logic is usually applied in many AI solutions. Explain what this area deals with. Also explain three areas of applications. **(4 Marks)**

(d). The following is a section of code showing the structure of a 'family' knowledgebase of an expert system. The knowledgebase consists of two types of predicates (**father**(**Father**, **Child**) and **mother**(**Mother, Child)**) that define the fathers and mothers of persons.

father(paul,tom). father(paul,susan). mother(eve,tom). mother(eve,susan). father(tom,james). mother(jane,james). mother(susan,ken).mother(mary,jane). father(jacob,jane).

**Required**:

(i). Draw an appropriate tree to represent the above section of relationships. **(2 Marks)**

(ii). Write the possible values of variables **A** and **B** of the following queries. **(3 Marks)**

(I). ?- father(D, C), father(D, B), father(C, A), mother(B, E).

(II). ?- father(A, C), mother(D, C), mother(B, D).

(iii). Define the following rules **(3 Marks)**

(i). **grandfather(A, B)** that defines that **A** is husband to **B**.

(ii). **maternal_uncle(A,B)** that defines that **A** is maternal uncle to **B**.

**QUESTION 4 (20 MARKS)**

(a). (i). Describe what the following AI research areas involve. **(4 Marks)**

(I). Neural networks (II). Data mining

(ii). For each of the above two areas (in a(i)), explain two areas of applications.**(4 Marks)**

(b). Describe briefly the four main natural language processing (NLP) understanding techniques. Use examples of English sentences. **(6 Marks)**

(c). Write a natural language program (in Prolog) that will return the following sentences as syntactically true when each is parsed. **(6 Marks)**

(i). the students attend classes (ii). the students attend class

(iii). the student attends classes (iv). the student attends class

(v). students attend classes (vi). students attend class

The following two sentences should however fail.

(i). student attends classes (ii). student attends class

**QUESTION 5 (20 MARKS)**

(a). Describe briefly the meanings of the following AI searching terms;

(i). Goal. (ii). Hill Climbing

(iii).Backward chaining. (iv). Informed Search **(6 Marks)**

(b). Consider the following rules.

Ru1e1: If A happens, the B also must happen.
Rule 2: Either C or D has happened.
Rule 3: B and C happening implies that E has not happened.
Rule 4: Either E has happened or F has not happened.
Rule 5: The failure of F to happen means the failure of G too.
Rule 6: G not happening means H happens.

**Required**

(i). Represent the above knowledge using the appropriate AI logic. **(2 Marks)**

(ii). Assume **A** happens while **D** fails to happen. Do we conclude **H** happened? Run;

(I). A forward chaining. (II). A backward chaining. **(5 Marks)**

(c). Consider the following rule: "If one is drunk or sick, then he/she is not sober".

Further, assume the following facts concerning the respective people.

"Tony is sober".
"Tom is not sober"
"Esther is sick"
"Alice is not sick and is not drunk"
"John is very principled. He can never be drunk when sick"

**Required**: State whether each of the following conclusion is **True** or **False** according to the above rule and facts based on the rules of propositional logic. (**3 Marks)**

(i). "Tony is not drunk and is not sick" (ii). "Either Tony is not drunk or is not sick"
(iii). "Tom is either drunk or sick" (iv). "Esther is not sober"
(v). "Alice is sober" (vi). "John is never sick when drunk"

(d). Consider the following Prolog Program.

```
go(A):- (A>=0;write('End')),
(A<0;loop(A, 0)).
loop(0, T):-write(T).
loop(T, K):- M is T+K, N is T-1, loop(N, M).
```

**Required**: Write the output of the following queries. **(4 Marks)**

(i). go(-5). (ii). go(0). (iii). go(3).