

KABARAK



UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

**FOR THE DEGREE OF BACHELOR OF COMPUTER
SCIENCE**

COURSE CODE: COMP 413

COURSE TITLE: ARTIFICIAL INTELLIGENCE

STREAM: Y4S1

DAY: TUESDAY

TIME: 11.00 -1.00 P.M.

DATE: 09/12/2008

INSTRUCTIONS:

Answer The First QUESTION and Any other TWO QUESTIONS

PLEASE TURN OVER

Question 1 (30 Marks)

- (a). Intelligence behavior According to Douglas Hofstadter involves flexibility of doing things and making sense out of ambiguous statements. Explain giving examples what these two elements are. **(3 Marks)**
- (b). Explain the meanings of the following Artificial Intelligence terms. **(3 Marks)**
(i). Goal (ii). Heuristics (iii). Pragmatic analysis
- (c). List six components of an expert system. **(3 Marks)**
- (d). One of the areas of Artificial Intelligence (AI) is ICAI.
(i). Explain what this field deals with. **(1 Mark)**
(ii). Explain two main challenges that ICAI researchers are likely to face. **(2 Marks)**
- (e). Explain the difference between syntax errors and semantic errors in NLP. For each error, give an English sentence with the error. **(3 Marks)**
- (f). Draw the truth table for $(P \text{ or } Q) \rightarrow ((\text{not } P) \text{ and } (\text{not } Q))$ **(3 Marks)**
- (g). Three coins are thrown. Find the probability of getting;
(i). A maximum of 1 head
(ii). No change i.e. either all heads or all tails **(3 Marks)**
- (h). Represent the following in Predicate logic. **(3 Marks)**
(i). There is an animal without limbs.
(ii). Every day has surprises.
(iii). Ink is found in pen.
- (i). Give four criteria used to determine the performance of a search technique. **(2 Marks)**
- (j). 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). **(4 Marks)**

Question 2 (20 Marks)

- (a). (i). Explain a main challenge of speech recognition as an AI research area. **(1 Marks)**
(ii). Give four main areas of applications of speech recognition. **(2 Marks)**
- (b). Explain two ways of applying fuzzy logic. Give examples. **(3 Marks)**

(c). Consider the following Prolog knowledgebase.

go(X, Y):-Y<0, X is -1.

go(X, Y):-Y>0, X is 1.

go(X, Y):-X is 0.

Required: Write down the **output** when the user gives each of the following queries.

(i). ?- go(T, -4).

(ii). ?- go(A, 5).

(iii). ?- go(a, 5).

(iv). ?- go(-1, 8).

(v). ?- go(0, 0).

(vi). ?- go(M, 0). **(3 Marks)**

(d). Describe how the following techniques are carried out. **(3 Marks)**

(i). forward chaining

(ii). Backward chaining

(e). Consider the following rules of an AI system.

Rule 1: If **a** happens, then **b** can not have happened.

Rule 2: It's not possible for both **b** and **c** not to have happened.

Rule 3: **c** happening and **e** not happening implies that **f** has not happened.

Rule 4: either **f** has happened or **g** has not happened.

Rule 5: **g** not happening means that **h** has happened.

Required

(i). Express the above rules in the appropriate AI logic. **(2.5 Marks)**

(ii). Assume **a** happens, while **e** does not happen. Do we conclude that **h** happens? Run

(I). A forward chaining **(2.5 Marks)**

(II). A backward chaining **(3 Marks)**

Question 3 (20 Marks)

(a). Neural networks is a popular area of research of artificial intelligence that concerns with producing systems that copy the human brain's neurons.

(i). Explain four differences between the traditional CPU and the human brain. **(4 Marks)**

(ii). Explain three areas of applications of artificial neurons in computing. **(3 Marks)**

(b). Describe the role played by heuristic functions in improving computing performance. Use an example. **(3 Marks)**

(c). (i). 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

2	3	1
	4	

Goal state

1	4	
2	3	

Required: Using the heuristic function $f(n)=g(n)$, where $g(n)$ is the total number of steps that each tile in node n is away from its correct position. (4 Marks)

(ii). When you compare the above heuristic $f(n)$ with another one $f'(n)$ =total number of tiles that are in wrong positions, it's clear that $f(n)$ is better, though not in all situations. Describe an example of such a scenario where $f'(n)$ will not be better than $f(n)$. (4 Marks)

(d). Consider the following program.

$s(A, B, C):- ((A\neq B); C \text{ is } 1), (A=B); C \text{ is } 0$.

Required: Write down the output of the program for the following queries. (2 Marks)

- (i). $s(4, 5, T)$. (ii). $s(8, 8, 0)$.
(iii). $s(2, 8, 0)$. (iv). $s(8, 8, R)$.

Question 4 (20 Marks)

(a). (i). Give the four levels used by Natural Language Processing (NLP) to understand a sentence. (2 Marks)

(ii). The following sentences are ambiguous in NLP. Explain why and at which of the above levels will this ambiguity be detected and solved. (4 Marks)

- (I). May you come here.
(II). The computer are okay.
(III). Tom beat Jack in his own game.
(IV). This is a characta.

(iii). Explain three areas where NLP could be of help in Kenya. (3 Marks)

(b). Consider the following rule of an expert system.

“A country with a weak economy is characterized by high unemployment and a low GDP”.

Further, assume the following facts.

- “Country A has a weak economy.”
“Country B has a high GDP”
“Country C has a strong economy”
“Country D has a high unemployment and a low GDP”
“Country E has very low unemployment and very high GDP”

Required

Which of the following conclusions are true according to the above rule and facts? State either **true** or **false** to each. (4 Marks)

- (i). Country A has a high unemployment.
(ii). Country B does not have a weak economy.
(iii). Either Country C does not have a high unemployment or does not have a low GDP.
(iv). Country D has a weak economy
(v). Country E does not have a weak economy.
(vi). If any country either does not have high unemployment or has a high GDP, then it does not suffer from a weak economy.
(vii). Countries with strong economies do not have high unemployment and have a high GDP.

(viii). The high unemployment of a country or its low GDP state does not tell us that the economy is weak.

- (c). Consider the following tree showing nodes as well as cost of reaching a node from the previous one. The problem is searching for the goal node.

Assume: Initial Node=5, Goal Node=30.

Question: Obtain the solution using;

(i). Breadth First Search strategy.

(ii). Greedy Best FS strategy whereby $h(n)=\text{Absolute}(\text{Goal}-n)$.

(iii). A* strategy whereby $f(n)=g(n)+h(n)$, $g(n)=\text{cost to reach node } n$, $h(n)=\text{Absolute}(\text{goal}-n)$.

(4 Marks)

- (d). Study the following Prolog program and write down its expected **output** (when the user runs it by typing **compute.** at the prompt). **(3 marks)**

compute:- nl, R is 2, func(R,0).

func(5,Q):- write(Q).

func(R,T):- X is (R+T), Y is (R+1), func(Y,X).

Question 5 (20 Marks)

- (a). (i). Briefly describe two areas of applications of expert systems. **(3 Marks)**

(ii). What human expertise is being computerized in each of the above areas? Explain with examples. **(3 Marks)**

(iii). Write short notes to describe one expert you know. **(3 Marks)**

- (b). Consider the following facts:

Ann and Peter have the following children: Tom, Alice, and Patrick. Alice has the following children: Susan and Alex. Alex is married to Eva and they have a child Daniel. Joshua and Mary are the parents of Eva. Tom has one child – Patricia.

NB: Assume that;

- Peter, Tom, Patrick, Alex, Daniel, and Joshua are all males while the rest are females.
- A wife or a husband (or parents of / someone married to the other) will be defined in that they both share a child and that the wife is a female while the husband is a male.
- A brother or a sister is defined in that both share a parent and that a brother is a male while a sister is a female.

Required:

(i). Show how you would define (by facts) the three types of relations explained above (show only one example of each type of relation) i.e.

(I). child_of(**child**, **parent**) relationship i.e. to show that **child** is a child of **parent**.

(II). male(X) i.e. **X** is a male.

(III). female(X). i.e. **X** is a female. **(1.5 marks)**

(ii). Write down the output of the following query (write the values of variables X and T only).

child_f(X, Y), child_of(Z, Y), child_of(T, Z), male(T), not (X=Z). **(1.5 marks)**

(iii). Using the above (already existing) relations, define the following relations (by rule)

(I). cousin_of(X, Y) i.e. X is a cousin to Y (a parent of X is a brother or a sister to a parent of Y). **(2 marks)**

(II). inlaw_of(X, Y) i.e. X is an in-law to Y (a child of X is married to Y). **(2 marks)**

(III). sister_in_law_of(X, Y). i.e. X is a sister in law to Y. (the husband of X is a brother to Y). **(2 marks)**

(IV). Paternal_aunt(A, B) i.e. A is a paternal aunt to B. **(2 Marks)**