THE UNIVERSITY OF DODOMA
COLLEGE OF INFORMATICS AND VIRTUAL EDUCATION
SCHOOL OF INFORMATICS

UNDERGRADUATE UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2015/2016

CS 413: ARTIFICIAL INTELLIGENCE

Date: 14th March 2016
Time Allocated: 3 Hours

Instructions:

1. *This question paper consists of two sections: A and B.*
2. *Answer ALL questions in section A and ANY two questions from section B.*
3. *All University of Dodoma examination regulations apply.*

SECTION A (60 Marks)

Question one

For each of the items (i)-(x) choose the correct answer from among the given alternatives and write its letter (comma separated letters for more than one answer) **[1 Marks each]**

i. Which of the following best describes AI

   a. The branch of computer science that is concerned with the automation of intelligent behavior

   b. The branch of computer science that is concerned with the automation of intelligent machine

   c. The branch of computer science that is concerned with the automation of intelligent actions

   d. None of the above

ii. Acting humanly can best be described by

   a. The Turing Test approach b. computer vision

   c. Robotics approach d. Thinking humanly

iii. System that thinking humanly can best be described by

   a. Acting rationally approach

   b. The cognitive modeling approach

   c. The rational agent approach

   d. None of the above

iv. An agent is just something that

   a. Perceives and understand b. Perceives and acts

c. Perceives and recognize d. Perceives and Reasons

v. Given the following definitions,

1. *Modeling exactly how humans actually think*
2. *Modeling how ideal agents "should act"*
3. *Modeling exactly how humans actually act*
4. *Modeling how ideal agents "should think"*

In implementation, the Modern AI focuses on

a. *1* only b. *2* only c. 3 only d. 4 only

vi. Which of the following is true in AI

1. *automated recognition and understanding of signals*
2. *Understanding and recognition*
3. *reasoning, planning, and decision-making*
4. *learning and adaptation*

a. 1, 2 and 3 only b. 2, 3 and 4 only c. 1, 3 and 4 only d. all of the above

Using Table 1; attempt the questions vii and viii

Table 1: Joint Probability table

p(smart ∧ study ∧ prep)	smart		¬smart	
	study	¬study	study	¬study
prepared	0.432	0.16	0.084	0.008
¬prepared	0.048	0.16	0.036	0.072

vii. The value of $P(smart \wedge study \wedge \neg prepared)$ is

a. 0.16 b. 0.208 c. 0.048 d. 0.64

viii. The value of $P(smart \mid study \wedge \neg prepared)$ is

a. 0.5714 b. 0.208 c. 0.048 d. 0.64

ix. The probability P(a,b,c,d) can best be described by the following chain rule

a. $P(a|b \wedge c \wedge d) * P(a|c \wedge d) * P(a|d) * P(d)$

b. $P(a|b \wedge c \wedge d) * P(b \wedge c|d) * P(c|d) * P(d)$

c. $P(a|b \wedge c \wedge d) * P(b|c \wedge d) * P(c|d) * P(d)$

d. $P(a|b \wedge c \wedge d) * P(b|c \wedge d) * P(c|d)/P(d)$

x. The following statement is a conversion of "All men who are neither sick nor disabled ride bicycle" in a prolog statement

a. men(X), disabled(X)→rides(X, bicycle).

b. men(X), disabled(X);-rides(X, bicycle).

c. rides(X, bicycle);- men(X), disabled(X).

d. rides(X, bicycle).→ men(X), disabled(X).

Question Two

Match the responses in List B with the phrases in List A by writing the letter of the correct response **[1 Marks each]**

List A		List B	
1	Recursive Best First Search	A	is a set of representations of facts about the world.
2	Rational agent	B	A discrete set of distinct, clearly defined percepts and actions
3	Goal-based agents	C	the goal test is decomposed into a set of constraints on variables rather than being a "black box"
4	Utility-based agents	D	Can be solved using either Genetics Algorithm or simulated Annealing only
5	Deterministic environment	E	Uses Depth limited concept with increasing limit
6	Entailment	F	Reduces the space requirement of A* search algorithm
7	CSP	G	An agent needs some sort of goal information, which describes situations that are desirable
8	Breadth-first	H	Expands the shallowest node in

	search		the search tree first.
9	Iterative deepening search	I	Expands the deepest node in the search tree first
10	Discrete environment	J	Does the right thing
		K	Can be solved using hill climbing algorithm, Random-Restart Hill-Climbing and Simulated Annealing
		L	The next state of the environment is completely determined by the current state and the action executed by the agent
		M	Uses utility function which defines the quality of a solution to be useful
		N	One sentence follows logically from another

Question Three

a. Consider the search tree in Figure 1, where each arc is labeled with the cost of the corresponding operator, and the leaves are labeled with the value of a heuristic function, h. For uninformed searches, assume children

are expanded left to right. In case of ties, expand in alphabetical order. Which node will be expanded next by each of the following search methods?

i. Depth-First Search

ii. Recursive Best-First Search

iii. A* Search

iv. Depth limited **[12 Marks each]**

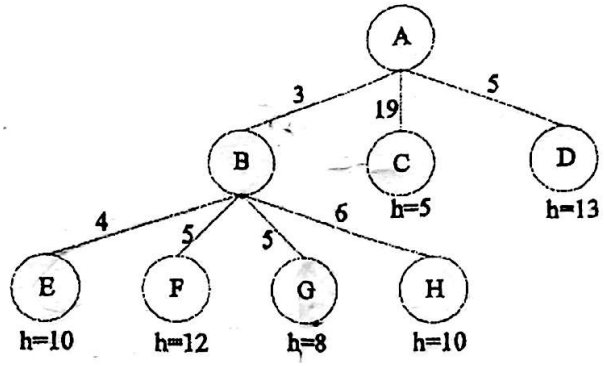


Figure 1 Search tree

b. In practice A* runs out of memory before it runs out of time, using recursive best first search describe how the memory problem is addressed **[6 Marks]**

c. What difference exist in implementation between the full recursive best first search and the simple recursive best first **[4 Marks]**

Question Four

a. *Using symbols, convert the following sentences in* ***Propositional Logic (PL)***

Both Thomas and Naima will go to Udom this Friday evening, but only one of them will go to Cive. Only if it is Naima who goes to Cive, Dorcus will go to Udom as well. And Doroth will go to Udom if and only if Dorcus goes to Udom too. So if Thomas goes to Cive, the others will not go to Udom **[6 Marks]**

b. By using symbols, convert the following sentence into PL and test its validity using the truth table

Neither Asha nor Juma did the CS 413 Course work and Asha did the Course work **[6 Marks]**

c. Using a truth table or other means, prove that $(P \wedge Q) \rightarrow (R \wedge S)$ follows from $P \rightarrow R$ and $R \wedge P \rightarrow S$ **[6 Marks]**

SECTION B (40 Marks)

Question five

a. Given a probabilities Table 2 which models Lecture provision circumstances under selected parameters, attempt the following probabilities

Table 2 Teaching joint table probabilities

	It rains (R)		¬ It rains (¬ R)	
	Traffic (H)	¬ Traffic (¬ H)	Traffic (H)	¬ Traffic (¬ H)
Teach (T)	0.1	0.1221	0.2	0.49
¬ Teach (¬T)	0.085	0.001	0.001	0.0009

i. $P(T|R)$ *ii.* $P(T|\neg R)$ *iii.* $P(T \wedge R)$

iv. $P(T \wedge \neg R)$ **[16 Marks]**

b. With your brief argument state whether

i. *Teach is independent of Traffic* **[2 Marks]**

ii. *It rains is independent of Traffic* **[2 Marks]**

Question six

a. Which of the following algorithms are not guaranteed to converge to the global maximum theoretically

i. Hill climbing using a randomly chosen initial condition

ii. Simulated Annealing with a fixed temperature parameter

iii. Hill climbing with many random restart **[4 Marks]**

b. Using diagram, define precisely the notion of a local maximum, global maximum and plateaus in local search **[6 Marks]**

c. Using algorithm describe the concept of Hill Climbing search algorithm **[10 Marks]**

Question seven

a. Represent the following sentences in first-order logic **[2 Marks each]**

i. Not all students take both CS 413 and CS 410.

ii. Only one student failed CS 413.

iii. Only one student failed both CS 413 and CS 413.

iv. The best score in CS 410 was better than the best score in CS 413.

v. No person likes larceny.

b. Rewrite the following statement in English language **[2.5 Marks each]**

i. `female(M),parent(M, C);-mother(C).`

ii. `male(H),spouse(H, W);-husband(H,W).`

iii. `male(Y) ;-\+(Female(Y)).`

iv. `likes(X,Y);-person(X),professor(Y), smart(Y).`

Question-one:

(i) A
(ii) A
(iii) B
(iv) B
(v) B
(vi) C
(vii)
(viii) } lecture 11 Habtamu Abishu.
(ix)
(x) C

Question-two.

1 F
2 J
3 C
4
5 L
6 N
7 D
8 H
9 E
10 B

Question-three:

a) (i) E
(ii) B, G
(iii) B, G
(iv) G

(iv) B, E, F, G, H, C, D

b) (i) Backtracking to alternat path.

(ii) keeps track of the f-value of the best alternative path available from any ancestor of the current node.

(c) Full recursive uses $f(x) = g(x) + h(x)$.
Simple recursive uses $g(x) = g(x)$.

Question four:

a) Let

T - Thomas U - Udom

N - Naema D - Dorcas

Do - Doroth C - Cive

$(T \wedge N) \rightarrow U$ — (i)

$(T \vee N) \rightarrow C$ — (ii)

$N \rightarrow C \rightarrow D \rightarrow U$ — (iii)

$D \rightarrow U \leftrightarrow Do \rightarrow U$ — (iv)

$T \rightarrow C \rightarrow \neg(D \wedge Do \wedge N \rightarrow U)$

$(T \wedge N) \rightarrow N \wedge (T \vee N) \rightarrow C \wedge N \rightarrow C \rightarrow D \rightarrow U$

$\leftrightarrow Do \rightarrow U \wedge T \rightarrow C \rightarrow \neg(D \wedge Do \wedge N \rightarrow U)$

b) Let

Asha → P

Uma → Q

Learn work → R

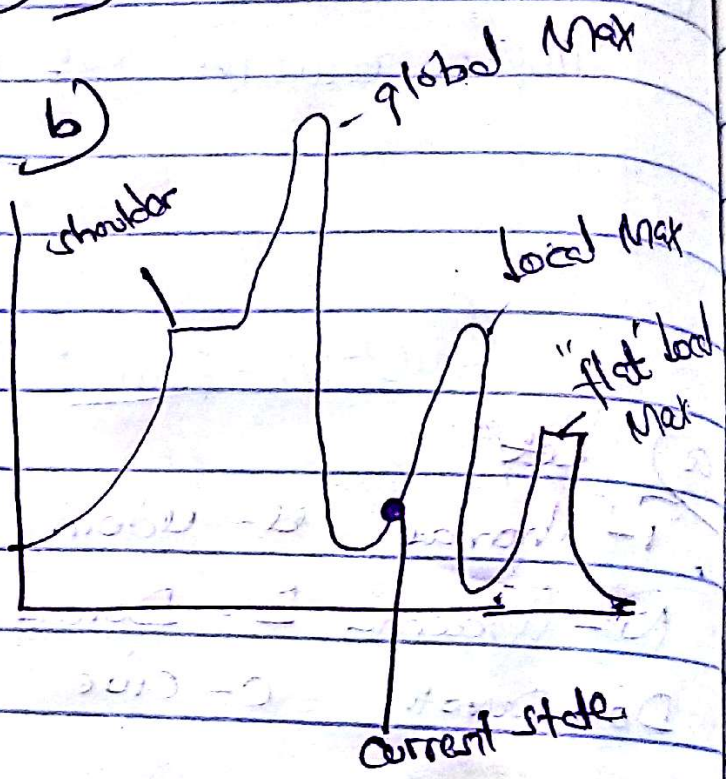
$(\neg(P \wedge Q) \rightarrow R) \wedge (P \rightarrow R)$

c)

P	Q	R	S
T	T	T	T
T	T	T	F
T	T	F	T
T	T	F	F
T	F	T	T
T	F	T	F
T	F	F	T
F	F	F	F
T	T		
T	F		
F	T		
F	F		

6) a) i

b)



a) function Hill climbing (problem)
returns a state that is a
local maximum
Inputs: problem, a problem
local variables: current, a node
neighbour, a node.
current ← MakeNode (RandomState
[problem])
Loop do

neighboor ← a highest-valued

Lecture

7) Paper folder: Assignment
8) Tutorial

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COLLEGE OF INFORMATICS AND VIRTUAL EDUCATION

UNDERGRADUATE UNIVERSITY TEST EXAMINATIONS

FIRST SEMESTER 2016/2017
CS 413: ARTIFICIAL INTELLIGENCE

Date: 02/02/2017
Time Allocated: 2 Hours

Instructions:

1. *Answer ALL questions*
2. *The test carries a total of 50 Marks*
3. *All University of Dodoma examination regulations apply.*

Question One

a. Define in your own words the following terms:
   i. agent,
   ii. agent program,
   iii. backtracking search,
   iv. Learning agent **[1 Marks each]**

b. Given the graph in Figure 1, Assume the worst case scenario,

i. show how the DFS will go about searching for the goal G. **[5 Marks]**

ii. if the depth-limited search with L=3 will be used, show how the search progresses and provide the resulting queue **[5 Marks]**

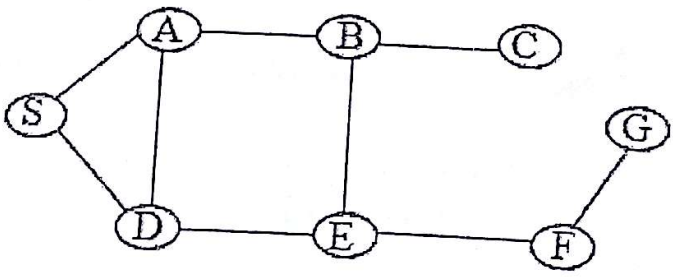


Figure 1: A tree for the Search scenario

Question Two

a. By using the definition of "Modal $\alpha \models b$ *i.e.* α *entails sentence b if and only if b is true in all worlds where* α *is true*". Which of the following are correct?

[1 Marks Each]

i. False $\models$ True.

ii. True $\models$ False.

iii. $(A \wedge B) \models (A \Leftrightarrow B)$.

iv. $A \Leftrightarrow B \models A \vee B$.

v. $A \Leftrightarrow B \models \neg A \vee B$.

b. Convert the following natural language sentences into First Order Logic statement **[1 Marks Each]**

i. All SE students passed CS 410

ii. Only one student failed both CS 413 and CS 410

iii. Every mother who is a student taking psychology is cute and cool

iv. None of the student will fail either CS 413 or CS 410

c. Write the sentences from (b) into prolog statement

[1 Marks Each]

Question Three

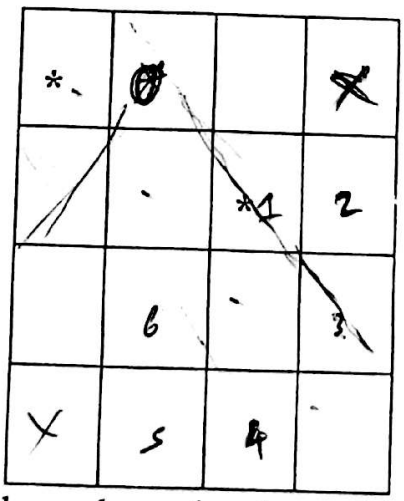
a. How many solutions are there for the four-queen problem in Table 1 assuming the "*" represents the queens to be arranged?

[2 Marks]

b. Will the current arrangement complete placement of the four queens? If no why?

[1 Marks]

Table 2: Four-queen problem



c. Using CSP show how backtracking is attainted when the queens placement starts from the position (1, 1).

[4 Marks]

d. Provide the pseudo code for the algorithm that can place the four queens without conflicts **[5 Marks]**

Question Four

a. Which of the following algorithms are not guaranteed to converge to the global maximum theoretically

   i. Hill climbing using a randomly chosen initial condition

   ii. Simulated Annealing with a fixed temperature parameter

   iii. Hill climbing with many random restart **[1 Marks]**

b. Using diagram, define precisely the notion of a local maximum, global maximum and plateaus in local search **[5 Marks]**

c. Using algorithm describe the concept of Hill Climbing search algorithm **[5 Marks]**

AI TOSI SOL 2016/2017.

Qn One:

a) i) Agent is anything that can perceiving its environment through sensors and acting upon it through actuators.

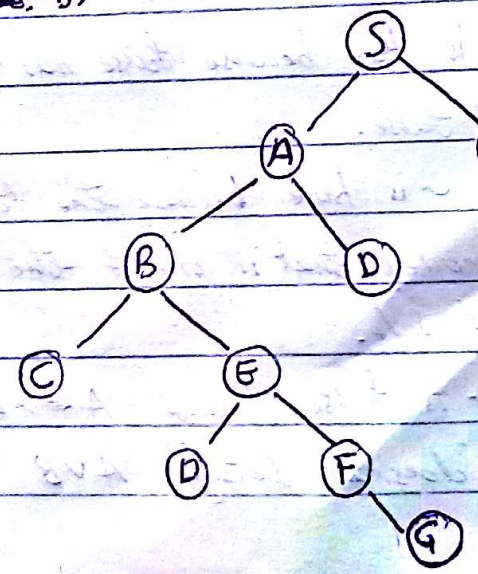
ii) Agent program, is a program that can be combined with a machine architecture, implement an agent function.

iii) Backtracking search, is a form of ~~depth~~ DFS in which there is single representation of the state that gets updates for each successor, and then must be restored when a dead end is reached.

iv Learning agent is an agent whose behavior improve over time based on its experience.

~~Qn Two~~: b)

i)



Select S [A, D] ~~Queue~~.

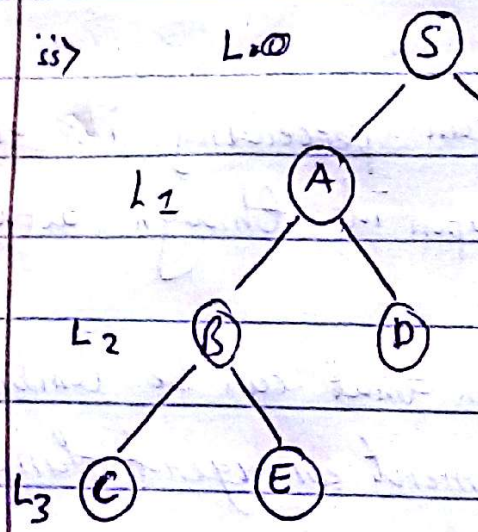
Select A [B, D, D]

Select B [C, E, D, D]

Select E [D, F, D, D]

Select F [G, D, D]

Select G [D, D]

ii) 

Qn Two:

NOTE: $\alpha \models \beta$ if and only if in every model in which α is true, β is also true.

2> from the definition of intailment

α intail β if and only if α is true and β is true.

i) False |= True ~ is true because false has no models.

ii) True |= False ~ is false.

iii) $(A \wedge B) \models (A \Leftrightarrow B)$ ~ is true because the left hand side is exactly one model that is one of the two model of the right hand side.

iv) $A <=> B \models A \vee B$ ~ is false because $A \Leftrightarrow B$ has balh A and B false, doesnot satisfy $A \vee B$

v) $A \Leftrightarrow B \models \neg A \vee B$ ~ is true because RHS is $A \Rightarrow B$ one of the Conjuct in $A \Leftrightarrow B$

b)

NOTE: $\forall_x$ [All, For all, Every one] $\exists_x$ [Some, a number of, Some of] $\exists!_x$ - only on

i) $\forall_x$ student(x) $\longrightarrow$ pass(x, CS410)

ii) $\exists!_x$ student(x) $\longrightarrow$ failed(x, CS413) $\wedge$ failed(x, CS410)

iii)