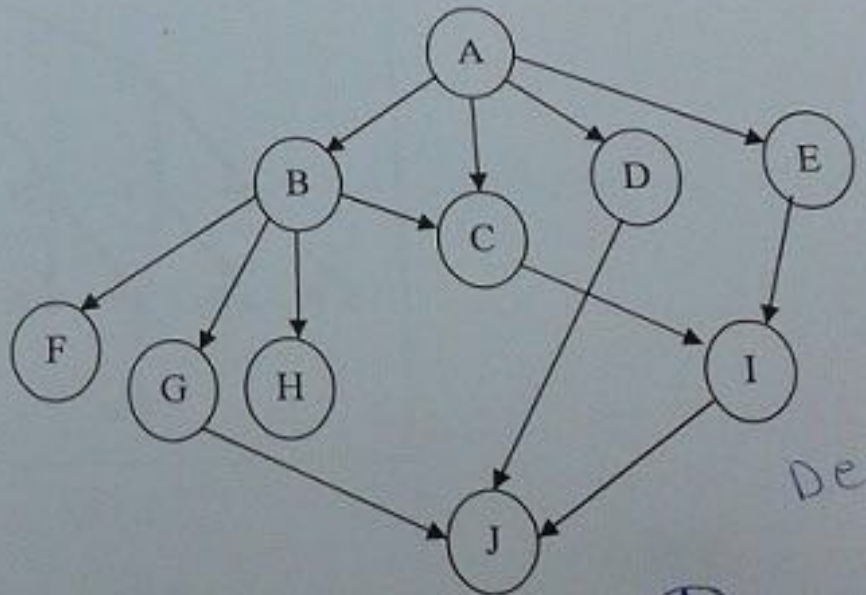


Question C: 2 parts (1 and 2) (15 degrees)

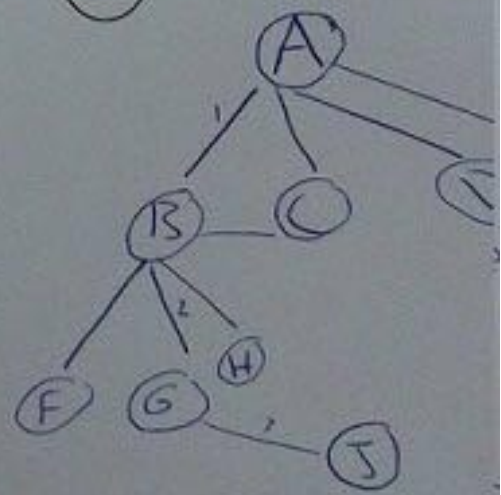
Given the tree below, show the Path, Nodes (visited) order sequence, Path cost in the state for each of depth-first search (DFS) and breadth first search (BFS). (10 marks)

Note: In DFS your trace must show iteration number, CS, and the SL, NSL, and DE lists and BFS your trace must show the iteration number, Open and Closed lists, A is the root and J the goal, each arc cost is 2.



L NSL DE
 [A]
 [BCD A]
 [GHBCDEA]
 [HBCDEA] [F]

open	⊕	close
A		()
BCDE		A
KDEFGH		BA
EBA		FBA
JGBA		FBAH



Path A B G J

Intelligent Systems - 2013

Section B: 2-parts (1 and 2) (10 marks)

(1) Define the following terminology (3 marks)

a) Logic:

referred sentences

b) Artificial intelligence system

The code, hardware, software, data and knowledge needed to design computer system and machines that demonstrate the intelligence of humans.

c) Knowledge Representation:

is the ability to using knowledge

(2) Answer the following using the Predicate Logic. (1 marks)

a) Using a binary predicate, $love(x, y)$, translate the following sentence in Predicate Logic.

"Some love some"

$\exists x love(x, x)$

b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

1. Everyone is liked by someone.

$\forall x like(x)$

2. No purple mushroom is poisonous.

$\neg \exists x is(mushroom, purple)$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (person(x) \wedge time(t) \rightarrow can-fool(x,t))$

2. $(\forall x), gardener(x) \rightarrow likes(x, sun)$

Section B: 2-parts (1 and 2) (10 marks)

(1) Define the following terminology: (3 marks)

Logic:

represented sentences

b) Artificial intelligence systems:

The *hardware, software, data* and knowledge needed to *build computer system and machines that* demonstrate the *characteristics of intelligent*.

Knowledge Representation:

is the ability to using knowledge

(2) Answer the following using the Predicate Logic. (1 marks)

a) Using a binary predicate, $Love(x, y)$, translate the following sentence in Predicate Logic.

"Some love some"

$\exists x Love(x, x)$

b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

1. Everyone is liked by someone.

~~$\forall x Like(x)$~~ $\forall x \exists y Like(x, y)$

2. No purple mushroom is poisonous.

~~$\neg \exists x (mushroom(x) \wedge purple(x) \wedge poisonous(x))$~~ $\forall x (mushroom(x) \wedge purple(x) \Rightarrow \neg poisonous(x))$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (person(x) \wedge time(t) \rightarrow can-fool(x, t))$

or
can fool every people some of the time
can fool all of the people some of the time

2. $(\forall x), gardener(x) \rightarrow likes(x, sun)$

all gardener likes the sun

or
Every gardener likes the sun

g.r

a) Logic:

represent formalized

b) Artificial intelligence systems:

The design, production, maintenance, software and knowledge needed to design computer systems and machines demonstrate the characteristics of intelligence.

Mid 1

c) Knowledge Representation:

is the ability to apply knowledge

(2) Answer the following using the Predicate Logic. (1 mark)

a) Using a binary predicate, Love(x, rose), translate the following sentence in Predicate Logic.

"Some love rose"

$\exists x \text{ Love}(x, \text{rose})$

b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

1. Everyone is liked by someone.

$\forall x \text{ like}(x)$

2. No purple mushroom is poisonous.

$\neg \exists x \text{ is}(\text{mushroom}, \text{poisonous})$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (\text{person}(x) \wedge \text{time}(t) \rightarrow \text{can-fool}(x,t))$

2. $(\forall x), \text{gardener}(x) \rightarrow \text{likes}(x, \text{Sun})$

Section A: 3-parts (1, 2, and 3) (15 marks)

(1) Multiple Choice Questions (5 marks)

1) For propositional expressions P, Q and R, the law below is:

$$(P \wedge Q) \equiv (Q \wedge P) \text{ and } (P \vee Q) \equiv (Q \vee P)$$

- a. Contrapositive law.
- b. Associative law.
- c. Distributive law.
- d. Commutative law.

2) If there is a sentences P, $P \rightarrow Q$, where P is known to be True and $P \rightarrow Q$ known to be false, then we can infer Q by use inference rule called :

- a. Elimination.
- b. Modus tollens.
- c. Modus ponens.
- d. Introduction.

3) The study of meaning. It focuses on the relation between signifiers, such as words, phrases, signs and symbols, and what they stand for, their denote is:

- a. Propositional calculus.
- b. Symbolic logic
- c. Semantics.
- d. Syntax.

4) This is a programming language that was designed for easy manipulation of data strings. It was developed in 1959 by John McCarthy and is still commonly used today in artificial intelligence (AI) programming.

- a. Assembly language.
- b. LISP.
- c. Machine code
- d. Ruby

5) Computer changes how it functions or reacts to situations based on feedback is

- a. Perceptive system.
- b. Learning system.
- c. Neural network.
- d. Natural language processing .

2) True or False Questions (5 marks)

Propositional calculus is the generic term for symbolic formal systems like first-order logic, second-order logic, many-sorted logic or infinitary logic.	T
Informal logic is the study of inference with purely formal content.	F
Expert system is to stores knowledge and makes inferences.	T
Prolog and Lisp emphasize programming in large pieces.	F
A Finite State Machines(FSMs) are often used in compilers and validity checking programs	F

Fill in the blank Questions (5 marks)

1) An inference rule is primitive if every predicate calculus expression produced by the rule from a set S of predicate calculus expression also logically follows from S.

2) _____ is a system of programs and data structures that approximates the operation of the human brain.

3) There are two most fundamental concerns of AI researchers are knowledge representation and Search.

4) The series of formulas which is constructed within such a system is called a _____

5) In knowledge type, if you want to know about heart attack, please read this book is example of predicates logic

Part A: Multiple Choice Questions (23 marks)

Choose the correct answer, then write your answers in the above table. All MCQs carry equal marks.

1) if given the node and goal bellow for 8-Puzzle Problem:

1	8	3
2	6	4
	7	5
Node State		

1	2	3
8		4
7	6	5
Goal State		

Then the Tiles out of the place are :

- a. 6
- b. 5
- c. 4
- d. 7

2) -----is a technique for systematically trying all paths through a state space.

- a. Expert System
- b. Backtracking search
- c. Machine Learning
- d. none

3) The example below is

“You can't log into the network
If you have a current password, then you can log into the network”

- a. Elimination
- b. Modus ponens
- c. Introduction
- d. Modus tollens

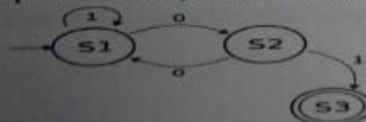
4) Machine Learning is important, because-----.

- a. Some tasks cannot be defined well, except by examples.
- b. Human designers often produce machines that do not work as well as desired in the environments in which they are used.
- c. Relationships and correlations can be hidden within large amounts of data.
- d. All

5) The example below is a:

All Living organisms can move
cat is a Living organism
Therefore cat can move.

- a. Formal Logic with valid logical form and invalid propositions
 - b. Formal Logic with invalid logical form and valid propositions
 - c. Formal Logic with valid logical form and valid propositions
 - d. Informal Logic with invalid logical form and invalid propositions
- 6) Which of the following inputs will be accepted by the following FSM?



- a. 10011001
- b. 11100001
- c. 00110010
- d. 00111101

Section A: 3-parts (1, 2, and 3) (15 marks)

(1) Multiple Choice Questions (5 marks)

1) For propositional expressions P, Q and R, the law below is:

$$(P \wedge Q) \equiv (Q \wedge P) \text{ and } (P \vee Q) \equiv (Q \vee P)$$

- a. Contrapositive law.
- b. Associative law.
- c. Distributive law.
- d. Commutative law.

2) If there is a sentences P, $P \rightarrow Q$, where P is known to be True and $P \rightarrow Q$ known to be false, then we can infer Q by use inference rule called :

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- c. Modus ponens.
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3) The study of meaning. It focuses on the relation between signifiers, such as words, phrases, signs and symbols, and what they stand for, their denote is:

- a. Propositional calculus.
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- c. Semantics.
- d. Syntax.

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- a. Assembly language.
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- c. Machine code
- d. Ruby

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- b. Learning system.
- c. Neural network.
- d. Natural language processing .

2) True or False Questions (5 marks)

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Expert system is to stores knowledge and makes inferences.	T
Prolog and Lisp emphasize programming in large pieces.	F
A Finite State Machines(FSMs) are often used in compilers and validity checking programs	F

Fill in the blank Questions (5 marks)

- 1) An inference rule is primitive if every predicate calculus expression produced by the rule from a set S of predicate calculus expression also logically follows from S.
- 2) _____ is a system of programs and data structures that approximates the operation of the human brain.
- 3) There are two most fundamental concerns of AI researchers are knowledge representation and Search.
- 4) The series of formulas which is constructed within such a system is called a _____.
- 5) In knowledge type, if you want to know about heart attack, please read this book is example of predicate logic

d. None of the above

5. The Intelligence is

- a. The ability to learn and solve problems
- b. The ability to think and act rationally
- c. The ability to act like humans
- d. All of the above

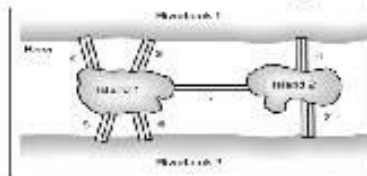
6. If there is a sentences $P, P \cdot Q$, where P is known to be True and $P \cdot Q$ known to be false, then we can infer Q by use inference rule called :

- a. Modus tollens
- b. Introduction
- c. Modus ponens
- d. Elimination

7. In expressions of the form $P \vee Q$, P and Q are called the:

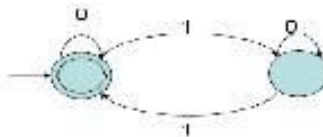
- a. Implication
- b. Disjuncts
- c. Conjuncts
- d. Negation

8. The bridges of Königsberg problem shown below can be represented as a state space graph. How many nodes and arcs will be required to show in a graph?



- a. 2 nodes and 7 arcs
- b. 7 nodes and 4 arcs
- c. 7 nodes and 2 arcs
- d. 4 nodes and 7 arcs

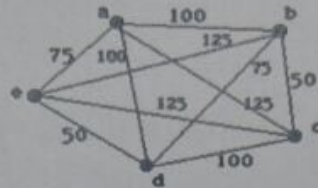
9. The FSM below accepts 0,1 strings which has an _____.



7) Backward chaining is a ----- search technique.

- a. Data driven
- b. Goal driven
- c. Both a & b
- d. None

8) The following graph represents five cities (a, b, c, d, and e) that a travelling salesperson is going to visit. Using the nearest neighbour search, which path the salesperson will follow if the starting point is city d?



- a) deabcd
- b) dbcdea
- c) daebcd
- d) dcbae

9) The two most fundamental concerns of AI researchers are:

- a. Logic and Mind
- b. Search and Mind
- c. Knowledge Representation and Search
- d. None of the above

10) One of the differences between machine intelligence and human intelligence is

- a. Machine is deterministic and Brain is stochastic
- b. Machine is stochastic and Brain is deterministic
- c. Machine and Brain are stochastic
- d. Machine and Brain are deterministic

11) What will be the complete traverse path for the following tree in case we apply Depth First Search

- a. ABDEFGHJLMKCI
- b. ABDEFGHJLMKIC
- c. ABCDEFGHJLMKI
- d. ABCDEFGHKJMLI



12) My office is in B12 building, this is a knowledge

- a. Heuristic
- b. Structural
- c. Declarative
- d. Procedural

13) Good students do not fail in exams; the translation of this sentence into First Order Predicate Calculus is.....

- a. $\forall X((\text{good_students}(X) \wedge \text{fail in exams}(X))$
- b. $\neg \exists X((\text{good_students}(X) \wedge \text{fail in exams}(X))$
- c. $\forall X((\text{good_students}(X) \rightarrow \text{fail in exams}(X))$
- d. $\exists X((\text{good_students}(X) \wedge \text{fail in exams}(X))$

a) Logic:

represent statements

b) Artificial intelligence systems:

The skills, procedures, mechanisms, software and knowledge needed to design computer systems and machines demonstrate the characteristics of intelligence.

Mid 1

c) Knowledge Representation:

is the ability to apply knowledge

(2) Answer the following using the Predicate Logic. (1 marks)

a) Using a binary predicate, Love(x, rose), translate the following sentence in Predicate Logic.

"Some love rose"

$\exists x \text{ Love}(x, \text{rose})$

b) Translate the following English sentences into Predicate Logic (V/A). (2 marks)

1. Everyone is liked by someone.

$\forall x \text{ like}(x)$

2. No purple mushroom is poisonous.

$\neg \exists x \text{ is}(\text{mushroom}, \text{poisonous})$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (\text{person}(x) \wedge \text{time}(t) \rightarrow \text{can-fool}(x,t))$

2. $(\forall x), \text{gardener}(x) \rightarrow \text{likes}(x, \text{Sun})$

Intelligent Systems - 2008

Section B: 2-parts (1 and 2) (10 marks)

(1) Define the following terminology: (2 marks)

- a) Logic: *logical sentences*
- b) Artificial intelligence systems: *The core, hardware, software, data and knowledge needed to design computer system and machines that demonstrate the characteristics of intelligent.*
- c) Knowledge Representation: *is the ability to using knowledge*

(2) Answer the following using the Predicate Logic. (1 marks)

a) Using a binary predicate, $love(x, y)$, translate the following sentence in Predicate Logic.

"Some love rose"
 $\exists x love(x, rose)$

b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

- 1. Everyone is liked by someone.
 $\forall x like(x)$
- 2. No purple mushroom is poisonous.
 $\neg \exists x is(mushroom, purple)$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

- 1. $(\forall x)(\exists t) (person(x) \wedge time(t) \rightarrow can-fool(x,t))$
- 2. $(\forall x), gardener(x) \rightarrow likes(x, sun)$

Section II: 2 parts (I and II) (10 marks)

(I) Answer the following questions (2 marks)

(a) Logic

→ propositional

(b) Artificial Intelligence

→ The study of intelligent behaviour and the methods used to design computer systems that simulate the intelligence of humans.

(c) Knowledge Representation

→ How to represent or model knowledge

(II) Answer the following using the Predicate Logic (2 marks)

(a) Using a binary predicate, $Love(x, y)$, write the following sentence in Predicate Logic

"Some love some"

$\exists x \exists y (Love(x, y))$

(b) Translate the following English sentences into Predicate Logic (FOL) (2 marks)

1. Everyone is liked by someone

$\forall x \exists y Like(y, x)$

2. No purple mushroom is poisonous

$\neg \exists x (Purple(x) \wedge Poisonous(x))$

(c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $\forall x (C(x) \wedge (parent(x) \vee sister(x)) \rightarrow can-look(x, I))$

2. $\forall x (graduate(x) \rightarrow like(x, Sam))$

- a. even number of 1's
- b. Any number of 0's and 1's
- c. odd number of 1's
- d. odd number of 0's

Q.2 True or False Questions

1	Atomic sentence is the most primitive unit of the predicate calculus language.
2	Artificial intelligence focus on problems that do respond to algorithmic solutions.
3	If you want to know about artificial intelligent, read this book. This is a Declarative knowledge
4	Expert system that approximates the way a human sees, hears, and feels objects.
5	Informal logic is the study of inference with purely formal content.
6	Unification is an algorithm for determining the substitutions needed to make two predicate calculus expressions match.

Q.3 Answer the following using the Predicate Logic.

a) Using a binary predicate, Love(X, rose), translate the following sentence in Predicate Logic.

“Some love rose”
 $\exists x, \text{Love}(X, \text{rose})$

b) Translate the following English sentences into Predicate Logic (I'OL).

1. All Taibah students are smart.

$\forall x \text{ student}(x) \wedge \text{at}(x, \text{Taibah}) \rightarrow \text{Smart}(x)$

2. Every man has a father.

$\forall x. \exists y. \text{Father}(x, y)$

c) Translate the following Predicate Logic into simple English sentences.

1. $\forall x \exists y \text{ mother}(x, y) \wedge \text{loves}(x, y)$

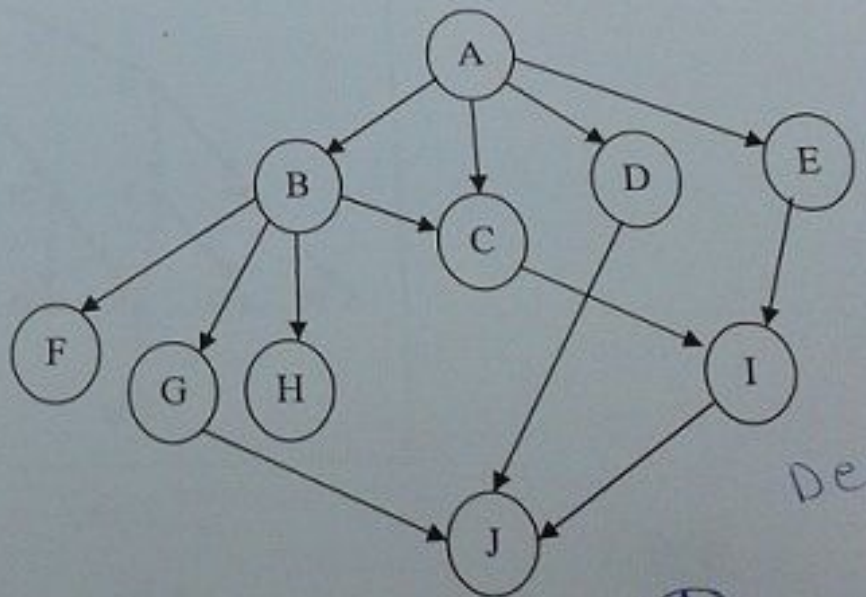


- 14) The implementation in BEST-FS is identical to that for, uses the priority queue
- Uniform-cost search
 - Greedy Best First Search
 - Bidirectional search
 - Iterative deepening Search
- 15) In Hill climbing, the criterion for the node to follow is that it's
- Sibling for the current state
 - Depth for the current state
 - The best state for the current state
 - Breadth for the current state
- 16) In Turing test, If the interrogator can distinguish the machine from the human then ...
- The machine is not intelligent
 - The machine is intelligent
 - The interrogator is intelligent
 - The interrogator is not intelligent
- 17) Techniques that are used in artificial are as follow, except ____
- knowledge representation
 - planning
 - automated processing
 - searching
- 18) Artificial intelligence is generally suitable for problems except
- that require common sense
 - that requires extensive computation
 - that many experts can solve *Pen*
 - with no good known algorithms
- 19) Given a predicate calculus for: $\forall X (\text{goal}(X) \wedge \sim \text{plan}(X)) \rightarrow \text{dream}(X)$.
- A goal without plan to dream
 - A goal without a plan is just a dream.
 - Every goal with plan can dream
 - Every goal with no plan dreams.
- 20) Find the unifier of $p(X, b)$ and $p(Y, Y)$, if one exist.
- $\{X/b, X/b\}$
 - $\{Y/b, Y/b\}$
 - $\{X/b, Y/b\}$
 - No unifier
- 21) Which of the following algorithm potentially face memory problem if the search space is huge and has many branches?
- depth-limited search
 - depth-first search
 - iterative deepening
 - breadth-first search
- 22) The following are the reasons for using data-driven search, except:
- All or most of the data are given
 - There are a large number of rules
 - There are a large number of potential goals
 - It is difficult to form a goal or hypothesis

Question C: 2-parts (1 and 2) (15 degrees)

Given the tree below, show the Path, Nodes (visited) order sequence, Path cost in the state for each of depth-first search (DFS) and breadth first search (BFS). (10 marks)

Note: In DFS your trace must show iteration number, CS, and the SL, NSL, and DE lists and BFS your trace must show the iteration number, Open and Closed lists, A is the root and J the goal, each arc cost is 2.



NSL DE

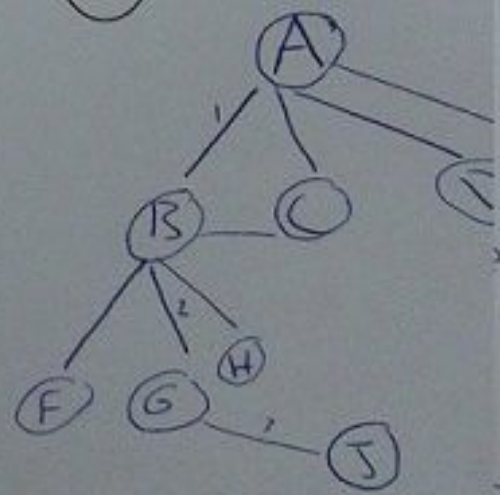
[A]

[BCD, A]

[GHBCDEA]

[HBCDEA] [F]

Open	⊕	Close
A		()
BCDE		A
KDEFGH		BA
EBA		FBA
JGBA		FBAH



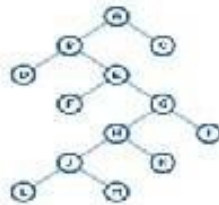
Path A B G J

Everyone loves his mother

2. $\exists x.\text{elephant}(x)$

There is at least one elephant.

Q.3 Consider the following graph, write (reorder) the state of graph by Breadth_first_search and Depth_first_search. (2 marks)



Depth : ABDEI'FGHJLMKIC
Breadth : ABCDEI'FGHIJKLM

Q.4. Draw the FSM for the following state transition table, where you have to write your S, I and F.

→	0	1
S ₂	S ₂	S ₁
S ₁	S ₁	S ₂

- 23) The performance of A* algorithm is said to be ___ and ___, with time and space complexities as ___ and ___.
- complete, non-optimal, $O(b^d)$ and $O(b^d)$
 - incomplete, optimal, $O(bm)$ and $O(bm)$
 - complete, optimal, $O(b^d)$ and $O(b^d)$
 - complete, optimal, $O(b^d)$ and $O(bm)$

Section B: Problem Solving Questions (7 marks)

1) Translate the following English sentences into first-order logic formulas and vice versa. (1mark)

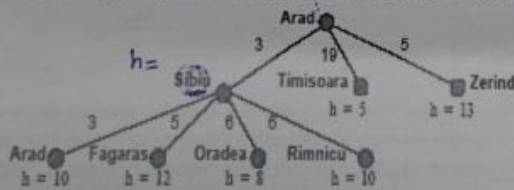
a. Not all students take ADB

.....

b. Knows(marc, elise) \wedge \neg Knows(elise, marc)

.....

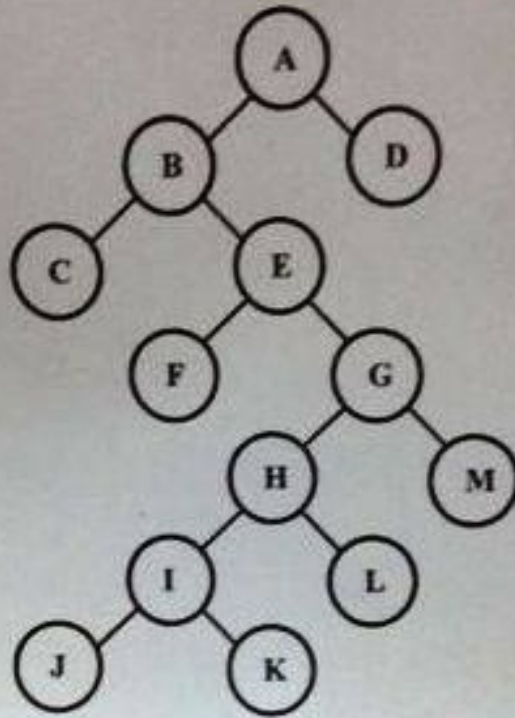
2) The following diagram shows a partially expanded search tree. Each arc is labelled with the corresponding step cost and the leaves are labelled with the h value.



Based on the calculated Goal Function, show which leaf will be expanded next by an A* search? (1mark)

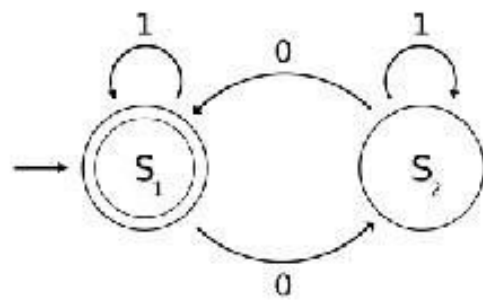
(3) Consider the following graph, write (reorder) the state of graph by Breadth_first_search and Depth_first_search. (5 marks)

Mid 1



Breadth_First_Search :
ABDCEFGHMLJK

Depth_First_Search :
ABCEFGHIJKLMD

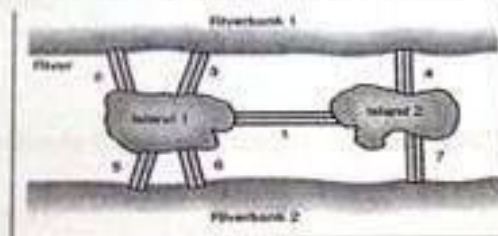


Section A : 3-parts (1, 2 and 3) (15 marks)

Mid 1

(1) Multiple Choice Questions (6 marks)

- In expressions of the form $P \vee Q$, P and Q are called the:
 - Implication
 - Conjuncts
 - Disjuncts
 - Negation
- _____ system that approximates the way a human sees, hears, and feels objects.
 - Learning
 - Perceptive
 - Expert
 - Neural
- If there is a sentences P , $P \rightarrow Q$, where P is known to be True and $P \rightarrow Q$ known to be false, then we can infer Q by use inference rule called :
 - Modus ponens
 - Introduction
 - Modus tollens
 - Elimination
- Which one of the following is an intelligent behaviour?
 - Learn from experience
 - Understand visual images
 - Use heuristics
 - All of them
- _____ are computer system that can act like or simulate the functioning of the human brain.
 - Expert systems
 - Machine learning
 - Neural Nets
 - robotics
- The bridges of Königsberg problem shown below can be represented as a state space graph. How many nodes and arcs will be required to show in a graph?



- 4 nodes and 7 arcs
- 7 nodes and 4 arcs
- 7 nodes and 2 arcs
- 2 nodes and 7 arcs

(2) True or False Questions (6 marks)

1	Informal logic is the study of inference with purely formal content.	F
2	Turing test is a test of machine's ability to exhibit an intelligent behaviour.	T
3	Artificial intelligence focus on problems that do respond to algorithmic solutions.	F
4	Planning assumes a robot that is capable of performing certain atomic actions.	T
5	In AI programming language Lisp uses predicate calculus and Prolog uses functions.	F
6	Unification is an algorithm for determining the substitutions needed to make two predicate calculus expressions match.	T

Intelligent Systems - 2008

Section B: 2-parts (1 and 2) (10 marks)

(1) Define the following terminology: (2 marks)

a) Logic:

verbal formulas

b) Artificial intelligence systems:

The core, hardware, software, data and knowledge needed to design computer system and machines that demonstrate the characteristics of intelligent.

c) Knowledge Representation:

is the ability to using knowledge

(2) Answer the following using the Predicate Logic. (1 marks)

a) Using a binary predicate, $love(x, y)$, translate the following sentence in Predicate Logic.

"Some love rose"

$\exists x love(x, rose)$

b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

1. Everyone is liked by someone.

$\forall x like(x)$

2. No purple mushroom is poisonous.

$\neg \exists x is(mushroom, poisonous)$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (person(x) \wedge time(t) \rightarrow can-fool(x,t))$

2. $(\forall x), gardener(x) \rightarrow likes(x, sun)$

Section II: 2 parts (I and II) (10 marks)

(I) Answer the following questions (2 marks)

(a) Logic

Logical Equivalence

(b) Artificial Intelligence

The early symbolic reasoning systems were developed to simulate the intelligence of humans.

(c) Knowledge Representation

Its main activity is using knowledge

(II) Answer the following using the Predicate Logic (2 marks)

(a) Using a binary predicate, $Love(x, y)$, write the following sentence in Predicate Logic

"Some love some"

$\exists x \exists y (Love(x, y))$

(b) Translate the following English sentences into Predicate Logic (FOL) (2 marks)

1. Everyone is liked by someone

$\forall x \exists y Like(y, x)$

2. No purple mushroom is poisonous

$\neg \exists x (PurpleMushroom(x) \wedge Poisonous(x))$

(c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $\forall x (C(x) \wedge (parent(x) \vee sister(x)) \rightarrow can-look(x, I))$

2. $\forall x (graduate(x) \rightarrow like(x, Sam))$

(3) Fill in the blank. Questions (3 marks)

- 1) The series of formulas which is constructed within such a system is called a _____.
- 2) In knowledge type, if you want to know about heart attack, please read this book is example of _____.
- 3) The two most fundamental concerns of AI researchers are search and _____.

Section B: 2-parts (1 and 2) (12 marks)

(1) Define or briefly discuss the following terminology: (3 marks)

Artificial intelligence systems.

(2) Answer the following using the Predicate Logic. (9 marks)

- a) Using a binary predicate, Like(
- Y
- , car), translate the following sentence in Predicate Logic.

"Some like car" (2 marks)

$$\exists Y \text{ Like} (Y, \text{Car})$$

- b) Translate the following English sentences into Predicate Logic (FOL). (2 marks)

All Tajseer lecturers are smart.

$$\forall X \text{ Tajseer Licturer} (X) \rightarrow \text{Smart} (X)$$

- c) Translate the following Predicate Logic into simple English sentences. (2 marks)

$$\forall x, \exists y \text{ father}(x,y) \wedge \text{loves}(x,y)$$

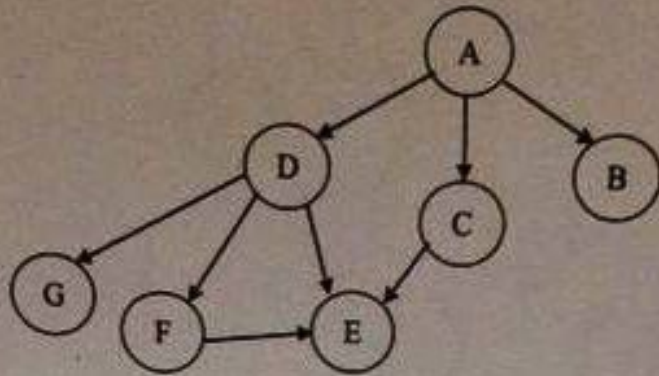
All Father Love his children

- d) Prove with reasoning the following logically formula whether equivalent or not. (3 marks)

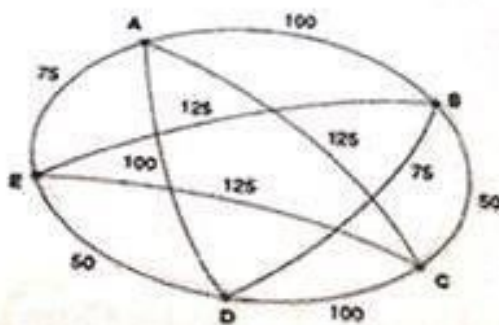
$$((P \wedge \neg H) \vee H) \rightarrow P \equiv (\neg H \rightarrow P)$$

(1) Show the complete trace of Breadth First Search (BFS) for the following tree to reach goal G from root A. Where you have to show your Path, Nodes (visited) order sequence and your trace must show the iteration number, Open and Closed lists. (5 marks)

Mid 1



(2) Show the path and its cost by using the nearest neighbor search for the following figure. Note: the root is E. (3 marks)



$50 \quad 75 \quad 50 \quad 125 \quad 75$
 $E \rightarrow D \rightarrow B \rightarrow C \rightarrow A \rightarrow E$
 Path (EDBCAE) = 375

F
F
F
T

Mid 2

A(2) True or False Questions (6 marks)

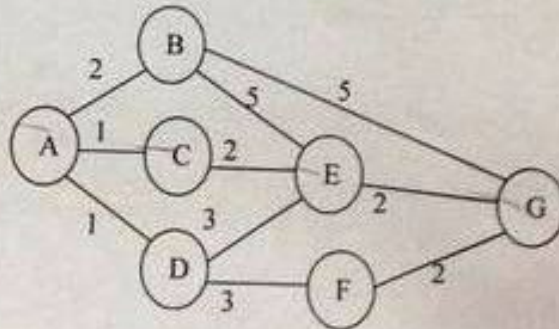
1	In Best first search, the breadth first is good because a solution can be found without computing all nodes and depth first is good because it does not get trapped in dead ends.	F
2	A search algorithm is Admissible if it is guaranteed to find a minimal path to a solution whenever such a path exists.	T
3	Scripts are used in natural language understanding systems to organize a knowledge base in terms of the situations that the system is to understand.	T
4	In state space search, Heuristics are formalized as rules for choosing those branches in a state space that are most likely to lead to an acceptable problem solution.	T
5	In steepest ascent hill climbing you will always make your next state the best successor of your current state, and will only make a move if that successor is better than your current state.	T
6	Medical diagnosis is an example of AI problem solvers that may have an exact solution. A given set of symptoms may have several possible causes; doctors use heuristics to choose the most likely diagnosis and formulate a plan of treatment.	F

Section B: 5-parts (1, 2,3,4 and 5) (19 marks)

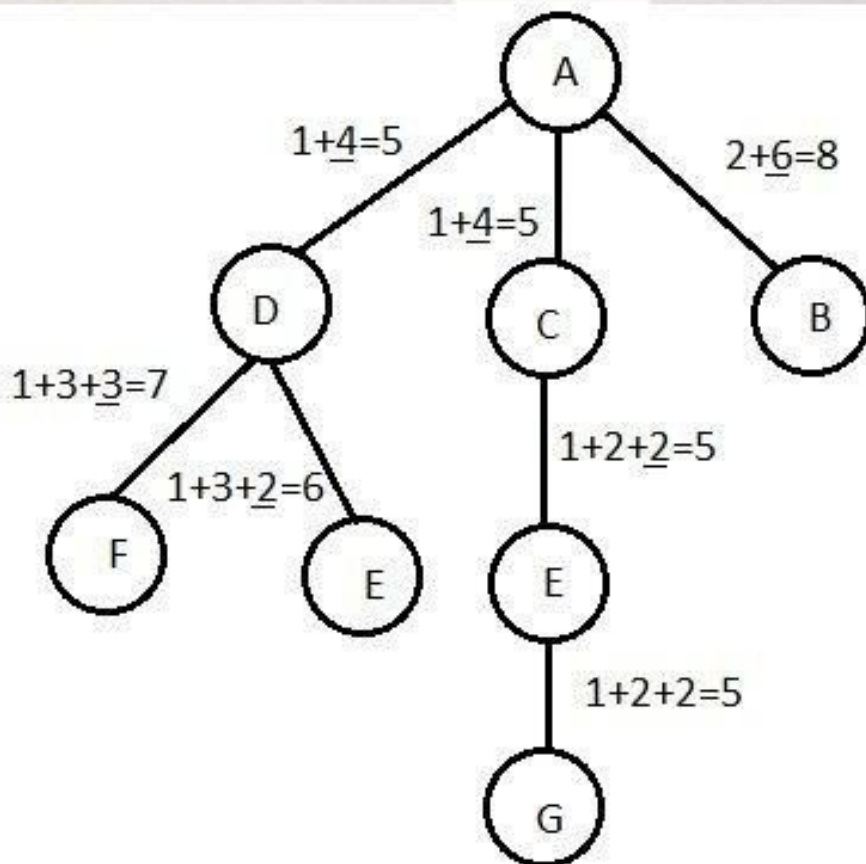
B(1) (5 marks)

If given the graph below (A is root and G is goal):

Straight line distance to G	
A	7
B	6
C	4
D	4
E	2
F	3

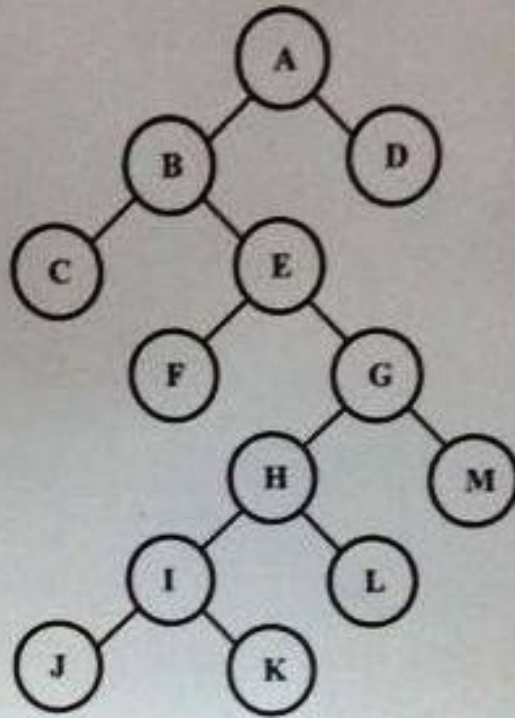


Draw the tree by using the A* search, where you have to show all details on the tree, path and cost?



(3) Consider the following graph, write (reorder) the state of graph by Breadth_first_search and Depth_first_search. (5 marks)

Mid 1



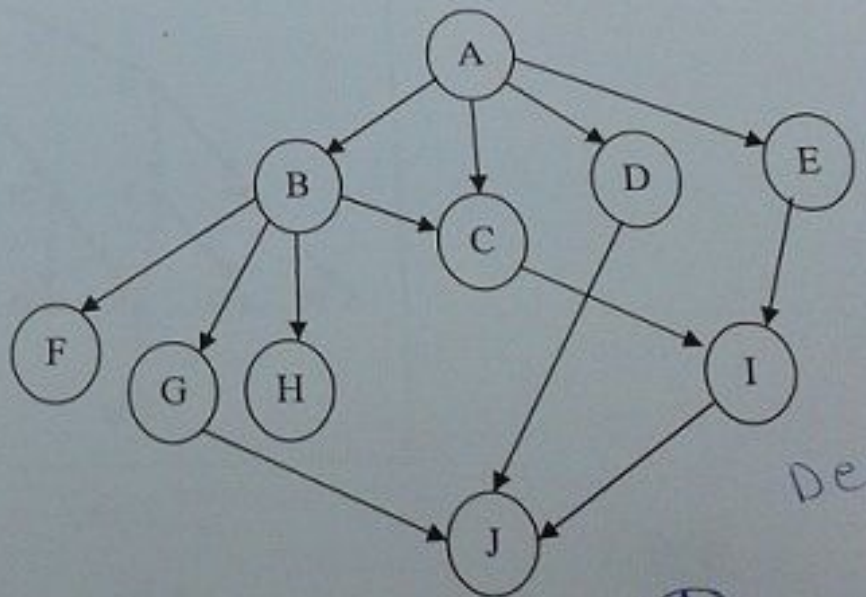
Breadth_First_Search :
ABDCEFGHMLJK

Depth_First_Search :
ABCEFGHIJKLMD

Question C: 2-parts (1 and 2) (15 degrees)

Given the tree below, show the Path, Nodes (visited) order sequence, Path cost in the state for each of depth-first search (DFS) and breadth first search (BFS). (10 marks)

Note: In DFS your trace must show iteration number, CS, and the SL, NSL, and DE lists and BFS your trace must show the iteration number, Open and Closed lists, A is the root and J the goal, each arc cost is 2.



NSL DE

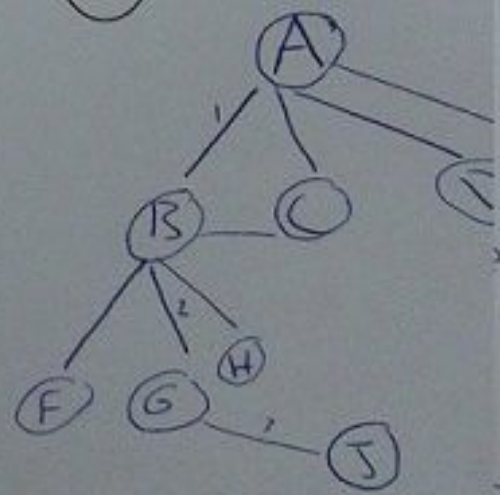
[A]

[BCD, A]

[GHBCDEA]

[HBCDEA] [F]

Open	⊕	Close
A		()
BCDE		A
KDEFGH		BA
EBA		FBA
JGBA		FBAH



Path A B G J

Section A: 3-parts (1, 2, and 3) (15 marks)

(1) Multiple Choice Questions (5 marks)

1) For propositional expressions P, Q and R, the law below is:

$$(P \wedge Q) \equiv (Q \wedge P) \text{ and } (P \vee Q) \equiv (Q \vee P)$$

- a. Contrapositive law.
- b. Associative law.
- c. Distributive law.
- d. Commutative law.

2) If there is a sentences P, $P \rightarrow Q$, where P is known to be True and $P \rightarrow Q$ known to be false, then we can infer Q by use inference rule called :

- a. Elimination.
- b. Modus tollens.
- c. Modus ponens.
- d. Introduction.

3) The study of meaning. It focuses on the relation between signifiers, such as words, phrases, signs and symbols, and what they stand for, their denote is:

- a. Propositional calculus.
- b. Symbolic logic
- c. Semantics.
- d. Syntax.

4) This is a programming language that was designed for easy manipulation of data strings. It was developed in 1959 by John McCarthy and is still commonly used today in artificial intelligence (AI) programming.

- a. Assembly language.
- b. LISP.
- c. Machine code
- d. Ruby

5) Computer changes how it functions or reacts to situations based on feedback is

- a. Perceptive system.
- b. Learning system.
- c. Neural network.
- d. Natural language processing .

2) True or False Questions (5 marks)

Propositional calculus is the generic term for symbolic formal systems like first-order logic, second-order logic, many-sorted logic or infinitary logic.	T
Informal logic is the study of inference with purely formal content.	T
Expert system is to stores knowledge and makes inferences.	T
Prolog and Lisp emphasize programming in large pieces.	F
A Finite State Machines(FSMs) are often used in compilers and validity checking programs	F

Fill in the blank Questions (5 marks)

1) An inference rule is primitive if every predicate calculus expression produced by the rule from a set S of predicate calculus expression also logically follows from S.

2) _____ is a system of programs and data structures that approximates the operation of the human brain.

3) There are two most fundamental concerns of AI researchers are knowledge representation and Search.

4) The series of formulas which is constructed within such a system is called a _____.

5) In knowledge type, if you want to know about heart attack, please read this book is example of predicate logic

Section A: 3-parts (1, 2, and 3) (15 marks)

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5) In knowledge type, if you want to know about heart attack, please read this book is example of predicate logic

a) Logic:

represent statements

b) Artificial intelligence systems:

The basic hardware, software and knowledge needed to design computer systems and machines demonstrate the characteristics of intelligence.

Mid 1

c) Knowledge Representation:

is the ability to apply knowledge

(2) Answer the following using the Predicate Logic. (1 mark)

a) Using a binary predicate, Love(x, rose), translate the following sentence in Predicate Logic.

"Some love rose"

$\exists x \text{ Love}(x, \text{rose})$

b) Translate the following English sentences into Predicate Logic (V/A). (2 marks)

1. Everyone is liked by someone.

$\forall x \text{ like}(x)$

2. No purple mushroom is poisonous.

$\neg \exists x \text{ is}(\text{mushroom}, \text{poisonous})$

c) Translate the following Predicate Logic into simple English sentences. (2 marks)

1. $(\forall x)(\exists t) (\text{person}(x) \wedge \text{time}(t) \rightarrow \text{can-fool}(x,t))$

2. $(\forall x), \text{gardener}(x) \rightarrow \text{likes}(x, \text{Sun})$

Part A: Multiple Choice Questions (23 marks)

Choose the correct answer, then write your answers in the above table. All MCQs carry equal marks.

1) if given the node and goal bellow for 8-Puzzle Problem:

1	8	3
2	6	4
	7	5
Node State		

1	2	3
8		4
7	6	5
Goal State		

Then the Tiles out of the place are :

- a. 6
- b. 5
- c. 4
- d. 7

2) -----is a technique for systematically trying all paths through a state space.

- a. Expert System
- b. Backtracking search
- c. Machine Learning
- d. none

3) The example below is

“You can't log into the network
If you have a current password, then you can log into the network”

- a. Elimination
- b. Modus ponens
- c. Introduction
- d. Modus tollens

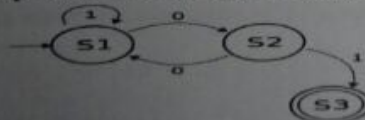
4) Machine Learning is important, because-----.

- a. Some tasks cannot be defined well, except by examples.
- b. Human designers often produce machines that do not work as well as desired in the environments in which they are used.
- c. Relationships and correlations can be hidden within large amounts of data.
- d. All

5) The example below is a:

All Living organisms can move
cat is a Living organism
Therefore cat can move.

- a. Formal Logic with valid logical form and invalid propositions
 - b. Formal Logic with invalid logical form and valid propositions
 - c. Formal Logic with valid logical form and valid propositions
 - d. Informal Logic with invalid logical form and invalid propositions
- 6) Which of the following inputs will be accepted by the following FSM?

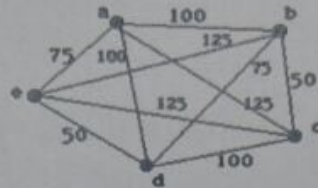


- a. 10011001
- b. 11100001
- c. 00110010
- d. 00111101

7) Backward chaining is a ----- search technique.

- a. Data driven
- b. Goal driven
- c. Both a & b
- d. None

8) The following graph represents five cities (a, b, c, d, and e) that a travelling salesperson is going to visit. Using the nearest neighbour search, which path the salesperson will follow if the starting point is city d?



- a) deabcd
- b) dbcdea
- c) daebcd
- d) dcbae

9) The two most fundamental concerns of AI researchers are:

- a. Logic and Mind
- b. Search and Mind
- c. Knowledge Representation and Search
- d. None of the above

10) One of the differences between machine intelligence and human intelligence is

- a. Machine is deterministic and Brain is stochastic
- b. Machine is stochastic and Brain is deterministic
- c. Machine and Brain are stochastic
- d. Machine and Brain are deterministic

11) What will be the complete traverse path for the following tree in case we apply Depth First Search

- a. ABDEFGHJLMKCI
- b. ABDEFGHJLMKIC
- c. ABCDEFGHJLMKI
- d. ABCDEFGHKJMLI



12) My office is in B12 building, this is a knowledge

- a. Heuristic
- b. Structural
- c. Declarative
- d. Procedural

13) Good students do not fail in exams; the translation of this sentence into First Order Predicate Calculus is.....

- a. $\forall X((\text{good_students}(X) \wedge \text{fail in exams}(X))$
- b. $\neg \exists X((\text{good_students}(X) \wedge \text{fail in exams}(X))$
- c. $\forall X((\text{good_students}(X) \rightarrow \text{fail in exams}(X))$
- d. $\exists X((\text{good_students}(X) \wedge \text{fail in exams}(X))$

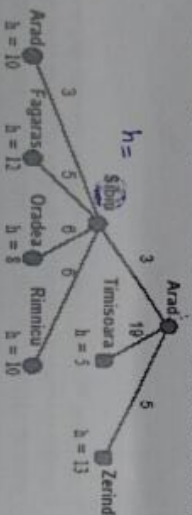
- 23) The performance of A* algorithm is said to be ___ and ___ with time and space complexities as ___ and ___.
- complete, non-optimal, $O(b^d)$ and $O(b^d)$
 - incomplete, optimal, $O(bm)$ and $O(bm)$
 - complete, optimal, $O(b^d)$ and $O(b^d)$
 - complete, optimal, $O(b^d)$ and $O(bm)$

Section B: Problem Solving Questions (7 marks)

- 1) Translate the following English sentences into first-order logic formulas and vice versa. (1 mark)

- Not all students take ADB
.....
- Knows(marc, clise) \wedge \neg Knows(clise, marc)
.....

- 2) The following diagram shows a partially expanded search tree. Each arc is labelled with the corresponding step cost and the leaves are labelled with the h value.



Based on the calculated Goal Function, show which leaf will be expanded next by an A* search? (1 mark)

- 14) The implementation in BEST-FS is identical to that for; uses the priority queue
- Uniform-cost search
 - Greedy Best First Search
 - Bidirectional search
 - Iterative deepening Search
- 15) In Hill climbing, the criterion for the node to follow is that it's
- Sibling for the current state
 - Depth for the current state
 - The best state for the current state
 - Breadth for the current state
- 16) In Turing test, If the interrogator can distinguish the machine from the human then ...
- The machine is not intelligent
 - The machine is intelligent
 - The interrogator is intelligent
 - The interrogator is not intelligent
- 17) Techniques that are used in artificial are as follow, except ____
- knowledge representation
 - planning
 - automated processing
 - searching
- 18) Artificial intelligence is generally suitable for problems Expert
- that require common sense
 - that requires extensive computation
 - that many experts can solve PCW
 - with no good known algorithms
- 19) Given a predicate calculus for: $\forall X (\text{goal}(X) \wedge \sim \text{plan}(X)) \rightarrow \text{dream}(X)$.
- A goal without plan is just a dream.
 - A goal with plan can dream.
 - Every goal with no plan dreams.
 - Every goal with no plan dreams.
- 20) Find the unifier of $p(X,b)$ and $p(Y, Y)$, if one exist.
- $\{X/b, X/b\}$
 - $\{Y/b, Y/b\}$
 - $\{X/b, Y/b\}$
 - No unifier
- 21) Which of the following algorithm potentially face memory problem if the search space is huge and has many branches?
- depth-limited search
 - depth-first search
 - iterative deepening
 - breadth-first search
- 22) The following are the reasons for using data-driven search, except:
- All or most of the data are given
 - There are a large number of rules
 - There are a large number of potential goals
 - It is difficult to form a goal or hypothesis