University of Chittagong
Department of Computer Science and Engineering
7th Sem. B. Sc. Engineering Examination, 2017
Course Code: CSE 713
Course Title: Artificial Intelligence
Total Marks: 52.5 Time: 4:00 Hours

[Answer any ***three*** questions from **Group-A** and any ***three*** questions from **Group-B;** Separate answer script must be used for Group-A and Group-B. Figures in the right-hand margin indicate full marks.]

Group-A

1. (a) What is search problem? Briefly explain why problem formulation must follow goal formulation. 1.25

(b) Give the initial state, goal test, operators, and path cost function for each of the following. 2.5

(i) Using only four colors, you have to color a planar map in such a way that no two adjacent regions have the same color.

(ii) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains two stackable, movable, climbable 3-foot-high crates.

(c) Suppose you have the following search space:

State	Next	Cost
A	B	4
A	C	1
B	D	3
B	E	8
C	C	0
C	D	2
C	F	6
D	C	2
D	E	4
E	G	2
F	G	8

State	h
A	8
B	8
C	6
D	5
E	1
F	4
G	0

i) Draw the state space of this problem. 1

ii) Assume that the initial state is A and the goal state is G. Show how each of the following search strategies would create a search tree to find a path from the initial state to the goal state. 3

Uniform cost
Greedy search
A* search

(iii) At each step of the search algorithm, show which node is being expanded, and the content of fringe. Also report the eventual algorithm, and the solution cost. 1

2. (a) What are the major differences in resolution in PL and resolution in FOL. 1.25

(b) Consider the following sentences:

(1) Marcus was a man.
(2) Marcus was a Pompeian.
(3) Marcus was born in 40 A.D.
(4) All men are mortal.
(5) All Pompeian died when the volcano erupted in 79 A.D.
(6) No mortal lives longer than 150 years.
(7) It is now 2014.
(8) Alive means not dead.

i) Translate these facts into well-formed formulas (wffs) in predicate logic. 2

ii Convert the formulas into clause form. 2

iii) Prove that "Marcus is not alive now" using resolution. 2.5

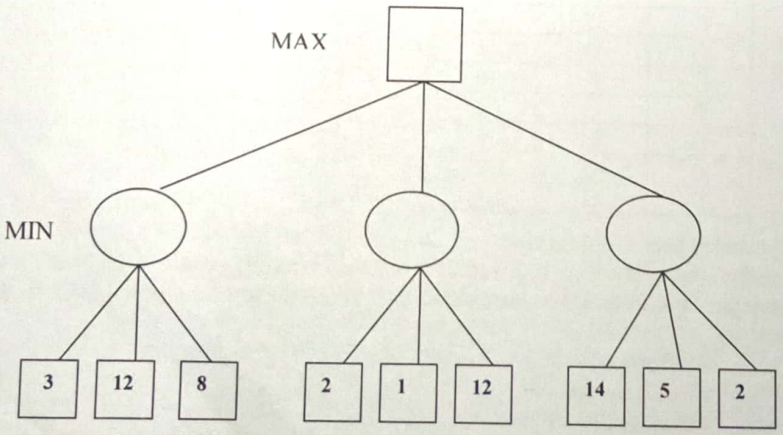
(c) Explain the concept of entailment with an appropriate example? 1

3. (a) Prove the optimality of A*. 2

(b) Is hill-climbing guaranteed to find a solution to the n-queens problem? Elaborate your answer. 2

(c) What is heuristic? Write the name of two heuristics associated with the eight puzzle problem. 1.5

(d) What is the Alpha-Beta pruning? How does pruning improves the situation in game playing? Elaborate your answer by taking account of the following tree. 3.25



4. (a) What is Bayesian Network? Describe the syntax and semantics of Bayesian Networks with necessary examples. 1.75

(b) Write the different types of inference procedures in BN. 1

(c) Your burglar alarm may or may not be sounding (node A). Possible causes of A are your house being burgled (node B) or a small earthquake (node E) setting it off by accident. Your reliable friend has called you saying that he thinks the alarm is sounding (node R). Your unreliable friend, who often calls when your alarm sounds, has not done so this time (node C). Your two friends do not have any contact with each other.

(i) Draw a Bayesian network representing the variables, causes and observations in this situation. 1

The following are conditional probabilities for the events in the model:

$P(B) = 0.02$

$P(E) = 0.001$

$P(A|\neg B,\neg E)=0.01$, $P(A|B,\neg E)=0.9$, $P(A|\neg B,E)=0.9$, $P(A|B,E)=0.99$

$P(R|A)=0.002$, $P(R|\neg A)=0.999$ (NB these do not have to sum to 1)

$P(C|A)=0.8$, $P(C|\neg A)=0.1$ (NB these do not have to sum to 1)

(ii) Compute the prior that the alarm is sounding. 1

(iii) Compute the normalised likelihood that alarm is sounding. 1

(iv) Compute the posterior that the alarm is sounding. 1

(v) Suppose that you hear a radio report that an earthquake has occurred near your home. Draw a modified Bayesian network to model this, and discuss qualitatively how your belief about each of A, E and B would change, earthquake has occurred and both Mary and Jhon call. 2

Section B

5. (a) Give a scientific definition of intelligence. Show how does it differ from dictionary definition of intelligence. 1

(b) "AI is the study and construction of rational agents" – do you agree with this statement? If yes, justify your answer. 1

(c) Suppose you design a machine to pass the Turing test. What are the capabilities such a machine must have? 1

(d) Find out the followings about the Automated Taxi Driving Agent..

(i) Identify its PAGE (Percepts, Actions, Goals and Environment) description. 0.75

(ii) Characterise it's environment as being either: accessible or inaccessible; deterministic or nondeterministic, episodic or non-episodic, static or dynamic, and, discrete or continuous; explaining what each of your selected term means. 3

(iii) What agent architecture is best for the Automated Taxi Driving Agent? Justify your answer. 2

6. (a) Define forward and backward chaining. What are the factors that determine whether it is better to reason forward or backward? 2

(b) What is conflict resolution? Discuss any two of the approaches, which are used solve conflict resolution. 2

(c) Draw the architecture of a rule-based system. Following are the rules and initial facts in the rule-base and database of facts of a rule-based expert system. 4.75

R1: IF A and C THEN E
R2: IF C and D THEN F
R3: IF B and E THEN F
R4: IF B THEN C
R5: IF F THEN G

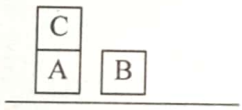
Initial facts in the database
A,B (both are true)
Objective:
Prove hypothesis G (goal)

Prove the goal (G) by applying both Forward Chaining and Backward Chaining inference procedures. You need to show the sequence of firing the rules and also need to draw the search tree, in which propagation of truth for FC and backtracking of goals for BC to be demonstrated diagrammatically.

7. (a) What is the goal stack planning? Write down the specification of the following operators / actions:- 2.75

(i) UNSTACK (A,B), (ii) STACK(A,B), (iii) PICKUP(A), and (iv) PUTDOWN(A)

(b) Consider the following blocks world problem known as Sussman Anamoly Problem. Develop an effective and complete plan using Partial-Order Planning/STRIPS approach to convert given Initial State into Goal State. It could be fine if you address the flaws such as threats to causal links and open conditions in developing the final plan. 6



Initial State:
ON(C, A) ^
ONTABLE(A) ^
ONTABLE(B) ^
ARMEMPTY

Goal State:
ON(B, C) ^
ON(A, B) ^
ONTABLE(C)

8. (a) What is Hypothesis? Describe how the concept of hypothesis is utilized in the inductive learning method. 2.75

(b) What is uncertainty? What are the different sources of uncertainty? 2

(c) Prove FOL is considered as the generalization of PL Briefly describe why FOL is more expressive than PL. 2

(d) Explain with example why universal quantification (∀) elimination is easy while existential quantification (∃) elimination is not that much easy 1

(e) Prove Modus Ponens is very much a sound inference procedure. 1

University of Chittagong

7th Semester B.Sc (Engg.)Examination 2018
Department of Computer Science & Engineering
Course Code: CSE 713
Course Title: Artificial Intelligence

Time: 4 Hours **Full Marks:** $52\frac{1}{2}$

[Answer six questions taking any three from each section and use separate answer script for each section]

Section A

1. a) Define Intelligence. What are the difference approaches in defining artificial intelligence? Which one do you think appropriate and why? 2

   b) Do you think humanoid *Sophia* and *Jarvis* possess the features and signs of intelligence? If so, elaborate your answer by taking account of the behavior of *Sophia* and *Jarvis*. 1.5

   c) What is intelligent behavior? Do you think only sensing and acting will make a machine intelligent? If not elaborate your answer. 1.5

   d) Find out the followings about Internet Shopping Agent.
   (i) Identify its PAGE description. 1.25
   (ii) Characterize its operating environment. 1.25
   (iii) How can one evaluate the performance of the agent? 1.25

2. a) Compare the basic search algorithms, which are used in both Tree and Graph data structures to represent a state space both in explicit and implicit ways. 1.5

   b) Give the initial state, goal test, sucessor function, and cost function for each of the following. 4

   i) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains two stackable, movable,
   climbable 3-foot-high crates.

   ii You have three jugs measuring 12 gallons, 8 gallons, and 3 gallons, and a water faucet. You need to measure out exactly one gallon.

   c) Suppose you have the following search space:

State	Next	Cost
A	B	4
A	C	1
B	D	3
B	E	8
C	C	0
C	D	2
C	F	6
D	C	2
D	E	4
E	G	2
F	G	8

State	H
A	8
B	8
C	6
D	5
E	1
F	4
G	0

   i. Draw the state space of this problem. 1

   ii. Assume that the initial state is A and the goal state is G. Show how each of the following search strategies would create a search tree to find a path from the initial state to the goal state. 2.25

   Uniform cost
   Greedy search
   A* search

3. a) What is iterative improvement algorithm? Do you consider both Hill-Climbing and Simulated Annealing are of this branch of algorithm? If yes why? 2

   b) What is CSP? Do you consider the following problem is an example of CSP? If so, identify the variables, domains and constraints associated with this problem. 2

   You have to color a planar map using only four colors, in such a way that no two adjacent regions have the same color

c) Compare and contrast between DFID and IDA* algorithms. 1.75

c) Consider any three agents from this list: Medical Diagnosis System, Park-Picking Robot, Interactive English Tutor, Vacuum Cleaner, Internet Shopping and Mars Rover; then find out following for the three selected agents. 3

i. What are the percepts for this agent?
ii. Characterize its operating environment.
iii. What are the actions the agent can take?
iv. How can one evaluate the performance of the agent?

What sort of agent architecture do you think is most suitable for this agent?

4. a) Determine whether the following sentence is (i) Satisfiable, (ii) Contradictory (iii)Valid 3

$$(P \vee Q) \wedge (P \vee \sim Q) \vee P$$

b) Given knowledge base R1, R2, R3, R4, R5 below, show that P1, 2 is false. 3.75

R1: $\sim P11$
R2: $B11 \Leftrightarrow (P2,1 \vee P1,2)$
R3: $B2,1 \Leftrightarrow (P1,1 \vee P2,2 \vee P3,1)$
R4: $\sim B1,1$
R5: $B2,1$

c) Prove FOL is considered as the generalization of PL. Explain with example why universal quantification (∀) elimination is easy while existential quantification (∃) elimination is not that much easy. 2

Section B

5. a)
i. If a perfect square is divisible by a prime **P**, then it is also divisible by square of **P**
ii. Every perfect square is divisible by some prime
iii. 36 is a perfect square
iv. Does there exist a prime **q** such that square of **q** divide 36?

Prove via the resolution method and unification (where needed) that "Does there exist a prime q such that square of q divide 36?" More precisely

a. First translate the sentences above into FOL Sentences 1.75
b. Convert to Clause Forms 3.5
c. Apply the resolution method with the unification (where needed) to prove the goal sentence: "Does there exist a prime **q** such that square of **q** divide 36?" 3.5

6. a) What is Rule-Based System (RBS)? Briefly describe the way in which IF-THEN rules can be used as a basis for knowledge representation and reasoning in RBS. 2

b) What is backtracking? Show how good conflict resolution strategy can be used to reduce backtracking. 2

c) Draw the architecture of a rule-based system. Following are the rules and initial facts in the rule-base and database of facts of a rule-based expert system. 4.75

R1: IF hot and Smokey THEN Add Fire
R2: IF Alarm beeps THEN Add Smokey
R3: IF Fire THEN Add Switch Sprinkler

Initial facts in the database
Alarm beeps and hot (both are true)
Objective: Prove hypothesis
Switch Sprinkler (goal)

Prove the goal by applying both Forward Chaining and Backward Chaining inference procedures. You need to show the sequence of firing the rules and also need to draw the search tree, in which propagation of truth for FC and backtracking of goals for BC to be demonstrated diagrammatically.

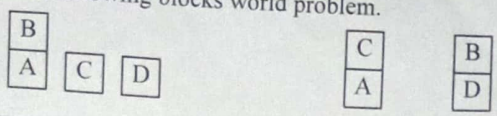
7. a) What is planning? Write the factors, considered in formulating a planning problem. 1.5

b) Explain how planning differs from classical search techniques. 1.5

4.75

c) Consider the following blocks world problem.

5.75



Start:
ON(B,A)^
ONTABLE(A) ^
ONTABLE(C) ^
ONTABLE(D) ^
ARMEMPTY

Goal:
ON(C,A) ^
ON(B,D) ^
ONTABLE(A) ^
ONTABLE(D)

Solve this problem using goal stack planning/partial order planning/STRIPS approach.

8. a) Taking account of the example below, explain the concept of uncertainty. 1.5

" The doorbell rang at 12'0 clock in the midnight.
- Was someone there at the door?
Did Karim wakeup?"

b) Differentiate among adductive, deductive and default reasoning. Explain why they are not considered as sound reasoning and hence, considered as the sources of uncertainty. 3.25

c) A doctor knows that the disease meningitis causes the patient to have a stiff neck, say, 40% of time. The doctor also knows some unconditional facts: the prior probability that a patient has meningitis is 1/50000, and the prior probability that any patient has a stiff neck is 1/25. Find the probability of patients with a stiff neck to have meningitis. 4

University of Chittagong

Department of Computer Science and Engineering

7th Semester B.Sc. (Engg.) Examination-2020

Course Code: CSE-713 Course Title: Artificial Intelligence

Total marks: 52.5 Marks Time: 4.00 hours

[Answer any ***three*** questions from each of the ***Group-A*** and ***Group-B***. A separate answer script must be used for Group-A and Group-B. Figures in the right-hand margin indicate full marks.]

Group-A

1. a) Give a scientific definition of intelligence. Do you think the following definition of intelligence constitutes a scientific definition? If not, justify your answer. 2

"*Intelligence is the acquiring and applying knowledge.*"

b) Discuss the different approaches of AI. Which one do you think is appropriate and why? 2

c) Find out the following about the automated taxi driving agent. 1+1.75+2

i) Identify its PAGE (Percepts, Actions, Goals, and Environment) description.

ii) Characterize its environment as being either: accessible or inaccessible; deterministic or nondeterministic; episodic or non-episodic; static or dynamic; and discrete or continuous; explaining what each of your selected terms means.

iii) What agent architecture is best for the Mars Rover? Justify your answer.

2. a) How can you formulate a search problem? Give examples of data structures that can be used to represent a state-space both in explicit and implicit ways. 1.75

b) Give the initial state, goal test, successor function, and cost function for each of the following. 2

i) In the travelling salesperson problem (TSP) there is a map involving N cities some of which are connected by roads. The aim is to find the shortest tour that starts from a city, visits all the cities exactly once, and comes back to the starting city.

ii) Missionaries and Cannibals problem: 3 missionaries and 3 Cannibals are on one side of the river. 1 boat carries 2 Missionaries must never be outnumbered by cannibals. Give a plan for all to cross the river.

c) Suppose you have the following search space: 1+3+1

State	Next	Cost
A	B	4
A	C	1
B	D	3
B	E	8
C	C	0
C	D	2
C	F	6
D	C	2
D	E	4
E	G	2
F	G	8

State	h
A	8
B	8
C	6
D	5
E	1
F	4
G	0

i) Draw the state-space of this problem.

ii) Assume that the initial state is A and the goal state is G. Show how each of the following search strategies would create a search tree to find a path from the initial state to the goal state. • Uniform cost • Greedy search • A* search

iii) At each step of the search algorithm, show which node is being expanded and the content of fringe.

3. a) What is a heuristic function? Consider the following block world problem: 2.5

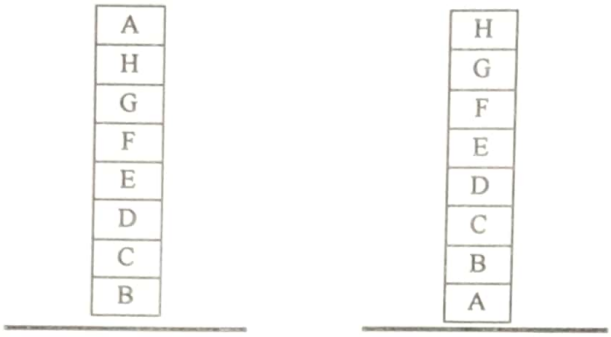


Fig.: A Hill Climbing Problem.

Show that the hill-climbing procedure is failed with the local heuristic function but works perfectly with the global heuristic function.

b) Iterative-deepening (ID) is a type of search algorithm, which is said to combine the benefits of breadth-first and depth-first search. Explain, using a diagram or otherwise, how ID achieves these benefits. 2

c) When is breadth-first search an *admissible* search strategy? Briefly explain. 1.75

d) Describe the Minimax algorithm for searching game trees. 2.5

4. Consider the following facts: 2+2+2+ 2.75

(i) Marcus was a man.
(ii) Marcus was a Pompeian.
(iii) Marcus was born in 40 A.D.
(iv) All men are mortal.
(v) All Pompeians died when the volcano erupted in 79 A.D.
(vi) No mortal lives longer than 150 years.
(vii) It is now 2021.
(viii) Alive means not dead.
(ix) If someone dies, then he is dead at all later times.

a) Translate these facts into well-formed formulas (WFFs) in predicate logic.
b) Answer the question "*Is Marcus alive now?*" using backward reasoning.
c) Convert the formulas into clause form.
d) Prove that "*Marcus is not alive now.*" using resolution.

Group-B

5. a) Define forward and backward chaining. What are the factors that determine whether it is better to reason by using forward or backward chaining? 1.5

b) What is conflict resolution? Discuss any two of the approaches, which are used to solve conflict resolution. 1.5

c) Draw the architecture of a rule-based system. Following are the rules and initial facts in the rule-base and database of facts of a rule-based expert system. 5.75

R1: IF A and C THEN E	Initial facts in the database
R2: IF C and D THEN F	A, B (both are true)
R3: IF B and E THEN F	Objective:
R4: IF B THEN C	Prove hypothesis G (goal)
R5: IF F THEN G	

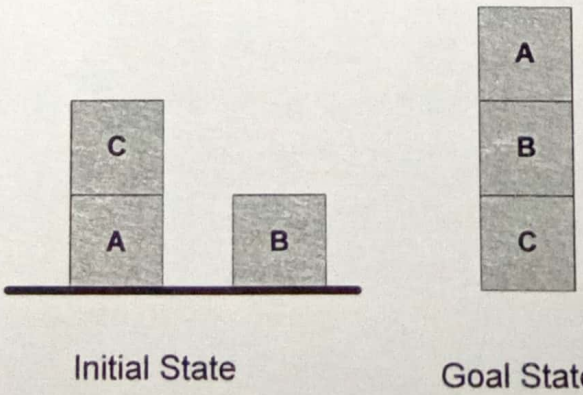
Prove the goal (G) by applying both forward chaining (FC) and backward chaining (BC) inference procedures. You need to show the sequence of firing the rules and also need to draw the search tree, in which propagation of truth for FC and backtracking of goals for BC are to be demonstrated diagrammatically.

6. a) Describe the STRIPS language for representing states, goals, and operators within a planning system. 2

b) Briefly explain why planning is difficult to cast as a state-space search problem. 1

c) Develop an effective and complete plan using the partial-order planning approach to convert the given initial state into the goal state. It could be fine if you address the flaws such as threats to causal links and open conditions in developing the final plan. 5.75

Sussman Anamoly Problem



7. a) Taking into account of the example given below, explain the concept of uncertainty. 1.75

"The doorbell rang at 12'0 clock in the midnight.
Was someone there at the door?
Did Karim wake up?"

b) What will be happened if h' underestimates and overestimates h in A* algorithm? 2

c) What is an expert system? Describe the two essential capabilities of an expert system. 2

d) Why do we need the extension of the Bayes theorem? Write the equations and the semantics of the two extended Bayes theorems. Show two application areas of these extended Bayes theorems. Why do we need the extension of the Bayes theorem? 3

8. a) What is the Bayesian network? Describe the syntax and semantics of Bayesian networks with necessary examples. 1.5

b) A doctor knows that the disease meningitis causes the patient to have a stiff neck, say, 40% of the time. The doctor also knows some unconditional facts: the prior probability that a patient has meningitis is 1/50000, and the prior probability that any patient has a stiff neck is 1/25. Find the probability of patients with a stiff neck to have meningitis. 1.5

c) Your burglar alarm may or may not be sounding (node A). Possible causes of A are your house being burgled (node B) or a small earthquake (node E) setting it off by accident. Your reliable friend has called you saying that he thinks the alarm is sounding (node R). Your unreliable friend, who often calls when your alarm sounds, has not done so this time (node C). Your two friends do not have any contact with each other. 1+1+1+1+1.75

i) Draw a Bayesian network representing the variables, causes, and observations in this situation. The following are conditional probabilities for the events in the model:

$P(B) = 0.02$

$P(E) = 0.001$

$P(A|\neg B, \neg E) = 0.01$, $P(A|B, \neg E) = 0.9$, $P(A|\neg B, E) = 0.9$, $P(A|B, E) = 0.99$

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ii) Compute the prior that the alarm is sounding.

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v) Suppose that you hear a radio report that an earthquake has occurred near your home. Draw a modified Bayesian network to model this, and discuss qualitatively how your belief about each of A, E, and B would change. An earthquake has occurred and both Mary and Jhon call.

University of Chittagong

Department of Computer Science and Engineering

7th Semester B.Sc. (Engg.) Examination-2021

Course Code: CSE-713 Course Title: Artificial Intelligence

Total marks: 52.5 Marks Time: 4.00 hours

[Answer any ***three*** questions from each of ***Section-A*** and ***Section-B***. A separate answer script must be used for Section-A and Section-B. Figures in the right-hand margin indicate full marks.]

Section-A

1. a) Do you think humanoid Sophia and Jarvis possess the features and signs of intelligence? If so, elaborate your answer by taking into account the behavior of Sophia and Jarvis. 1.5

   b) Suppose you design a machine to pass the Turing test. What are the capabilities such a machine must have? 1

   c) Describe how Simple Reflex agents differ from Goal Driven agents by taking account of their architecture. 1

   d) Consider an intelligent agent named "*Amazon Echo*". Now, answer the following questions: 2+2

      i) Write a PAGE (Percepts, Actions, Goals, and Environments) description of the above intelligent agent.

      ii) Characterize the agent's environment with a proper explanation as being either: accessible or inaccessible; deterministic or non-deterministic; episodic or non-episodic; static or dynamic; and discrete or continuous.

   e) What agent architecture is best for the automated taxi driving agent? Justify your answer. 1.25

2. a) What is the state space search problem? 0.75

   b) Give the initial state, goal test, successor function, and cost function for each of the following. In addition, you need to elaborate the working principle of the basic search algorithm in each of the cases. 3

      i) Using only four colors, you have to color a planar map in such a way that no two adjacent regions have the same color.

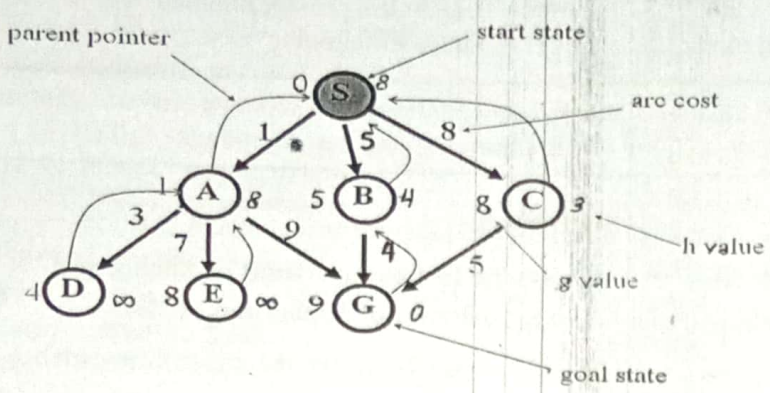
      ii) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains two stackable, movable, climbable 3-foot-high crates.

   c) Suppose you have the following search space as shown in Figure 1: 3+2

      i) Assume that the initial state is S and the goal state is G. Show how each of the following search strategies would create a search tree to find a path from the initial state to the goal state.

      - Depth First Iterative Deepening
      - Greedy search
      - A* search

ii) At each step of the search algorithm, show which node is being expanded, and the content of the fringe. Also, report the eventual algorithm, and the solution cost.



N	h*(n)
S	9
A	9
B	4
C	5
D	∞
E	∞
G	0

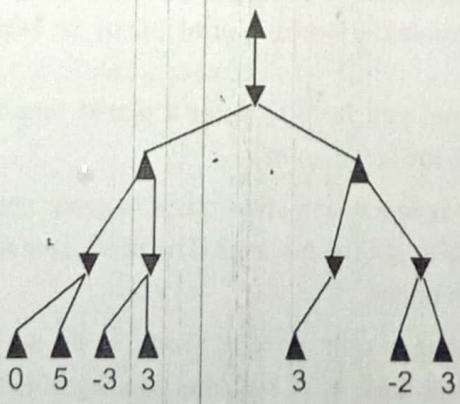
Figure 1

3. a) Write down Steepest-Ascent Hill Climbing algorithm. What are the problems that the hill-climbing search process may reach? How the problems can be dealt with? 1.5

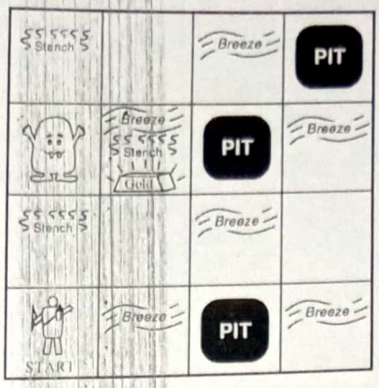
b) Differentiate between DFID and IDA* algorithms. Demonstrate how DFID incorporates the advantages of the Breadth First Search algorithm and the Depth First Search algorithm with an example. 1.75

c) What is CSP? Do you consider the following problem is an example of CSP? If so, identify the variables, domains, and constraints associated with this problem. 1.5
"*You have to color a planar map using only four colors, in such a way that no two adjacent regions have the same color.*"

d) Explain how does Alpha-Beta pruning improve the situation in the game playing in the following example. 4



4. a) The figure below shows a Wumpus World game, where the agent starts from location [1,1]. Briefly discuss with diagrams how the agent generates new knowledge through perceiving the environment and choosing his next move. 3



b) Differentiate between proof and theorem in one point? 0.75

c) Determine whether the following sentence is (i) Satisfiable, (ii) Contradictory, or (iii) Valid 2

$$(P \vee Q) \wedge (P \vee \sim Q) \vee P$$

d) Given knowledge base R1, R2, R3, R4, and R5 below, show that P1, 2 is false. 3.5

R1: $\sim P11$

R2: $B11 \Leftrightarrow (P2,1 \vee P1,2)$

R3: $B2,1 \Leftrightarrow (P1,1 \vee P2,2 \vee P3,1)$

R4: $\sim B1,1$

R4: $\sim B1,1$

R5: $B2,1$

Section-B

5. a) Briefly explain why FOL is considered as the generalization of PL. 1

b) Consider the following sentences: 1.75+2.5 = 3.5

i) If a perfect square is divisible by a prime P, then it is also divisible by the square of P.
ii) Every perfect square is divisible by some prime,
iii) 36 is a perfect square,
iv) Does there exist a prime q such that the square of q divide 36?

Prove via the resolution method and unification (where needed) that "*Does there exist a prime q such that square of q divide 36?*" More precisely

i) First, translate the sentences above into FOL sentences.
ii) Convert to Clause forms.
iii) Apply the resolution method with the unification (where needed) to prove the goal sentence: "*Does there exist a prime q such that the square of q divide 36?*"

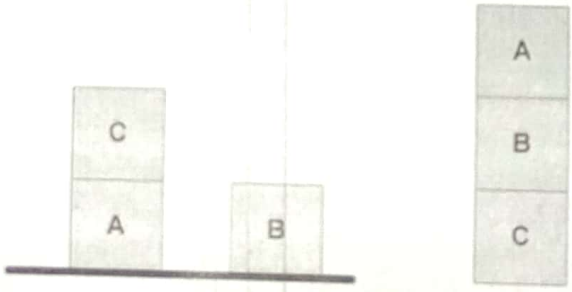
6. a) Following are the rules and initial facts in the rule-base and database of facts of a rule-based expert system.

R1: IF A and C THEN E	Initial facts in the database
R2: IF C and D THEN F	A, B (both are true)
R3: IF B and E THEN F	Objective:
R4: IF B THEN C	Prove hypothesis G (goal)
R5: IF F THEN G	

Prove the goal (G) by applying both forward chaining (FC) and backward chaining (BC) inference procedures. You need to show the sequence of firing the rules and also need to draw the search tree, in which propagation of truth for FC and backtracking of goals for BC are to be demonstrated diagrammatically.

b) Consider the following blocks world problem known as Sussman Anamoly problem. Develop an effective and complete plan using Partial-Order Planning/STRIPS approach to convert the given initial state into goal state. It could be fine if you address the flaws such as. threats to causal links and open conditions in developing the final plan. 4

Sussman Anamoly Problem



Initial State

Goal State

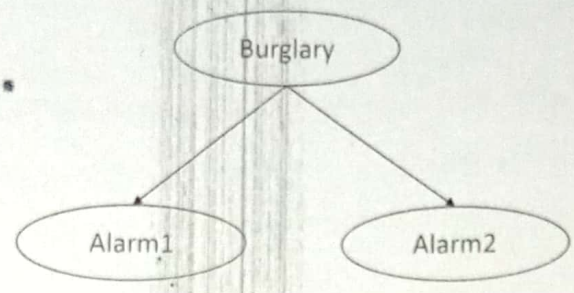
7. a) Taking into account of the example given below, explain the concept of uncertainty. 2.75

"The doorbell rang at 12'0 clock in the midnight.
Was someone there at the door?
Did Karim wake up?"

b) Explain why deductive and adductive reasoning are not considered as the examples of sound reasoning and hence, they are considered as the source of uncertainty. 2.5

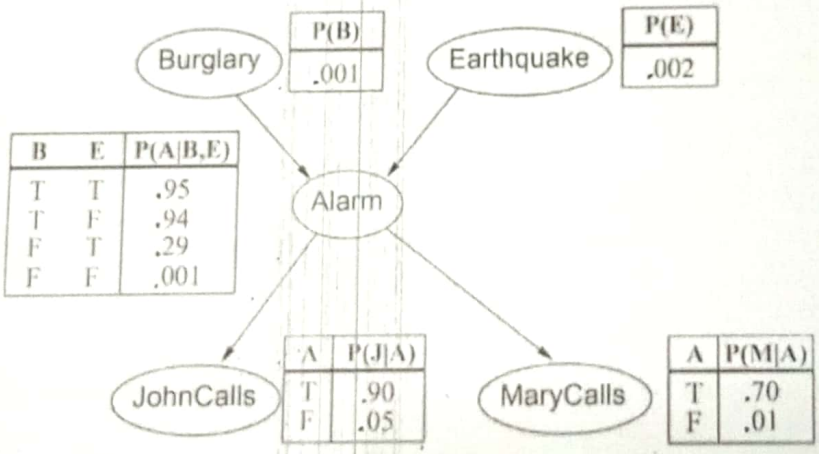
c) What is Baye's theorem? A doctor knows that the disease meningitis causes the patient to have a stiff neck, say, 40% of the time. The doctor also knows some unconditional facts: the prior probability that a patient has meningitis is 1/50000, and the prior probability that any patient has a stiff neck is 1/25. Find the probability of patients with a stiff neck having meningitis. 3.5

a) To safeguard your house, you recently installed two different alarm systems by two different reputable manufacturers that use completely different sensors for their alarm systems. Considering these facts the Bayesian network is given below: 3.5



How many probabilities need to be specified for its conditional probability tables? How many probabilities would need to be given if the same joint probability distribution were specified in a joint probability table?

b) A Bayesian network (Figure 1), showing both the topology and the conditional probability tables (CPTs). In the CPTs, the letters B, E, A, J, and M stand for Burglary, Earthquake, Alarm John Calls, and MaryCalls, respectively. The Independent conditional probability helps us to write in a simplified way the joint distribution P(B, E, A, J, M). 5.25



i) Express the joint distribution P(F, E, A, Y, S) in terms of the conditional probabilities (and independencies) expressed in the Bayesian Network above.

ii) Probability of the event that the alarm has sounded but neither a Burglary nor an earthquake has occurred and both Mary and Jhon call.

iii) Probability of the event that the alarm has sounded and Burglary has occurred, an earthquake has not occurred, and both Mary and Jhon call.