Register Number															

Set - A

SRM Institute of Science and Technology
College of Engineering and Technology
School of Computing
Department of Data Science & Business Systems

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamil Nadu

Academic Year: 2023-24 (EVEN)

Test: CLA-T2 | **Date: 03.04.2024**

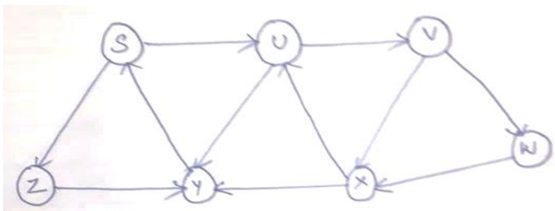
Course Code & Title: 18CSC305J – Artificial Intelligence (Answer Key) | **Duration:** 9.45 – 11.30 AM

Year & Sem: III Year / VI Sem | **Max. Marks:** 50

Course Articulation Matrix:

S. No	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	CO1	3	2	3	-	-	-	-	-	-	-	-	-
2	CO2	3	2	3	-	-	-	-	-	-	-	-	-
3	CO3	2	3	3	-	-	-	-	-	-	-	-	-
4	CO4	2	3	2	-	-	-	-	-	-	-	-	-
5	CO5	2	3	3	2	-	-	-	-	-	-	-	-

Answer any Five Questions
(5 x 10 = 50 Marks)

Q. No	Question	Marks	BL	CO	PO	PI Code
1.	Consider the given graph. Each edge is considered to have a value of 1 by default.  Identify the searching algorithm that we can apply for the above graph with starting vertex as "**S**" and ending vertex as "**X**".	10	3	2	2	2.1.3

Solution: Suitable search Algorithm is "Best First Search". 1 mark

Adjacency Lists

S: U, Z
U: V, Y
V: W, X
W: X
X: U, Y
Y: S
Z: Y

Two queues are used namely QUEUE1 and QUEUE2. QUEUE1 holds all the nodes that are to be processed, while QUEUE2 holds all the nodes that are processed and deleted from QUEUE1.

Step 1 - First, add A to queue1 and NULL to queue2.

QUEUE1 = {S}
QUEUE2 = {NULL}

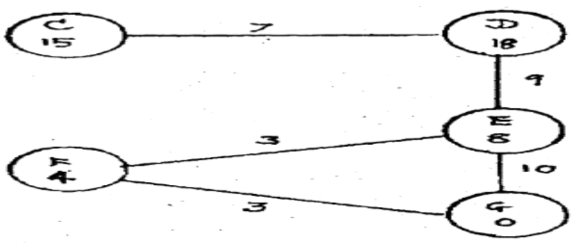
Step 2 - Now, delete node S from queue1 and add it into queue2. Insert all neighbours of node S to queue1.

QUEUE1 = {U, Z}
QUEUE2 = {S}

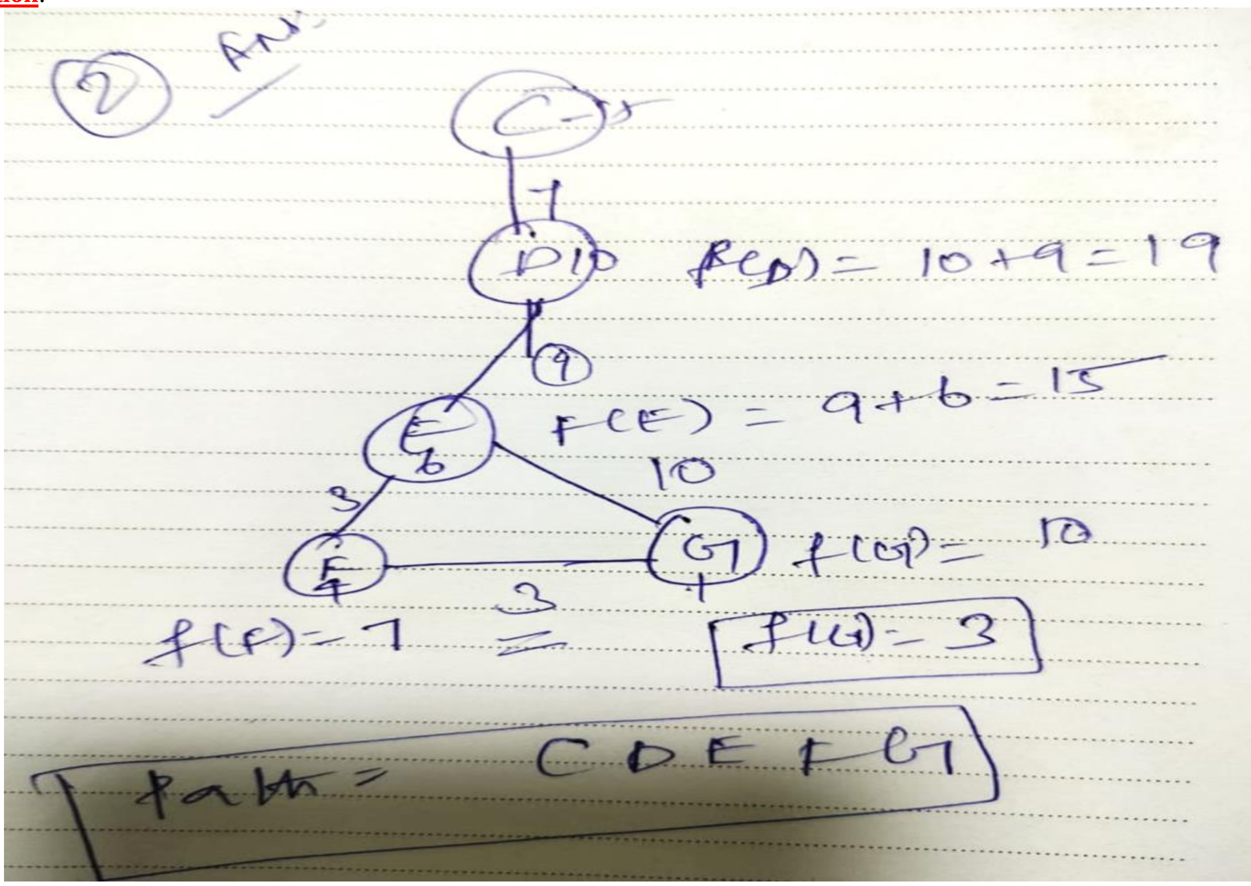
Step 3 - Now, delete node U from queue1 and add it into queue2. Insert all neighbours of node U to queue1.

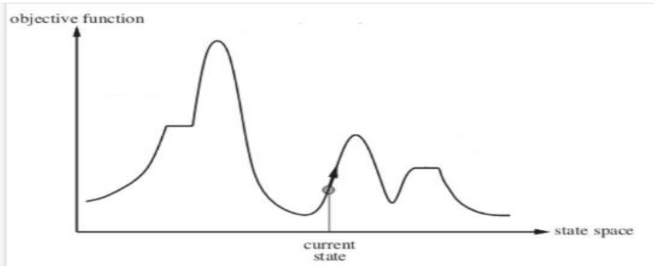
QUEUE1 = {Z, V, Y}
QUEUE2 = {S, U}

Step 4 - Now, delete node Z from queue1 and add it into queue2. Insert all neighbours of node Z to queue1. The only neighbour of Node Z is Y since it is already inserted, so it will not be inserted again.
QUEUE1 = {V, Y}
QUEUE2 = {S, U, Z}
Step 5 - Delete node V from queue1 and add it into queue2. Insert all neighbours of node V to queue1.
QUEUE1 = {Y, W, X}
QUEUE2 = {S, U, Z, V}
Step 5 - Delete node Y from queue1 and add it into queue2. Insert all neighbours of node Y to queue1. Since all the neighbours of node Y are already present, we will not insert them again.
QUEUE1 = {W, X}
QUEUE2 = {S, U, Z, V, Y}
Step 6 - Delete node W from queue1. Since all its neighbours have already been added, so we will not insert them again. Now, all the nodes are visited, and the target node X is encountered into queue2.
QUEUE1 = {X}
QUEUE2 = {S, U, Z, V, Y, W}
Step 7 - Delete node X from queue1. Since all its neighbours have already been added, so we will not insert them again. Now, all the nodes are visited, and the target node X is encountered into queue2.
QUEUE1 = {NULL}
QUEUE2 = {S, U, Z, V, Y, W, X}

2.	Apply a suitable search algorithm for the given tree, in which “C” is the initial state and “G” goal state. For each node in each stage, obtain cost estimates where g(n) is the numeral by the side of an arc and h(n) is the numeral at the node. 	10	4	2	2	2.1.3

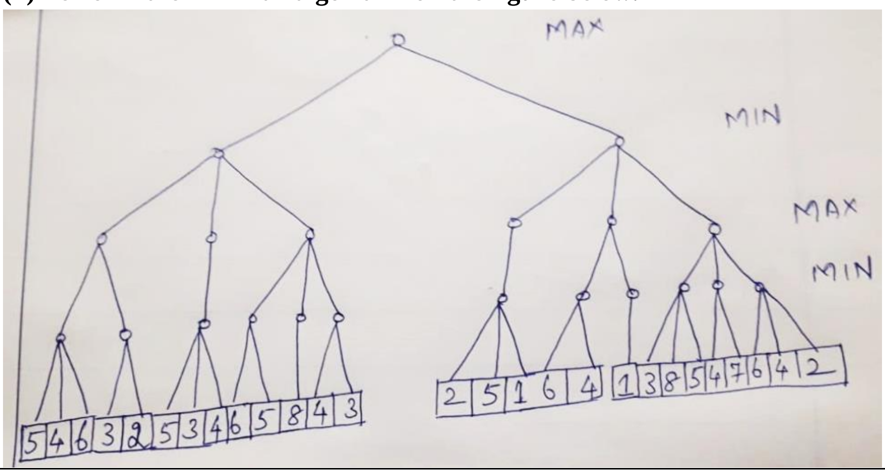
Solution:



3.	Consider the following State Space diagram for Hill Climbing  (a) Which all are the regions that prevent from reaching best state (global maximum)? (b) Mention what exact problem occurs at each region and the solution to overcome the same?	10	2	2	2	2.1.1

Solution:

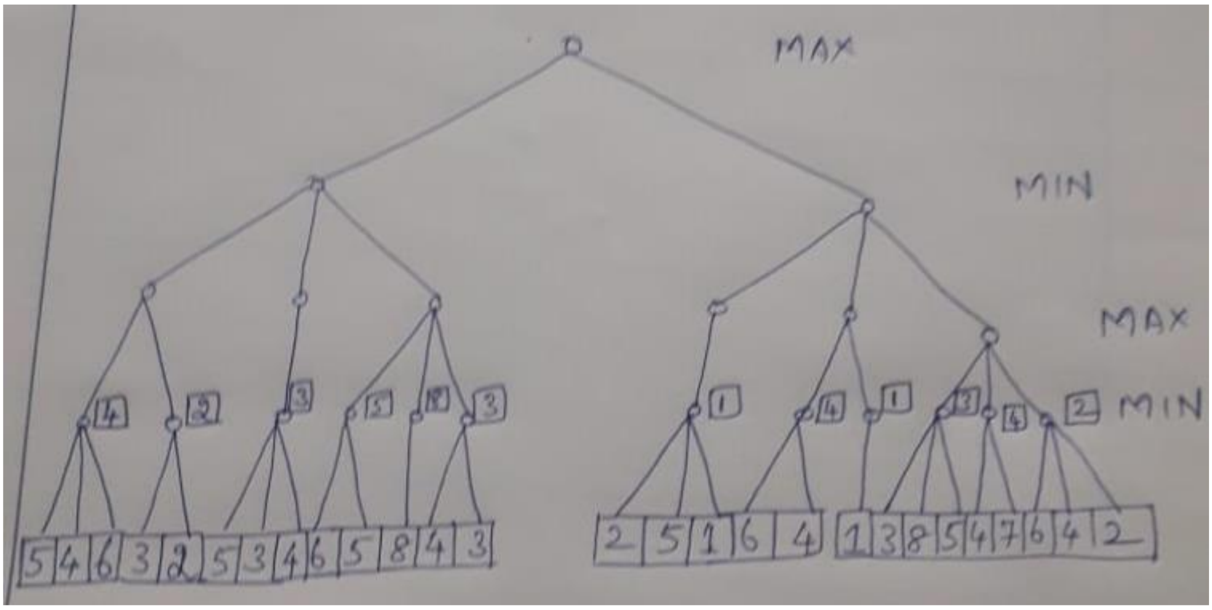
- Hill climbing cannot reach the optimal/best state(global maximum) if it enters any of the following regions :
- **Local maximum :** At a local maximum all neighboring states have a values which is worse than the current state. Since hill-climbing uses a greedy approach, it will not move to the worse state and terminate itself. The process will end even though a better solution may exist.
  To overcome local maximum problem : Utilize backtracking technique. Maintain a list of visited states. If the search reaches an undesirable state, it can backtrack to the previous configuration and explore a new path.
- **Plateau :** On plateau all neighbors have same value . Hence, it is not possible to select the best direction.
  To overcome plateaus : Make a big jump. Randomly select a state far away from the current state. Chances are that we will land at a non-plateau region
- **Ridge :** Any point on a ridge can look like peak because movement in all possible directions is downward. Hence the algorithm stops when it reaches this state.
  To overcome Ridge : In this kind of obstacle, use two or more rules before testing. It implies moving in several directions at once.

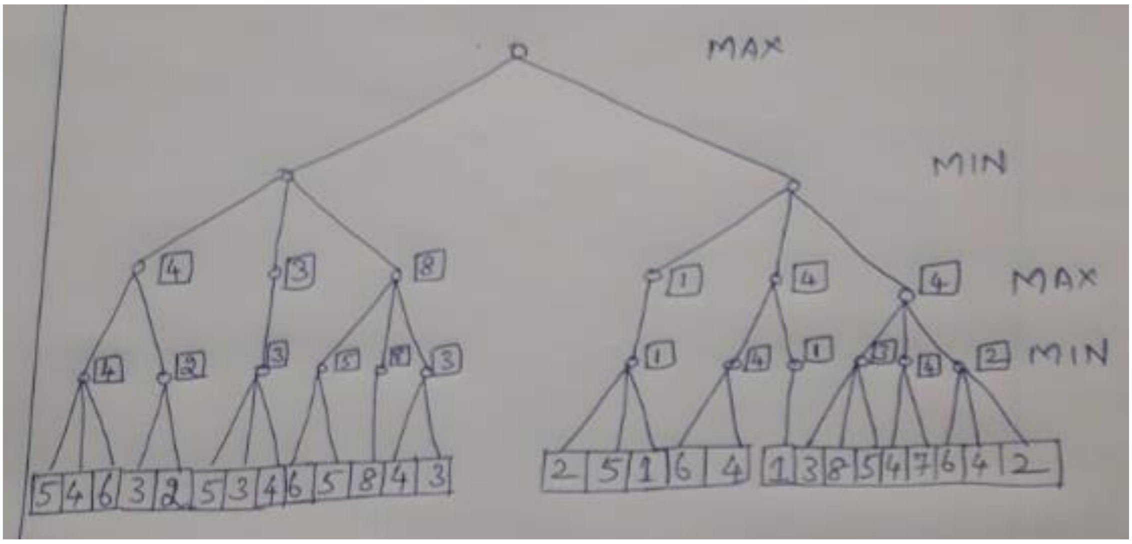
4.	(i) **Here are three populations from a genetic algorithm**: (a) 01010000 10000001 (b) 10010000 01000001 (c) 01010000 10100001 Population b was created by population a reproducing (the crossover is after the second digit). Population c was created by population a mutating (the second string was mutated). Let the fitness function be the number of 1's in a string. What is the maximum fitness of each population? Is there a better crossover point than the one used for creating population b? If so, where is it and why is it better? Justify	5	3	2	2	2.2.3
	(ii) Perform the minimax algorithm on the figure below.  	5	3	2	2	2.2.3

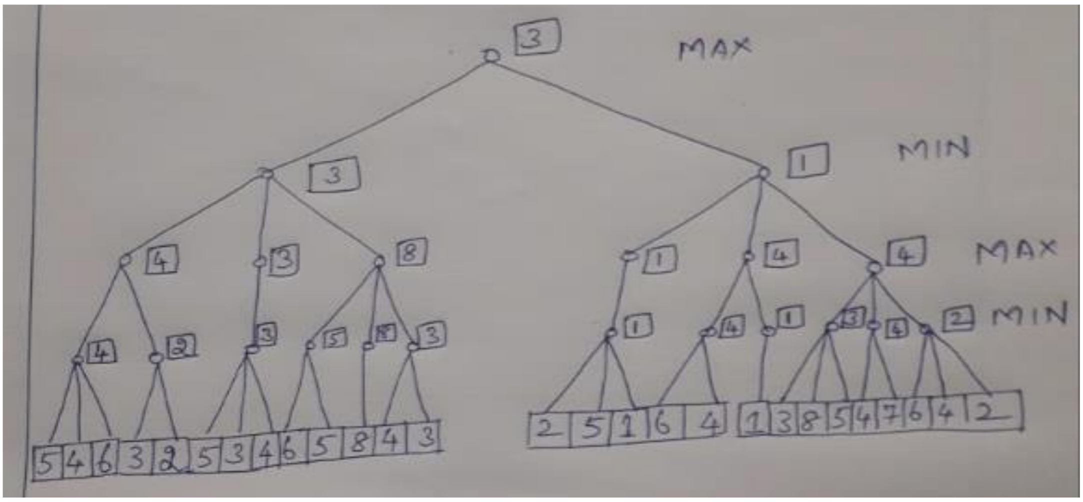
Solution:

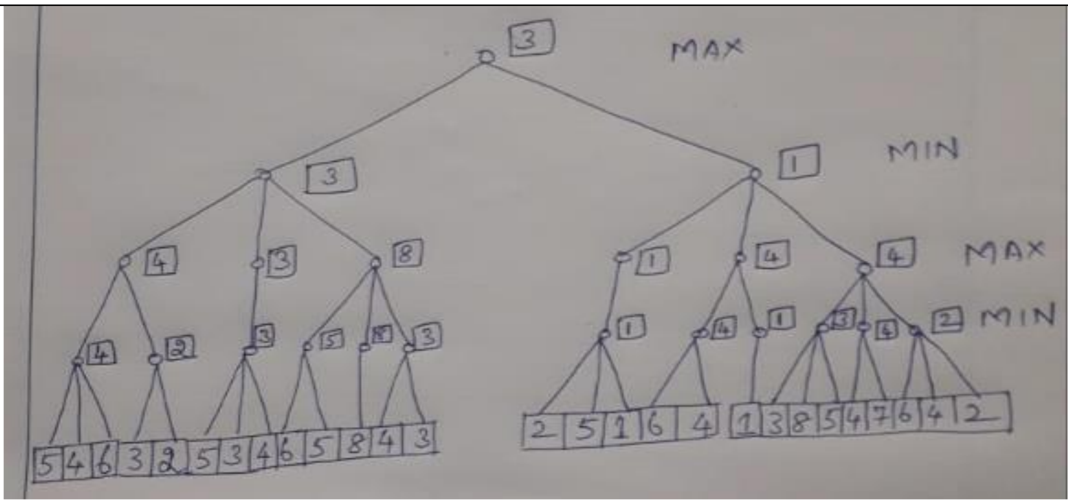
i) The maximum fitness of a string is 2 for population a, 2 for population b, and 3 for population c. Better crossover points would be after the first digit, after the fourth digit, after the fifth digit, after the sixth digit, or after the seventh digit.
These are better crossover points as the child generation, b would have a maximum fitness of 3, rather than 2.

ii)



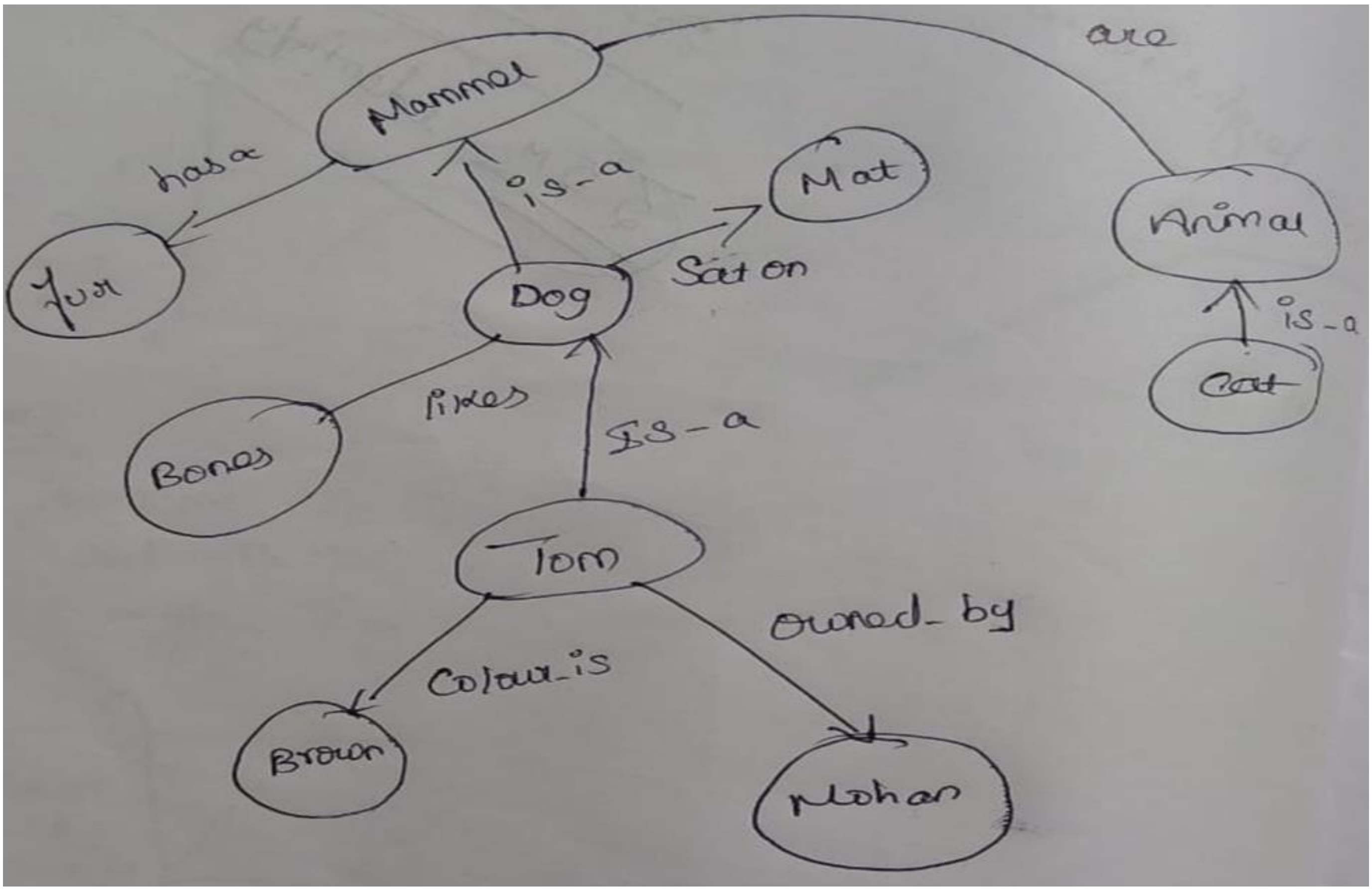






5.	Use the below facts and using Semantic network conclude Tom is a Mammal. ▪ Tom is an instance of dog. ▪ Tom caught a cat. ▪ Tom is owned by Mohan. ▪ Tom is brown in colour. ▪ Dogs like bones. ▪ The dog sat on the mat. ▪ A dog is a mammal. ▪ A cat is an instance animal. ▪ All mammals are animals. ▪ Mammals have fur.	10	3	3	2	2.2.3

Solution:



6.	Consider the following facts and represent them in predicate form: F1. There are 500 employees in ABC company. F2. Employees earning more than Rs. 5000 pay tax. F3. John is a manager in ABC company. F4. Manager earns Rs. 10,000.	10	3	3	2	2.2.3

	Convert the facts in predicate form to clauses and then prove by resolution: "John pays tax".					

Solution:

Convert into predicate Logic

1. company(ABC) ^employee(500,ABC)
2. ∃x company(ABC) ^employee(x,ABC) ^ earns(x,5000)→pays(x,tax)
3. manager(John,ABC)
4. ∃x manager(x, ABC)→earns(x,10000)

Convert to clausal form

(i) Eliminate the → sign

1. company(ABC) ^employee(500,ABC)
2. ∃x¬(company(ABC) ^employee(x,ABC) ^ earns(x,5000)) v pays(x,tax)
3. manager(John,ABC)
4. ∃x¬ manager(x, ABC) v earns(x,10000)

(ii) Reduce the scope of negation

1. company(ABC) ^employee(500,ABC)
2. ∃x¬ company(ABC) v ¬employee(x,ABC) v¬earns(x,5000) v pays(x,tax)
3. manager(John,ABC)
4. ∃x¬ manager(x, ABC) v earns(x,10000)

(iii) Standardize variables apart

1. company(ABC) ^employee(500,ABC)
2. ∃x¬ company(ABC) v ¬employee(x,ABC) v¬earns(x,5000) v pays(x,tax)
3. manager(John,ABC)
4. ∃x¬ manager(x, ABC) v earns(x,10000)

(iv) Move all quantifiers to the left

(v) Eliminate ∃

1. company(ABC) ^employee(500,ABC)
2. ¬company(ABC) v ¬employee(x,ABC) v¬earns(x,5000) v pays(x,tax)
3. manager(John,ABC)
4. ¬manager(x, ABC) v earns(x,10000)

(vi) Eliminate ∀

(vii) Convert to conjunct of disjuncts form

(viii) Make each conjunct a separate clause.

1. (a) company(ABC)
   (b) employee(500,ABC)
2. ¬company(ABC) v ¬employee(x,ABC) v¬earns(x,5000) v pays(x,tax)
3. manager(John,ABC)
4. ¬manager(x, ABC) v earns(x,10000)

(ix) Standardize variables apart again.

Prove: pays(John,tax) Disprove: ¬pays(John,tax)

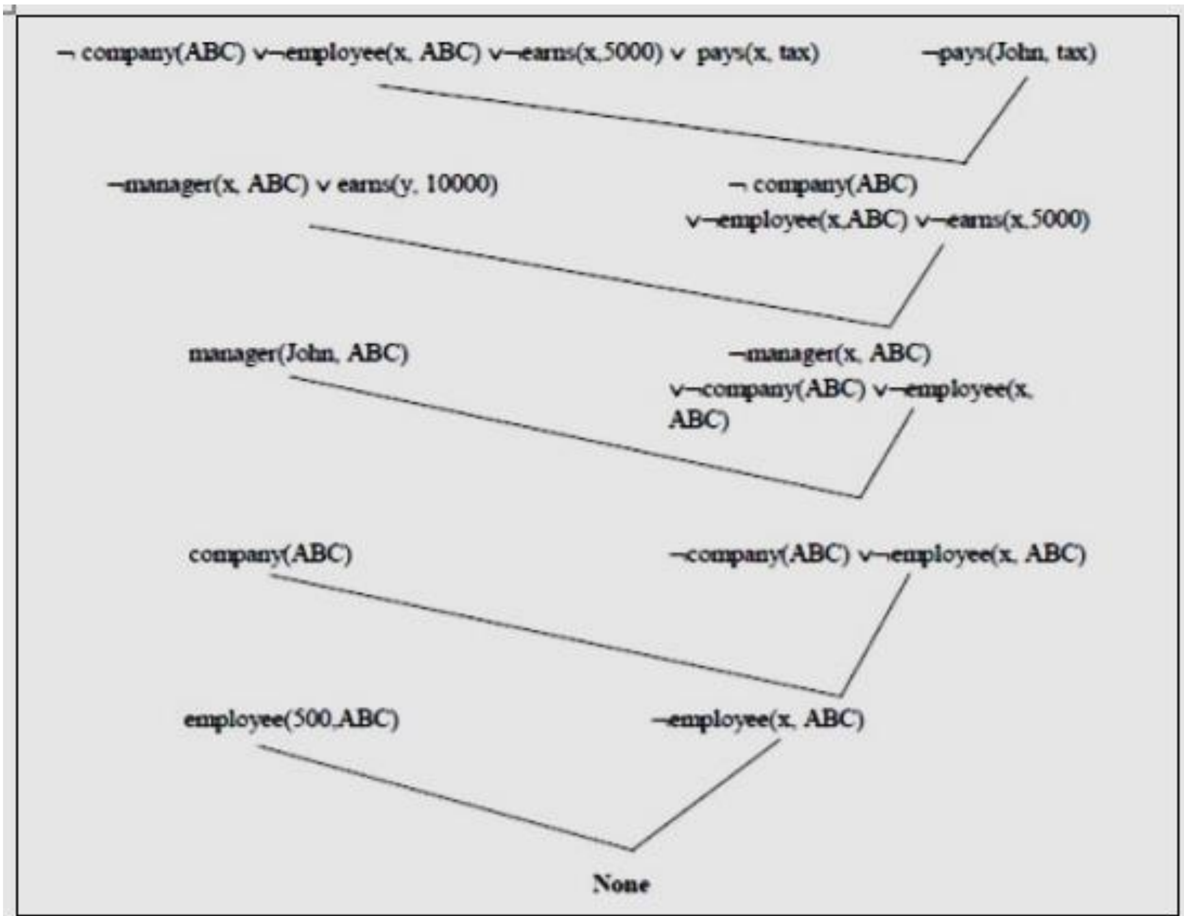


Figure 3. Standardize variables

Thus, proved john pays tax.

7.	Consider the following: A ball is placed under one of the three boxes, and the boxes are then manipulated in such a fashion that all three appear to be equally likely to contain the ball. Nevertheless, you win a prize if you guess the correct box. So, you make a guess. The person running the game does know the correct box, however, and uncovers one of the boxes that you did not choose and that is empty. Thus, what remains are two boxes: one you choose and one you did not choose. Furthermore, since the uncovered box did not contain the ball, one of the two remaining boxes does contain it. You are offered the opportunity to change your selection to the other box. Should You? Work through the conditional probability mentioned in this problem using Bayes theorem. What do the results tell about what you should do?	10	3	3	2	2.2.3

Solution:

$$\begin{aligned}\Pr(A \mid B) &= \frac{\Pr(B \mid A) \times \Pr(A)}{\Pr(B)} \\ &= \frac{1/2 \times 1/3}{1/3 \times 1/2 + 1/3 \times 0 + 1/3 \times 1} \\ &= 1/3.\end{aligned}$$