

Read the Instructions before proceeding:

1. This is a **closed book exam**. You can use a **calculator** if necessary.
2. **Please Write/Draw legibly!** If we can't understand what you have written, we can't grade it.
3. **Don't use Pencils** for answering/drawing. The final answer **must** be in blue or black ink.
4. Clearly mention the question number before the answer.
5. It is Mandatory to read all the notes/instructions given in the question and answer accordingly.
Any irrelevant answers will not be evaluated and awarded with zero marks.

1. Some Propositional Rules for the wumpus world are as follows:

$$R_1 : \neg S_{1,1} \Rightarrow \neg W_{1,1} \wedge \neg W_{1,2} \wedge \neg W_{2,1}$$

$$R_2 : \neg S_{2,1} \Rightarrow \neg W_{1,1} \wedge \neg W_{2,1} \wedge \neg W_{2,2} \wedge \neg W_{3,1}$$

$$R_3 : \neg S_{1,2} \Rightarrow \neg W_{1,1} \wedge \neg W_{1,2} \wedge \neg W_{2,2} \wedge \neg W_{1,3}$$

$$R_4 : S_{1,2} \Rightarrow W_{1,3} \vee W_{1,2} \vee W_{2,2} \vee W_{1,1}$$

S = Stench, W = Wumpus

Convert above rules into CNF.

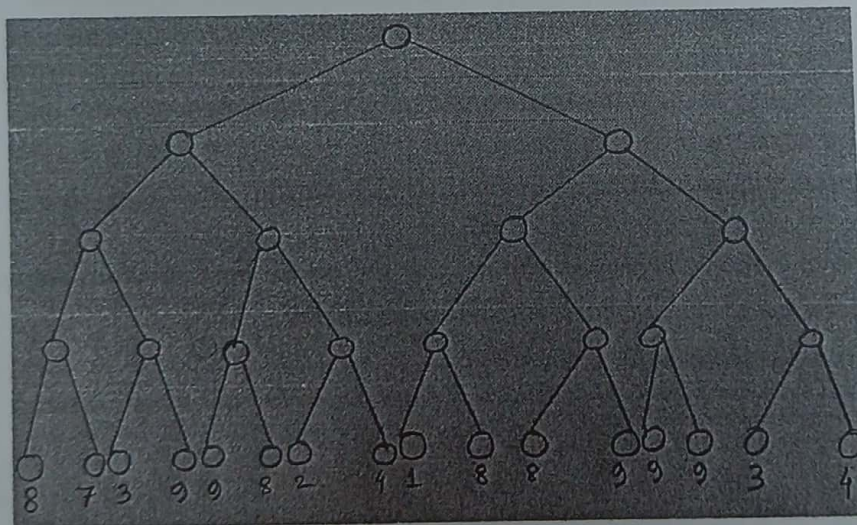
Prove that Wumpus is in the room (1, 3) using the Resolution.

Note: You have to clearly specify all steps.

[3M]

[6M]

2. (a) Write the limitation of the Min-Max algorithm. How can the Alpha Beta pruning technique resolve it? [2M]
(b) For a two player game, a decision tree with utility values is given below. Find the best move for each player using alpha beta pruning technique. [6M]



Note: Write each step in text mentioning the order of traversal, determination of alpha-beta values based on the decision, and pruned nodes due to the algorithm. You may draw a single tree to show the alpha-beta values and the pruned nodes.

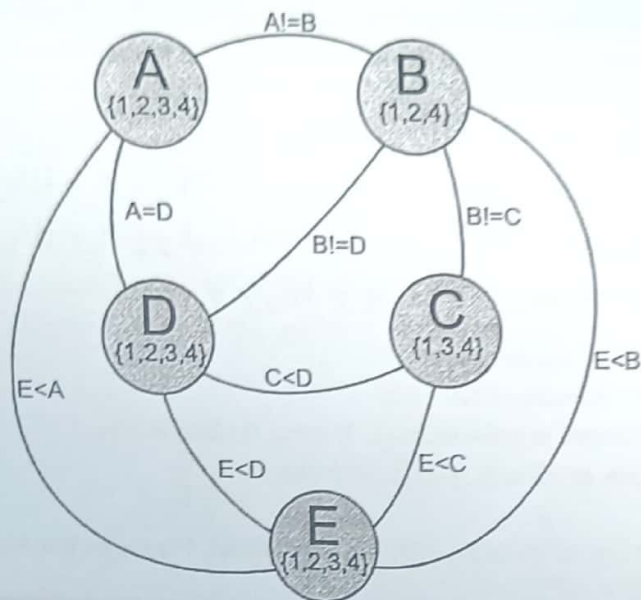
3. Solve the following constraint graph using AC-3 Algorithm.

Variables: {A,B,C,D,E}

[9M]

Domain values are given inside the node. for e.g. $A=\{1,2,3,4\}$

Constraints are given in the edges of the graph. For e.g. $\{A \neq B, A=D\}$



Note:

- a) In the First step, you have to clearly specify all the variables and constraints and write all the arcs in the initial state of the queue in alphabetical order only. (1M)

Indicative example:

Queue = $\{(A \neq B); (A \neq D); (A > E); (B = A); (B = C); (B = D); (C = A); (C < D), \dots\}$

- b) You have to clearly specify all the arcs in the queue w.r.t. previous steps, queue status and domain sets for each variable at each step. (8M)

- c) Marks will be appropriately deducted for not following the above instructions.

- d) No partial marks will be given for remaining steps if note (a) is not followed in the first step.

- e) No partial marks will be given for the problem if the queue and domain set are not written for the steps.