

Time: 30 minutes

Max. Marks: 10

Name and Roll No.: \_\_\_\_\_

**Instructions:**

- Do not plagiarize. Do not assist your classmates in plagiarism.
- Show your full solution for the questions to get full credit.
- Attempt all questions that you can.
- True / False questions will get full credit only if the justification and answer are both correct.
- A multiple choice question may have one or more correct answers. Credit will only be awarded if all correct answers are marked and none of the incorrect answers are marked.
- In the unlikely case that you find a question ambiguous, discuss it with an invigilating TA/invigilator. Please ensure that you clearly write any assumptions you make, even after clarification from the invigilator.

**V. Imp.:** If you do not write your **Name and Roll No.**, you will get a zero.

1. (2 points) The resolvent arising from the resolution step applied on two definite clauses can result in the following (Tick all that apply).

A. Definite clause   B. Horn clause   C. Goal clause   D. None of the above.

2. ( $1 \times 3 = 3$  points) State True or False with justification. In case a statement is False, provide a counter-example.

- (a) Entailment can be established by solving some satisfiability (SAT) problem.

**Solution:**

**True.** To show  $A \models B$ , we can solve the satisfiability problem of  $A \wedge \neg B$ . If it is unsatisfiable, then  $A \models B$ , else  $A \not\models B$ .

- (b) Forward Chaining is *sound* for propositional logic.

**Solution:**

**True.** Since forward chaining uses modus ponens, i.e., it builds upon affirmations from what it knows (from the knowledge-base for example), every deduction is a true deduction. Therefore it is sound.

- (c) Forward Chaining is *complete* for propositional logic.

**Solution:**

**False.** Consider the following example where you have two sentences in the  $KB \equiv \{(P \vee Q), (\neg P)\} \equiv \{C_1, C_2\}$  and we want to query  $Q$ .

Here, we see that  $Q$  can be inferred by resolution, but not by forward chaining. We can start with the initial fact  $\neg P$  but we cannot use forward chaining (modus ponens) to infer anything from the  $C_1$  clause because it is not a Horn clause (more than one positive literal). Therefore, forward chaining can not infer all sentences. It is complete *only if* the KB comprises of Horn clauses and if it has to infer a single literal.

3. (2 points) Draw the AND-OR graph for the following set of sentences. Sharma plays well. Kohli also plays well. When both Sharma and Kohli play well, India makes lots of runs. India makes lots of runs if Sharma and Pandya, both play well. If Kohli plays well and India makes lots of runs, then Dhoni is proud. If Dhoni is proud and India makes lots of runs, then Pandya plays well.

**Solution:****Interpretation:**

1.  $A \equiv$  Sharma plays well.
2.  $B \equiv$  Kohli plays well.

3.  $L \equiv$  India makes lots of runs.
4.  $P \equiv$  Pandya plays well.
5.  $M \equiv$  Dhoni is proud.

The Knowledge-Base:

1.  $A$
2.  $B$
3.  $A \wedge B$
4.  $A \wedge B \Rightarrow L$
5.  $A \wedge P \Rightarrow L$
6.  $B \wedge L \Rightarrow M$
7.  $L \wedge M \Rightarrow P$

The And-Or graph is shown in Fig. 1.

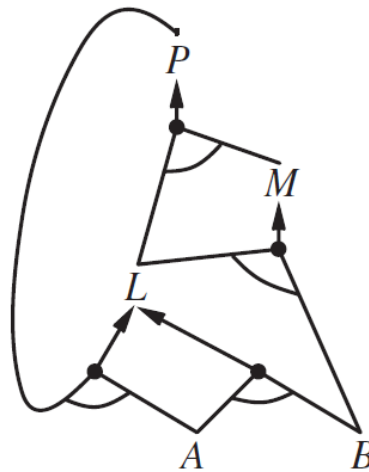


Figure 1: And-Or Graph for Q3

4. (3 points) If either Kohli or Sharma hit a century, then India makes 300 runs. India made only 250 runs. Prove by resolution that Kohli did not hit a century.

**Solution:**

See solution to Q1 in [Quiz-2-v0-Solution.pdf](#). The question is exactly the same with the symbol interpretations changed.