CS228 Logic for Computer Science 2023

IITB, India

Quiz 1

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Duration : 45 minutes Total: 30 marks

1. (6 marks) Give an example of the following.
   (a) a propositional logic formula that is satisfied by exactly 1/4th of all models.
   (b) a resolution proof step, where conclusion is same as one of the premises.
   (c) a partial model and clause such that the clause is a unit clause under the model.
2. (3 marks) Convert $(q \Leftrightarrow (p \vee (r \wedge s)))$ into CNF using Tseitin encoding.
3. (3 marks) Prove/Disprove the following statement: For propositional formula F, and variables p and q, F and $F[(p \oplus q)/p]$ are equisatisfiable if q does not occur in F. Please give a counterexample if the statement is not true.
4. (6 marks) Write a formal proof for the following statement

$$\{r \vee (s \wedge \neg t), (r \vee s) \Rightarrow (u \vee \neg t)\} \vdash t \Rightarrow u$$

   [You may also use the derived rules presented in the lecture five.]
5. (6+6 marks) Consider a CNF formula F equivalent to $p_1 \oplus .... \oplus p_n$. F only contains variables $p_1, ..., p_n$.
   a. Show that the size of each clause in F is at least n.
   b. Show that F has at least 2^{n-1} clauses.