CS21201 Discrete Structures
Tutorial 2

Propositional Logic

1. Consider the following problem statements to be coded in propositional logic:

   S1: Swapna either wrote on paper or typed the answers for the examination
   S2: If Swapna wrote on paper or did not have a camera, she could not complete in time.
   S3: Swapna could not complete in time
   G : Swapna wrote on paper

   Answer the following questions:
   a. List all propositions that you will use for encoding the problem
   b. Code all the statements in propositional logic using the propositions defined in (a).
   c. Can you deduce G from S1, S2 and S3? If yes, show all the steps in the deduction. If not, provide a counterexample (i.e. describe a situation where S1, S2 and S3 are all true, but G cannot be accomplished)

2. Prove the following logical deduction:

$$
\begin{array}{l}
(\neg p \vee q) \rightarrow r \\
r \rightarrow (s \vee t) \\
\neg (s \vee u) \\
t \rightarrow u \\
q \leftrightarrow v \\
(v \oplus w) \rightarrow \neg p \\
\hline
\therefore \ \neg w
\end{array}
$$

3. Your task is to (logically) solve a murder mystery on behalf of Sherlock Holmes, which appeared in the novel “A Study in Scarlet” by Sir Arthur Conan Doyle. The arguments (simplified from the novel) go as follows.
   a. There was a murder. If it was not done for robbery, then either it was a political assassination, or it might be for a woman.

b. In case of robbery, usually something is taken.
c. However, nothing was taken from the murderer's place.
d. Political assassins leave the place immediately after their assassination work gets completed.
e. On the contrary, the assassin left his/her tracks all over the murderer's place.
f. For an assassin, to leave tracks all over the murderer's place indicates that (s)he was there all the time (for a long duration).

Frame and derive the solution using propositional logic. Present your answer as asked in the following parts:

a. Write all propositions with English meaning (statements) that you have used.
b. Build suitable propositional logic formulae to encode each of the six statements above.
c. Show all deduction steps (with the name of the rules you apply) to derive the goal (solve the mystery).
d. What was the reason for the murder?