MDL Assignment 1

13 January 2025

Instructions

The deadline for the assignment is **January 20, 2025**. Submissions made after the deadline will be penalized by **20%** of the total marks, and late submissions will only be accepted up to **January 23, 2025**.
You are expected to submit handwritten solution to Moodle. The submission should be named as $<$ RollNo $>$ _*Assignment*1.*pdf*

Questions

1. Use the truth table method to determine whether the formula
$$(p \to q) \vee (p \to \neg q)$$
is a tautology. (2 Marks)
2. Given the formulas:
$$\psi : (p \wedge \neg q) \to (p \wedge q), \quad \phi : \neg p,$$
perform the following tasks:
   (a) Show, using the truth table method, that $\phi \implies \psi$. (2 Marks)
   (b) Show $\phi \implies \psi$ using a set of valid arguments. (2 Marks)
3. A 9×9 grid is given, and we want to verify whether it represents a valid Sudoku solution. Let x_{ijk} denote a proposition that is true if the cell in row i, column j contains the integer k, and false otherwise. Write down the set of axioms that x_{ijk} must satisfy for the grid to represent a valid Sudoku solution. (8 Marks)
4. Convert the following formula into its Conjunctive Normal Form (CNF) and Disjunctive Normal Form (DNF):
$$\big((\neg p \to q) \to (q \to \neg r)\big).$$
(4 Marks)

5. Check the validity of the following argument: (2 Marks)

   (i) If it rains, either I carry an umbrella or I get wet, but not both.
   (ii) If I get wet, I drink tea.
   (iii) If I do not get wet, I drink coffee.
   (iv) Therefore, if I drink coffee and it rains, I carry an umbrella.