Assignment 1

Your Full Name
Your Student ID

February 27, 2025

Abstract

Course: SOEN 331
Instructor: Dr. Constantinos Constantinides
Due Date: Tuesday, 4 March 2025 (23:59)
Weight: 10% of the overall grade

General information

Introduction and ground rules

1 Problem 1: Propositional Logic (7 pts)

1.1 Statement by Sophia the robot (3 pts)

1.2 Argument from "Computing Machinery and Intelligence" (4 pts)

2 Problem 2: Predicate Logic (8 pts)

2.1 Interpreting given formalizations (4 pts)

- (a) $\forall x : \mathbb{R} : \mathrm{number}(x) \rightarrow \neg\mathrm{rational}(x)$

- (b) $\exists x : \mathbb{R} : \mathrm{number}(x) \wedge \mathrm{rational}(x)$

2.2 Formalizing statements (4 pts)

- (a) "There are no irrational real numbers."

- (b) "Some real numbers are irrational."

3 Problem 3: Linear Temporal Logic 1 (15 pts)

3.1 (3 pts)

3.2 (3 pts)

3.3 (3 pts)

3.4 (3 pts)

3.5 (3 pts)

4 Problem 4: Linear Temporal Logic 2 (15 pts)

4.1 Visualizing all models of behavior (9 pts)

4.2 Mathematical structures (4 pts)

4.3 Observations on termination, non-termination, consistency (2 pts)

5 Problem 5: Unordered Structures (10 pts)

6 Problem 6: Ordered Structures (10 pts)

6.1 Implementing a Queue using two lists (4 pts)

6.2 Defining Enqueue and Dequeue (6 pts)

7 Problem 7: Binary Relations, Functions, and Orderings (15 pts)

7.1 Poset proofs and Hasse diagrams

- (a) $\big(\{2,3,4,6,24,36,72\}, / \big)$ is a poset (2 pts)
  Hasse diagram, maximal/minimal elements

- (b) $\big(\mathcal{P}\{1,2,3\}, \subseteq\big)$ is a poset (1 pt)
  Hasse diagram, maximal/minimal elements

7.2 Analyzing variable `map` (12 pts)

8 Problem 8: Binary Relations, Functions, and Orderings 2 (10 pts)

8.1 Is `map2` a function, domain/codomain (2 pts)

8.2 Properties (8 pts)

9 Problem 9: Construction Techniques (10 pts)

9.1 Function $\text{map}(f, \Lambda)$ (5 pts)

- (a) Transform into computable function

- (b) Define function recursively

- (c) Unfold your definition for $\text{map}(f, \langle a, b, c \rangle)$

9.2 Function $\text{insert}(x, \Lambda)$ (5 pts)

- (a) Transform into computable function

- (b) Define function recursively

- (c) Unfold example: $\text{insert}(5, \langle 1, 3, 5, 7 \rangle)$

What to submit