Concordia University

Department of Computer Science and Software Engineering

SOEN 331-S:

Formal Methods for Software Engineering

Assignment 2

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October 17, 2022

Contents

1 General information

Date posted: Monday 17 October, 2022.

Date due: Monday, 31 October, 2022, by 23:59.

Weight: 7.5% of the overall grade.

2 Introduction

You should find one partner and between the two of you should designate a team leader who will submit the assignment electronically. There are **7** problems in this assignment, with a total weight of **75** points.

3 Ground rules

This is an assessment exercise. You may not seek any assistance while expecting to receive credit. **You must work strictly within your team and seek no assistance for this assignment (e.g. from the teaching assistants, fellow classmates and other teams or external help)**. You should **not** discuss the assignment during tutorials. I am available to discuss clarifications in case you need any.

Both partners are expected to work relatively equally on each problem. Accommodating a partner who did not contribute will result in a penalty to both. You cannot give a "free pass" to your partner, with the promise that they will make up by putting more effort in a later assignment.

You are expected to start learning LaTeXand use it for this assignment.

If there is any problem in the team (such as lack of contribution, etc.), the team leader must contact me as soon as the problem appears.

4 System requirements

Consider a system such as `flightradar24.com`. A flight is associated with a **flight number** (such as `UA79`), a specific code that an airline assigns to a particular flight in its network, and a **route** which is a source-destination city pair such as $(NY, Tokyo)$. For example, the United Airlines flight from New to Tokyo is tracked by the system as $UA79 \mapsto (NY, Tokyo)$. The formal specification of the system introduces the following three types:

$$FLIGHT\_NUMBER,$$
$$ROUTE,$$
$$CITY$$

where

$$ROUTE : CITY \times CITY.$$

Flight numbers are unique, and there are possibly several flights that cover the same route. For example, there are possibly several flights from New York to Tokyo. The system must keep track of all active flights. Formally, let us have the following variables:

1. *active*: holds all active flight numbers.
2. *map*: holds a collection of active flight-route pairs.

5 Your assignment

1. (2 pts) Provide a declaration of variable *active*.
2. (3 pts) What kind of collection is variable *map*?
3. (10 pts) Is variable *map* a function and if so, comment on whether it is a total or partial function, as well as on the properties of injectivity, surjectivity and bijectivity.
4. (10 pts) Provide a formal specification of the state of the system in terms of a **Z specification schema**.

5. (15 pts) Provide a schema for operation `RegisterFlightOK` that adds a flight to the tracker. With the aid of success and error schema(s), provide a definition for operation `RegisterFlight` that the system will place in its exposed interface.

6. (15 pts) Provide a schema for operation `GetRouteOK` that returns the route given its flight. With the aid of success and error schema(s), provide a definition for operation `GetRoute` that the system will place in its exposed interface.

7. (20 pts) Provide a schema for operation `GetFlightOK` that returns any and all active flights given a route. With the aid of success and error schema(s), provide a definition for operation `GetFlight` that the system will place in its exposed interface.

6 What to submit

You must prepare all your solutions in LaTeX and and produce a single `pdf` file. You may use the .tex template provided. Name both your .tex and .pdf assignment files after the Concordia id of the person who will submit, e.g. `123456.pdf`, and submit both .tex and .pdf files at the Electronic Assignment Submission portal at

(`https://fis.encs.concordia.ca/eas`)

under **Assignment 2**.

END OF ASSIGNMENT.