CS 511
Formal Methods for High-Assurance Software Engineering
Homework Assignment 03

Out: 20 September 2024
Due: Thursday, 26 September 2024, by 11:59 pm

Repeated below are administrative issues already mentioned in the handout of Assignment 01:

- You need to open a Gradescope account, after which you need to add yourself to the CS511 roster for this semester. The entry code for CS511, Fall 2023, is `WWX2NW`.

  If you want to read more on adding yourself to the CS511 roster, go to Adding a Course .

- You also need to create a *GitHub repository* where you store your solutions for *coding exercises with* Lean_4.

  To create a GitHub repository, you need to open a GitHub account. Instructions for how to do this are at the following webpages: Set Up a GitHub Account and Create a GitHub Repository.

- Typically, each weekly assignment consists of two parts:

  1. One part includes ***hand exercises***, *i.e.* ***pencil-and-paper exercises***, and
  2. One part includes ***coding exercises*** in Lean_4.

  And each of the two parts will consist of:

  - **2 easy exercises**, and
  - **1 demanding exercise**, which we will call a **problem**,

  for a total of **4 easy exercises** and **2 problems** in each weekly assignment.

- Typeset your solutions with Latex to produce a single '`.pdf`' file containing:

  1. All your solutions for the ***hand exercises***, and
  2. Links to your ***coding exercises***, which are stored in your GitHub repository. (You should insert the links as active, *i.e.* clickable, *hyperlinks* in your '`.pdf`' file.)

  It is the '`.pdf`' file produced with Latex that you will submit in Gradescope.

  You do not need to use any particular format in naming your '`.pdf`' file, because Gradescope will keep track of who is submitting it. Nonetheless, it is nice to use suggestive names in case of a mishap and we need to recover your file. So, here is a possible naming:

  ```
  <your last name>_<your first name>.hw01.pdf
  ```

  For example, for myself, I would call my file '`kfoury_assaf.hw01.pdf`'.

1 By Hand

Exercise 1 Go to page 13 in ***Lecture Slides 09***. Your task is to carefully do part 1 of the exercise on that page.

Remark: Keep in min that "$\wedge$" and "$\vee$" are binary logical connectives, which are left-associative, *i.e.*, $(p \wedge q \wedge r)$ means $((p \wedge q) \wedge r)$. □

Exercise 2 Go to page 18 in ***Lecture Slides 10***. Your task is to carefully do part 1 of the exercise on that page. □

PROBLEM 1 There are do parts:

(a) Go to page 13 in ***Lecture Slides 09*** once more. Your task is to carefully do parts 2, 3, and 4 of the exercise on that page.

(b) Go to page 18 in ***Lecture Slides 10*** once more. Your task is to carefully do parts 2, 3, and 4 of the exercise on that page.

2 With Lean_4

Exercise 3 Three easy exercises from Macbeth's book:

1. Exercise 2.3.6.2,
2. Exercise 2.3.6.3,
3. Exercise 2.3.6.4 . □

Exercise 4 Three easy exercises from Macbeth's book:

1. Exercise 2.3.6.12,
2. Exercise 2.4.5.1,
3. Exercise 2.4.5.6 . □

PROBLEM 2 Three exercises, a little less easy, from Macbeth's book:

1. Exercise 2.3.6.10,
2. Exercise 2.3.6.14,
3. Exercise 2.4.5.7 . □