**Hoare Triples pt.2**

*CS 536: Science of Programming, Spring 2021*

Due Sun Feb 28, 11:59 pm  Post solution Mon Mar 1

**Preliminary Exam 1**

- **Exam 1 is Thu Mar 4** and covers classes 1 – 9 (i.e., up through Hoare Triples pt.2). Mostly multiple choice but some written problems too.

**Notes**

- This homework is only 25 points (it covers just one class, not two).
- This homework is due on Sun Feb 28; no late submissions allowed so that I can post a solution Monday Mar 1. (There isn’t time to grade and return this homework before the exam.)

**Problems [25 points total]**

**Class 9: Hoare Triples, pt 2 (25 points)**

1. [3 points] Study the triple \( \{???\} \ x := b^2 - 4ac \ \{0 \leq x \to \sqrt{x}\text{ is defined}\} \). Using backward assignment, what can we use for the precondition of the triple?

2. [4 points] Study the two triples \( \{p\} \ x := n; \ y := m \ \{p \land x = n \land y = m\} \) and \( \{1 \leq x \cdot y \leq n \cdot m\} \ S \{q\} \). Find a predicate \( p \) that makes it possible to join the two triples into a sequence.

3. [6 = 2*3 points] Let \( p_0 \to p, p \to p_1, q_0 \to q, \) and \( q \to q_1, \) all be valid. From \( \{p\} S \{q\}, \) there are four triples of the form \( \{p_i\} S \{q_j\} \) that get by replacing \( p \) by \( p_0 \) or \( p_1 \) and \( q \) by \( q_0 \) or \( q_1 \).
   a. If \( \sigma \models \{p\} S \{q\}, \) which of the four triples \( \sigma \models \{p_i\} S \{q_j\} \) is/are also satisfied by \( \sigma \) (under \( \models \))? Briefly justify.
   b. If \( \sigma \models_{tot} \{p\} S \{q\}, \) which of the four triples \( \sigma \models \{p_i\} S \{q_j\} \) is/are also satisfied by \( \sigma \) (under \( \models_{tot} \))? Briefly justify.

4. [12 = 4*3 points] Say \( \sigma \models \{p_1\} S \{q_1\} \) and \( \sigma \models \{p_2\} S \{q_2\}. \)
   a. Does \( \sigma \models \{p_1 \land p_2\} S \{q_1 \land q_2\}\)? Justify briefly.
   b. Does \( \sigma \models \{p_1 \lor p_2\} S \{q_1 \land q_2\}\)? Justify briefly.
   c. Does \( \sigma \models \{p_1 \lor p_2\} S \{q_1 \lor q_2\}\)? Justify briefly.
   d. Does \( \sigma \models \{p_1 \land p_2\} S \{q_1 \lor q_2\}\)? Justify briefly.