

# IIT CS536: Science of Programming

## Homework 4: WP and SP

Prof. Stefan Muller

Out: Tuesday, Oct. 10

Due: Thursday, Oct. 19, 11:59pm CDT

**This assignment contains 5 task(s) for a total of 28 points.**

## Logistics

### Submission Instructions

Please read and follow these instructions carefully.

- Submit your homework on Blackboard under the correct assignment by the deadline (or the extended deadline if taking late days).
- You may submit multiple times, but we will only look at your last submission. Make sure your last submission contains all necessary files.
- Email the instructor and TAs ASAP if
  - You submit before the deadline but then decide to take (more) late days.
  - You accidentally resubmit after the deadline, but did not intend to take late days.

Otherwise, you do not need to let us know if you're using late days; we'll count them based on the date of your last submission.

- Submit your written answers in a single PDF or Word document. Typed answers are preferred (You can use any program as long as you can export a .pdf, .doc or .docx; LaTeX is especially good for typesetting logic and math, and well worth the time to learn it), but *legible* handwritten and scanned answers are acceptable as well.
- Your Blackboard submission should contain only the file with your written answers. Do not compress or put any files in folders.

## Collaboration and Academic Honesty

Read the policy on the website and be sure you understand it.

## 1 Weakest Preconditions

Compute the following using the algorithms given in class. **Show the steps you take to get to your answer.** You don't need to simplify the conditions.

**Task 1.1 (Written, 12 points).**

- a) (3 points)  $wlp(n := \text{sqrt}(y) + \bar{1}; n := x * n; \text{skip}, n = 0)$
- b) (3 points)  $wp(n := \text{sqrt}(y) + \bar{1}; n := x * n; \text{skip}, n = 0)$
- c) (6 points)  $wp(y := -1; \text{if } y > 0 \text{ then } z := \bar{1} \text{ else } z := x/y \text{ fi}, z = 1)$

**Task 1.2 (Written, 5 points).**

Consider a program  $S$  and a condition  $P$ . What is the relation between  $P$  and  $wlp(S, sp(S, P))$ ? In particular, do we have  $wlp(S, sp(S, P)) \Rightarrow P$ ? If yes, provide a proof, if not a counterexample.

## 2 Strongest Postconditions

**Task 2.1 (Written, 6 points).**

Compute the following using the algorithms given in class. **Show the steps you take to get to your answer.** You don't need to simplify the conditions.

- a) (3 points)  $sp(x := -1; \text{if } y > 0 \text{ then } x := \bar{1} \text{ else } z := x/y \text{ fi}, y \geq 0)$
- b) (3 points)  $sp(\text{if } y = 0 \text{ then } x := x * \bar{5} \text{ else skip fi}, x = 10)$

**Task 2.2 (Written, 5 points).**

Consider a program  $S$  and a condition  $Q$ . What is the relation between the postcondition  $Q$  and  $sp(S, wlp(S, Q))$ ? In particular, do we have  $sp(S, wlp(S, Q)) \Rightarrow Q$ ? If yes, provide a proof, if not a counterexample.

## 3 One more wrap-up question

**Task 3.1 (Written, 0 points).**

How long (approximately) did you spend on this homework, in total hours of actual working time? Your honest feedback will help us with future homeworks.