CMSC 631, Fall 2006
Homework 5

Due Monday, November 13, in class

This homework is concerned with the practice of program verification according to Hoare logic. Please refer to the Huth & Ryan chapter for background and terminology. As a primer, try the practice exercises at `http://www.cs.bham.ac.uk/research/projects/lics/tutor/chap4/questions.html` (solutions provided on the web site).

1. (H & R, 1st ed., Ex. 4.3.1.) Use the proof rule for assignment and logical implication as appropriate to show the following partial correctness proofs:

   (a) $\vdash_{\mathsf{par}} (\!|x > 0|\!)\ y = x + 1\ (\!|y > 1|\!)$

   (b) $\vdash_{\mathsf{par}} (\!|\top|\!)\ y = x; y = x + x + y\ (\!|y = 3 \cdot x|\!)$

   (c) $\vdash_{\mathsf{par}} (\!|x > 1|\!) a = 1; y = x; y = y - a\ (\!|y > 0 \wedge x > y|\!)$

2. (H & R, 1st ed., Ex. 4.3.2.) Write down a program P such that

   (a) $(\!|\top|\!)\ P\ (\!|y = x + 2|\!)$

   (b) $(\!|\top|\!)\ P\ (\!|z > x + y + y|\!)$

   and prove it.

3. (H & R, 1st ed., Ex. 4.5.2(b).) Write code for P for the following specification and prove the correctness of the input/output behavior:

   $$(\!|\top|\!)\ P\ (\!|z = \max(w, x, y)|\!)$$

   where $\max(w, x, y)$ denotes the largest of w, x, and y. Show your program and the proof that it satisfies the given post condition using a proof tableaux.

4. (H & R, 1st ed., Ex. 4.6.1.) Show that $\vdash_{\mathsf{par}} (\!|x \geq 0|\!)$ `Copy1` $(\!|x = y|\!)$ where `Copy1` is the following code:

```
a = x;
y = 0;
while (a != 0) {
  y = y + 1;
  a = a - 1;
}
```