Software Engineering
http://proglang.informatik.uni-freiburg.de/teaching/swt/2009/

Exercise Sheet 5

Exercise 1: Partial Correctness (12 Points)

- Are the following hoare triples partially correct? If yes, please give a derivation in the hoare calculus.

  (i) {true} x := 0; {false}

  (ii) {false} x := 0; {true}

  (iii) $\{x \geq y\}$ y := y + 1; $\{x = y - 1\}$

  (iv) $\{x = y\}$ y := y + 1; $\{x \geq y - 1\}$

  (v) $\{a = x, b = y\}$
  ```
      a := a + b;
      b := a - b;
      a := a - b;
  ```
  $\{a = y, b = x\}$

  (vi) {true}
  ```
      int x;
      if (x % 2 == 0)
        h := x / 2;
      else
        h := (x - 1) / 2;
  ```
  $\{2 * h \leq x \leq 2 * h + 1\}$

- State a program S with a single variable x such that $\{y = 5\}\ S\ \{y = 23\}$ is partially correct.

Exercise 2: Loop invariants (8 Points)

Have a look at the program:

```
while (a < x)
{
  a++;
  b := b + a;
}
```

Which of the following assertions are invariants for the `while` loop of the program? Give a proof in the hoare calculus.

(i) `true`

(ii) `false`

(iii) $x \geq a \wedge a \geq a_0$

(iv) $b = a(a+1)/2$