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](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) \( \vdash_{\text{par}} (x > 0) y = x + 1 (y > 1) \)
   (b) \( \vdash_{\text{par}} (\top) y = x; y = x + y (y = 3 \cdot x) \)
   (c) \( \vdash_{\text{par}} (x > 1) a = 1; y = x; y = y - a (y > 0 \land x > y) \)

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 \( \vdash_{\text{par}} (x \geq 0) \text{Copy1} (x = y) \) where \( \text{Copy1} \) is the following code:

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