Tutorial problems

1. (a) Write down a program $P$ such that $|=_{p} [\text{true}] P[y = x + 2]$ holds and prove that this is so.
   (b) Write down a program $P$ such that $P$ contains an if-statement and $|=_{p} [\text{true}] P[z > x + y + 4]$ holds, and prove that this is so.

2. Show that the following holds for program $\text{Prog}$:

   $|=_{p} [\text{true}] \text{Prog}[x = v - z],$

   where $\text{Prog}$ is as follows:

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

3. (a) For any $B_1, B_2$ and $P$ explain why $|=_{p} [B_1] P[B_2]$, whenever the relation $|=_{r} [B_1] P[B_2]$ holds.
   (b) Show that the following holds for program $\text{Prog}$ in Exercise 2:

   $|=_{r} [z >= 0] \text{Prog}[x = v - z].$
Demonstration problems

4. Use propositional logic to prove the equivalence of the following statements.
   (a) ! (a == b | | a < b)
   (b) a != b && ! (b > a)

5. Prove the partial correctness in the following cases.
   (a) |=p [x > 0] y = x + 1 [y > 1]
   (b) |=p [true] y = x; y = x + x + y [y == 3*x]
   (c) |=p [x > 1] a = 1; y = x; y = y - a [y > 0 && x > y]

6. Show that |=p [true] P [z == min (x, y)], where P is the following program:

   if (x > y) then {
       z = y
   } else {
       z = x
   }

7. Show that
   (a) |=p [true] Sum [z == x + y]
   (b) |=t [0 <= y] Sum [z == x + y]

   where Sum is the following program:

   z = x;
   v = y;
   while (! (v == 0)) {
       z = z + 1;
       v = v - 1
   }