CS4112 Tutorial Exercises 4

1. Q5 in the last tutorial asked: Suppose that $\{sum > 1\}sum := sum + 4\{sum > 5\}$ is correct. Which of the following can be proved correct? Can you now use the precondition strengthening rule and postcondition weakening rule to formalise your reasoning for those which can be proved correct. Remember a counterexample is sufficient to prove incorrectness whereas the rules must be applied to prove correctness.

   - $\{sum > 2\}sum := sum + 4\{sum > 5\}$
   - $\{sum \geq 1\}sum := sum + 4\{sum > 5\}$
   - $\{sum > 0\}sum := sum + 4\{sum > 5\}$
   - $\{sum > 1\}sum := sum + 4\{sum > 6\}$
   - $\{sum > 1\}sum := sum + 4\{sum > 4\}$

2. Consider the assertion $(i > 2) \wedge (j > 3) \wedge (k = i * j)$. Are you allowed to replace this assertion with $(k > 6)$ if the assertion is (a)a precondition or (b) a postcondition? State why or why not.

3. Given that $\{x < y\}C_1\{u < v\}$ which of the following triples can be proved, and if so by what rule?

   - $\{x \leq y\}C_1\{u < v\}$
   - $\{x < (y - 2)\}C_1\{u < v\}$
   - $\{x < y\}C_1\{u \leq v\}$
   - $\{x < y\}C_1\{u \leq (v - 2)\}$
   - $\{x \leq y\}C_1\{u \leq v\}$

4. Prove that for any possible precondition the following program fragment has $\{max \geq a\}$ as a postcondition.
   $if(max < a)\{max = a\}$

5. Prove that the following statement has the postcondition $\{(x \geq 0) \wedge (x^2 = a^2)\}$
   if $(a > 0)$ then $x = a$; else $x = -a$;