CS615 Quiz 1

Max marks: 30 **Time: 1.5 hours**

- *Be brief, complete and stick to what has been asked.*

- *Unless asked for explicitly, you may cite results/proofs covered in class without reproducing them.*

- ***If you need to make any assumptions, state them clearly.***

- <u>***Do not copy solutions from others. Penalty for offenders: FR grade.***</u>

Consider the following program in a C-like language, in which all variables are of type `int`.

```
L1:  while (a <= 1000) {
L2:    a := b + i;
L3:    b := a + 1;
L4:    i := i + 1;
L5:  } //end-of-while loop
```

We wish to analyze this program using Hoare logic.

1. *[10 marks]* Give a formula in first-order logic that computes as strong a loop invariant as you can for the loop starting at `L1`. Recall a strong loop invariant gives the maximum possible information about the state of the program whenever the control reaches the loop head. Prove the loop invariance of your formula using Hoare logic rules.

2. *[10 marks]* Using Hoare logic and the calculus of strongest post-conditions, calculate the strongest post-condition of this program starting from the pre-condition $\{(a = 0) \wedge (b = 0) \wedge (i = 0)\}$.

3. *[10 marks]* Using Hoare logic and the calculus of weakest pre-conditions, calculate the weakest pre-condition of this program starting from the post-condition $\{(a + b) > 3000\}$.