
CS402/615 Take-home Quiz 3

Max marks: 25

Time: 1 week

- *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.*
- *Do not copy solutions from others. Penalty for offenders: FR grade.*

1. Consider the program given in the mid-semester exam, reproduced below for convenience.

```
L0:  a := 0; b := 0; i := 0;
L1:  while (a < 5) do
L2:      a := b + 1;
L3:      b := a + 1;
L4:      i := i + 1;
L5:  }
L6:  // end of while loop
```

As discussed in problem 2 of the midsem, we wish to use an abstract domain that uses only a strict subset of the inequalities used in the octagon domain, and yet be able to have a precise upper bound on i , i.e., the number of times the loop iterates.

- (a) *[10 marks]* Describe the abstract domain (i.e. specify the subset of inequalities from the octagon domain) that you would use for purposes of this question.
- (b) *[2.5 × 4 marks]* Compute the abstract state at the loop head after each of the first four iterations using the above abstract domain.
- (c) *[10 marks]* What is the upper bound of i that you obtain by analyzing the above program using your abstract domain? Indicate the iterations in which you used *lub* and those in which you used *widen* to compute the loop invariant in your analysis. Does the upper bound of i obtained by your analysis match the exact number of iterations of the loop?