COL869: Special Topics in Concurrency

January 16, 2017 **Home-work 1** deadline Mon 23 Jan 2017

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1. Given integer variables a and b, prove that the following program swaps the values of the variables.

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a := a+b ; b:= a-b; a := a-b
```

2. The following (informally specified) algorithm was used by Russian peasants to multiply two numbers. Encode it as a while program and prove it correct. Given integers $a = a_0 > 0$ and $b = b_0 > 0$, keep doubling a while halving b and ignore the remainder obtained while halving. Finally add up all those values of a for which the corresponding value of b is odd and the sum obtained is $a_0 b_0$.

3. Implement bubble-sort (sorting in a non-descending order) on an array of integers in at least two different ways! and prove each of them correct. In particular your complete proofs should make the following clear.

   (a) What are the pre-condition and post-condition of the two programs?

   (b) What are the loop-invariants in each case? In what whay are they different?

   (c) What is the measure of convergence in each case?

4. Code the following problems in the language of Guarded Commands and prove their correctness using the weakest-precondition calculus.

   (a) The russian mulitplication algorithm.

   (b) Binary search in a sorted array

   (c) Bubblesort (you could translate the code you have previously written).

5. Assume you are given two (unsorted) arrays of integers `L[0..l-1]` and `M[0..m-1]`. Using only swaps write a GC program to modify the two arrays such that

   (a) each value in the two arrays occurs exactly the same number of times and

   (b) every element in `L[0..l-1]` is less than or equal to every element in `M[0..m-1]`.

   Develop your program using the weakest-pre-condition calculus.