

# Testing and Verification (DIT085)

## Final Examination - March 17, 2015

**Important Notes.** It is not allowed to use study material, computers, and calculators during the examination. The examination comprises 5 question in 2 pages. Please check beforehand whether your copy is properly printed. In order to obtain a VG you need to obtain 80/100, for a G you need to obtain 60/100. Give complete explanation and do not confine yourself to giving the final answer. The answers may be given in Swedish or English. The solutions to the exercises will be available after the examination through the course page. **Good luck!**

**Exercise 1 (20 points)** Define the following concepts:

1. Validation and verification,
2. Boehm's curve,
3. Pairwise Testing,
4. Prime Path.

**Exercise 2 (25 points)** Consider the following program.

```
1: Input(x);
2: Input(y);
3: Input(z);
4: if y < 10 then
5:   x := 10;
6: else
7:   x := y;
8: end if
9: if y <= z then
10:  y := y + z;
11: end if
12: y := x
13: x := y
14: write(x);
```

1. Draw the control-flow graph of the program (5 pts),
2. Calculate all definition-clear paths with respect to  $x$  starting from a definition of  $x$ . (10 pts),
3. Give a minimal test suite (a set with the fewest number of test cases) that satisfies DU-path coverage with respect to  $x$ . For each test case indicate the DU paths that it covers. (10 pts)

**Exercise 3 (20 points)** Specify the following English properties in the TCTL language (input language for UPPAAL queries / properties):

1. There is no deadlock (5 pts),
2. In some execution of the model, a state can be reached in which automaton  $m$  is in state  $s_0$  and automaton  $mp$  is not in state  $s_1$  (5 pts),
3. In all executions, if automaton  $m$  is in state  $s_0$  then eventually automaton  $mp$  will be in state  $s_2$  (10 pts).

**Exercise 4 (25 points)** Consider the program given for exercise 2; calculate  $Slice(14, \{x\})$  for it. The final solution is not sufficient; you need to elaborate on the steps towards the final solution (include the relevant variables and the approximations towards the final slice).

**Exercise 5 (10 points)** Consider the following procedure, which is supposed to take an array of integers and its size and write the average of the numbers in the array (up to size) on the screen. It turns out that it outputs '8.0' when input  $arr = [2, 2, 2, 14, 8]$ ,  $size = 5$  is given (which is incorrect). Simplify the test-case using simplification. (Assume that you can manually check whether the outcome of each test is really correct or not.)

```

1: const MAX = 100;
2: procedure writeAvg(arr: array of integer; size: integer);
3: var i : integer;
4:   avg : real;
5: begin
6:   avg := 0;
7:   for i := 0 to size - 1 do
8:     avg := avg + arr[size - 1];
9:   write(avg/size);
10: end;

```