Exam for ETS200 Software Testing
Lund University, Department of Computer Science
Time: 2014-03-14, 14:00–19:00
Place: MA10-F-G
Assessment: total 60 points, at least 30 points is required in order to pass the exam.
Answers may be written in Swedish or English. Basic calculator may be used for task 5.
Start answering each new task on a new page.

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1. Define the following terms (one sentence each):
   a) Black box testing b) Integration testing c) Quality d) Reliability e) Maintainability
   f) Validation.   (6p)

2. Consider the following types of defects: (a) Missing functionality, (b) Erroneous functional-
   ity, and (c) Unexpected, not required functionality. Which type of defects are best found with
   white box and *black box* testing methods, respectively? Motivate your answers.   (6p)

3. For the method `sort` below,
   (a) draw the control flow graph and calculate the McCabe Cyclomatic Complexity,   (3p)
   (b) define the minimal set of test cases needed to achieve 100% decision coverage,   (3p
       for correct answer, reduction for too many test cases)
   (c) set up def-use tables for all four variables `k, i, min, minPlace`, and define minimum
       test cases needed to achieve 100% def-use coverage.   (4p)
   Note that test cases should include both input values and expected output.

```
1   class Data{
2       private int[] v;
3       private int n;
4
5       public void sort() {
6          for (int k=0; k<n-1; k++) {
7              int min = Integer.MAX_VALUE;
8              int minPlace = 0;
9              for (int i=k; i<n; i++)
10                 if (v[i] < min) {
11                     min = v[i];
12                     minPlace = i;
13                 }
14             v[minPlace] = v[k];
15             v[k] = min;
16          }
17       }
18   }
```

4. Develop black box test cases using equivalence class partitioning to test a module for an
   automated teller system (ATM). The module reads the amount the user wishes to withdraw
   from his/her account, returns cash and the remaining balance on the account. The withdrawn
   amount must be a multiple of 500 SEK and be less than or equal to 2500 SEK.
   (a) Define input and output equivalence classes for the module. Be sure to list any assump-
       tions you make.   (4p)
   (b) Define a minimal set of test cases that cover the equivalence classes. Each test case
       should include test case identifier, input values, expected output values, valid and invalid
       equivalence classes covered.   (4p)

5. During system testing, a number of failures occur at time intervals (execution time since last failure occurred) as reported in the table below. Faults are corrected as soon as they are found.

Failure number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Execution time (h)	39	10	4	36	4	5	4	91	49	1	25	1	4	30	42

Failure number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Execution time (h)	9	49	44	32	3	78	1	30	205	5	129	103	224	186	53

   (a) Calculate Mean Time Between Failures (MTBF) for the first 15 failures, $MTBF_{15}$. (1p)
   (b) Calculate the Reliability (R) after 15 failures, R_{15}, using Shooman's measure:
       $R = \frac{MTBF}{1+MTBF}$. (1p)
   (c) Calculate $MTBF_{30}$ and R_{30}. (2p)
   (d) Express in your own words an interpretation of $MTBF_{30}$ and R_{30}. Include the words *execution, probability, representative* and *next defect*. (2p)
   (e) Can you expect that these numbers are good estimates of the operational MTBF and R? Under which conditions? (2p)
   (f) The continued testing gives $MTBF_{50} = 44.7h$, $MTBF_{75} = 44.4h$, $MTBF_{100} = 46.2h$. Interpret this trend in terms of the *quality of the software* and the *software testing process*. (2p)

6. (a) Discuss the advantages and disadvantages of the three different ways (i, ii, iii below) to organize testers in a company:
       i) Developers test their own artifacts.
       ii) A test group and development group work separately in the same department.
       iii) Testers are in a separate department.
       (6p)
   (b) Suggest approaches to organize a test group for a company which develops very large and complex software for customers affiliated with the defense industry. Motivate why you choose that approach. (4p)

7. ISO 9126 defines six types of high-level quality characteristics: i) functionality, ii) reliability, iii) usability, iv) efficiency, v) maintainability, vi) portability. Which characteristic can be defined in various forms of testing and reviews? Which characteristics are best verified in:
   i) system testing,
   ii) integration testing,
   iii) unit testing, or
   iv) reviews.
   Motivate your answers. For full points, you may have to discuss the sub-characteristics level as well. (10p)