Written exam for Software Engineering Theory

Date: 2007-08-22
Time: 14.00-18.00

Valid for pass of the written exam in courses: TDBB61, TDBB62, TDDC01, TDDC06, TDDC88, TDDC93.

Allowed aids: Two sheets of handwritten A4 pages. You may write on both pages, with any type of size and colours. One volume of dictionary to or from English or an English wordbook.

Explicitly forbidden aids: Textbooks, machine-written pages, photocopied pages, pages of different format than A4, electronic equipment.

Graded exams will be handed out 2007-09-06 in Donald Knuth between 12.00 and 13.00.

Questions of clarification will be answered by examiner Kristian Sandahl, who will visit the exam about an hour after start. Examiner Kristian Sandahl can be reached on phone 013-28 19 57 or 0706-68 19 57 during the exam.

Instruktioner till tentamensvakter
Studenterna får ha med sig 2 handskrivna A4-blad med text på båda sidorna och ett lexikon. Studenter med andra hjälpmedel utan särskilt tillstånd får inte påbörja tentamen förrän examinator kontaktats.

Instructions to students, please read carefully

- Try to solve as many problems as possible.
- Motivate all solutions.
- Please, write and draw clearly.
- Write only on one side of the paper.
- Write solutions to problems on separate sheets of paper.
- Label all papers with name and your Swedish personal number.
- You may write solutions in either Swedish or English.
- Please, note that the problems are not necessarily written in order of difficulty.
**Grading**
The exam consists of two parts: Fundamental and Advanced.

The Fundamental part has problems worth 10 credits per area. Areas are: Requirements, Design & Architecture, Testing, Planning & Processes, and Quality factors. Thus the Fundamental part can give maximally 50 credits.

The Advanced part has problems with 50 credits in total. They can be distributed over two to five problems. Each problem typically requires a longer solution of several pages.

The maximum number of credits assigned to each problem is given in within parentheses at the end of the last paragraph of the problem.

**Pass condition:** At least 5 credits per area in the Fundamental part and at least 50 credits in total. This gives you the mark 3 in the Swedish system and an E in ECTS.

Higher marks are given based on fulfilled pass condition and higher amounts of credits according to the following table:

<table>
<thead>
<tr>
<th>Total credits</th>
<th>Mark in Swedish system</th>
<th>Mark in ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-85</td>
<td>5</td>
<td>A</td>
</tr>
<tr>
<td>84-76</td>
<td>4</td>
<td>B</td>
</tr>
<tr>
<td>75-67</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td>66-58</td>
<td>3</td>
<td>D</td>
</tr>
<tr>
<td>57-50</td>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td>49-0</td>
<td>UK</td>
<td>F</td>
</tr>
</tbody>
</table>

**Good Luck!**

**Kristian**
Problems

Part 1: Fundamental

Area 1: Requirements

1. Suggest three different methods that an analyst can use for getting requirements for an information system from an organisation. Please note that using the same method with different parties in the organisation counts as one method. (3)

2. Give one advantage and one disadvantage of specifying requirements by using models as a complement to natural language. (2)

3. Define the terms non-ambiguous, consistent and complete in the context of desired properties of a written requirements specification. (3)

4. Write and draw a use-case diagram of a use-case for a flight ticket reservation system and the actor Traveller. (2)

Area 2: Design and Architecture

5. A young friend of yours says: Why bother about coupling? Changing 100 lines of code is the same job no matter where the code is. Write down an explanation of why he/she is wrong. (2)

6. Explain three different advantages and/or disadvantages with a layered architecture. (3)

7. Draw a UML statechart of the class car in the context of an information system for a car rental company. At least three non-pseudo states are required. (3)

8. Suppose you are making an architecture of a system of 1000 independent sensors, which each will be sending up to 500 Bit per second to a central statistics module presenting aggregated information to a user. Thus we need at least 500 kBit per second bandwidth of incoming traffic to the central statistics module. Now suppose that we only have 250 kBit per second to the central statistics module. Describe what you can do to still provide the user with correct information. Explain additional assumptions. Exact calculation of resulting bandwidth is not necessary; just argue that your solution will lower the bandwidth. (2)

Area 3: Testing

9. Explain the concept of an oracle in the context of automated software testing. (2)

10. Name and define at least three roles in a software inspection. (3)
11. Consider a system with the following component hierarchy

```
    A
   / \
  B   C
 /   / \
D   E F
     /   /
    G   H I
     /   /  /
    J   K   L
            /  \
           M
```

Write down a diagram showing the sequence and dependency for a `bottom-up integration testing` of the system. Is this a good strategy for the system? Write down a motivation for your decision. (5)

**Area 4: Planning and Processes**

12. Thoroughly describe the `waterfall life-cycle model`. Make sure the description includes the major idea, benefits and drawbacks. (5)

13. `Brook’s law` states that if you add people late in a project that is already behind the schedule, your project will be even further delayed. Explain why. (3)

14. Describe how a `parametric effort estimation model`, for example, COCOMO, can help a project manager. Give an example of information that is input to such a model. (2)

**Area 5: Quality factors**

15. Suggest three `metrics` that you can calculate if you get a `UML statechart` from a designer. (3)

16. Define the `Usability attributes, Relevance, Efficiency, Attitude, and Learnability`. (4)

17. Describe two principles behind `ISO 9000-3`. Describe a drawback of focusing a company only to the ISO 9000-3 principles. (3)
Part 2: Advanced

18. You are describing roles of your project in a table as below:

<table>
<thead>
<tr>
<th></th>
<th>Project leader</th>
<th>Chief Analyst</th>
<th>Architect</th>
<th>Test leader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks and authorities</td>
<td>- Has the final word in all matters.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edited documents</td>
<td></td>
<td>- Requirements specification.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skills in order of priority</td>
<td></td>
<td></td>
<td>1. Technical knowledge</td>
<td></td>
</tr>
</tbody>
</table>

Continue filling in the table. You get one credit per correct item apart from the ones in the example above. Apparently incorrect items, such as, Test leader has the final word in all matters, give negative credits. You may add roles if you define them. Max 15 items are rewarded. (15)

19. Draw a UML sequence diagram of the process of getting into India:

- Book your flight tickets.
- Download a visa application form from the homepage and fill this in.
- Retrieve the current visa application fee from the homepage.
- If you come from a country on the restricted list on the homepage, please contact the embassy before you send in the applications.
- Go to the embassy with application, passport, photo, copies of travel documents and the application fee in cash. You will receive a visa stamp in your passport.
- Alternatively, you can send in the documents with a prepaid return envelope. Append a proof of internet bank payment to the account found on the homepage.
- You should check that the visa stamp is correct. If not, you should notify the embassy. They might want to see your passport again.
- Travel and present your passport with the visa to the emigration officer.

Some hints for credits: syntactic errors -2, semantic errors -4, omitting items from the list above -4, other types of diagram -20. (20)

20. Thoroughly describe two different life-cycle models, other than the waterfall model. For each of the models, discuss the applicability to two different organisations:
   1. A large EU project with developers in six countries.
   2. A 10 person start-up in Mjärdevi with one major customer. (10)

21. Formally prove that the cyclomatic number for a flow graph is the number of the binary decisions + 1 for all flow graphs with exactly one entry point and exactly one exit point. (5)