

Written exam for Software Engineering Theory

Course codes TDDC88, TDDC93, 725G64

Note: When I visit the exam, I will take a slow walk among all students, so you don't need to sit with your hand raised. Just call for my attention when I pass your desk.

Instructions to students, please read carefully

- **Explicitly forbidden aids:** Textbooks, machine-written pages, photocopied pages, pages of different format than A4, electronic equipment.
- Try to solve as many problems as possible.
- Motivate all solutions.
- Please, write and draw clearly.
- Write solutions for different areas (fundamental part) and different problems (advanced part) on separate sheets of paper.
- Label all papers with AID-number, date of examination, course code, examination code, and page number.
- You may write solutions in either Swedish or English.
- Please, note that the problems are not necessarily written in order of difficulty.
- **TIP!** Read through all exercises in the beginning of the exam. This will give you the possibility to ask questions about all parts of the exam, since the examiner will visit you in the beginning of the exam time.

Grading

The exam consists of two parts: Fundamental and Advanced.

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

The Advanced part has problems worth 50 credits in total. Each problem typically requires a longer solution of several pages.

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

Pass condition: At least 4 credits per area in the Fundamental part **and** at least 50 credits in total. The total amount of credits also includes the bonus credits you might have got in lecture exercises autumn 2016. This gives you the mark 3. If you have at least 4 credits for 4 of the areas in the Fundamental part, then you can still pass if you have more than 60 credits in total.

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

Total credits	Mark
0-49	U (no pass)
50-66	3
67-83	4
84-	5

Multiple choice questions

In multiple choice questions we will ask you to write down the letters A, B, C, or D for the one or two statements that you think are true. Note that you should not write down the statements that you think are false. There are exactly two true statements per question, so answering with three or four alternatives with gives 0 credits.

For each statement that you select that is correct (i.e., that the statement is in fact true) you get one credit. For each statement that you select that is incorrect (i.e., that the statement is in fact false, but you believed it was true) you get minus one credit. Each multiple choice question can give maximum 2 credits and minimum 0 credits, i.e., you cannot get negative credits for one multiple choice question.

Example 1: Assume that you have written down statements A and C. If now statements A and B were true, and statements C and D were false, you would get +1 credit for writing down A, but -1 credit for writing down C. Hence, the total credits for the multiple choice question is 0.

Example 2: Assume that you have written down statement B. If now statement A and B were true, and statement and statement C and D were false, you would get +1 credit for the multiple choice question.

Example 3: Assume you correctly wrote both statement A and B. If now statement A and B were true, and statement and C and D were false, you would get +1 credit for writing down A, and +1 for writing down B. Hence, the total credits for the multiple choice question is 2.

Good Luck!

Kristian

Problems

Part 1: Fundamental

Area 1: Requirements

1 a) Which of the following statements are true? Answer with the statement letter only, no motivation is needed. (2)

- A. The RAM model is focused on handling requirements of memory management of parallel execution.
- B. In the analysis phase of requirements engineering you use interviews and observation techniques to determine the true needs of the customer.
- C. Software reviews can be used to validate a requirements specification.
- D. Traceability of a requirement can be a link to the elements of the design that contribute in the realization of the requirement.

1 b) Scenario: In a social media system users can upload pictures, short movies, and sound files. There are features of basic editing of the media files as well as sharing and commenting functions. You have a detailed personal profile including your ambition level and dreams when it comes to media production. It's possible to submit files to panels of well-renowned members that can give you constructive criticism on how to improve your media production.

Task 1: Write a use-case of the system described above and draw a UML use-case diagram. Write two user stories of the above system where at least one is related to the use-case. (4)

Task 2: Write a quality requirement and one design constraint of the system described above. For each of the two requirements, write a short motivation on which level of testing they can be tested. (Hint: a motivation is typically 1-2 sentences.) (4)

Area 2: Planning and Processes

2 a) Which of the following statements are true? Answer with the statement letter only, no motivation is needed. (2)

- A. The buffer time is the difference between internal and external deadlines.
- B. A toll-gate is described by activities that has to be finished before a certain date.
- C. The critical path in a Gantt-chart contains activities performed by the most expensive resources.
- D. A consequence of time-boxing can be that you need to postpone the implementation of low-priority functions.

2b) Describe the Delphi method for effort estimation. Describe a potential limitation of the method. (4)

2c) Describe two advantages and two disadvantages of moving from the classical waterfall model to an iterative model. (4)

Area 3: Design and Architecture

3 a) Which of the following statements are true? Answer with the statement letter only, no motivation is needed. (2)

- A. An implementation (code) view of a system can be illustrated with a UML package diagram.
- B. An execution view of a system shows which source code artifacts that shall be compiled together.
- C. A deployment view of a system shows on which hardware different components shall execute.
- D. An implementation (code) view of a system can be used to analyze the need of bandwidth and processing power for a client-server architecture.

3 b) Give two examples of things you can do when you create the architecture that can improve the maintainability of the system. Clearly motivate your answer (Hint: a clear motivation is typically 3-5 sentences.) (4)

3 c) Scenario: A shop has two kinds of customers: corporate customers and personal customers. The customers place orders for the shop and the shop stores their name, address, and credit rating. At the shop's web-pages, a corporate customer is shown prices without VAT, whereas a personal is shown the price including the VAT. Another difference is that a corporate customer gets monthly bills whereas a personal customer pays with credit card using a third-party paying service.

Task: Draw a UML class diagram describing the situation above. Use at least one generalization association. Don't forget to put name and multiplicity information on the other associations. (4)

Area 4: Testing and SCM

4 a) Which of the following statements are true? Answer with the statement letter only, no motivation is needed. (2)

- A. The cost of using a bottom-up integration testing strategy is the need to develop drivers.
- B. A benefit of using a top-down integration testing strategy is that defects of lower-levels off-the-shelf components can be found early.
- C. The cost of using a big-bang integration testing strategy is the need to implement both stubs and drivers.
- D. A benefit of using a sandwich integration testing strategy is that it works well for large systems with many levels in the decomposition tree.

4 b) Describe the four types of acceptance testing: benchmark test, alpha test, beta test, and parallel testing. (4)

4 c) Explain with an example the following parts of a history tree in version handling: trunk, development branch, merge, and release branch. (4)

Area 5: Software Quality

5 a) Which of the following statements are true? Answer with the statement letter only, no motivation is needed. (2)

- A. The duty of the inspectors in an inspection process is to resolve as many defects as possible found in the inspected artifact.
- B. The inspection leader (moderator) can act as a recorder in an inspection process.
- C. The author does not report known or recently found bugs, they are handled separately.
- D. The reader keeps the pace of the inspection meeting to ensure that people are not stuck in details.

5 b) Scenario: You have a fairly large development company and you have a good reputation when it comes to understand the customers' true needs and you deliver fast. However, you need to spend too much time in repairing defects of the products, since your reliability of the products vary a lot.

Task: Describe a CMMI process area that you think would help you to deliver less faulty software. Summarize the process area's purpose and introductory notes in 5-6 sentences, and motivate how this could help you. (4)

5 c) Describe two metrics that can help you to measure the usability of a product developed in an iterative fashion. It's important that the metrics can be applied on prototypes of different fidelity and maturity through the project. (4)

Part 2: Advanced

6. Scenario: Your company of 10 skilled software engineers has been assigned to develop a safety critical software in a medical equipment. The calendar time for the development is not too short, but there is no room for unnecessary delays. After the start in January 2018 you are supposed to deliver in June 2018. Hence, you have started making preparations by:

- Sending one of your developers to a course in formal methods for requirements engineering.
- Placing an order for a logic inference tool to help you proving the consistency and correctness of your requirements.
- Outsourcing the coding to a company in India that is evaluated on the CMMI level 5.
- Contracting a medical expert of 100 hours to be used in different types of reviews and testing.

Task: Identify two project-specific risks with high risk magnitude. Create four different plans per risk: avoidance, transfer, mitigation, and a contingency plan. The risks shall use information from the scenario.

(10)

7. SCRUM is a popular frameworks for organizing development teams in software engineering. Select five concepts that are prescribed by SCRUM. For each of the concepts, write down:

- a) A description of the concept.
- b) A motivation of why the concept is agile (follows the agile manifesto).
- c) A motivation of the benefits of using the concept from the team perspective.
- d) A motivation of the benefits of using the concept from the customer perspective.

(20)

8. Scenario: Oh, no! After the election in 2018 Sweden got a prime minister who likes to post drastic and provocative messages on Facebook. This creates lot of unnecessary conflicts that aren't even appreciated within the prime minister's own party.

Luckily you have hacked the prime minister's account and you have planted a softbot that alters the formulations or even choice of subject of the messages so that they are aligned with a more normal debate climate. But, the softbot has to be careful of not overusing its capacity, because then its existence might be revealed. The softbot has a partner that watches the debate in the press.

The specification of the softbot is:

- 1) Never change the first message of the day.
- 2) After three messages have been posted in a single day, start altering the formulations.
- 3) If seven or more messages have been posted during a single day, start altering both the formulations and subjects.
- 4) If both the formulations and subjects are altered and the press writes more than five positive articles about the prime minister, stop altering subjects.
- 5) If formulations are altered and more than three positive statements about the prime minister from the opposition are cited in the press, stop all alterations.
- 6) At 24:00 o'clock every night, the system is reset and no alterations are made.

Task: Draw a UML state diagram showing the behavior of the softbot. (10)

9. Scenario: The same scenario as in problem 8 above.

Task: Identify input and output variables of the softbot. Identify five equivalence classes and write a test case for each of the equivalence classes. (10)