

## Written exam for Software Engineering Theory

Course codes TDDC88, TDDC93, 725G64

This is a special arrangement of a distance examination as prescribed by LiU. Instructions sent out in advance appears after the exam problems for reference.

### 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 & SCM, Planning & Processes, 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 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 2019. 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

*Good Luck!*

*Kristian*

# Problems

## Part 1: Fundamental

### Area 1: Requirements

**1 a)** Write a user story of a university on-line library system. Hint: A user story consists of a text and two attributes. (2)

**1 b)** A centralized patient information management system keeps all information of patients treated by the hospitals in a health care region. Health care personnel and the patients themselves can read or sometimes edit the information. There are strict rules for *confidentiality*, *integrity*, and *availability*. Draw a *UML use-case diagram* of this system with two different *use-cases* and two different *actors*. Don't forget the use case textual descriptions. Use full sentences. Logging in to the system is not a use-case of its own. (4)

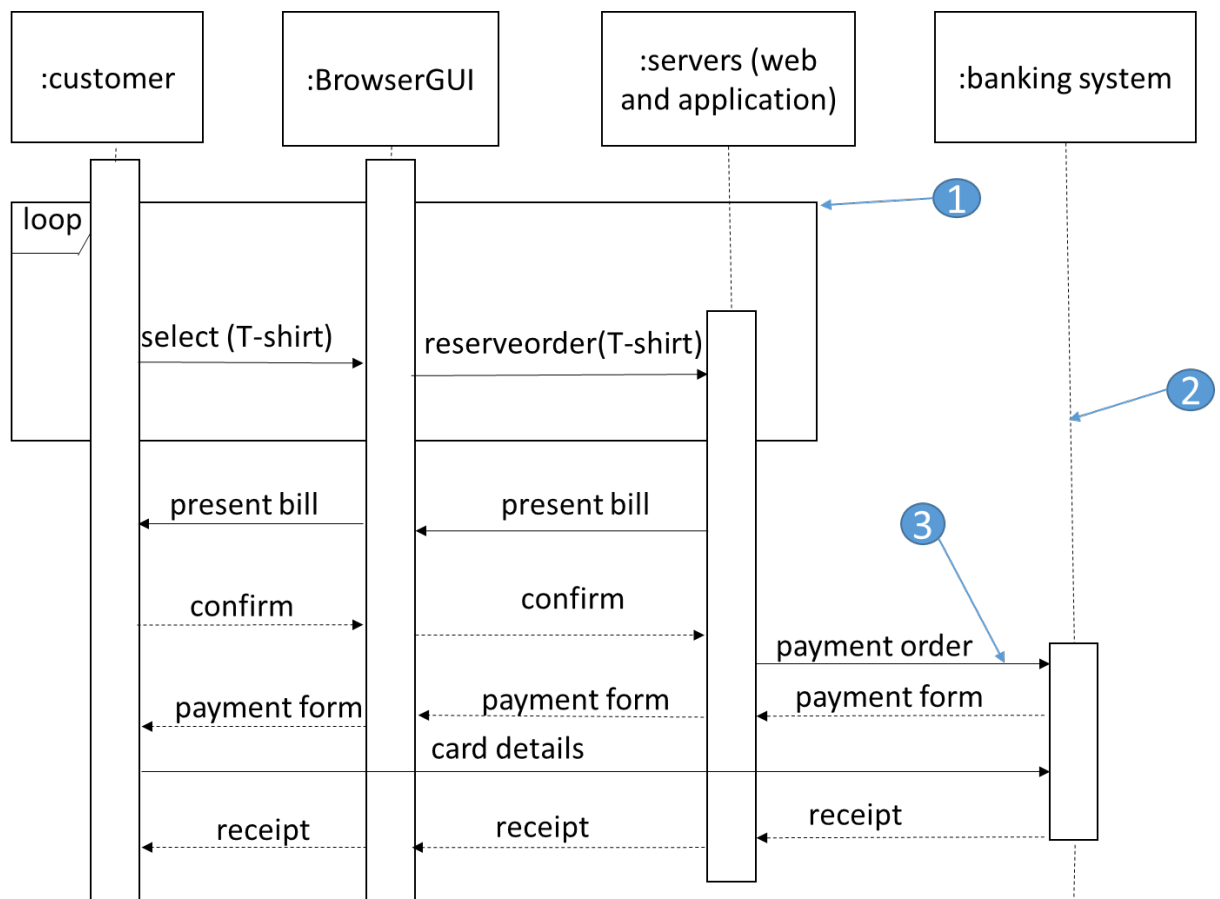
**1 c)** Write down two ways that be used to classify requirements. For each way of classification, write down a short motivation of why this classification can give advantages. (4)

## Area 2: Design and Architecture

2 a) Give two reasons of why it is a good idea to design and document a software architecture. (2)

2 b) Describe with an example how a client-server architecture can work. What are the strengths and weaknesses of the architecture in your example? (4)

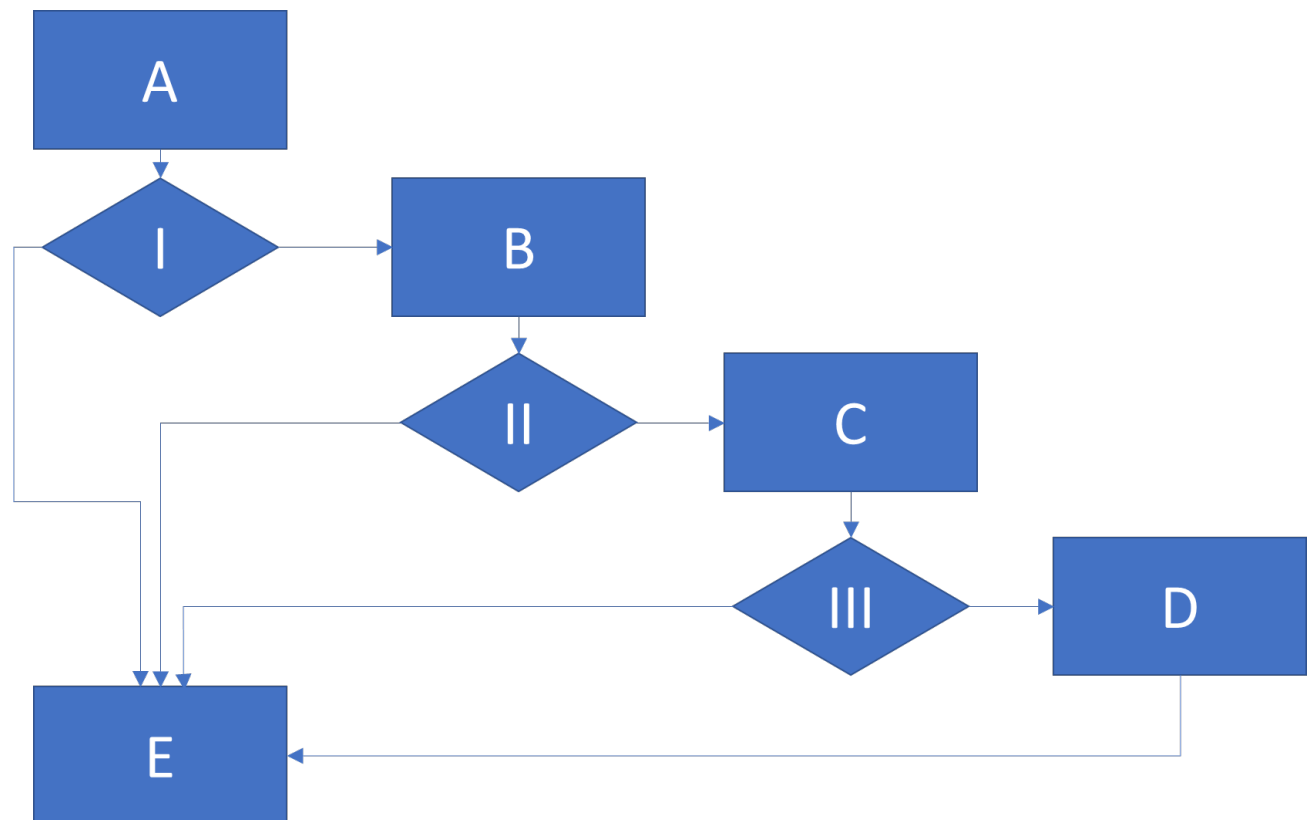
2 c) The diagram below is a UML Sequence diagram of a web-shop. Three model elements are numbered. Describe what these model elements are called and how they are used. There is at least one thing missing in the diagram. Describe what that is. (4)



### Area 3: Testing and SCM

3 a) Explain the concepts “sins of omission” and “sins of commission” in the context of software engineering. (2)

3 b) The figure below shows a flowgraph of a program. Given that there are no problems in the calculations, how many test cases do you minimally need for i) statement coverage, ii) branch coverage, and iii) full path coverage? Is coverage criteria testing a black box or white box technique? Motivate your answer. (4)



3 c) Describe the following concepts in version control: *branch*, *pull*, *push*, and *pull request*. (4)

## **Area 4: Planning and Processes**

**4 a)** Describe the concept of *buffer* time in project planning. What are the advantages and disadvantages of having a relatively large buffer time? (2)

**4 b)** Describe the four different meetings of SCRUM: *daily SCRUM*, *sprint planning meeting*, *sprint review meeting*, and *sprint retrospective*. (4)

**4 c)** Describe in detail what a *burn down chart* is, e.g. What are the values of the axes? How to you make the calculations? When do you update the chart? How do you handle vacations? Why is it useful? (4)

## **Area 5: Software Quality**

**5 a)** What is a *maturity level* in CMMI? How do you determine the maturity level for an organization? (2)

**5 b)** You have for long measured the *lines of code* of software you have developed. Name and describe two quality factors that, at least to some degree, can be related to lines of code. Don't forget to motivate your answer. (4)

**5 c)** Compare the two software review methods *inspection* and *code peer-review*. The code peer review is organized in such a way that at least one other team member must approve a change made by someone in the team This can, for example, be done with Gerrit. Draw a table with the review methods in the columns and comparison criteria as the rows. The comparison criteria are: resources needed, time duration, type of artefacts reviewed, and type of *defects* that can be detected. (4)

## Part 2: Advanced

6. A friend of yours wants to introduce *risk management* in his/her company. Therefore, your friend asks you to write a convince-your-boss letter explaining what risk management is. Credits will be given for texts explaining the different *types of risks* and the different *steps in risk management*. Some kind of introduction about the benefits of risk management is needed. (10)

7. Describe characteristics of a project that is suitable for

- a) A classical waterfall software life cycle
- b) An incremental software life cycle
- c) An iterative software life cycle

There will thus be one project description per sub-problem. Hint: Typical project characteristics are: Number of people, time scale, important quality requirements, release strategy, dependence of suppliers, dependence of hardware, stakeholders, difficulty, etc. (15)

8. *Scenario:* You have developed a mobile phone app called “NOvid-20” that will help private persons and health authorities to limit the transmission of coronavirus.

The input to the system contains:

- your own virus status
- the risk group you might belong to
- the virus status of other people with the app you have been close to (measured with Bluetooth)
- the history of infected people who have visited the same locations as you the last 14 days (measured with GPS)
- empirical thresholds for warning levels (learned through statistical machine learning)

Example outputs are:

- the probability that the user of the app needs to take precautions (calculated with statistical machine learning), for instance, to stay at home for x days or take a test
- a text message to the private person if the probability is higher than an empirical threshold
- alert functions to authorities about possible local outbreaks
- risk maps over certain geographical areas for authorities
- alert function to authorities if the user of the app ignores precautions

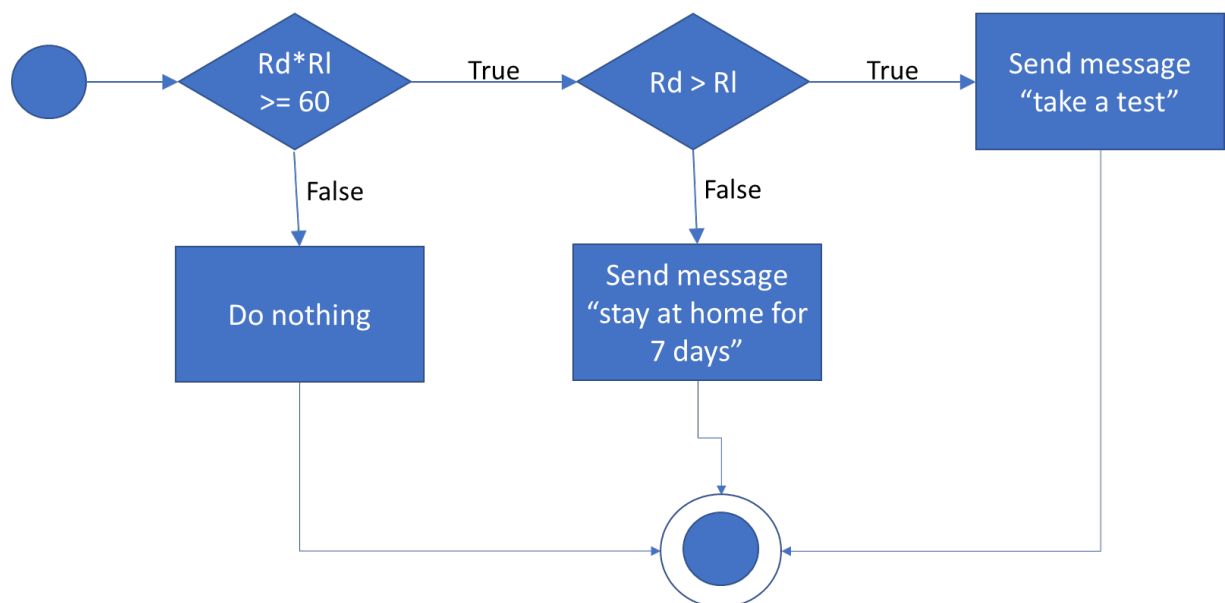
Task: You have sold the app for large sum of money and are now documenting the system:

Draw a UML class diagram of the concepts described above. You may invent new things if you explain them first. We expect around 7 classes with *attributes*, *operations*, and *associations*. (10)

9. Scenario: Same as in problem 8. But we also have a model where we determine the type of message to send to the private person. A risk can be a real number between 0 and 100. There are two types of risks:

- Rd = the calculated risk depending of the user’s distance to people
- Rl = the calculated risk depending of the locations the user visited

The algorithm is



Task:

a) Create a test table for equivalence class testing of the model. (10)

b) Write a short discussion of what you can do to test or validate the statistical machine learning components leading to Rd and Rl. What type of activities would you plan? What results can you expect? Are there parts that are not possible to test? It's hard to know the right answer, so the grading will depend on the creativity and quality of your argumentation around the problem. (5)



## Instructions for written exam 2020-08-27 14:00-18:00 TDDC93, TDDC88, and 725G64

The exam will be given in distance mode as a Zoom-monitored event. This way the exam will be as similar as possible to the earlier exams during the study year 2019/2020. The only difference is that there will be no multiple-choice questions, they will be replaced with a short question worth 2 credits per knowledge area.

As usual, bonus credits earned from the home exercises during fall 2019 will be added to the total sum of credits. Pass condition and marking are the same as the earlier exams.

The exam problems will be mailed as a PDF at exam start. This instruction will be appended.

### 1. Allowed aids

- Yourself. No help from others in whatever form.
- 2 handwritten A4 sheets. You may write on both pages.
- A dictionary or English wordbook or its digital equivalent.
- Nothing else (no printed or hand-written material, no material available electronically such as webpages).

### 2. Zoom and Webcam

- You need a webcam on your laptop/computer, alternatively run Zoom on your smartphone for connecting.
  - Have Zoom on your smartphone ready as a backup solution.
- The Zoom-link is:

<https://liu-se.zoom.us/j/69733078124?pwd=RWVMUnlDSXdOamRHRnJvNC9QSHVJQT09>

- Please log in to Zoom with your LiU-ID (SSO login, Zoom domain liu-se) at least 15 minutes before the exam starts (i.e., 13:45). The Zoom room will open at 13:30.
- We aim to do the identity check before the exam starts so you have more time for the exam itself.
- We request that you remain connected via Zoom throughout the exam.
- We request you to keep your camera switched on throughout the exam and your microphone on request (muted by default).
- You should remain visible within your camera scope throughout the exam, except for short breaks.
- If you need to leave the camera scope for a break, email your current draft file to the examiner for documentation before you leave, be back as soon as possible and send another email when you are back.
- Artificial backgrounds in Zoom or other funny effects are not allowed.
- No headset/ear plugs. We will not disturb each other with talk. Use the chat for questions.
- If you switch off the camera or leave its scope (except during a short break), your exam might not be accepted.
- The same applies if you accidentally get disconnected from Zoom – reconnect as soon as possible and explain what happened.
- Checkout when you are done with the final submission – chat or email to examiner

Zoom GDPR:

- Recording the Zoom session is forbidden (like any other video session in LiU courses where it is not explicitly granted) and is disabled in Zoom; we do not record the session either.
- We will keep the list of participants logged in and store it for 12 months.

### 3. Identity check

For the identity check, please have a photo ID ready and show it up in the camera on request. Also show your handwritten sheets.

We will do that in a Zoom breakout room, one student at a time.

### 4. Lisam

A course room for all course codes has been created in Lisam:

[https://studentsubmissions.app.cloud.it.liu.se/Courses/TDDC88\\_2019HT\\_22/admin/opportunities/66961](https://studentsubmissions.app.cloud.it.liu.se/Courses/TDDC88_2019HT_22/admin/opportunities/66961)

- We use this course room only for distance exam submission, not for anything else.
- Only exam-registered students will have access.

### 5. Submission Deadlines

- Hand-in your final version by 18:00 (sharp).
- Material coming in after the corresponding deadline may not be considered.
- All submissions must be done by Lisam.
- Only if you experience technical problems with submitting via Lisam and approach the deadline, you may submit by email to the examiner as a fall-back solution.

### 6. Plagiarism Checking

- All submitted material will undergo automated analysis by URKUND.
- Hence, if you google answers on the web, URKUND will detect it.

### 7. No Anonymous Correction

- We cannot guarantee anonymous correction of exams, unfortunately.  
[Dnr LIU-2020-01124]
- Submission in Lisam will not be anonymous, but only permanently hired teachers will help in the grading.

### 8. File Format for Answers

- Only .doc, .docx and .pdf files are allowed at submission. All answers are merged into a single file.
- Please write your name and LiU-ID on top of each document that you hand in.
- If you need to write diagrams etc. that you cannot easily draw with your favorite drawing program and include in your exam answer, draw it on paper and scan or photograph it and paste it into your answer file.
- It is your responsibility that the answer file and any attachment is readable.

## 9. Questions to the Examiner

- You can reach the examiner via e-mail, [kristian.sandahl@liu.se](mailto:kristian.sandahl@liu.se) or by phone 0706-68 19 57.
- The chat function in Zoom will be restricted to communication with the examiner only.

## 10. In Case of Emergency

- If anything unforeseen happens, contact the examiner immediately and submit your solution to the examiner by email on time if any possible.

*Thanks for your understanding and cooperation in this difficult situation!*