

Please, do not repeat the question text in the answer.

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Written exam for Software Engineering Theory

Course codes TDDC88, TDDC93, 725G64

This is a special arrangement of an exam written in distance mode. Instructions are sent out in advance and are available in Lisam for reference.

The solutions will be sent to Urkund for plagiarism checking, to avoid unnecessarily high similarity scores, only write the number of the problem in your solutions. **Do not repeat the problem text in your solution file.**

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 2020. 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

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Problems

Part 1: Fundamental

Area 1: Requirements

1 a) Describe two techniques that can be used to elicit requirements. (2)

1 b) Write four user stories of a system for a social network system, such as Facebook or LinkedIn. There are many users such as members, administrators, advertisers etc. The user stories can have different users. Hint: A user story consists of a text and two attributes. (4)

1 c) Explain what the following concepts are: *Feature*, *use-case*, *actors*, and *the IEEE standard 830*. (4)

Hint: by “explain” we mean that a student like you who has not taken the course shall be able to understand what you wrote. (1-2 sentences per concept)

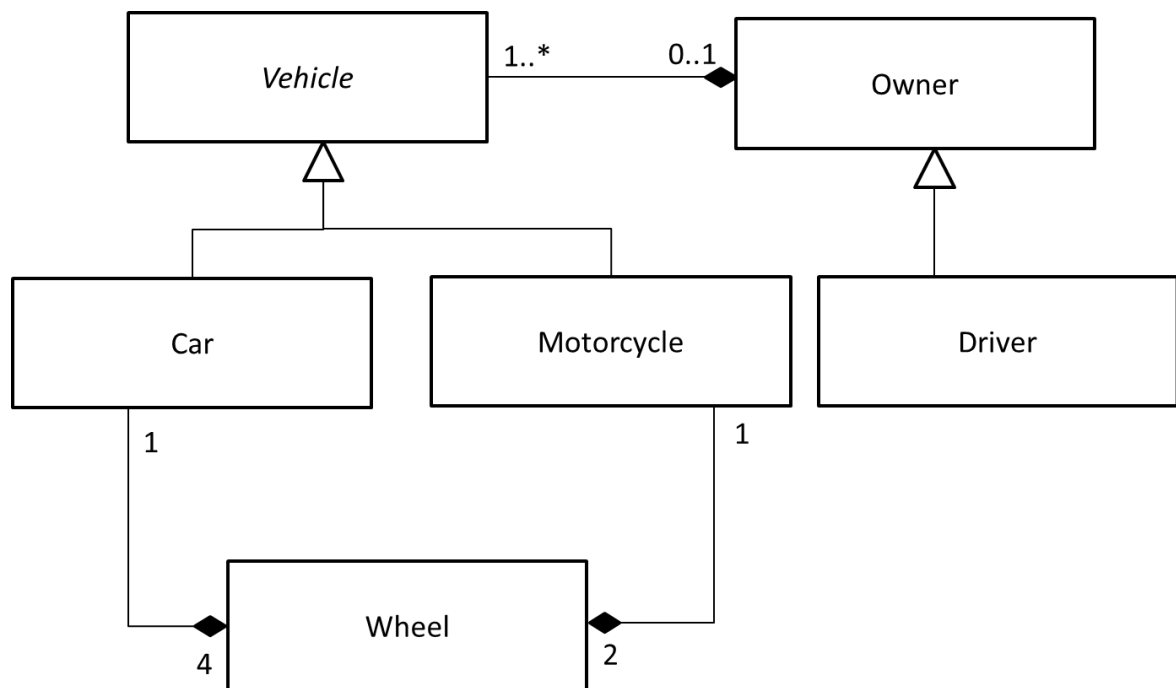
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Area 2: Design and Architecture

2 a) Explain why high coupling and low cohesion of a design can give unwanted effects. (2)

2 b) Describe two advantages and two disadvantages with a *layered architectural style*. (4)

2 c) In the UML Class diagram below there are two types of mistakes, one UML-mistake and one domain modelling mistake. Describe what is wrong. The class-name *Vehicle* is written in italics. What does that mean? What would be the consequences if we wrote it in a regular font as in the other classes? (4)



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Area 3: Testing and SCM

3 a) What is an oracle in the context of software testing? (2)

3 b) Suppose that your system has a *functional decomposition tree* with few levels (not more than 3), but high fan out (7-10 descendants per node). Describe one advantage and one potential risk with applying: i) a *top-down integration testing strategy*, and ii) a *big-bang integration testing strategy*. Remember to motivate all your answers. (4)

3 c) Describe the centralized workflow in Git which is an open source distributed version control system. Mention one advantage and one disadvantage of this workflow. (4)

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Area 4: Planning and Processes

4 a) What is the critical path in the context of project planning? Why is it important to know what tasks/activities that belong to the critical path? (2)

4 b) Explain the concept of a *burn-down chart*, for instance from SCRUM. Make an example and describe how it shall be interpreted. Also, explain shortly how it can be used by a development team. (4)

4 c) Describe the idea behind *iterative development*. Also explain 2 advantages and 1 potential problem with using an iterative development method. (4)

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Area 5: Software Quality

5 a) What characterizes an organization on CMMI maturity level 3 compared to an organization on CMMI maturity level 2? (2)

5 b) Peer-review (buddy-check) is a popular method for quality work in coding. Describe how it works in terms of:

- Goal
- Participants
- Process
- Output

(4)

5 c) How do you calculate the cyclomatic complexity of a flowgraph of a program? If the cyclomatic complexity is high, what are the consequences for maintainability and testability of the program? (4)

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Part 2: Advanced

6. Scenario: Your firm developed a telephone answering service ten years ago, and now your non-technical manager wants to read the requirements specification in order to compare it with other products on the market. The problem is that the development team forgot to write a requirements specification, all you find is the UML state diagram in version 0.9 below.

Task:

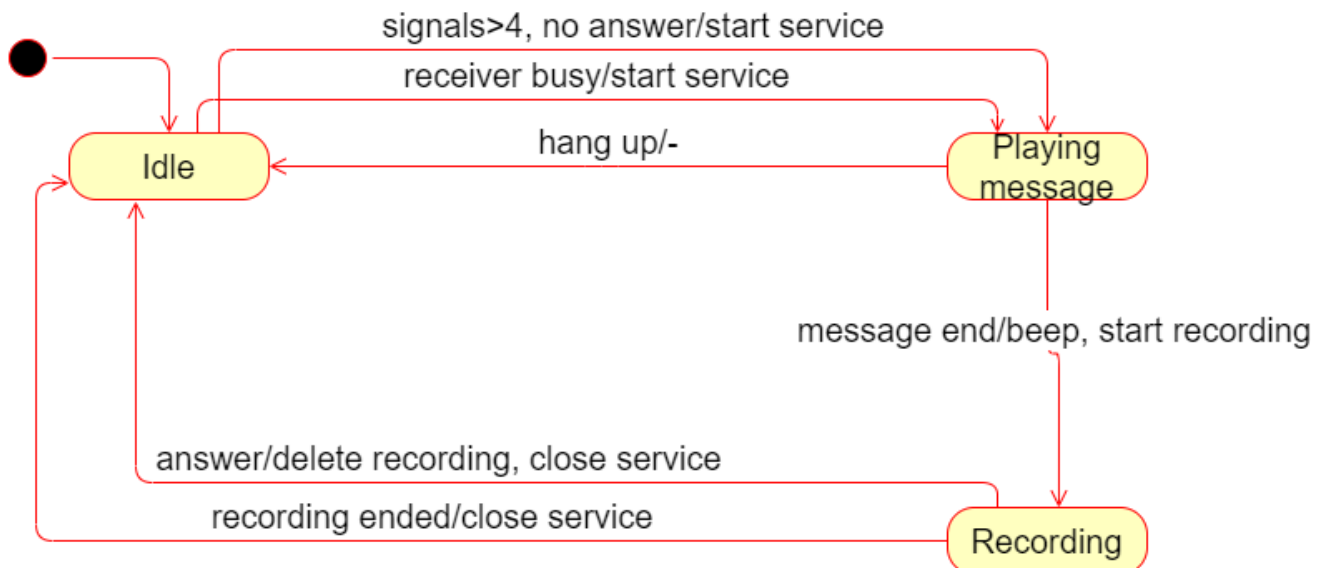
- Formulate the requirements in natural language that are fulfilled by the state diagram.
- There is a fairly obvious transition missing. Describe what that is.

Please note that your manager doesn't understand terms such as state, transition, triggering event or action so don't use them in the requirements.

One example can be:

1. If the receiving phone is busy, the answering service starts immediately

(10)

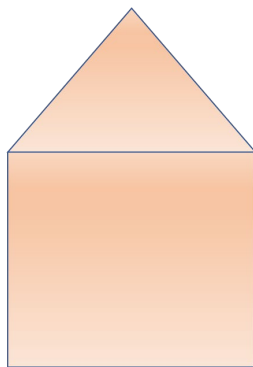


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7. Scenario: Diana the Developer lives in a house with white walls. She installed a high-tech lighting equipment that project colors on the wall in mild and sober tones during Christmas. She has designed 10 different light settings and has a system that automatically changes light settings every 30th minute. When the setting is changed the transition is spectacular with a myriad of colored spots moving fast in advanced trajectories for a few seconds until the new setting is shown steadily.

Diana likes to impress on her neighbors and has sensor that can determine if a person has stopped outside her house. If a person has stopped and it is less than five minutes left until the next scheduled change of settings, the change will happen immediately to allow the person to enjoy the change even though it is a bit early compared with the schedule. The next change is then scheduled in 30 minutes after the current time.

Task: Your task is to test the system governing when the changes occur. Find equivalence classes and create a test table with one test case per equivalence class. (10)



Steady lightning



Short spectacular transition

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8. Scenario: You are developing the software of a system for monitoring and controlling an industrial process of importance, such as a factory for covid-19 vaccine production. Your release in May 2021 will contain new AI technique for data analysis, prognosis, alarm, visualisation etc. Some characteristics of your environment are:

- You have three teams in Sweden, one in India, one in South Chorea, and one in Canada.
- You have a tight relationship with a Polish vendor which you are thinking of buying if they perform well this year too.
- You have strategic partnerships with experts in production control in various domains.
- Three key persons are retiring at the end of 2021.
- Most of the data management is handled in the cloud apart from some especially valuable information that is handled on a dedicated hardware with a trusted provider.
- The operator interface with all privileges can be run on a desktop workstation running Windows, macOS, or Linux. There is also an administrator interface for system configuration, data management, and user administration.
- There are also apps available for operators working remotely with lower privileges on major mobile devices and web-browsers.
- You maintain API's for most vendors of sensors and actuators.
- The competition is tough, you are one of four world-leading development companies.

Task:

- Perform a risk identification leading to ten project-specific risks.
- Make a reasonable risk analysis leading to a prioritized list of risks.
- Make a risk planning for the risks.

For full credits you shall make use of all four types of risk planning. You only need one plan per risk, but all four types of plans shall occur at least once in your list of ten risks. You may invent new characteristics of the system and the environment as long as you write them down. (20)

9. There are many practices that are popular when using agile methods. Some of them, not mentioned earlier in this exam are:

- Refactoring
- Pair-programming
- Test-first programming
- Planning poker
- Cross-functional teams

Describe two of them thoroughly, 4-5 sentences each. In addition to this, describe expected benefits and potential risks of using the practice. (10)