DAT360 / DIT345

Fundamentals of Software Architecture Final Exam

Time:	8:30-12:30
Examiner:	0760268580 - Rebekka Wohlrab
Place:	October 27, 2023. Lindholmen
	I'm coming to the exam hall at approximately 9:45-10:15 and at 11:30-11:50.
Max Score:	100
Exam aids:	*none (except for generally allowed aids, such as dictionaries)*

Grading Scale: 3: >=50 4: >=70 5: >=85

The exam consists of the following parts:

- P1: Identifying architectural drivers
- P2: Quality attribute scenarios and utility trees
- P3: Architectural styles and patterns
- P4: Architectural trade-offs

Answer in full sentences or paragraphs in questions where a description, explanation or similar is required.

Please write legibly. If we cannot read your handwriting, we cannot give you points.

Read each assignment thoroughly before starting to work on it.

Begin each assignment on a new sheet.

Only write on the front of each sheet.
Label each sheet with:

- The assignment number and sub-assignment number (e.g., P1.1, P2.2, …)
- The anonymous code provided by the student office. (The exam is anonymous.)

Before handing it in: Sort your sheets in the assignment order and enumerate them as 1, 2, 3, …

Additional information

Keep in mind that we always require you to motivate your answer and to demonstrate your understanding of the subject matter. Max points will be given for:

- Correctness.
- Soundness of your argumentation.
- General demonstration of knowledge.
- Clearness, readability and correct use of English.

Good luck!

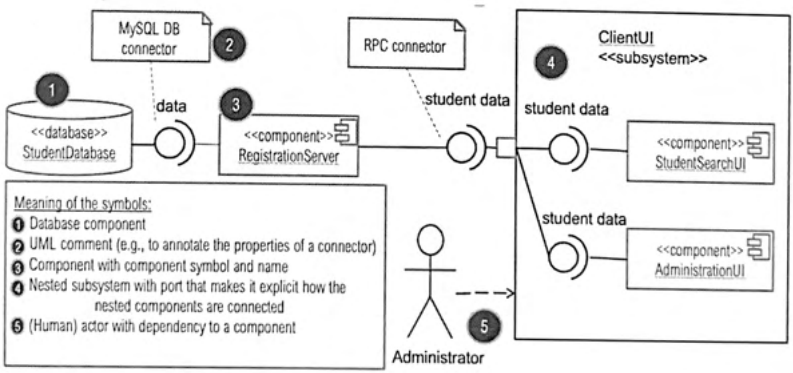
Breakdown of tasks:

- Part 1: Identifying architectural drivers (16p)
  - A. Identify technical and business constraints (5p)
  - B. Functional requirements (5p)
  - C. QA requirements (6p)
- Part 2: Quality attribute scenarios and utility trees (24p)
  - A. Quality attribute scenarios (12p)
  - B. Utility tree design (12p)
- Part 3: Architectural styles and patterns (38p)
  - A. Identify an architectural style (7p)
  - B. Identify issues (7p)
  - C. Create an architecture supported by QAs and tactics (17p)
  - D. Tradeoff analysis (7p)
- Part 4: Architectural trade-offs (22p)

Acronyms:

CTO: Chief technology officer
CFO: Chief financial officer
MLAV system: management of logistics and vehicles (MLAV) system, an example system in this exam
QAR: quality attribute requirement
QAS: quality attribute scenario

Cheat sheet to clarify the notation for component diagrams:



P1: Identifying architectural drivers (16p)

Transportation Systems AB is a company that produces software that facilitates the management of logistics and vehicles (MLAV) for transportation companies. After a decade of working with an underperforming monolithic architecture, the CTO of the company has requested you to start gathering architectural ideas for a new system that will satisfy the following requests:

Requests made

1. The company wants users to be able to sign up and sign in.
2. There should be an overview page that showcases all vehicles in a map with relevant information (speed of vehicle, ability to see the cargo of each vehicle, description of task the vehicle is completing, scheduled trips for the vehicle).
3. There should be a page to manage the vehicles (register new vehicles, manage registered vehicles, manage tasks and inventory for register vehicles).
4. Users should be able to access page to view statistics for the company (completed trips, cash flow, % of booked vehicles, ...).
5. There should be a settings page to change the following aspects in the system (brightness, sound, notifications, language, account information, subscription to the software service).
6. The technical advisor of one of the primary stakeholders has requested a minimum uptime of 99.75%.
7. Some stakeholders have expressed concerns about security and data privacy. Those are crucial because much of the cargo will be extremely valuable, and information on its real time location could lead to cargo/freight theft.
8. Your CTO has expressed the concern that a competing system is being developed by a rival company and is planned to launch in March of next year.
9. Your CFO has expressed that due to the large threat of losing market share to the competition, the development cost for the system is not a concern.
10. The end users should be able to access the page with their Android work phones only.

Your Task:

A. Identify a technical constraint and a business constraint (5p).

B. Identify two functional requirements (5p).

C. Identify and formulate the two most relevant quality attribute requirements (QARs) for the system (6p). You do not need to create complete Quality Attribute Scenarios at this point.

Make sure that:

1. **You label the requirements with the quality attributes that they are concerned with.**
2. **You write one sentence per requirement.**
3. **Each requirement is precise and testable.**

P2: Quality attribute scenarios and utility trees (24p)

A. Your CTO has informed you of the following new requirements.

- The system is developed for the European market. It should be possible to also handle concurrent requests from users from other continents without a decrease in performance.
- The MLAV system should be able to quickly recover from cyber-attacks to be able to market the product to private security companies.

Formulate a quality attribute scenario for each of those quality attribute requirements (12p).

QAS :	
Portion of Scenario	**Possible Values**
Source	
Stimulus	
Artifact	
Environment	
Response	
Response Measure	

QAS :	
Portion of Scenario	**Possible Values**
Source	
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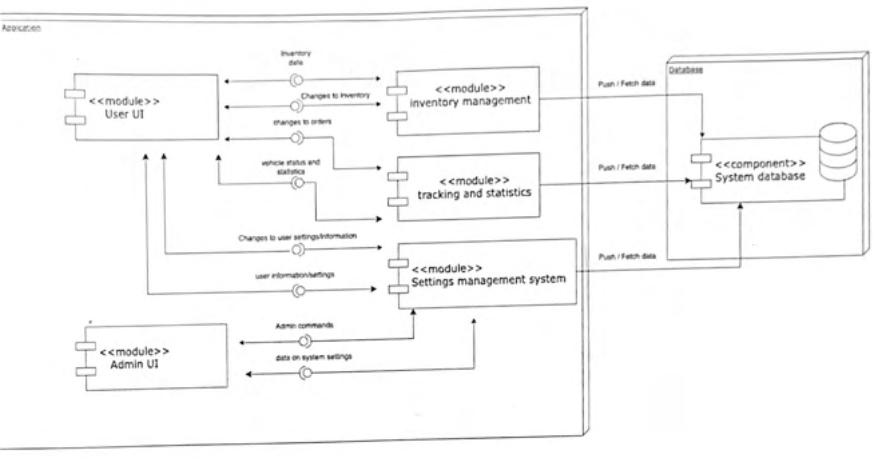
Response	
Response Measure	

B. Draw a utility tree for your QARs (both from P2.A and P1.C), where you clearly label the QAs and QA refinements (12p).

P3: Architectural styles and patterns 38p

A junior software architect within your company has produced the following component diagram as a suggestion for the new software product (MLAV):



Your task:

A. **Identify the architectural style/styles present in the diagram (7p).**

B. **Identify the issues that might arise if this architecture is used for the final product (7p).**

C. **Create a component diagram and propose a new architecture that fixes those issues. Make sure that it clearly addresses the 4 QARs present in your utility tree. Explain in simple terms your designed architecture and at least two tactics that you used (17p).**

D. **Argue why your solution is better than the one presented by your coworker in terms of security, privacy, and availability (7p).**

P4: Architectural trade-offs (22p)

You need to do either P4.Normal or P4.Alt. Don't do both!

Reminder: We learned how to illustrate tradeoff points. You show a pair of conflicting quality attributes and indicate which of the quality attributes is prioritized. This tradeoff point illustration means that the tradeoff between cost and reliability is decided slightly **in favor of cost**:

Did you participate in one of the workshops (from the beginning to the presentation)?

☐ Yes ☐ No

Do you remember the tradeoff points and decisions that your group made?

☐ Yes ☐ No

If you chose no at least once: see task P4.Alt at the bottom of the page.
If you chose yes: do task P4.Normal.

P4.Normal

A. **Describe two of the tradeoff points that your group elicited for the development of the Bästtrafik system. Explain why it is necessary to make a tradeoff between the depicted quality attributes (i.e., why they are not compatible). (8p)**

Reasoning (1-2 sentences):

Reasoning (1-2 sentences):

B. **Explain what architectural style your group chose. After reflecting on the solution and listening to other groups' presentations, would you still choose that style? Why? Why not? (8p)**
C. **What was the main insight you got from the discussions in the workshop? Write 4-5 sentences. (6p)**

P4.Alt: If you did not attend the workshop or don't feel comfortable about your group's solution:

This task is concerned with the MLAV system from the previous parts of the exam. Your CTO has argued that even though the cost is not an issue, a short time-to-market is key for the application to succeed.

A. Draw circles in the three lines between the QAs below to depict how much (if at all) you prioritized one QA over the other. (8p)

B. Explain how and why you have prioritized one of the following Quality Attributes over the other in the architecture for your MLAV system. (6p)

C. Formulate a tactic that could help to improve the QA you did not prioritize. (8p)

1)
Performance _____ Security / Privacy
Reasoning:

Tactic:

2)
Cost _____ Performance
Reasoning:

Tactic:

3)
Maintainability _____ Scalability
Reasoning:

Tactic: