DIT345: Fundamentals of Software Architecture Final Exam

Time: 14:00-18:00
Examiner: 0760268580 - Rebekka Wohlrab
Place: Nov 1, 2024 - Lindholmen
I'm coming to the exam hall at approximately 15:15 and at 17:00.
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:

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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.A, …)
- The anonymous code provided by the student office. (The exam is anonymous.)

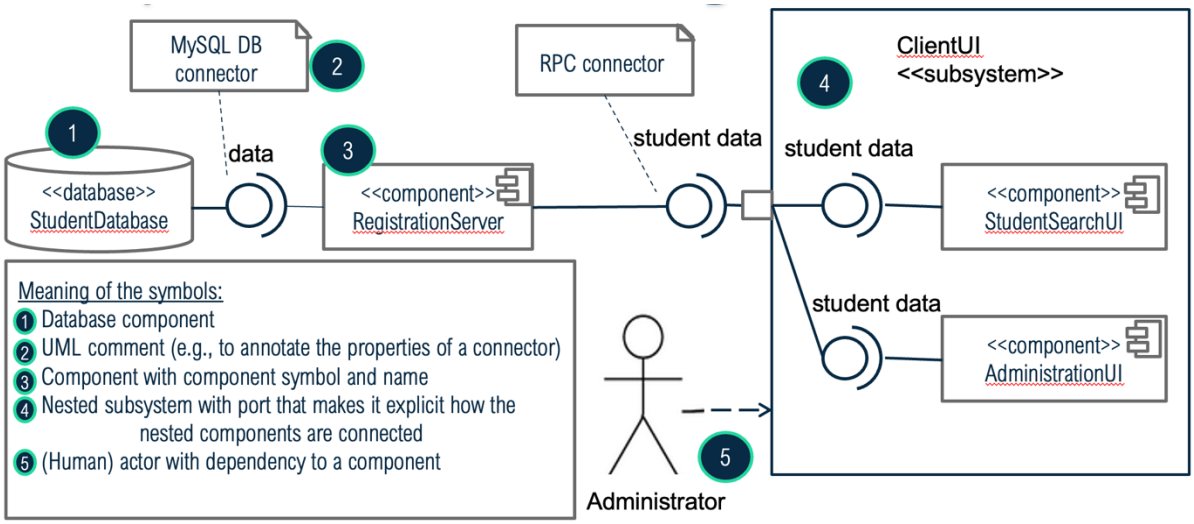
Before handing it in: Sort your sheets in the assignment order and enumerate them as 1, 2, 3, …

Additional information

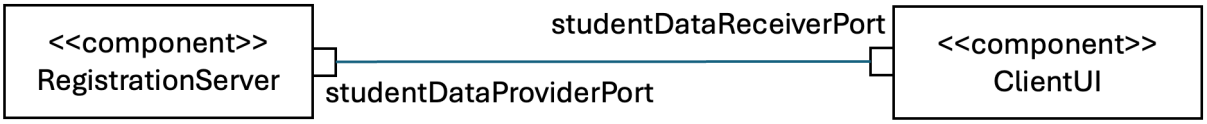
Keep in mind that we always require you to motivate your answer and to demonstrate your understanding of the subject matter.

Good luck!

Sheet to clarify the notation for component diagrams:



Alternative notation using ports:



P1: Quality attributes and architectural significance (23p)

A. Briefly define what the properties of "architecturally significant requirements" are. (4p)
B. Write down an example requirement that is not architecturally significant. Explain why. You can make assumptions about the context/system for which the requirement should hold and document those assumptions. (2p)
C. Write down an example requirement that is architecturally significant. Explain why. You can make assumptions about the context/system for which the requirement should hold and document those assumptions. (2p)
D. Your friend has found three definitions online. Each of them defines a term that is important in the context of availability. Write down what the corresponding terms for a), b) and c) are.
   a) a defect in the software or hardware required to execute the software (1p)
   b) deviation of a system from its specified behavior (1p)
   c) manifestation of a fault that results in incorrect output or behavior (1p)

E. Map the security areas of concern on the left (I-VI) to the statements on the right (1-6). Each item on the left shall be mapped to exactly one item on the right (a 1:1 mapping). You can simply write down the combinations (e.g., III (1), if you want to map III to (1)). (12p)

I. Confidentiality II. Authentication III. Authorization IV. Availability V. Nonrepudiation VI. Integrity	(1) Is high if a system is available for legitimate use (2) Is a mechanism that checks that a party/user is who they claim to be (3) Is high if data and services are protected from unauthorized access (4) Is a mechanism that ensures that transactions cannot be denied by any of the parties participating in the transaction (5) Is high if system data is not subject to unauthorized manipulation (6) Is a mechanism that grants a user the privileges to perform a task

P2: Design Principles (25p)

One of the junior software developers at a bank submitted the following code for review.

They suggest creating two modules (the classes “Account” and “Person”) and have sent you the public methods of the modules.

Your colleague suggests that this is breaking at least one of the software architecture design principles.

```
public class Account {
   // returns the account's balance
   public double getBalance() {
      ...
   }
   // returns whether the owner has paid tax
   public boolean hasPaidTax() {
      ...
   }
   // returns the list of other accounts of the person who owns this
account
   public List<Account> getOtherAccounts(){
      ...
   }
   // returns whether the account's balance is negative
   public boolean isNegative() {
      ...
   }
}
```

```
public class Person {
   //gets the total income of the person
   public double getIncome(){
      ...
   }
   //gets the paid tax
   public double getPaidTax() {
      ...
   }
   //gets the list of all accounts
   public List<Account> getAccounts() {
      ...
   }
   //gets the sum of the balance of all accounts
   public double getAccountBalance() {
      ...
   }
}
```

A. Create a list of at least 4 design principles that we have discussed in the course. For each principle, justify in 1-2 sentences why this code violates it or why it does not violate it. (8p)
B. Write your own new version of the modules, so that it does not violate the design principles. If you want to create an additional module or remove one, that is okay.
    a. Write down the class names and the public methods of the modules that you want to create. You may add private attributes and methods as well. (8p)
    b. Draw a module view diagram. (5p)
    c. Explain for all principles (from part A) why they are not violated anymore in your new version of the modules. (4p)

P3: Architectural styles and patterns (28p)

You want to design a new auction platform. It shall be a reliable and secure website that will allow users to conduct auctions online. It needs to be a system that offers different functionalities for sellers or buyers: a trading platform where sellers can announce what they want to sell and buyers can lay bids, a live chat that allows buyers to communicate with each other, a live video service that allows the sellers to stream the auction and update the viewers on the status of the product and latest offers, a marketplace where a buyer can view all ongoing and upcoming options and where sellers can list items, and a secure payment service for buyers to load funds and for sellers to withdraw funds.

Your task:

A. Describe what architectural style or combination of styles you think would be most appropriate for this system. Present one alternative style that you could consider and explain why you did not choose it. (8p)
B. Draw a component and connector diagram that shows how you plan to design the architecture of the system. (12p)
C. Describe what quality attribute you think is most important and why. Describe a complete quality attribute scenario for this quality attribute. (8p)

P4: Architectural decisions (12p)

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

Write down on a sheet of paper:

- Did you participate in one of the role-playing workshops?
- Do you remember the decisions that your group made?

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 one or two quality attributes that your group prioritized. Why did you consider them important? (2p)
B. What is a design decision that you made which is connected to this quality attribute (1-2 sentences)? (2p)
C. Briefly describe the architecture that you designed. Write a short text and explain what style(s)/tactic(s) you used. Were those decisions well thought-out or would change them in retrospective? (6p)
D. Reflect on the discussion in your group. How difficult or easy was it to reconcile the different quality attributes' perspectives? What have you learned from the discussions? (2p)

P4.Alt: If you did not attend the workshop or don't remember your group's solution:
This task is concerned with a new system that is going to be developed. It delivers packages to people with the help of drones that can be tracked using an app.

A. What quality attribute do you consider most important? Describe what tactic(s) you would choose to promote it. (2p)
B. Draw a small diagram and briefly describe how you would design the system. What style(s) would you use? (6p)
C. Following the ATAM terminology, describe at least one trade-off of your solution. (4p)
D. Write a sentence about the following questions: Did you participate in the workshop but were not sure about your solution? Or were you not there for the workshop? Either is completely fine.

P5: Fill the Gap (12p)

A. Module views are __ and are useful to describe the system at __. (2p)
B. Component-and-Connector views are __ and are useful to describe the system at __. (2p)
C. In quality attribute scenarios, a ___ is a condition that requires a response. (1p)
D. In utility trees, the ___ and the ___ are ranked with High, Medium, and Low. (2p)
E. ___ is an availability tactic that can be used to detect faults. (1p)
F. A disadvantage of microservices is that ___. (1p)
G. In the BAPO model, B stands for ___, A stands for ____, P stands for ____, and O stands for ____. (2p)
H. The quality attribute that is concerned with making future changes easier is called ___. (1p)