DIT345: Fundamentals of Software Architecture Final Exam

Time: 8:30-12:30
Examiner: Rebekka Wohlrab
Place: January 9, 2025 - Lindholmen
I'm coming to the exam hall at approximately 10:00 and at 11:30.
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:

Table of Contents

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.)

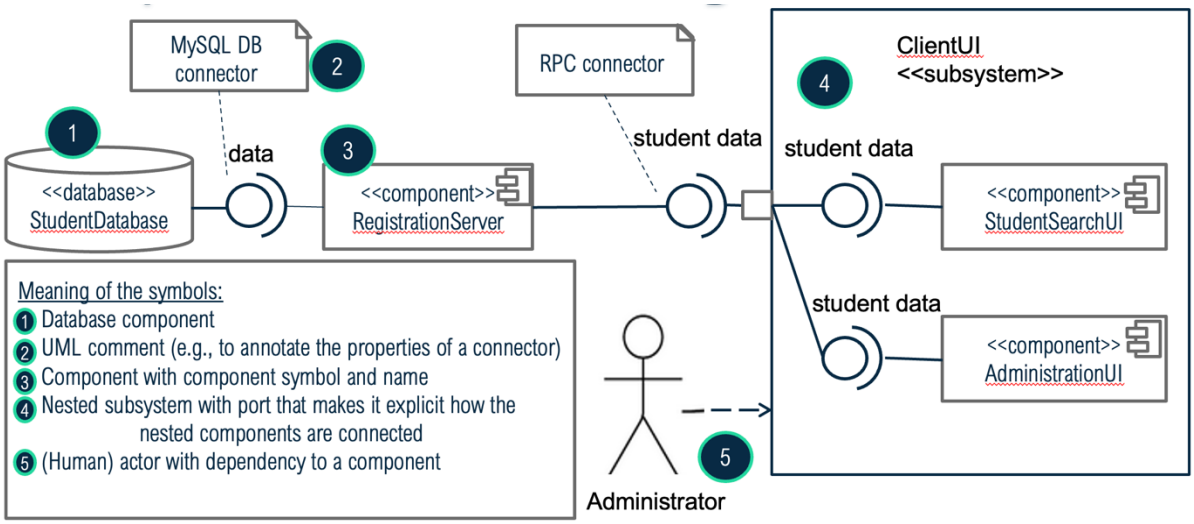
Before handing it in: Sort your sheets in the assignment order and enumerate them as 1, 2, 3, …

Additional information

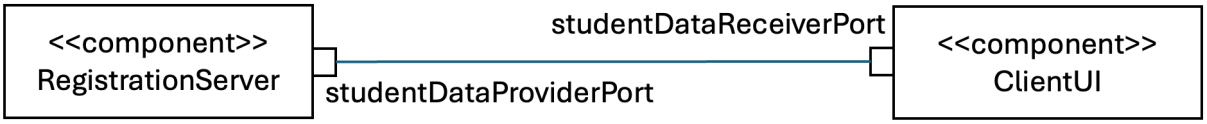
Keep in mind that we always require you to motivate your answer and to demonstrate your understanding of the subject matter.

Good luck!

Sheet to clarify the notation for component diagrams:



Alternative notation using ports:



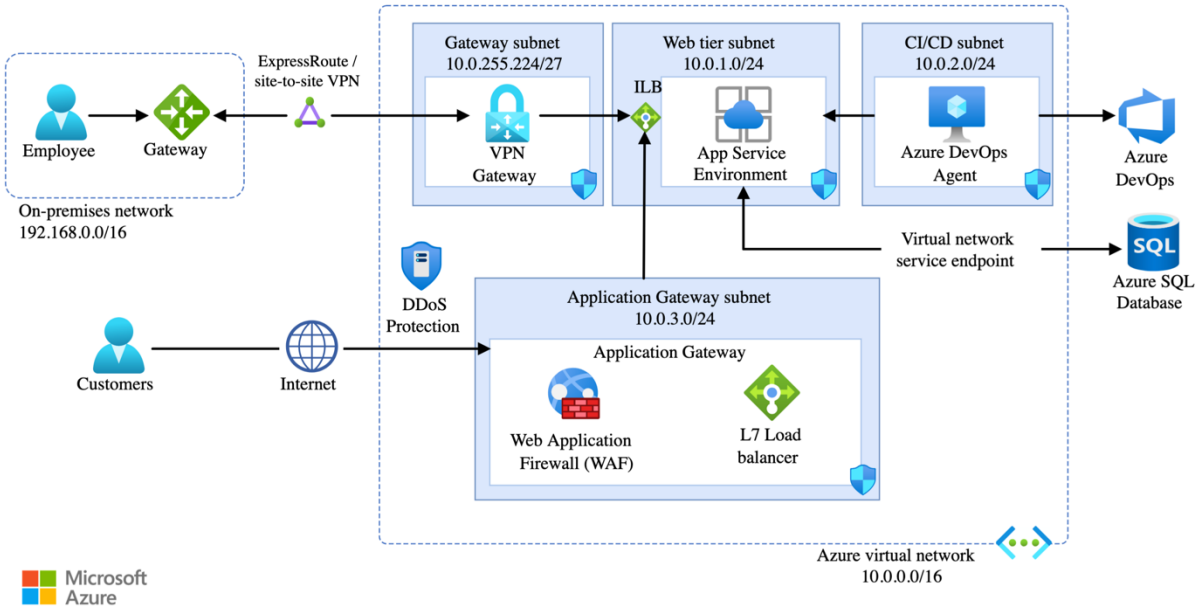
P1: Quality attributes and architectural significance (22p)

A. List three design principles that we learned in the course and explain them briefly. (3p)
B. Constraints can be architectural drivers. We learned that they belong to two categories. What are those two categories of constraints that influence the architecture? Give one example constraint for each category. For each of the examples, explain why it is an architectural driver. (6p)
C. What are the four levels of the C4 model? (4p)
D. What is "steady-state availability"? How is it defined? (6p)
E. Map the performance measures on the left (I-III) to the definitions on the right (1-3). 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 (2), if you want to map III to (2)). (3p)

I. Latency II. Throughput III. Jitter	(1) time between the arrival of the stimulus and the system's response to it (2) the allowable variation in latency (3) the number of transactions the system can process in a unit of time (e.g., 1000 requests per second)

P2: Architectural Drivers (22p)

A book publishing company is considering buying Microsoft Azure's services for its web application. Customers should be able to use their phones or computers to access the company's web portal, browse through lists of books, and purchase books. Microsoft suggests the following architecture:



Your Task:

A. What are the two most important quality attributes for the system? Describe how you can see that they were relevant for the designers of the architecture. To do that, write down one design decision per quality attribute and argue how you can see in the figure above that those design decisions have been applied. (8p)

B. For each of the two quality attributes in P1.A, specify a quality attribute scenario (6p). Make sure that each scenario is precise and testable.

C. The image above shows only one view of the architecture. We cannot see the internal architecture of the book publishing application. Create a design of the application architecture that considers the functional requirements described above. What architectural style would you use? Why? Draw a diagram of your application architecture and explain your reasoning. (8p)

P3: Architectural styles and design principles (31p)

Your tasks:

A. Think of a system that has modules with high coupling. What are the consequences of high coupling? Illustrate your analysis by drawing a small class diagram of an example system of your choice. Explain your reasoning. (8p)
B. Draw a component diagram of a publish-subscribe system. The sheet at the beginning of the exam can help you with the notation. You can choose the system. Briefly describe its purpose and its main functional requirements. Explain all components and the data/control flow of the system. (11p)
C. List and explain at least 2 advantages of the publish-subscribe architecture style. Then, list at least 2 limitations/disadvantages of the publish-subscribe architecture style. For what kinds of systems is the publish-subscribe style most appropriate? (12p)

P4: Architectural decisions (10p)

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. Following the notation on the notation sheet (at the beginning of this exam), draw a diagram that depicts the architecture that you designed. Explain what style(s) you used and why. Explain at least one tactic that you used and why. (6p)
B. What was your most important quality attribute? Why was that one prioritized? How can you see in the final architectural design that it was appropriately considered? (4p)

P4.Alt: If you did not attend the workshop or don't remember your group's solution:
You're a new employee at an automotive company. They want to create an eye-tracking system that tracks driver data to identify when people get angry at other drivers. The goal is to detect road rage.
You can make assumptions about the system and document them.

A. What quality attribute do you consider most important? Why is that one the most important? Motivate and explain what tactic(s) or style(s) you would choose to promote it. (2p)
B. Following the notation on the notation sheet (at the beginning of this exam), draw a diagram that depicts the architecture you would use to design the system. Briefly describe all components and the data/control flow of the system. (8p)
C. 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 (15p)

Write the letters (A, …, J) on a sheet of paper and then list the answer(s) to the gaps.

A. An _____ is a set of element and relation types, together with a set of constraints on how they can be used. (2p)
B. There exist formal, semi-formal, and informal modelling notations. UML is a(n) ____ notation. (1p)
C. _____ means keeping an installed system running with no change to its design, whereas ____ means creating new but related designs from existing ones to support new functionalities or make the system perform better. (3p)
D. In quality attribute scenarios, a ___ is a condition that requires a response. (1p)
E. The design principle of _____ indicates that you should "keep things together that belong together". (2p)
F. ____ is the coordination of multiple services through the use of a separate mediator service that controls and manages the workflow of the transaction. (1p)
G. An _____ is a short text file that describes a set of forces and a single decision in response to those forces. It includes at least the context, the design decision, and its consequences. (1p)
H. The software architecture of a computing system is the set of _____ needed to reason about the system, which comprise _____, _____ among them and properties of both. (3p)
I. In Quality Attribute Scenarios, the condition/context under which the stimulus occurs is called _____. (1p)