

Examination

Fundamentals of Software Architecture 7.5 hp

Course code
DIT360/344

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| <i>Date:</i> | 1 st Nov 2019 |
| <i>Time:</i> | AM / morning |
| <i>Place:</i> | Lindholmen |
| <i>Teacher:</i> | Prof. Dr. M.R.V. Chaudron |
| <i>Visit to exam hall:</i> | 09:00, 11:00 |
| <i>Questions:</i> | 4 (frontpage + 3 pages) |
| <i>Results:</i> | Will be posted by 18 Nov 2019 |
| <i>Grade Limits:</i> | Pass (G) 55%, Pass with honors (VG) 75% |
| <i>Allowed aids:</i> | Dictionary, ruler |

Please observe the following:

- Write in legible English (unreadable means no points!).
- Diagrams are nicer if you use a ruler.
- Motivate your answers, and clearly state any assumptions made.
- Start each task on a new sheet!
- Write only on one side of the paper!
- We prefer that you write with a **pen**, not with a pencil.
Drawings may be made using a pencil.
- Before handing in your exam, number and sort the sheets in task order!

NOTE:

Not following these instructions may result in the deduction of points!

Question 1 (2 + 2 + 2 + 2 + 2 = 10 pts) *General knowledge on software architecture*

- (a) Give a definition of 'Software Architecture'
- (b) Give 2 clearly different purposes of using 'Software Architecture' in developing software systems - consider the entire lifecycle of a system.
- (c) Explain the notion of 'Architectural View' through an example.
- (d) Explain the notion of 'consistency' across architectural views.
- (e) Describe 2 ways in which performing an architecture evaluation provides benefits to system development.

Question 2 (2 + 6 = 8 pts) *Drivers and Quality attribute scenarios*

Consider a video-on-demand service, like Netflix. Once subscribed to this service, users can stream videos (of movies, or tv-series or documentaries) 'on-demand' – meaning at any time they choose – to a device that can run the Netflix-client (this can be a personal computer or a mobile phone). Users can stream to at most 4 devices in their home at the same time. The streaming of videos has a real-time character: watching a movie requires displaying 50 images per second.

- (a) Mention 2 architectural drivers for the system architecture for this video-on-demand service. You are not allowed to mention cost or schedule as drivers.
- (b) For each of the drivers of question (a), provide a quality-attribute scenario.

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Question 3 (2 + 2 + 2 = 6 pts) *Architectural styles*

Choose the most appropriate architectural style (one) for the descriptions below.

Motivate your choice; i.e. explain your reasoning for choosing the style.

- a) An app for following sports-matches: users can register interest in a match. When the match is going on, users receive messages about interesting events in the match (such as goals, player substitutions, fouls, ball-possession statistics).
- b) A system where satellite images are analysed for signs of alien life. This system continuously collects huge volumes of satellite data. Various specialized applications perform different types of analyses on this data and share their findings with the other applications. For example, one application can detect whether some object in the image is a planet. Some other application can detect whether there is water on a planet. A third application can detect radio-signals coming from a particular direction.
- c) In many developing countries, governments are tracking their progress towards the UN-goals. To this end, they have set up a software system that collects data about different regions in the country about various goals, such as: the success of education, the availability of health-care services and the level of poverty/prosperity. This system can aggregate, combine and present this data at different geographical levels: from smallest (village), to medium (district) to large (province).

Question 4 (2 + 2 + 4 + 6 + 6 + 2 + 2 = 24 pts) *Architectural design*

Read the case description below and make and answer the questions below the case description. Motivate for your answers and state your assumptions, and provide explanatory text with your diagrams.

Smart Fashion Mirror

A smart fashion mirror is a system that can be used to 'virtually' try on different pieces of clothing. The main functionalities of this system are:

- **Browse** a catalogue of clothing. The system will show the items on the mirror-screen.
- **'Try on'** a piece of clothing': In this case, the system creates a virtual copy of the person in front of the mirror and 'dresses' the virtual persona in the mirror with the selected piece(s) of clothing.
- **Order** an item: there is a button on the mirror which can be pressed to buy a piece of clothing. If you use the mirror in a shop, then the system will check whether the item is in stock, and a clerk will bring it to you. If you use the mirror outside a shop (e.g. at an airport), then the system will e-mail a link to an order for the clothing item in the web shop of the clothing company.



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- **Snapshot:** the smart mirror can take a snapshot of the way you look and share this with the customer - either by sending the photo to the customer's e-mail address, or posting it on the customer's facebook page (the customer has to login to their facebook account via the smart mirror first).
- **Ask a friend:** the smart mirror allows the user to set up a video-call with a friend. Through this video-call, the system shares the image of the virtually dressed persona with a friend so as to ask her/him for advice. The duration of this video-call is limited to 5 minutes.

The smart mirror contains a camera and has capabilities to communicate wirelessly with mobile telephones (via Bluetooth). Also, it has a connection to the central IT-system of the shop-owner: this system stores the catalogue of all pieces of clothing and can handle packaging and shipping of orders. For video-calling, the system has the capability to set up the video-call, but the actual video-stream is handled by an existing external video-calling service (such as facebook, whatsapp, skype, hangout, or).

In your structural design, you have to infer which subsystems/components are needed in the smart mirror system. For example, one subsystem that will be needed is one for image recognition.

- a) Mention 2 architectural drivers for the system (but not cost or schedule)
- b) Describe one security requirement for the system (you should think of/invent one yourself)
- c) Create a use case diagram for the system that lists the 5 most important use cases for the system
- d) Create a structural view for the architecture of the smart mirror system.
For each component in your architecture, briefly explain its responsibility in 1 sentence.
- e) Create a behavioural view for the system. This view should describe at least the following use cases:
 - i) Try on a piece of clothing and take a snapshot
 - ii) Order a piece of clothing
- f) Give one example in your architecture design where you used 'Information Hiding'. Explain what is the 'secret' that is hidden?
- g) Describe one trade-off point in your architecture design.