Examination

Fundamentals of Software Architecture 7.5 hp

Course code
DIT360/344

Date:	9th Jan 2020
Time:	AM / morning
Place:	Lindholmen
Teacher:	Prof. Dr. M.R.V. Chaudron
Visit to e*xam hall:*	09:00, 11:00
Questions:	4 (frontpage + 3 pages)
Results:	Will be posted by 28 Jan 2020
Grade Limits:	Pass (G) 55%, Pass with honors (VG) 75%
Allowed aids:	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!

Software Engineering and Management
Software Architecture
DIT 360 / 344

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

(a) Give a definition of 'Software Architecture'

(b) Describe 2 clearly different ways in which 'Software Architecture' helps in ***maintaining*** software systems.

(c) Explain the notion of 'Stakeholder' through an example.

(d) Explain the notions of 'architectural force' and 'architectural driver'. Your answer should make clear how these concepts are different.

(e) Describe what are 'architectural styles' and 'architectural tactics'. Your answer should make clear how these concepts are different.

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

Consider the following satellite-system. The mission of this satellite is to monitor the biomass in a particular region. To this end, the satellite is equipped with a highly sensitive sensing device that can capture 'photos' of particular regions of earth. The satellite takes a picture 12 times every day (once every 2 hours). The satellite compresses the data of the photo and sends this to two ground-station on Earth. Building and launching a satellite is very expensive. Therefore satellite should stay in operation for at least 20 years.

(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.

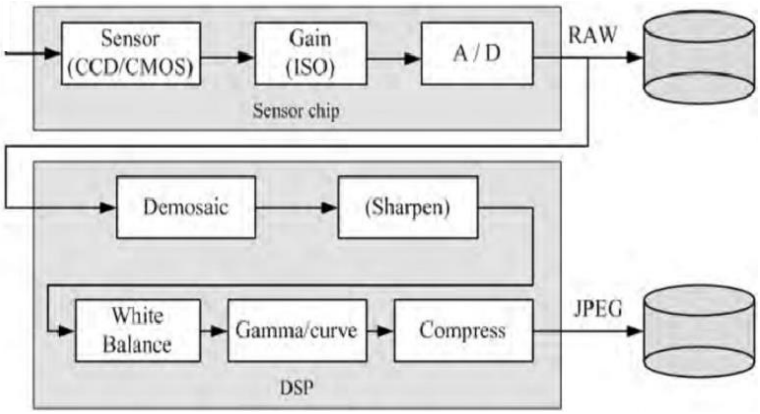
Question 3 (2 + 2 + 2 = 6 pts) *Architectural styles*

Choose the most appropriate architectural style (one) for the descriptions below.
Motivate your choice; i.e. explain your reasoning for choosing the style.

a) A system for Air Traffic Control (ATC): This is a system that monitors and guides both incoming and outgoing airplanes towards (and away from) an airport. The ATC system is equipped with radar for building up a 3D view of the airspace around the airport. Inside an air-traffic control tower, there are large video-displays where operators can see and plan trajectories. Also, the ATC system is equipped with communication system to enable voice-communication with the pilots of the nearby airplanes.

b) Archaeological map: for a particular area, a group of different experts search for evidence of ancient human and animal activity. This system stores a map of the area. Moreover, the system stores findings of artefacts (tools, objects of everyday use, weapons), buildings (houses, wells, walls, cemeteries, canals, bridges, roads), and animal remains. The system then supports the interactive querying in order to create visualisations of different 'slices' of the collected data. Only experts can enter date, but anyone can query the system.

c) The software in digital camera has a user-interface part and an image processing part. This question focusses on the image processing part. The processing of the digital image is represented by the following schema. This schema shows that the processing consists of a series of image processing, image enhancements and image compression steps.



Question 4 (2 + 2 + 4 + 6 + 6 + 2 = 22 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.

The case study we consider in this question is an automated plagiarism checking tool (APC) for student-assignments. This is a system that teachers of higher level education (universities, polytechnics …) can use to check for plagiarism in the electronic documents that are handed in by students. To this end, universities can have subscriptions to the APC-service. Teaching staff of such universities can then create an account (by registering their e-mail address) with the APC. Teaching staff can use the APC by sending an email with an attachment of a student hand-in to an assignment as attachment. The APC has conversion functionality which it uses to convert a variety of document formats (of the attachments) such as Word (.doc and .docx) as well as open document format (.odf) into pdf-format. The pdf is then 'segmented': the segmentation functionality produces a XML-document that contains the main structures of the document (such as title, table of contents, section-header, figure, table, section-text, sentence). Next, the APC system performs an analysis to find out if there are parts of the hand-in that match any parts of any other document that it knows. For this, the APC system

has a large repository of previous assignments and published scientific papers and books. This repository is updated automatically with new papers from scientific databases (such as IEEE Explore). For comparing a new hand-in, a reduced version of the XML document of the hand-in is made that only contains significant keywords (thereby omitting non-significant words such as 'the' and 'a'). This step is called 'pre-processing'. Then, in the actual comparison, each sentence of the reduced hand-in is compared to all sentences of all papers in the repository. Each comparison produces a similarity score. The scores of larger sections of a hand-in are obtained by summing up the scores of the sentences of which it consists. Ultimately, this leads to a plagiarism score for the entire hand-in. The analysis of a hand-in produces a report. This report shows which sentences of the hand-in have a significant 'plagiarism'-score with which specific documents from the repository. This report is sent by e-mail to the staff member that has submitted the request for analysis. At the end of each month, the APC system sends a management-overview report to the universities that are subscribed. This report describes basis statistics about the number of hand-in's that have been analysed and from which department and staff-member the hand-in's were submitted.

a) Mention 2 architectural drivers for the system (but not cost, schedule or maintainability)
b) Create a use case diagram for the system that lists the 3 most important use cases for the system
c) Create a structural view for the architecture of the APC system.
   In your structural design, you have to infer which subsystems/components are needed in the system. For each component in your architecture, briefly explain its responsibility (aim for 1 sentence).
d) Create a behavioural view for the system. This view should describe at least the following:
   i) Send a report in response to the request to analyse a hand-in
   ii) Send a management overview report
e) Give one example in your architecture design where you used 'Information Hiding'. Explain what is the 'secret' that is hidden?