Summary of topics for the theoretical exam

Dr. ir. Jacopo De Stefani

February 14, 2024

This document describes the topics covered during the TB141IC - ICT SYSTEM ENGINEERING AND RAPID PROTOTYPING course that will be evaluated during the theoretical exam.
Non-binding and **non-exhaustive** examples of exam questions are also included for practicing. Only a brief overview is presented here: for a complete reference, see the course slides and recordings.
During the exam, for a given topic, you might be receiving either a case-based or a theory based question.

Lecture 1 - Introduction

Topics

- Introductory concepts and definitions for the course

Example questions

- What is an ICT system?
- What is an information system?
- Why is ICT engineering important?
- Why do ICT projects fail?

Lecture 2 - Software development methodology

Topics

- Software development processes
- Software development methodologies
  - Waterfall
  - Agile
  - Re-use based
- Software development processes and change

Example questions

Case-based questions Given a case (cf. Formative assignment 1):

You are allowed to use material from the course slides, but we expect you to make the exercise of reformulating the existing content using your own words.

- **Identification of the development methodology**
  - What methodology is employed here?
  - What are the concepts that allowed you to identify the methodology?
- **Discussion of alternative methodologies**
  - What other methodologies could have been employed here?
  - For one alternative methodology, describe how the development process should look like if that methodology was employed.

Theory based questions

- For the X software development process, provide :
  - A list describing the sequence of the different software development activities for the proposed text
  - A brief description, for each activity in your solution, of the details of the operations that need to be performed within that step
  - Advantages and disadvantages of the considered methodology
- What is the phase of Verification and Validation of the software?
- How is the testing of a software performed in practice?
- What is a prototype?
- How is a prototype developed with an incremental delivery process?

Lecture 3 - Requirements Engineering

Topics

- Requirement definition
- Requirement elicitation
- Requirement specification
- Requirement validation

Example questions

Case-based questions Given a case (cf. Formative assignment 1):

You are allowed to use material from the course slides, but we expect you to make the exercise of reformulating the existing content using your own words.

- **Requirements identification**
  - Provide a short definition for the different category of requirements (functional, non-functional, domain requirements).
  - Provide a table, for each category of requirements, summarizing the classification of the different requirements in the text and the motivation behind your choices.
  - For 3 requirements of your choice, describe which format (natural language, structured natural language, graphical notation, mathematical specification) you will be using for their specification.

Theory based questions

- What is a requirement?
- What are the different types of requirements?
- How is requirement specification conventionally performed?
- What are the different formats for requirement specification?
- How is requirement validation conventionally performed?

Lecture 4 - Modeling with UML: Use Case & Activity

Margin note lecture 4

Topics

- System modeling
- Perspectives on modeling
- Use case diagrams
- Activity diagrams

Example questions

Case-based questions Given the aforementioned requirements (cf. Formative assignment 2) of the application, provide:

- A **Use Case Diagram** and the corresponding specification, describing all the functionalities that the system should offer, including all the relevant actors.
- An **Activity Diagram** describing the shipping process to the central warehouse.

Theory based questions

- What is a model?
- What is descriptive modeling?
- What is prescriptive modeling?
- What are the different perspectives for ICT modeling?

No theory based questions on UML, only case based modeling.

Lecture 5 - Modeling with UML: Class & Sequence Diagram

Margin note lecture 5

Topics

- Class diagrams
- Sequence diagrams

Example questions

Case-based questions Given the aforementioned requirements (cf. Formative assignment 2) of the application, provide:

- A **Class Diagram** of the different entities/elements that the application needs to manipulate.
- A **Sequence Diagram** of the registration process for new clothes, including the registration of multiple clothes and regular/exceptional flows.

Theory based questions No theory based questions on UML, only case based modeling.

Lecture 6 - Architecting: Hardware and Software

Margin note lecture 6

Topics

- Architectural modeling
- Architectural design

- Local hardware architectures
- Distributed hardware architectures
- Software architectures

Example questions

Case-based questions Given a specific case (cf. formative assignment 4):

You are allowed to use material from the course slides, but we expect you to make the exercise of reformulating the existing content using your own words.

- **Identification of the distributed hardware architecture**
  - What distributed hardware architecture is employed here?
  - What are the concepts that allowed you to identify the distributed hardware architecture?
- **Discussion of alternative distributed hardware architectures**
  - What other distributed hardware architectures do you know?
  - Present them using a table summarizing the (distributed hardware) architectures presented during the lectures. The table should contain 2 columns:
    * Name
    * Description
- **Identification of the software architecture**
  - What software architecture is employed here for the mobile application?
  - What are the concepts that allowed you to identify the software architecture?
- **Discussion of alternative software architectures**
  - What other software architectures do you know?
  - Present them using a table summarizing the (software) architectures presented during the lectures. The table should contain 4 columns:
    * Name
    * Description
    * Advantages
    * Disadvantages

Theory based question

- What is the difference between architecting in the small and architecting in the large?
- What are the different components of the Von Neumann Architecture?
- In a modern PC, what corresponds to the different elements of the Von Neumann architecture?
- What is the difference between distributed and parallel computing?
- What is a database?
- What is the difference between a client-server and peer to peer architecture?
- Present the X software architecture presented during the course by providing :
  - Its description.
  - Its advantages and disadvantages.
  - Its domain of application.
  - A practical example of its implementation.

Lecture 7 - Programming Languages

Topics

- Programming paradigms
- Programming languages categories
- Programming languages
  - C
  - C++
  - Java
  - Javascript
  - Matlab/Octave
  - Python
  - SQL
  - R
- Code quality
- Code hygiene

Example questions

Case-based questions

- Not applicable.

Theory-based question

- What are the different categories of programming languages presented during the course?
- What are the different programming paradigms presented during the course?
- What is code quality? Give the definition and an example of code quality in one of the languages presented during the lecture.

Lecture 8 - Agile methodologies

Topics

- Agile principles
- Extreme Programming (xP)
- Extreme Programming practices

Example questions

Case-based questions Given a case (cf. Formative assignment 1):

You are allowed to use material from the course slides, but we expect you to make the exercise of reformulating the existing content using your own words.

- **Identification of the development methodology**
  - What methodology is employed here?
  - What are the concepts that allowed you to identify the methodology?
- **Discussion of alternative methodologies**
  - What other methodologies could have been employed here?
  - For one alternative methodology, describe how the development process should look like if that methodology was employed.

Theory-based questions

- What are the agile principles? Give the principle name and a brief description for one of the principles.
- How is the extreme programming release cycle structured?
- What are the extreme programming practices? Give the practice name and a brief description for one of the practices.
- How does the extreme programming practices relates to the Agile principles?
- What is refactoring? Give the definition and one example of refactoring activity.
- What is the role of the customer in the testing process in an XP project?
- How is XP implemented in the context of the Mendix project?

Lecture 8 - Agile software prototyping with Mendix

Topics

- Agile project management
- SCRUM

Example questions

Case-based questions

- Not applicable.

Theory based questions

- What are the differences between a plan-driven and an agile project management approach?
- What is SCRUM? Describe the phases of SCRUM.
- What is a potentially shippable product increment?
- What is the product backlog?
- What is the difference between a product and a sprint backlog?
- How is SCRUM implemented in the context of the Mendix project?

Licensing