TB141 – ICT System Engineering and Rapid Prototyping Example Exam

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Instructions

General remarks

- The exam lasts three hours and it is a closed book, computer exam in two parts :
  - **First part - UML Modeling**
    * Points : 10 pts
    * Weight on the final grade of the course : 30%
  - **Second part - ICT System Engineering**
    * Points : 10 pts
    * Weight on the final grade of the course : 40%
- The remaining 30% of final grade of the course is based on the summative assigment.
- Make sure to write **your name, family name, student ID and faculty** on **each** sheet you are going to hand in.

Disclaimer

All characters and other entities appearing in this work are fictitious. Any resemblance to real persons or other real-life entities is purely coincidental.

Part I - UML Modeling

The proposed inventory management application is a local computer program used to keep track of the second-hand clothes received by the association.

The application should allow to register the arrival of new clothes, classify the clothes according to their properties and level of wear, visualize the clothes stock in the warehouse of the local branch of the association, prepare and track the shipping of the clothes to the central warehouse.

The classification of the clothes size should be done according to the standard ISO 8559-1 :2017 Size designation of clothes — Part 1 : Anthropometric definitions for body measurement and an export of the full content of the warehouse should be allowed at any moment in time, in order to comply with the audit requirements set by the Dutch law. The export format should be compatible with the following operating systems : Linux (Ubuntu, Debian and Arch at least), Windows (starting from XP version) and Mac OS (starting from 10.0).

Only one among the aforementioned activities must be active at a time and the switching time between two activities should be shorter than 3 seconds.

The registration of new clothes starts by a manual sorting by the operator. The operator can choose to discard the clothes in case they are excessively worn-out or unhygienic. If the clothes are kept, the registration starts by loading a photo of clothes at hand. After processing the photos, the system provides an identification code for the considered object, in the form of a QR code (according to the standard ISO/IEC 18004 :2006).

After the registration step, the operator should be able to enter all the details concerning the clothes, including at least : size, color and level of wear. The system should support the possibility of auto-completing the insertion with the most frequent items as well as to be able to select the most-used categories from a drop-down menu. The operator needs to be able to save a partial registration for later completion. In case of a sudden error during this step, the system also needs to be able to perform a temporary save on a persistent device (such as a hard drive), and to restore the content at the following restart of the application. Besides that, the visual representation of the registration on the screen has to be accessible by visually impaired people (for instance by allowing high contrast mode or adapting the text size).

The visualization of the local warehouse stock is done through a dashboard. The dashboard should contain the current occupation percentage of the warehouse, as well as a set of plots summarizing the distribution of the clothes by color, size and level of wear respectively. The visualization should respect the same accessibility constraints as before, in addition to a support of colorblind-friendly color palettes.

The shipping to the central warehouse is made through an additional window. In this window, the operator is able to filter the content of the warehouse through simple filters. On one hand, through a text box, the operator can search for a specific term inside the warehouse. On the other hand, he/she can apply some filters on the features of the clothes (color, size or state of wear) to reduce the number of visible items. Once the desired item is found, it can be added through the current shipping list, either via drag-and-drop, or via a dedicated button.

When the shipping list is completed, the approval by the director of the local branch is required in order to finalize the shipping to the central warehouse, taking place once per week.

We ask you to model the aforementioned ICT system using the UML modeling language. For each of the following questions, provide :

- The required UML diagram
- A brief text motivating the modeling choices you made

Make sure to employ the appropriate notation for the considered diagram.

Question 1 (UML Class Diagram - 3 points)

Represent the entities that the application described in the previous text needs to manipulate using a UML Class Diagram. Make sure to include all the relevant attributes and methods in the appropriate parts of the diagram.

Question 2 (UML Sequence Diagram - 3 points)

Represent the registration process for new clothes, including the registration of multiple clothes and regular/exceptional flows. described in the previous text using a UML Sequence Diagram. Make sure to use the appropriate notation to distinguish between synchronous, asynchronous and response messages.

Question 3 (UML Use Case Diagram - 2 points)

Represent the functionalities offered by the app described in the previous text using a UML Use Case Diagram, including all the relevant actors and employing inclusion and extension relationships when appropriate.

Question 4 (UML Activity Diagram - 2 points)

Represent the shipping process to the central warehouse, described in the previous text using a UML Activity Diagram.

Part II - ICT System Engineering

Question 5 (LG-02 - Software engineering requirements - 2,5 points)

Present the requirement specification techniques seen during the course and, **for each technique** :
- Discuss positive and negative aspects, when applicable.
- Give one practical example of application of the aforementioned technique.

Answer :

See Slide 60 - Lecture 3 for an overview, and Slides 61-74 + Reading material in the reference book (Chapter 4) for more information.

Question 6 (LG-03 - Methodology comparison - 2,5 points)

For the **Re-use based** 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

Answer :

See Slides 26-27 - Lecture 2 for an overview and reading material in the reference book (Chapter 2) for more information.

Question 7 (LG-09 - Programming languages - 2,5 points)

Use Case

The first project (codename Alpha) requires the development of the code for an embedded system, to be installed on a portable device to monitor the air quality of a city. (example CurieusNeus). After a discussion with the clients, our consultants have established that the solution to be implemented will be a small scale program, where efficiency has a paramount importance (as they want to maximize the lifetime of the monitoring station and limit the required maintenance).

We ask you to analyze the considered project and determine the most appropriate programming language for the problem at hand among those presented during class.

Make sure to include in your solution :
- A table summarizing the programming language categories presented during the lectures. Make sure to include 2 examples of programming languages for each category.
- A table summarizing the programming paradigms presented during the lectures. Make sure to include 2 examples of programming languages for each category.
- **For the considered case**, a brief text (1-2 paragraphs maximum) motivating what is the most appropriate programming language category and paradigm for the considered problem.

Answer :

Slides 19-43 - Lecture 7, including languages and then paradigms, with corresponding examples.

For the considered case, as the required program is a small scale program, dealing with embedded devices (i.e system programming), with a focus on efficiency, a possible choice of language would be C/C++ (system language), with mostly an imperative paradigm.

Question 8 (LG-11 - Computing Hardware and Architectures - 2,5 points)

Present the **Pipe and Filter** software architecture presented during class by providing :
- Its description
- Its advantages and disadvantages
- Its domain of application
- A practical example of its implementation

Answer :

Slides 56-58 - Lecture 6 + Reading material in the reference book (Chapter 6) for more information.

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