Introduction to Software Engineering (F28SD) 2023-24

Specification of Coursework-1

An Exercise in Designing a Software-Based System: *From requirements through to design-level models and scenario test cases*

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THIS IS AN INDIVIDUAL PROJECT

While discussion with fellow students as to the general nature of this project is acceptable, it is critically important that the solution you adopt and report are completely your own work. The re-use of other peoples work is not permitted and if identified will be treated as a disciplinary matter. Information on plagiarism can be found via

`https://www.hw.ac.uk/students/studies/examinations/plagiarism.htm`

1 Introduction

F28SD is assessed 100% by coursework. The coursework is divided into 2 parts, this document specifies what is required for the first part – Coursework-1.

2 The tasks involved in Coursework-1

You are required to develop a series of design models for a software-based system that supports the management of a *vehicle rental business*. The system is to be called *Vehicle Hire System* (VHS). The remit for VHS is described informally below:

> VHS shall support the management of vehicle rentals for EASYRENTALS LTD. The company has multiple sites, each site will be managed by its own copy of VHS. A customer can only request a rental via a touch screen that is located within the reception area of the associated site. The management of the touch screen is part of the VHS system. The company rents out two categories of car, i.e., *economy* and *premium*, as well as two categories of van, i.e., *standard* and *large*. Note that the rental of a car requires the driver to have a *Category B* driving license while standard and large vans require *Category C1* and *Category C* driving licenses respectfully. The minimum age[1] to rent a

[1] The minimum age to drive a car in the UK and Malaysia is 17 while it is 18 in the UAE.

vehicle from EASYRENTALS LTD is 22. VHS shall interface with customers, garage technicians and system administrators. This design remit focuses only on the customers and garage technicians. VHS shall have the capability of storing and managing a set of customer records internally (i.e., no involvement of external databases). Customers shall be assigned a unique ID number and their record will also include their name, date of birth, address, mobile number, email address, driving license number (i.e., a 16 character alphanumeric code) along with its associated category and expiry date. VHS shall be capable of validating a customer's driving license details using an external service provided by the *Driver and Vehicle Licensing Agency* (DVLA). That is, given a driver's name, address, and driving license number, an external system called VALIDATEMYDVL will either accept or reject the given details. A customer shall have the option to store their credit card details as part of the internal record held by VHS, i.e., credit card number, expiry date (i.e., month and year), security code (i.e., 3-digits). VHS shall be capable validating a customer's credit card details using an external service that is supported by a system called VALIDATEMYCC. Given a driver's name and credit card details, VALIDATEMYCC will either validate or reject the payment card. For customers that indicate that they do not want their credit card details to saved for future rentals, their details shall be deleted after the successful return of a rental vehicle. However, a customer shall be allowed to have their other details saved by VHS if they wish. VHS shall maintain an internal record (i.e., no involvement of external databases) of the pool of vehicles that are available at its associated site. The internal record for each vehicle will contain its registration number, current mileage, category, colour and status, i.e., *available-for-rental*, *unavailable-for-rental* and *out-of-service*. For each rental, VHS shall maintain a rental record that includes at least a reference to the customer, a reference to the vehicle, start and end dates for the rental period. When a vehicle is returned, it under goes a manual inspection by an on-site garage technician. The garage technician interacts with VHS via a touch screen device within their inspection area. The management of this touch screen interface is part of the VHS system. The technician will update the rental record after an inspection. The inspection shall focus on missing fuel and damage to the vehicle. That is, all vehicles are expected to be returned with a full tank of fuel. Customers are informed and charged to their credit card for any missing fuel. In terms of any damage identified, the technician records a corresponding repair charge and provides a textual description of the damage. Again the customer is informed and charged to their credit card. The technician shall be prompted by VHS to provide an up-to-date mileage of a vehicle at the time of an inspection. Daily at 23:59, VHS shall archive the rental records that were completed within the last 24-hours. For each of these rentals, the archive capability shall involve VHS sending the customer's name, address, vehicle registration number and rental start/end dates to an external system called RENTALARCHIVE. Once this transfer has been completed successfully, VHS shall delete its corresponding internal rental records.

Based upon the informal description above, you are first required to define and model a set of requirements for VHS. Secondly, you are required to develop a set of design models that achieve your requirements. Thirdly, you are required to derive a set of scenarios test cases using aspects of your design models. **Guidance:** VHS needs to robust, e.g., it needs to be able to deal with erroneous or inconsistent inputs. Your requirements and design models should reflect this. The assessment of Coursework-1 will take into consideration the robustness of your design.

Specific Tasks:

T1: State explicitly any **assumptions** that you have made about the capabilities required of VHS that have not been made explicit above in the informal design remit. In addition, state explicitly any **expectations** you have made about the environment in which VHS will operate, e.g., expectations of the users and the external systems that have not be made explicit above in the informal design remit. **Guidance:** you are not being asked to restate the above description. You are being asked to make explicit any gaps that you have identified in the description above that are relevant to your design of VHS, and importantly how you dealt with them. Your assumptions and expectation should be realistic. For example, it is *not* realistic to expect that customers will never supply erroneous data to VHS.

T2: Develop a set of **functional** and **non-functional**[2] **requirements**. **Guidance:** your requirements need to be sufficiently precise and complete that a third party, e.g., a fellow student, would be able to produce a design for VHS solely on the basis of your stated requirements, i.e., without sight of the informal design remit. Ensure that your requirements capture how bad behaviours should be dealt with as well as good behaviours. Moreover, for all requirements you should adopt a simple and uniform style – see the lecture notes entitled *"Software Design: Requirements Engineering"* (see Week 1 on Canvas).

T3: Develop a **Use Case** model for VHS that includes at least the following base use cases:

- *Create Rental*.
- *Return Rental*.
- *Archive Rental*.

Guidance: you may require additional base use cases and auxiliary use cases (i.e., inclusion/extension use cases). Your **Use Case** model should include **ONE Use Case Diagram** for VHS and **Use Case Specifications** (textual descriptions) for all your use cases. **Guidance:** don't forget to specify alternative flows. Any auxiliary use case(s) that you choose to introduce should appear within the **Use Case Diagram** and their **Use Case Specifications** should also be defined.

T4: Provide a **traceability matrix** that links all your **use cases** with your **functional requirements.** **Guidance:** see lecture notes on *"UML Use Case Modelling (Part 1)"* (see Week 2 on Canvas).

T5: Develop a **Class Diagram** for VHS – include all the classes that will form part of the VHS software, and ensure that you include their associations. **Guidance:** VALIDATEMYDVL, VALIDATEMYCC and RENTALARCHIVE are external to VHS. If you chose to include them in your diagram then be sure and show the boundary between them and the classes that define VHS. Ensure that your **Class Diagram** is consistent with your **Sequence Diagram(s)**.

T6: Develop a **Sequence Diagram(s)** based upon your **Use Case Specification(s)** for *Create Rental* (**T3**). **Guidance:** ensure that your model captures the alternative flows. Note that an alternative flow can be represented as a separate **Sequence Diagram**, or using conditional blocks within a single diagram, i.e., referred to as *interaction frames* in the lecture entitled *"UML Sequence Diagrams"* (see Week 4 on Canvas). Ensure that your **Sequence Diagram(s)** are consistent with your **Class Diagram**.

T7: Develop **Activity Diagram(s)** based upon your **Use Case Specifications** for *Create Rental*, *Return Rental* and *Archive Rental* (**T3**). **Guidance:** ensure that your model captures the alternative flows.

[2] Two non-functional requirements will be sufficient.

T8: Develop a **State Machine Diagram** that models the lifetime of a rental from the perspective of VHS, i.e., from the creation of a rental record through to when it is deleted. **Guidance:** ensure all transitions represent actions/events, e.g., user supplies payment details. Ensure also that states represent key moments, e.g., payment completed.

T9: Derive a set of **Scenario Test Cases** from the **Activity Diagram** you developed for a rental request by a customer, i.e., *Create Rental*. For each **Scenario Test Case** clearly show the path(s) that it exercises within your **Activity Diagram**. (**T7**). **Guidance:** for background on **Scenario Test Cases**, see the lecture notes entitled *"Software Verification: A Life-Cycle Perspective"* (see Week 7 on Canvas).

You **should** use the specification templates (i.e., Use Case templates) given on the Canvas course pages (see the *"UML Related Material"* module). UMLet is recommended for developing your UML diagrams, however, you may use an alternative drawing tool if you wish. But please note that hand-drawn UML diagrams are **not acceptable**.

3 The structure and content of your submission for Coursework-1

Your submission **should** take the form of a self-contained report (**MS Word or PDF format**)[3]. Your report **should** contain page and section numbers, as well as a table of contents. Your report **should** include a **front page** that contains at least your name, student number, email address and your campus location. The **main body** of your report should contain 10 sections corresponding to the following 10 deliverables:

D1: Your **assumptions** and **expectations**. Each assumption and expectation should be numbered. **[T1] (10-marks)**

D2: Tables containing your **functional** and **non-functional** requirements, again using a clear numbering scheme. **[T2] (12-marks)**

D3: Your **Use Case Diagram** for VHS. **[T3] (10-marks)**

D4: **Specifications** (textual descriptions) for the base use cases within your **Use Case Diagram**, including any auxiliary use cases. **[T3] (10-marks)**

D5: Your **traceability matrix**. **[T4] (4-marks)**

D6: Your **Class Diagram** for your VHS design. **[T5] (10-marks)**

D7: The **Sequence Diagram(s)** you derived from your *Create Rental* **Use Case Specifications**. **[T6] (10-marks)**

D8: The **Activity Diagram(s)** you derived from your **Use Case Specifications** for VHS. **[T7] (10-marks)**

D9: Your **State Machine Diagram**. **[T8] (10-marks)**

D10: Your set of **Scenario Test Cases**. **[T9] (10-marks)**

Note that you are required to complete a Declaration of Authorship to confirm that all work you have submitted for individual assessment is your own (see 28SD Canvas section "Declaration of authorship AY23-24").

[3]Note that MS Word allows you to export a document as a pdf file.

4 Submission deadline for Coursework-1

Coursework-1 counts for 80% of the overall mark for the course. Your report should be submitted via Canvas. **4-marks** will be allocated to the quality of your report. The submission link can be found within the "Assessment" link of the F28SD "Course Navigation" panel. The **deadline** for submitting **Coursework-1** is **Monday 11 March 2024 (Week 9):**

15:30 Edinburgh (local time)

23:59 Malaysia (local time)

17:00 Dubai (local time)

The standard penalty for the late submission of coursework will be applied unless evidence of Mitigating Circumstances is provided (see Undergraduate Programme Handbook for details).