Lancaster University Leipzig

Part II (Second Year)

SCHOOL OF COMPUTING AND COMMUNICATIONS **[2 hours]**

LZSCC.211 Software Design MAIN EXAM

Instructions to candidates:

- Do not turn over the exam paper until you are told to do so.
- You have 2 hours for this exam, which is worth 70% of your overall module grade.
- Answer all questions.
- The use of calculators is not allowed in this exam.
- This exam consists of 3 questions.
- Every question has equal weighting and is worth 20 marks (20 * 3 = 60).

2022–23

1 Software Requirements (20 marks total)

A new Leipzig start-up, LeipDrinks, sells low-calorie soft drinks, and it is developing a system for their vending machines. The vending machines are expected to have a touch-screen with a numerical pad to allow users to select their beverage of choice. The machine should display an error if the input number does not exist, or if the selected dispenser has no beverages on it. Once the customer has selected their drink, they can choose whether to pay with coins or with a contactless card. In the latter case, the transaction is taken care by an external payment system. To make the customer experience better, the company allows customers to request assistance from the closest LeipDrinks local branch at any time via a "request assistance" option on the touch-screen. Customers can also use the touch-screen to request a refill of the vending machine with any of the beverages from the company. Those requests are sent to the LeipDrinks headquarters, which takes care of the relevant order and inform the LeipDrinks branch closest to the vending machine. Refill request are expected to be fulfilled within 48 hours.

(i) [5 marks] Write three (3) functional and two (2) non-functional requirements for the LeipDrinks vending machine system.

(ii) [13 marks] Draw a use case diagram for the LeipDrinks vending machine.

(iii) [2 marks] What is the role of exceptions in a use case description?

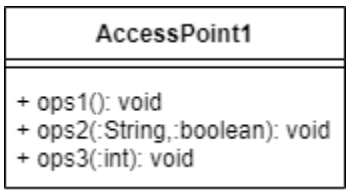
2 Class Diagrams and Design Patterns (20 marks total)

(i) [10 marks] Consider state machine diagrams.

(a) Briefly describe what a state is. [2 marks]

(b) A transition in a state machine diagram can be decorated by three distinct elements. State and explain those elements, and what notation is used to represent them on a transition. [8 marks]

(ii) [10 marks] You have recently joined a new software company. One of your first tasks has been to understand how to integrate a legacy implementation while fulfilling the specification of the current user access to the system depicted in the following figure.



You were also informed that the company wants to discriminate among users, so that some of them have a restricted access to the functionalities of the system. You have worked hard on the problem and are really proud of your solution. Due to a non-disclosure agreement you are not allowed to provide details, but you explain the problem to a fellow software engineer (SE) by showing the UML class diagram depicted in Figure 1.

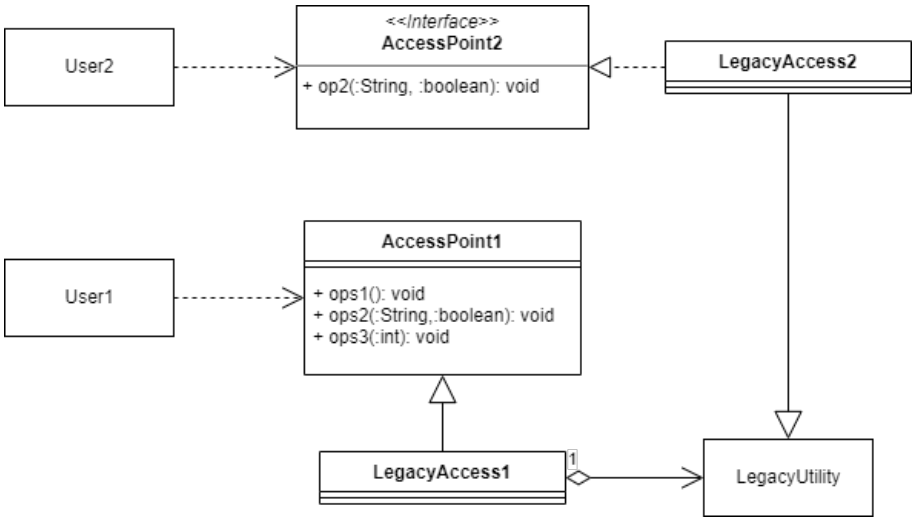


Figure 1: UML class diagram of your solution

The SE is not convinced by your solution. And the discussion goes as follows.

(a) The SE does not understand the benefit of **AccessPoint2** and thinks **User2** should simply use **AccessPoint1**. What SOLID principle would be violated by the SE's approach? Provide a brief explanation of the principle and how your solution respects it. [3 marks]

(b) The SE agrees with you, but they still think that your solution is unnecessarily complex. The SE claims that you do not need two different classes to access the legacy system. What could be the solution that the SE has in mind? You can either draw a new class diagram, or briefly explain it in writing. [2 marks]

(c) After critically evaluating the SE's solution, you reach the conclusion that there are advantages in your original idea which are not worth losing. What are those advantages? [2 marks]

(d) What design pattern and instances of it are used in Figure 1? [3 marks]

3 Software Architecture (20 marks total)

(i) [3 marks] Briefly describe what are event-driven systems, and mention the two principal event-driven models.

(ii) [17 marks] A cloud computing company wants to revamp a standalone legacy system so to make it easily and remotely accessible by a large number of users. The idea of the company is to add functionalities on top of the ones provided by the legacy system, to ensure a certain level of security to new and old functionalities, and to be able to adjust and change the user interface based on future requirements.

(a) Two architectural styles can be combined together to achieve the company's aims. State what those architectural styles are and provide a brief description of the two. Also state why you have chosen those styles (i.e., what required functionality of the example are they addressing?), and how they are used in the example scenario. [9 marks]

(b) Draw a simple high level box-and-line diagram highlighting the two architectural styles. [8 marks]

END OF EXAM