

CS 355: Software Design and Architecture, MIDTERM EXAMINATION

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Fall 2021 – CLOSED Book Exam – Total marks: 20 – Duration: 60 mins

This exam comes in four pages

Note: This document is not a complete set of answers, but ONLY an explanation of how the answers would be done.

STUDENT NAME _____

STUDENT ID # _____

Question 1 [6 marks]

- i. Provide an example for one decision that would be classified as an architectural design decision [1].

[The examples below are sample solutions. Other reasonable examples related to the architecture not to the design could be accepted too].

Reasoning about the components to include, and the types of connectors between them is an example of an architectural design decision (e.g., to support availability, you could include multiple copies of one component).

- ii. Explain the design tradeoff between cost and robustness. [2]

Robustness means the ability of the system to handle the end users errors (e.g., invalid/unexpected user inputs). One design goal is to increase the system's robustness.

Costs means the financial costs needed to develop the application (e.g., the developers' salaries). One design goal is to decrease the system's development cost.

The tradeoff here is that if we want to increase the robustness, we would need to increase the cost, hence achieving one non-functional requirement, implies trading off (i.e., losing) the other non-functional requirement.

- iii. [3 marks] Categorize each of the following requirements according to the sub-categories of non-functional requirements explained within the course. You must provide a written explanation for your answer. ***If no explanation is provided, no mark will be given for the corresponding part.***

- i. For the FCI's new e-com system, students should know about 90% of the provided features after using the system for 3 full days. _____

Usability

- ii. For the FCI's new e-com system, one student should not be able to view the grades of another student. _____

Authorization

- iii. Fawry electronic payment for mobile phone bills of Etisalat should support 3000 payments per second all over Egypt. _____

Throughput

Question 2 [10 marks]

- a) **[3 marks]** Consider the following design goals. For each of them, **identify** a candidate design pattern that you would use to satisfy such goal, and **justify** your answer. If no justification is given, no grade will be given.

- i. File system with directories (folders), and files arranged in a tree structure.

Composite

- ii. You have a class that accepts and returns values in British Imperial units (feet, miles, etc.), but you need to use different units (centimeter, meter, etc).

Adapter

- iii. To produce sales revenue reports for stores [أرباح المبيعات للمحلات], their sales values reports [التقارير التي تحتوي على أرقام المبيعات] need to be (1) parsed to extract the information within those reports, (2) analyzed through some calculations, and (3) aggregated to produce the revenues. However, as the sales values reports come in different formats: PDF, XML, and CSV, which demands different parsing approach according to each format.

Template method

- b) **[3 marks]** Consider an electronic chess game that includes a chess board, and the different chess pieces. A human player registers moves by dragging a piece from one part of the board to another, using his mouse. Within that game, the human player is playing against the computer. The computer should have two different planning algorithms for moving the chess pieces around. **Explain** how you would use the MVC pattern to model that game. You don't need to sketch a diagram, but mainly explain what should be included in each part of the MVC model.

Option 1:

Model → should include the 2 planning algorithms [0.5 mark] + the entities of the system like the chess pieces states (killed, alive, location on board), the current state of the chess board, the current state of the game being played [0.5 mark]

Controller → should include the business logic needed to modify the user interface, upon receiving some update to the view (user interface of the game) [1 mark].

View → Should include the user interface elements that represent the visual side of the chess board [1 mark]

Option 2:

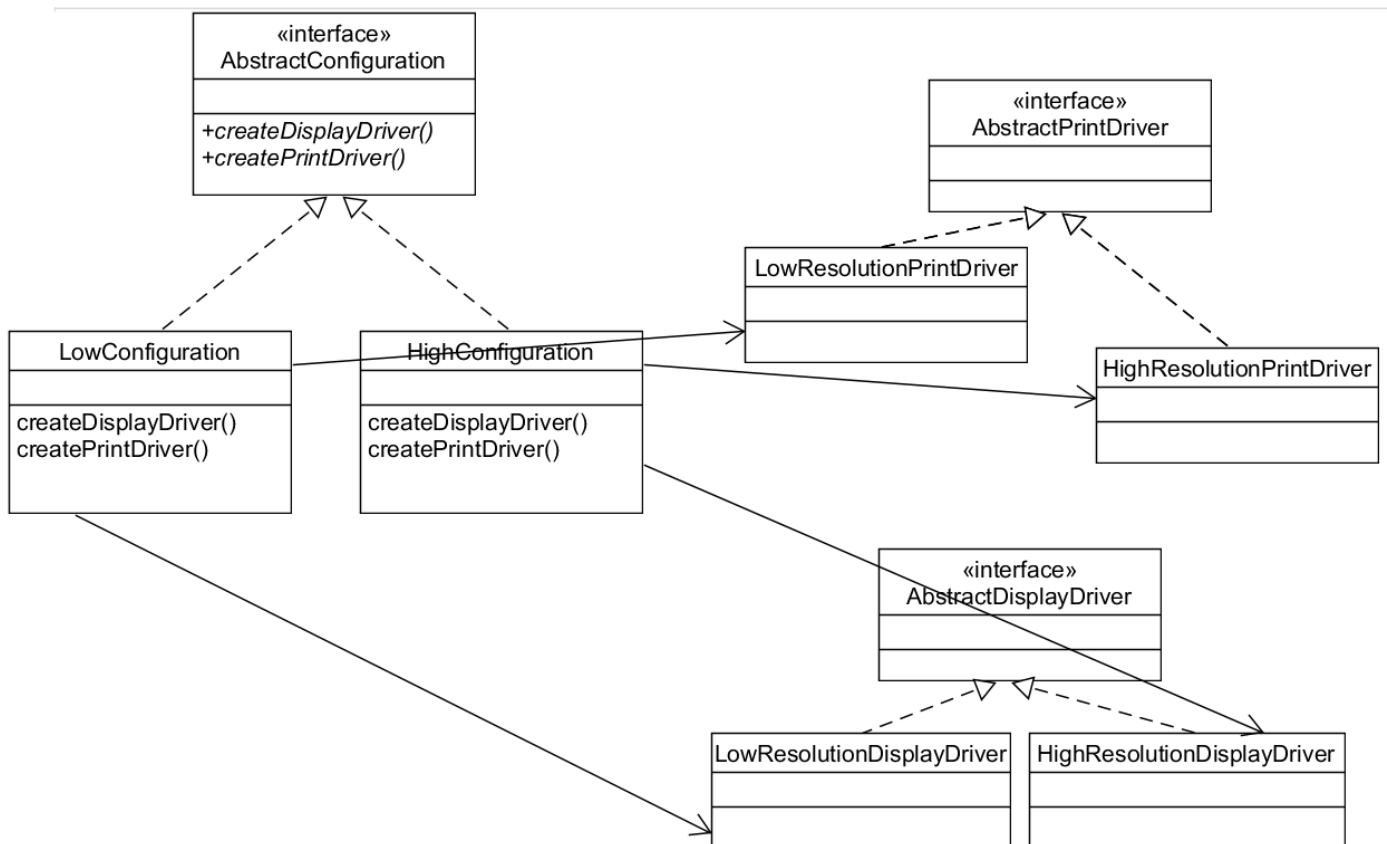
Model → should include the business logic related to how the computer would move the next piece [0.5 mark] + the entities of the system like the chess pieces states (killed, alive, location on board), the

current state of the chess board, the current state of the game being played [0.5 mark]

Controller → should include the 2 planning algorithms used to modify the user interface [1 mark]

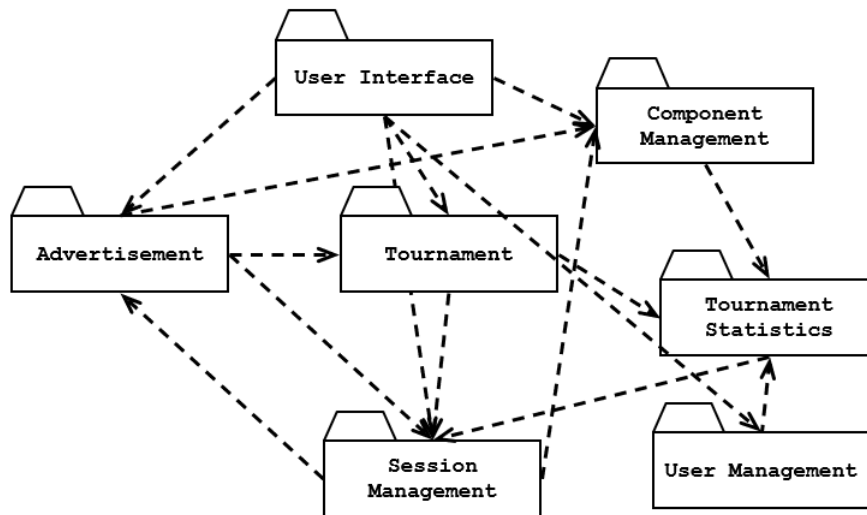
View → Should include the user interface elements that represent the visual side of the chess board [1 mark]

- c) [4 marks] Consider that you are required to design a software system to display and print shapes from a database. The type of resolution to use to display and print the shapes depends on the hardware configuration of the computer on which the software system is running. If the computer has **low configuration**, the software system should use a **low**-resolution display driver (**LRDD**) to display the shapes and a **low**-resolution print driver (**LRPD**) to print the shapes. If the computer has a **high configuration**, the software system should use a **high**-configuration display driver (**HRDD**) to display the shapes and a **high**-resolution print driver (**HRPD**) to print the shapes. **Sketch** a class diagram for the software system while **using the abstract factory design pattern** and **explain** your solution. The diagram should clearly show the attributes/operations/relationships as applicable.



Question 3 [4 marks]

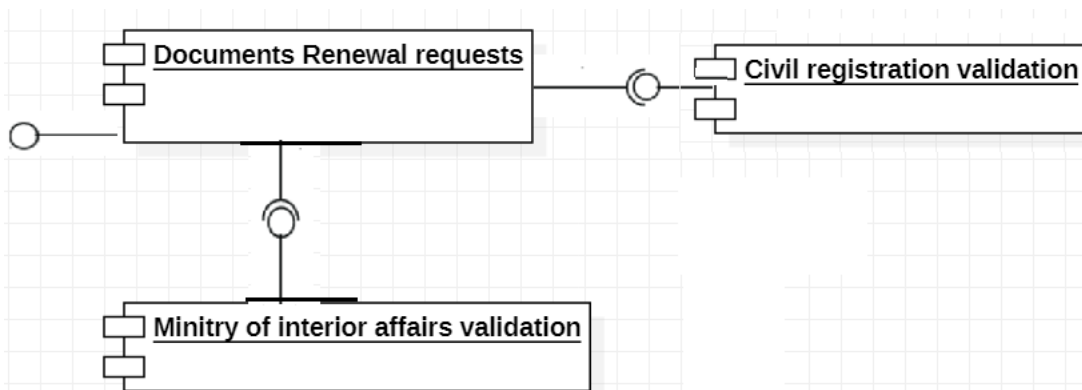
a) Evaluate the following subsystem decomposition. **Justify your answer.** [1]



High coupling along with explanation of why it was classified as high coupling.

b) [3 marks] Maykanah is an online website for automating the renewal of several governmental documents [أوراق رسمية حكومية] including the national ID. Maykanah allows **customers** to submit a request for renewing some government-issued document. But, for the renewal process to work properly, it needs to validate some information about the customer from the Civil registration (سجل مدني) that holds all the information of customers like his current living address (بمعنى أن عملية التجديد تتطلب إحضار بعض البيانات التي تخص (المواطن من السجل المدني بطريقة ممكنة). Additional information needs to be validated about the customer from the ministry of interior affairs like his criminal record (بمعنى أن عملية التجديد تتطلب إحضار بعض البيانات التي تخص المواطن من وزارة الداخلية مثل السجل الجنائي بطريقة ممكنة).

Create a component diagram showing the main components of the above system. Your diagram should show the components, and the component interfaces as well using the UML notations.



End of Exam