Bar Code

اسم الطالب

رقم الطالب

Cairo University
Faculty of Computers and Artificial Intelligence

Final Exam

Department: Computer Science – Joint Masters in Software Engineering
Course Title: Software Design and Architecture
Course Code: SE 605
Semester: Fall 2019
Instructor: Dr. Soha Makady
Date: Jan 14th, 2020
Exam Duration: 2 Hours

تعليمات هامة

- حيازة التليفون المحمول مفتوحا داخل لجنة الإمتحان يعتبر حالة غش تستوجب العقاب وإذا كان ضرورى الدخول بالمحمول فيوضع مغلق فى الحقائب.
- لا يسمح بدخول سماعة الأذن أو البلوتوث.
- لايسمح بدخول أي كتب أو ملازم أو أوراق داخل اللجنة والمخالفة تعتبر حالة غش.

Question	Mark	Signature
One		
Two		
Three		
Four		
Five		
Six		
Seven		
Eight		
Nine		
Ten		
Total Marks		

_____

60

Total Marks in Writing: _____

This exam is a CLOSED BOOK exam

Question 1 [12 marks]

a) Explain the difference between prescriptive architecture and descriptive architecture **[2]**.

b) Give an example to illustrate the difference between an architectural drift and an architectural erosion. The example can be from real life, or for some software system as per your preference **[2]**.

c) Explain the difference between scaling out and scaling up as two alternative solutions to increased request load within an application **[2]**.

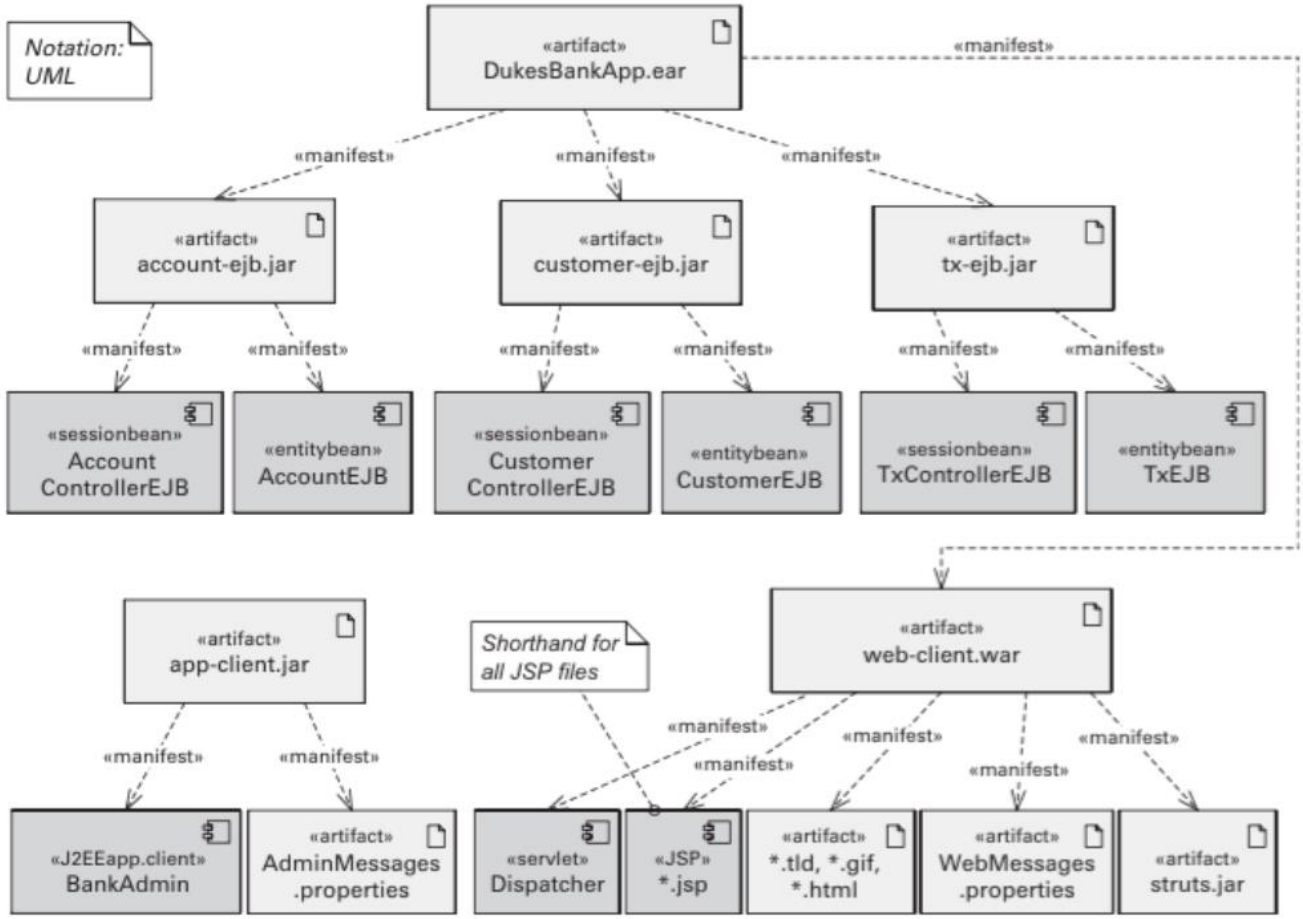
d) Consider the concept of a book, provide two different abstractions for that concept according to the following two applications: Library management system, and Online book purchase system. **[2]**

e) Discuss a typical design tradeoff between two non-functional properties. **[2]**.

f) Provide an example for one decision that would be classified as an architectural design decision, and another that would be classified as a non-architectural design decision **[2]**.

Question 2 [8 marks]

a) Consider the following architectural view for some system. Using plain English words, explain this view. Your explanation needs to cover all the notations and details shown in the figure **[4]**.



b) Identify the target quality attribute for each of the following requirements. Provide a written explanation for every selected quality attribute. ***If no explanation is provided, no mark will be given for the corresponding part [4].***

i. The ARENA system must support the kick-off of many parallel Tournaments (e.g., 20), each involving up to 64 Players and several hundreds of simultaneous Spectators. _____

ii. All related software associated with SatWatch, including the onboard software, will be written using Java, to comply with current company policy. _____

iii. 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. _____

iv. A single server is hosting three different services: a web application, a file sharing service, and a printing service. If 1000 persons attempt to print at the same time, the printing service might go down. However, if the print service goes down, none of the other services functionality should be affected. _____

Question 3 [10 marks]

Consider a network analysis tool that should be built. Its requirements include the following:

- The system can calculate various measures including the distribution of weakly connected nodes, and the distribution of strongly connected nodes.
- The networks to be analyzed are stored in dataset files.
- Users can upload multiple datasets to the system.
- To perform an analysis, users select a dataset, and then choose a measure to calculate.
- For each user and for each dataset, the system manages a history of calculations.
- The calculated results are presented in a textual (CSV) as well as a graphical (PNG) form.
- Users can register with the system by providing their email address.
- Users can log-in and log out.
- If the user is logged out, the system notifies the user about a finished calculation by email.

a) Propose an initial high-level conceptual architecture for this system **[6]**.

b) Write down a usage scenario for Dalia as she attempts to use that system to calculate some measures for some network **[1]** .

c) Apply the scenario proposed within part (b) to your proposed architecture within part (a), in order to evaluate that architecture. You do not need to modify the architecture of part (a). You mainly need to evaluate it against the proposed scenario, and mention its current limitations (if any) **[3]**.

Question 4 [8 marks]

During the lectures, we discussed three different architectural patterns: N-tier client server pattern, messaging pattern, and broker pattern.

a) Pick **only one** of those three patterns, and **explain** how it operates **[2]**.

b) Discuss, with justifications, whether the **modifiability quality attribute** is promoted or not **within each** of the three architectural patterns **[6]**.

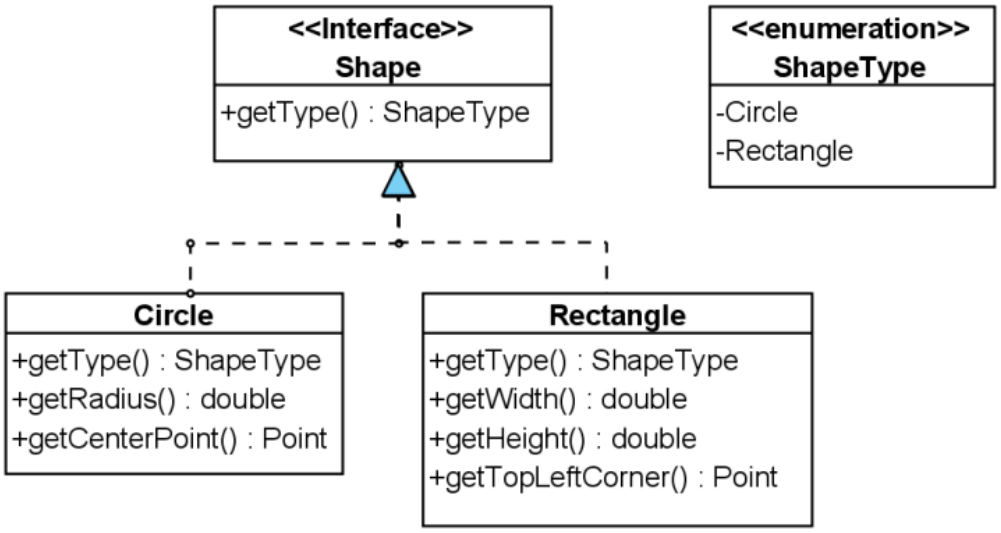
Question 5 [10 marks]

a) During the lectures, we discussed the SOLID principles. For each of the following designs, **identify** the violated SOLID principle, **explain** how it was violated, and **modify** that design to abide by the identified SOLID principle. Make and state any needed assumptions that would help you answer this question **[6]**.

1) Consider a smart home system that allows controlling several features at some home electronically. Such features include opening/shutting doors and turning lights on/off. The following source code is part of the proposed design.

```
abstract class Location {
    abstract List<Shutter> shutters();
    abstract List<Light> lights();
    ...
}
class Room extends Location {
   List<Light> lights;
   List<Light> lights() { return lights; }
   List<Shutter> shutters;
   ...
}
```

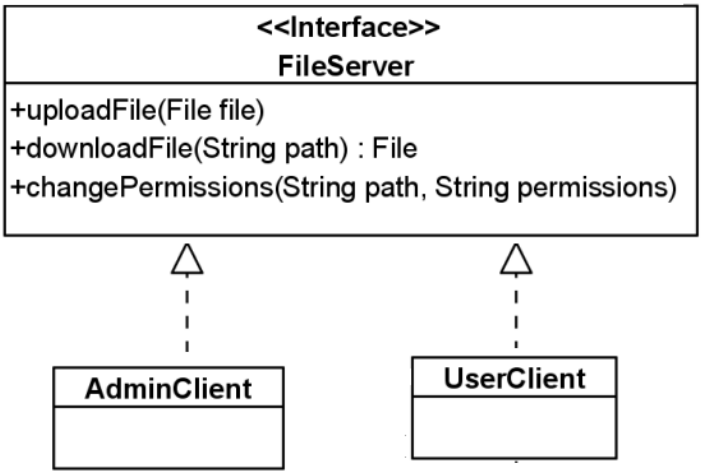
2) Consider an application that draws shapes (e.g., circles, rectangles) on a standard GUI. The following design is provided for shapes.



Drawing is implemented in a separate method within an **Application** class as follows:

```
public class Application {
   public void drawAllShapes(List<Shape> shapes) {
      for(Shape shape : shapes) {
           switch(shape.getType()) {
             case Circle:
                drawCircle((Circle)shape);
                break;
             case Rectangle:
                drawRectangle((Rectangle)shape);
                break;
              }
       }
   }
   private void drawCircle(Circle circle) {...}
   private void drawRectangle(Rectangle rectangle) {...}
 }
```

3) Consider the design of a file server system. The interface FileServer declares methods provided by any file server. Various classes implement this interface, including the two clients AdminClient and UserClient



b) The electronic chess game consists of a chess board with a built-in computer, lights, chess clock, and membrane switches. The human player registers moves by moving and pressing chess pieces on the board, activating membrane switches mounted under each square. After each move the computer updates the chess clock. The computer should only make legal moves, should reject attempted illegal human moves, and should try to win **[4]**.

i. Explain how the MVC pattern could be applied to the electronic chess game.

ii. Is there any benefit to using the MVC pattern in this particular system? Justify your answer.

Question 6 [6 marks]

During the course, we discussed several scientific papers. Answer **only three of the following four** questions:

i. Explain the difference between the connector envy and the ambiguous interface architectural smells using examples **[2]**.

ii. Explain the difference between the client-side discovery architecture pattern and the server-side discovery architecture pattern **[2]**.

iii. During the study used to assess whether projects followed an agile or a plan driven approach, various software metrics were collected, including CLOC (comments per lines of code), DIT (depth of inheritance tree). **Discuss** whether those metrics varied across plan-driven and agile-driven projects or not. **Explain** why those metrics varied (if any variance was found) **[2]**.

iv. A controlled experiment was conducted to evaluate the impact of using design patterns versus simpler solutions during software design. Within that experiment, the authors picked four systems for evaluation, where those systems ranged in size between 200 and 500 lines of code. Developers were asked to perform some tasks using design patterns and other tasks without using design patterns. Twenty-nine developers were selected with experience ranging from 2.4 to 4.5 years. **Explain all pros/cons for such an experimental setup [2].**

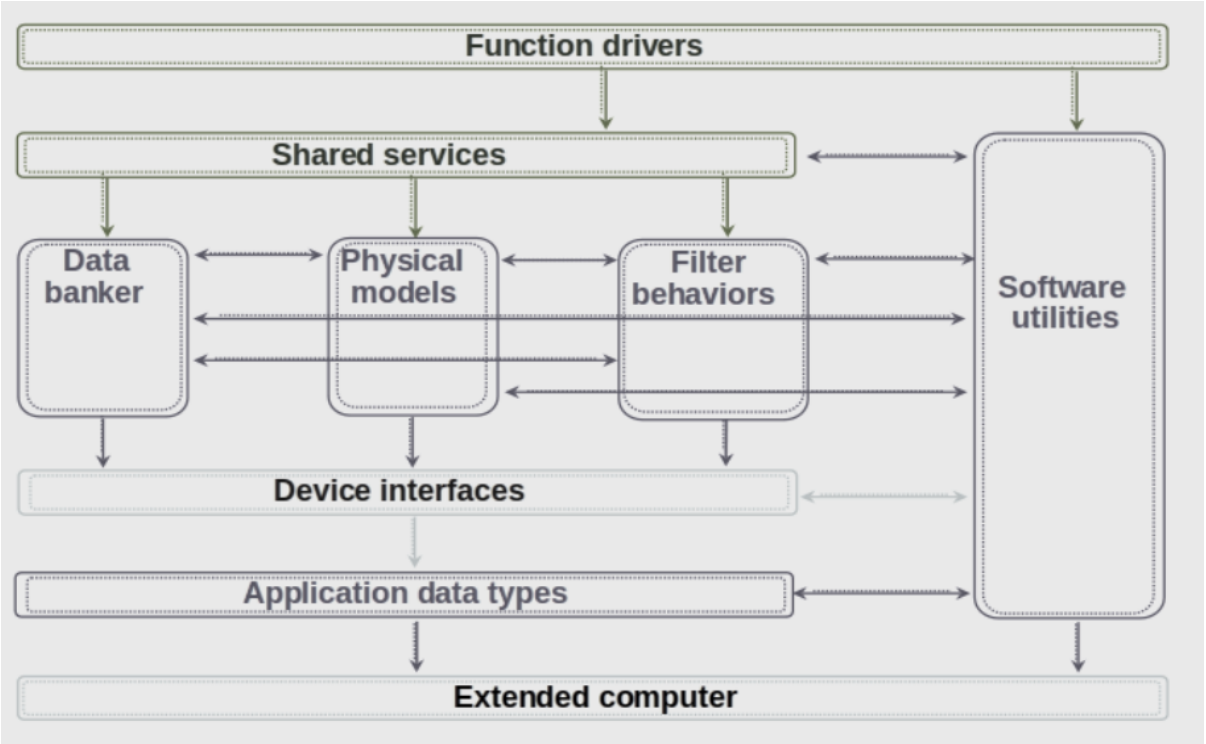
Question 7 [6 marks]

During the course, we discussed several topics. Answer **only three of the following four** questions:

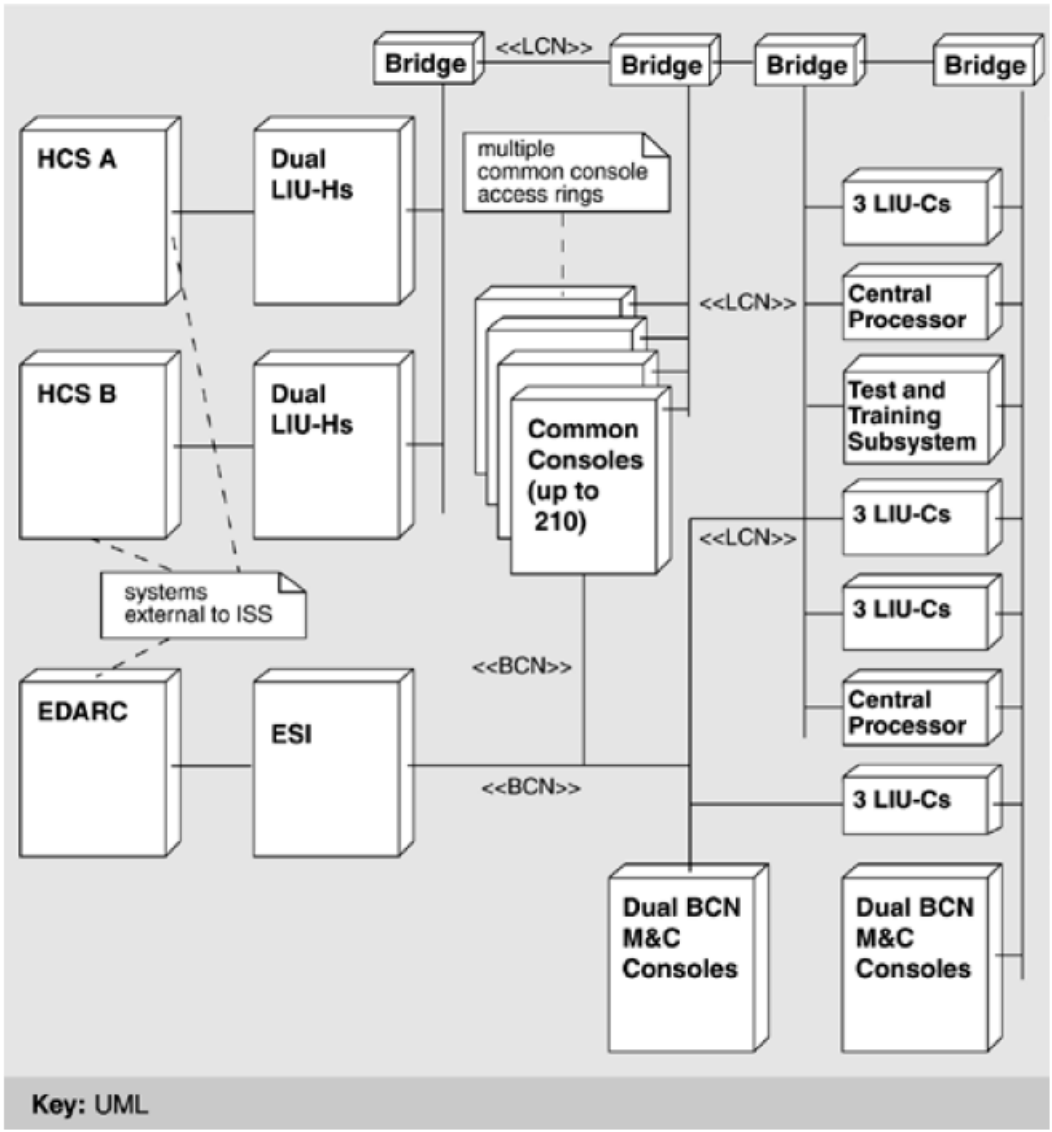
i. Identify and explain two design constraints for the REST architectural style **[2]**.

ii. Pick an example application that demands the use of the Map/Reduce architectural style, and explain how that architectural style would be used. You need to clearly explain the roles of the mappers and reducers within that specific application **[2]**.

iii. Within the A7E-avionics system presentation, the following "Uses architecture diagram" was discussed. Explain that diagram shown below **[2]**.



iv. Within the Air-traffic control system presentation, the following physical view diagram was discussed. **Identify which quality attribute** was targeted by the design within that physical view. **<u>Explain how that design achieves the identified quality attribute</u>** as per the shown figure **[2]**.



End of Exam