29th March 2022

B.Sc. Engg. SWE 6th Semester

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **SUMMER SEMESTER, 2020-2021**

DURATION: 3 HOURS — **FULL MARKS: 150**

SWE 4601: Software Design and Architecture

There are **6 (six)** questions. Answer all of them. Figures in the right margin indicate marks. For each question, corresponding CO and PO are written in the brackets.

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1. a) What is startup latency? Differentiate ***cold start*** and ***warm start*** in "***Function as a Service (FaaS)***". — 5 (CO2) (PO2)

   b) Suppose, a web application has to give an immediate response for some kind of user interaction (e.g., ad clicking event). The application has to perform some calculation asynchronously and does not require maintaining session state during such events. The number of events at a time could not be anticipated. So, running multiple instances of the application to meet certain performance is not worthwhile. (CO4) (PO2)

   i. Which design architecture would be appropriate for this situation? You can consider either server-based or serverless architecture. — 2

   ii. Justify your solution by designing and describing the architecture. — 10

   iii. Mention possible advantages and drawbacks of your selected architecture? — 8

2. XSoft built an electronics shop (e-commerce) without considering any architectural design. After some releases, managing the software became difficult with the increasing number of features along with an increasing number of team members, having knowledge of different technology stacks. They shifted to 3-layered monolithic architecture.
   After some releases, XSoft identified some parts of the application require more performance than others. A few team discussions reveal that migrating to a microservice architecture will solve this. They immediately migrate to microservice architecture without giving proper thought and maintaining any architectural pattern. Now, they are facing the following problems.

   - Changing one microservice requires changes to other microservices.
   - Duplicating codes across multiple services to support some functionality like authentication and authorization.
   - Scaling the shared database for multiple services
   - Not capable of designing different database schema for frequently requested immutable data and mutable transactional data
   - Discovering active instances of microservices

   Based on the above scenario answer the following.

   a) Write the characteristics of layered architecture prompt XSoft to migrate. — 5 (CO2) (PO2)

   b) Identify design issues that create the above-mentioned problems. Propose and justify a solution by considering the following microservice patterns: — 4 × 5 (CO4) (PO3)

   Circuit Breaker, Client/Server-side discovery, Strangler, API Gateway, Decompose by business capability, CQRS, Event Sourcing, Saga, Log Aggregation, Service registry. [To fix the problems multiple patterns could be required.]

3. a) Gono Library of Dhaka was established in 1983. It has numerous collections of books. Each book has a ***title***, ***author***, ***publication date***, and ***genre*** whether it is a ***novel***, ***story***, ***biography***, or ***fiction***. Any person can have an account there. Library maintains those accounts by a unique number, date the account opened, and state whether the account is ***active***, ***frozen***, or ***closed***. A person borrows books using his/her account and can be an author as well. — 10 (CO3) (PO3)

Based on the above scenario, XSoft has to build a library management.
Now, design the corresponding UML class diagram by giving proper details of each ***class***, its ***properties***, ***methods***, ***relations***, and ***dependencies***. Modularize your design by identifying ***packages*** or ***modules***.

b) Consider the interaction scenario with the system: — 10 (CO3) (PO3)
The library system has an existing database of all books. New books can be added by librarians. Any person can be a member of the library and borrow books for reading. To borrow books, a user has to be registered to the system through an account. Users can search multiple times by specifying the ***title*** or ***author name***.

Now, design the interaction with the system using a sequence diagram. Use appropriate notations.

c) In Evolutionary Database Design, how ***change_log*** of database schema should be maintained in version control? — 5 (CO2) (PO1)

4. a) DreamSoft has hired you to review their new software project plan where they are planning to have two software architects, who will make a detailed design of a specific scenario in the form of ***blueprint UML***. The blueprint will then be passed to four programmers for implementation. — 5+5 (CO2) (PO2)

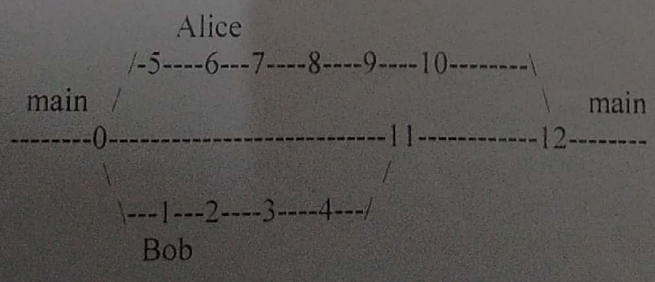
State your opinion about this plan in no more than 5 sentences. What alternative approach do you suggest?

- Software is always changing so "design first then code" is not a practically feasible approach.
- Sketch of UML can be prepared through discussion between architects and programmers.

b) Do you think architectural smells are responsible for architectural decay of software? Justify your answer. — 5 (CO2) (PO1)

c) Continuous Integration (CI) of source code is considered best practice for large scale systems. However, poorly managed CI is responsible for anti-patterns. Shortly describe any four CI anti-patterns. — 10 (CO2) (PO2)

5. a) Consider the following revision history of a project done using a basic ***Version Control System (VCS)***. Two developers namely Alice and Bob split into two branches from the main branch at revision 0. Bob merged his changes in the main branch in revision 11 while Alice merged in the main at revision 12. — 5+5 (CO3) (PO3)



Based on the above scenario answer the following-

i. Alice and Bob both changed a file ***thecode.c*** in their respective branches. The VCS, unfortunately, cannot track which files were changed. Explain a problem that may happen in this situation.

ii. The system has an auto-sync feature - "*pull changes automatically when any change is pushed*". Bob has enabled this feature. For a critical bug, he had to manually check all the 30 files in a folder. When he was looking into the 20th file (sorted alphabetically), Alice pushed 3 files in that folder. What problem can happen in this situation?

b) What is session state? Briefly describe session state patterns by giving an example - 10 (CO3) (PO3)

Notes:

- Your example should include client and server machine capabilities, data security and ease of implementation.
- when to use one pattern over another.

c) Differentiate Optimistic and Pessimistic Concurrency Control. 5 (CO1) (PO1)

6. a) What are the golden rules of user interface design? Shortly describe each of them. 7 (CO1) (PO1)

b) Shortly describe user interface design process 10 (CO1) (PO1)

c) In a microservice architecture, you have two microservices. One is Book-Service, which is responsible for serving the details of books and the other is Author-Service, which is responsible for serving the details of authors. 8 (CO4) (PO2)

Book Service Endpoints	Comments	**Author Service Endpoints**	Comments
GET /	get all books	GET /	get all authors
GET /id	get book details, including author_ids	GET /id	get author details, including book_ids
POST /	create a new book.		Create new author

Now, you have to implement a search feature which will return all authors, where the name starts with 'A' and all books written by the authors where the book title starts with 'B'. Assume, there will be millions of calls to the services and you have to uphold specific availability and throughput of those services.

i. What problems will you encounter if you keep the aforementioned two services and implement the search feature?

ii. What are the alternative solutions that can be used? Give your constructive feedback.

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Course Code: SWE 4601

Quiz - 3

Time: 22 minutes

Marks: 15

Answer all of the following questions

1.	a)	What is dependency relation in the UML class diagram? Shortly define any three dependency relations.	3
	b)	Differentiate serverless architecture and traditional server-based architecture.	4
2.	a)	Shortly describe the Broker architectural pattern with an example?	4
	b)	What is layered architecture? What are the advantages and disadvantages of layered architecture?	4

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Quiz - 2

Time: 22 min **Marks: 15**

Answer all of the following questions

1.	a)	What is microservice pattern? What are the elements you should use to describe a pattern?	3 (CO1, PO1)
	b)	Suppose, you have a monolith app and want to move to microservice architecture. Despite having several benefits of monolithic architecture, what characteristics of microservice motivate you to shift to microservice architecture? Give 2 reasons with proper explanation.	4 CO2, PO1)
	c)	Differentiate Orchestration vs. Choreography in Saga pattern of microservices.	4 CO2, PO2)
2.		Write a short requirement (in the form of query or story) where you would need a reporting database. Give two advantages and two disadvantages of reporting database.	4 CO2, PO1)