Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Specialized in Software Engineering

Final Examination
Year 3, Semester I (2024)

SE3030 – Software Architecture

Duration: 2 Hours

June 2024

Instructions to Candidates:

- This paper is proceeded by a **10-minute** reading time. The supervisor will indicate when answering may commence.
- This paper has **Four** questions.
- Answer all questions in the booklet given.
- The total marks for the paper is **100**.
- This paper contains 05 pages, including the cover page.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (30 marks)

a) This Question is based on the **Enterprise Application Integration (EAI)**

i). What are the 7 root patterns in Enterprise Application Integration?

(2 marks)

ii). Assume you have a distributed system with 10 nodes as shown in figure 01 and if you are planning to increase number of nodes into 20, explain the relationship in between nodes and physical links with a formula and compute total possible links.

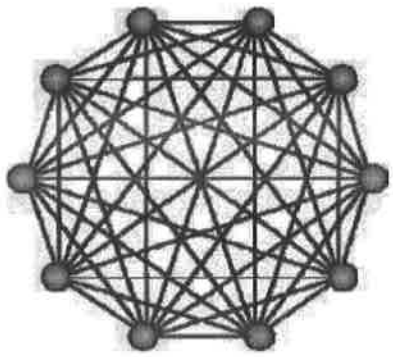

Figure 01

(3 marks)

iii). According to the above architecture represented in the Figure 01, analyze the problem you face when increasing the number of components in the system.

(3 marks)

iv). Compare ***Adapter Pattern*** with ***message translator pattern*** in EAI, and draw a diagram to explain the ***message translator*** with an example.

(9 marks)

b) This question is based on the ***Presentation Layer*** (***Intercepting Filter pattern*** according to the ***Decorator implementation)***. The sample test class and its output displayed in the below.

```
1  package com.filter.decorator;
2  public class Test {
3      public static void main(String[] args) {
4          IFilter iFilter = new AuthenticationFilter(new DebuggingFilter(new InputValidationFilter())).execute();
5          System.out.println();
6
7          new DebuggingFilter(new InputValidationFilter()).execute();
8          System.out.println();
9
10         new AuthenticationFilter().execute();
11     }
12 }
```

Console | Problems | Javadoc | Declaration | Servers | Data Source Explorer | Debug

<terminated> Test (6) [Java Application] C:\Program Files\Java\jre1.8.0_20\bin\javaw.exe (Apr 4, 2019, 3:47:10 PM)

```
Authentication Filter
Debugging Filter
Input Validation Filter

Debugging Filter
Input Validation Filter

Authentication Filter
```

i). Create an Interface **IFilter** that consist the method declaration of **execute**() method

(1 marks)

ii). Write the code for three filter classes **AuthenticationFilter**, **InputValidationFilter**, and **LoggingFilter**. You should implement the interface **IFilter** and override the method. As per the displayed output modify your filter classes accordingly.
Note: If you cannot write the code, as alternative draw the detailed design class diagram and explain with using simple English – full marks will be given.

(12 marks)

Question 2 (20 Marks)

This question is based on **Microkernel Architecture** (Plugin-architecture Pattern).

a) List down 06 Life-Cycle methods in the OSGi Framework?

(3 marks)

b) Which architectures use Service Registry? (Name three architectures)

(3 marks)

c) Explain what OSGi is and name two collaborators who helped creating OSGi?

(4 marks)

d) Classify the advantages and disadvantages of implementing a microkernel architecture in a real-time operating system, considering the factor of scalability.

(4 marks)

e) Draw and explain the Plugin-architecture pattern by providing an example.

(6 marks)

Question 03 (25 marks)

a) What are the key **Architectural Activities**.

(3 marks)

b) Explain why software Architect should work with the Business Analyst when **studying** the **overall requirements**.

(3 marks)

c) Differentiate **Architectural Structure** and **View**.

(4 marks)

d) How is **N-Tier Architecture** different to **Layered Architecture?** What are the distinct **advantages** and **disadvantages** of N-Tier Architecture compared to Layered Architecture.

(4 marks)

e) Compare architecture evaluation methods **ARID** and **SAAM**, outline the key differences and explain the situations where each method more useful than the other.

(5 marks)

f) Explain **MicroServices Architecture** style and describe its challenges in **runtime communication** and propose a strategy to mitigate them.

(3 marks)

g) What are the tactics that would generally apply to improve **Performance**, describe them with examples on how to use.

(3 marks)

Question 04 (25 marks)

a) A courier service is planning to introduce QR code based sticker to track the parcels it deliver. The service is mainly comprised of part-time individual who conducts the last mile pick-up and drop-off of items. The courier system would have multiple system to system integrations and different modules including a customer facing web system, payments, central monitoring, reporting, etc . If you are asked to design this system, explain what considerations you will prioritize. Propose a **design** that can help above and **explain** how it will improve the key systems qualities.

(5 marks)

b) Write concrete Quality Attribute scenarios of an inflight entertainment system of commercial airlines for below Quality Attributes.

i). Usability

(3 marks)

ii). Modifiability

(3 marks)

c) An enterprise currently using a few interconnected legacy software systems that are built with the **same technology stack** (e.g. Java/JSP). All of which was custom built by the internal IT team more than 15 years ago and the functionalities has not changed much over time. The enterprise is planning to upgrade some of the software components and as a result few of the systems will be migrated to a **different technology stack** (e.g. JavaScript/Node.JS). The functionalities of the systems will mostly remain unchanged and the upgraded systems with new technology stack need to be connected with the rest of the systems that are not planned to change technology stack. You are asked with bringing a solution for this problem.

i). Identify the main Quality Attributes in consideration above.

(1 mark)

ii). Draw and explain how you would re-architect the above solution.

(3 marks)

iii). Identify the Trade-off in above proposal and discuss mitigation plans.

(3 marks)

d) Education authorities are planning to automate the current manual process used by school libraries in rural areas of the country. The rural areas are suffering from low network connectivity and low IT literacy. The authorities are planning to develop the infrastructure to address the issues in the next 3-5 year timeline and implement a single centrally governed school library systems to all schools in the country. In the transition period, its proposed implement an **intermediate system** with the goal of capturing the manual data into a computerized system. If you are to architect this intermediate system, how would you plan to design targeting the long-term transition.

(7 marks)