



Sri Lanka Institute of Information Technology

B. Sc. Special Honours Degree
in
Information Technology

Final Examination
Year 3, Semester I (2019)

SE3030 – Software Architecture

Duration: 2 Hours

Instructions to Candidates:

- ❖ This paper is preceded by **10 minutes reading period**. The supervisor will indicate when answering may commence
- ❖ This paper contains **Three** questions. **Answer for All** Questions.
- ❖ Marks for each question are given in the paper.
- ❖ Total Marks: 100.
- ❖ This paper contains **6** pages including Cover Page.
- ❖ The Final Exam is a **CLOSED BOOK** exam

Question 1

(40 marks)

Given below is a Case Study for Colombo Life. Read the case study and answer the following. You can use your own experiences when answering this question.

Colombo Diversified Holdings (CDH) is international diversified business company founded in Colombo, Sri Lanka and has been operating since 1864. The main sectors the company operates are Food & Beverages (F&B), Hotels, Travel, Manufacturing and Real Estate. The company have some presence of operations and/or investments in other areas as well.

The new Group Chief Information Officer (GCIO) of the company have formed a team to analyze various software systems used in the different sectors and plan to revamp all the systems and introduce a new concept called Colombo Life. The goal of Colombo Life is to provide all the needs of customers through a self-managed single IT platform. The GCIO also understands the different software sub systems for each sector would have their own independence and integrations while key focus will be given to Colombo Life initiative.

As of today, the systems are disintegrated (e.g. customers of Hotels will make bookings via each Hotel's website and if the customer needs to book a travel they must book via a different web system). It's also found that some systems are not directly exposed to the end user, rather they are operated by internal staff on request of the customer (e.g. for hotel in-room dining the guest must call the operator and operator will place the order through the internal system). The Colombo Life initiative will consolidate all the systems in to one place giving customers a self-managed superior experience.

Each software system in operation today are separately connected to banking payment gateways so the Customers can make payments online. As of today, the customers are making separate and isolated payments per transaction for each system i.e. Book the hotel separately to booking the travel. The proposed IT systems is expected to consolidate the payments in to one transaction, so the customer will be billed once for all the services at once (instead of separate bills)

A committee has been formed headed by GCIO to identify the needed System changes and new development. Below are key highlights from the committee report:

- Integrated Self-Care system for Customers via Web and Mobile
- Facilitate booking/ordering any good/service offered within the group
- Facilitate viewing of detailed bill
- Facilitate Consolidate Payments

Other than providing a superior end user experience to the customers the GCIO also envisions the solution would bring advancements on how the group operates. Since the new solution consolidates all the payments via a single gateway the group is planning to merge the Finance units spread across the group in to one single unit. The Group Financial Controller require to analyze data: Weekly, Monthly and End of Year where each process the transactions for its

respective week, month or year. The data analysis operation and to produce reports would take a significant computational power during its execution time.

For maintenance of the integrated solution and its sub-systems the existing System Administration teams will be trained to look after each sub-system and their regular operations.

While the group is committed to make all the suggested changes, due to the financial investment and time to develop & roll-out the GCIO is suggesting a phased-out approach for system development so each sub-system can be developed and delivered separately. It's expected that each sector will be starting to use its new software one they are available independently from other sectors. Meanwhile for the end Customer the features offered by each sub-system will be rolled out as and when the services/sub-systems are ready in an incremental approach.

- a) Identify **4 main stakeholders** in this case study. (4 marks)
- b) **Draw** the Architecture Business Cycle with All the relevant details. (4 marks)
- c) Identify **2 key Quality Attributes** each from below categories in this Case Study and **justify** why they are important in this context.
 - i) Runtime Qualities (2 marks)
 - ii) Design Qualities (2 marks)
 - iii) User Qualities (2 marks)
- d) In reference to the identified Quality Attributes in part (c) **select 2 attributes** and explain what **Trade-Offs** should be made to improve them with proper **justification**. (6 marks)
- e) Suggest a suitable **tactic** for implementing **2 of the identified Quality Attributes** in part (c) with proper **justification**. (6 marks)
- f) Write concrete Quality Attribute Scenarios for the **2 Runtime Qualities** identified in part (c). (6 marks)
- g) How **MicroServices Architecture** can be used to develop the system & and help with the **operational strategy** for this case study.

- i) Explain with a **Diagram** and outline your **recommendations** for a solution based on MicroServices Architecture for above. (4 marks)
- ii) Explain how **Scalability** of the sub-systems of above case study can be achieved with MicroServices Architecture. (2 marks)
- iii) Outline your **recommendations** on a **communication & integration strategy** between sub-systems with proper justification. (2 marks)

Question 2 **(30 Marks)**

- a) What are the key **Architectural Activities**. (4 marks)
- b) Explain **Component-based Architecture** Style and describe its **advantages**. (5 marks)
- c) 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)
- d) What is the main objective of **ATAM** (Architecture Trade-Off Analysis Method) and what are its key benefits. (6 marks)
- e) What are the tactics that would generally apply to improve **Availability**. (3 marks)
- h) A higher education institute require a Software System which consists of several sub-systems. The operational demand for each sub-system fluctuates heavily throughout the year. During a prior analysis it was found that there are Commercial off-the-shelf (COTS) software products available which would satisfy the requirements of some of the sub-systems.

These COTS software are available as packages for download which can be easily deployed on common application servers. For the rest of the software systems the institute is planning to build software solutions in-house.

How **Cloud Architecture** can be used for above requirement? Explain what **Could Service Model(s)** is/are mostly recommended for above with proper justification.

(4 marks)

- f) What is **Enterprise Architecture**? What are its key **Architectural Considerations**.

(4 marks)

Question 3

(30 Marks)

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

- i) What are the 7 **root patterns** in Enterprise Application.

(2 marks)

- ii) Explain one pattern with an example.

(3 marks)

- iii) Assume that you have a distributed application which connects 8 nodes (machines over the network) and communicate according to the conventional Service Oriented Architecture (SOA). Analyse the situation if this application is planning to **further expands** for more nodes what are the probable **limitations** and what is your **proposed solution** to avoid those limitation. Draw a diagram and explain.

(4 marks)

- iv) To solve the above problem what is the **design pattern** you can suggest in sub question iii).

(1 marks)

- v) What is the proxy configuration in Enterprise Service Bus (ESB).

(2 marks)

- b) This question is based on the **Presentation Layer** and **Business Layer** Patterns. Explain **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 - Hierarchy - Explanation - Java - Data Structures - Test
<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 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 can't write the code draw the detailed design class diagram and explain with using simple English – full marks will be given
(12 marks)
- iii) List 3 **presentation layer patterns**.
(1 marks)
- iv) Draw the **class diagram** of **Service Locator** pattern in Business Layer and explain usage of it.
(4 marks)

End of the Question Paper