Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree in Information Technology

Final Examination

Year 3, Semester 1 (2017)

SE3020 – Distributed Systems

Duration: 2 Hours

June, 2017

Instructions to Candidates:

- This paper has **four** questions. Answer **all** Questions.
- Total Mark 50 (Contributes to 50% of the final grade).
- The marks allocated for each question may vary.
- This paper contains **six** pages with the cover page.

Question 01 **(14 marks)**

a) List **three** different motivations for distributing the computation of a system.

(3 Marks)

b) You have been asked to develop a mobile application as a client application for the existing banking system. The core banking system is developed using C++ and you need to support both Apple and Android mobile phones with this mobile application. Identify **three different** challenges in developing this client and **briefly explain** how you would try to address those challenges.

(3 Marks)

c) Name a suitable **Software architectural style** to develop **each** of the following systems. Briefly justify why you suggested each style. Note that you may suggest a **combination** of multiple Software Architectural styles.

i) An online forum to share travel information among users
ii) A remote monitoring system that monitors the health of an elderly person.
iii) A music file sharing system among a group of users.

(3 Marks)

d) You have been asked to develop an e-channeling system to channel doctors online. The system should facilitate the searching of a particular doctor who is visiting a particular hospital, based on his/her availability and specialty. Once a particular doctor is selected, the patient should be able to book an appointment with that doctor, using his/her credit card. Once a transaction is made, an email and an SMS notification will be sent both to the hospital and the patient, confirming the booking.

i) Using a particular Software Architectural style/styles of your choice, draw the **Software Architecture** for the system.

(3 Marks)

ii) Draw the **System Architecture** to indicate where **each** Software Component would be deployed in a real system.

(2 Marks)

Question 02 **(12 Marks)**

a) Compare and contrast remote blocking calls, remote polling calls and asynchronous callback functions, giving **an advantage and a disadvantage** of using **each** approach.

(3 Marks)

b) Assign the Distributed communication technologies; Socket programming, Java RMI, Java RMI with asynchronous callback functions, Java RMI based polling, as the most appropriate communication method to solve each of the following problems. **One technology** may be most suitable for **only one of the problems** given. Briefly **justify each** answer that you give.

i) To send air quality information from a fire sensor, which only has a very basic micro-controller to process data and to communicate.

ii) To login to a Banking system from a Java based mobile device, using the account number and a user specific PIN number.

iii) To check the share price of a particular company, every minute.

iv) To get notified of a sudden heart beat irregularity of a remote patient, who is been continuously monitored.

(4 Marks)

c) You have been asked to design and develop an online bookstore, which may expand to have thousands of concurrent users later on. Using the online bookstore, the users should be able to search for books using the book name, author or ISBN number. Upon selecting a book, the user may buy it, by doing a Credit card transaction, which may be handled by a remote payment gateway. Once the transaction is done, the shipping department will ship the book to the designated address. The inventory should keep track of the available suppliers and the amount of books available for each title, as the bookstore doesn't maintain its own stocks. Instead, it merely connects different suppliers of books with the customers, through their online bookstore. The site should be secure as it may store the clients' credit card information and purchase histories.

i) Based on the J2EE specification on Enterprise Java Beans, identify different EJBs that could be used to develop this system. For **each** EJB, write its type, its function and the remote or local interface it may expose. You may use pseudocode to write the interfaces.

(4 Marks)

ii) Identify **two** non-functional requirements that may be handled by the Application Server in which the EJBs will be deployed.

(1 Mark)

Question 03 **(12 marks)**

a) List **two** advantages of using a Message Queue or a Message Oriented Middleware, instead of remote callback functions to implement asynchronous communication in a distributed system.

(2 Marks)

b) Briefly **explain each** of the following components in XML.

i) XML Namespace
ii) XML Schema
iii) XML Header
iv) XML Attribute

(2 Marks)

c) An online bookstore stores a list of books under each category. The booklist may contain a category name and a category ID. Both fields may contain alpha-numeric characters. In a given book list, there may be zero or multiple books. Each book may have the fields; title, author, ISBN number and price. While price is a numeric value, all other fields may have alpha-numeric characters. For each author, the author first name, last name and address may be stored. All those fields may contain alpha-numeric characters as well.

Based on the above information, write an XML schema to represent a booklist. You need not write the XML header information (such as namespaces)

(4 Marks)

d) The online bookstore that is mentioned in part c) facilitates searching for books, placing orders via paypal or a payment gateway of a local bank using credit cards. It also has a shipping section to handle shipping of books. The bookstore does not maintain any in-house inventory but connects different suppliers with customers through its online portal.

Briefly explain how **four of the basic principles** of the Service Oriented Architecture (SOA) can be applied to design and develop the above described online bookstore.

(4 Marks)

Question 04 **(12 marks)**

a) **List two advantages** of RESTful Web Services, in comparison to SOAP Web Services.

(2 Marks)

b) Draw the architecture diagram for OAuth 2.0 username/password authentication for RESTful Services authentication and **name each message** that is passed among the components, prefixed with the **sequence of the message** occurrence.

(4 Marks)

c) Name **four characteristics** of a typical Cloud Computing environment.

(2 Marks)

d) For each of the following scenarios, **briefly explain** how Cloud services may be utilized to improve the productivity of the organization or the individual involved.

(4 Marks)

i) The servers allocated for storing the emails of employees are running out of storage, and the employees are forced to delete their old, yet important emails to free up the space of their email boxes.

ii) The company's web based in-house HR management system is out of date, and the IT department is lacking staff to maintain the HR management system that keeps on failing frequently.

iii) A bank needs to provide Virtualized computing environments to its entire staff using Virtual machines, who are working at branches that are spread around the country. This will save them the hassle of maintaining the Operating systems and application software of PCs that located at various branches. However, their data security policy states that they should not store their data in any outside server other than their own privately owned servers.

iv) You need to share files easily between your mobile phone, tablet and your laptop.

END OF EXAMINATION PAPER