Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree
in
Information Technology

Final Examination

Year 3, Semester 1 (2018)

SE3020 – Distributed Systems

Duration: 2 Hours

June, 2018

Instructions to Candidates:

- There is an additional 10 minute reading time provided.
- 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 **five** pages with the cover page.

Question 01 **(14 marks)**

a) You have been asked to develop a system where the student information of a University is managed and shared. List **three** different motivations in making the above system a distributed system.

(3 Marks)

b) You have been asked to develop a distributed system where the attendance information of staff can be remotely monitored. The staff will mark their attendance at different locations and all the attendance details are sent to a central server, from which the attendance details and reports can be generated using a web client as well as a mobile client. Identify **three different** challenges in developing this system 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 human resource management system

ii) A remote monitoring system to monitor the air quality of a building using a sensor network

iii) A legal file sharing system for the lawyers employed at a law firm

(3 Marks)

d) You have been asked to develop an online supermarket system to buy grocery items online. The system should facilitate search and purchasing grocery items online. The customers may make the payments using a credit card. The system may use a third party payment gateway to handle the payments. Once a particular purchase is made to buy a set of grocery items, the users have the option to arrange a delivery or to pick-up the items later at a supermarket outlet. Once the order is complete, SMS notifications will be sent to the customer as well as the delivery person (if a delivery was arranged). The delivery service is provided by a third party taxi company. The SMS notifications are sent using a service provided by a mobile operator.

i) Using the Object/Component based Software Architectural style, draw a **Software Architecture diagram** for the system.

(3 Marks)

ii) Draw an appropriate **System Architecture diagram** for the above system.

(2 Marks)

Question 02 **(12 Marks)**

a) Identify and briefly explain the function of three components in the Java RMI framework.

(3 Marks)

b) Assign the Distributed communication technologies; Socket programming, Java RMI blocking, 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 get an alert from the remote weather monitoring system, only when there is a sudden rainfall.

ii) To send the rainfall details from a weather monitoring sensor to a central server. The sensor has a network port but doesn't have the computing power to run any high level distributed computing framework.

iii) To login to an ATM machine using a PIN number.

iv) To check the position of a flight in a flight monitoring system, in every 10 seconds.

(4 Marks)

c) This questions also refers to the online supermarket application mentioned in Question 1 part (c). The customer name, username, email, mobile no. and address is maintained for each customer in that system. For each purchase, a shopping cart is maintained. The customers can search for grocery items using the item name and when adding an item to a shopping cart, they have to mention the quantity. For each grocery item, the name and the unit price is stored. The shopping cart may contain one or more grocery items at a given time. The delivery method has to be given by the customer. A JMS message is used to send a message containing the shopping cart from the Java Servlets to the EJB Container.

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 and/or interfaces it may expose. You may use pseudocode to write the interfaces.

(5 Marks)

Question 03 **(12 marks)**

a) Briefly explain how message queues would facilitate reliable delivery of messages and improve the decoupling of a system.

(2 Marks)

b) Compare and contrast JSON and XML as two open message format by giving an advantage and a disadvantage of using each formats in sending messages in a distributed system.

(2 Marks)

c) This question also refers to the online supermarket mentioned in Question 1 (c). Assume that for each customer, the customer first name, mobile no, email and address are stored. The name consists of two elements, the first name and the last name. The address is a string.

Based on the above information, write an XML schema to represent a customer list. Select the appropriate datatype for each property. You do not need to write the XML header information (such as namespaces)

(4 Marks)

d) For the above Customer data structure, write a sample JSON object to represent a customer.

(2 Marks)

e) Name and briefly explain two ways on how the Service Oriented Architecture facilitate reusability of distributed components.

(2 Marks)

Question 04 **(12 marks)**

a) In the online supermarket system mentioned in Question 1 (c), assume that there are select, select all, create, update and delete remote operations are performed on a Customer object. Write sample RESTful service URLs that can be used to perform these operations. Indicate the appropriate HTTP method to use with the URL.

(5 Marks)

b) Briefly explain two reasons for having Service Orchestration in Service Oriented distributed systems.

(2 Marks)

c) Briefly explain how Cloud computing can help to reduce the cost of scaling up/down a distributed system.

(1 Marks)

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

i) You have developed a machine learning algorithm and need to train it in a high performance computer with a GPU (graphics processing unit), which is fairly expensive.

ii) The web based student management system, Courseweb of SLIIT is becoming difficult to manage and too complex, and the student data and the module data is getting too large to store in-house.

iii) The defense ministry needs to store all its data in-house securely, but wants to create virtual machines to provide its staff at different locations to securely and remotely access/update its data.

iv) You need to share files easily with your final year project team members.

(4 Marks)

END OF EXAMINATION PAPER