00337

Sri Lanka Institute of Information Technology

B.Sc. Honours in Information Technology (Software Engineering)

Final Examination
Year3, Semester I (2022)
Regular Intake

SE3020 – Distributed Systems

Duration: 2 Hours

Instructions to Candidates:

- This paper has 4 questions. **Answer all Four (4) questions in the given booklet.**
- Total marks for the paper is 100.
- This paper contains 5 pages including the cover page.
- Calculators are NOT allowed.

Question 01 **(25Marks)**

a) You have been asked to develop a distributed system where the rainfall of a particular area is remotely monitored using rainfall sensors. The sensors will record the rainfall at different locations and all the rainfall details are sent to a central server, from which the rainfall details and reports can be viewed using a web client as well as a mobile client. Identify **4 (four)** different challenges in developing this client and briefly explain how you would try to address those challenges.

(06 marks)

b) Name the most appropriate Software Architectural style (out of Layered architecture, Component based, Event based, Data Centric) for each of the following application.

(04 marks)

i. A cloud-based voting system
ii. An app for food ordering
iii. A legal document sharing system
iv. Remote baby monitoring system

c) Justify why we should distribute business tier.

(04 marks)

d) Out of the server object instantiation methods Singleton, Per call and Per client, select the appropriate instantiation method for each of the following scenario.

(03 marks)

i. A shopping cart object must be created for each client. The cart object is shared over multiple client requests of the same client.
ii. A counter object is shared across all clients to record the number of clients logged in at any given time.
iii. A taxi booking request object is created for each booking in a taxi app. Even for the same client, multiple bookings will create multiple and equal number of booking request objects.

e) Apply the Distributed communication technologies; Java RMI blocking, Java RMI with asynchronous callback functions, Java RMI based polling, socket programming 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 using only one or two sentences each.

(08 marks)

i. To get an alert from a remote health monitoring system, only when the heart rate exceeds a particular value.
ii. To login to an online banking application using the account id and the password.
iii. To check the heart rate using a remote health monitoring system, every five minutes.
iv. Fire alarm system that can sending/receive in an internal system with high internet traffic

Question 02 **(25 Marks)**

a) Distinguish the difference between Local Method invocation and Remote Method Invocation (03 Marks)

b) Following interface and information given.

(hint : $\pi = 22/7$, Area of a cylinder $= 2\pi rh + 2\pi r^2$, Volume of a Cylinder $= \pi r^2 h$)

```
import java.rmi.Remote;
import java.rmi.RemoteException;

public interface CylinderService extends Remote {
    public double calculateArea (double radius, double
height) throws RemoteException;
    public double calculateVolume (double radius, double
height) throws RemoteException;

}
```

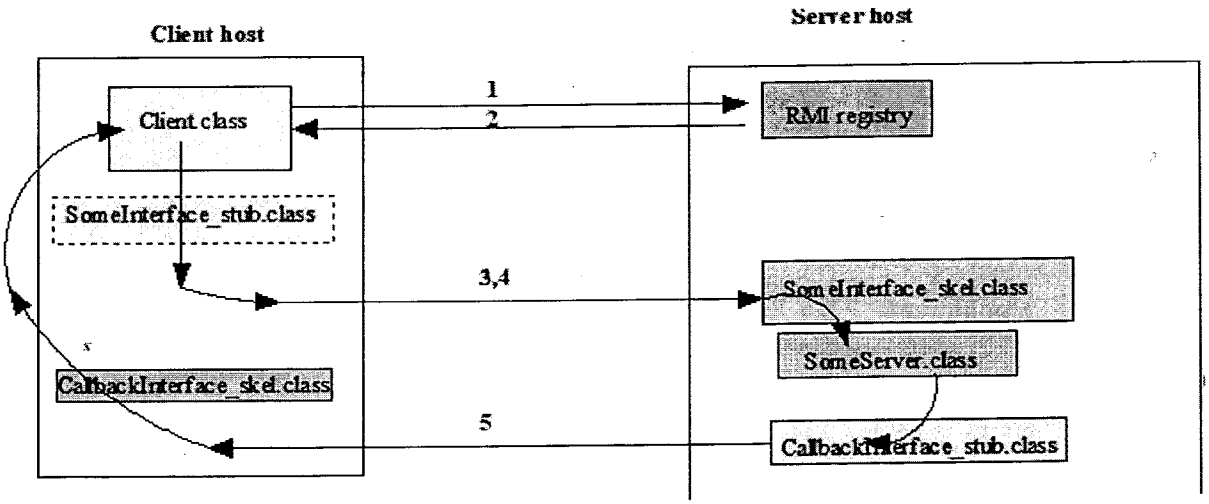
i. Construct java RMI code necessary to host server object at the url tcp://localhost/Cylinderserver

(08 marks)

ii. Construct the client code (cylinderClient.java) necessary to connect with server.

(06 marks)

c) Describe the steps (1 -5) of Asynchronous communication illustrates on diagram below.



(05 marks)

d) Construct the listener interface you need in client side to convert Cylinderarea and cylinderVolume you developed above (II) in to asynchronous communication . (Call back function names are areaCalculated and volumeCalculated)

(03 marks)

Question 03 **(25 Marks)**

The RPC frameworks such as CORBA, java RMI etc, share a few common issues that tend to inter-relate. They are Tight coupling between client and server, Security problems: Trust, Firewalls, The Internet, Limited/non-existent interoperability between frameworks

a) Describe SOA and prove how its different from traditional RPC frameworks.
(04 marks)

b) Compare Monolithic architecture, SOA & Microservices
(06 marks)

c) Service Discovery in micro services means find the available microservices and their location. Illustrate service discovery in client side and server side.
(05 marks)

d) Justify the main 4 (four) dependability factors of a software system/application.
(04 marks)

e) Following information's are given, Compute the availability of the CPU as a percentage.
MTBF= 250,000h
MTTR = 8H
(02 marks)

f) Redundancy is simply the addition of information, resources, or time beyond what is needed for normal system operation. Recommend the available redundancy options that could practice when handling fault tolerance.
(04 marks)

Question 04 **(25 Marks)**

Accident Capture Inc (accidentCapture.lk) is a local startup that has been asked by the city to monitor and record near misses and accidents between train and vehicles, and pedestrians 24 hours per day,7 days per week, 365 days per year. Accident Capture (AC) is planning to deploy video cameras and dedicated computing at each busy railway intersection in the city.

AC plans to capture video at a sustained frame grab rate of 20 frames per second, 24 hours per day. They will provide privacy to drivers, cyclists, and pedestrians by denaturing the video at the intersection before it is stored. Since the bandwidth from the intersection to the cloud is limited, AC plans to process the streams of data at the intersection to identify near misses and accidents. They will then send the data for just the "interesting" cases to the cloud for storage and potential further analysis.

a) Cloud Computing offers various benefits and features to users. For each benefit listed below, **indicate whether it would be important (yes or no)** to Accident Capture Inc and **justify your answer.**
No upfront Cost, Reduced IT maintenance, VM Elasticity, Faster market time
(08 marks)

b) AC has grown and gone international, soon to cover 68% of the world's big cities! Should they build their own private cloud? Explain your answer.
(04 marks)

c) Compare vertical scaling and horizontal scaling with regards to cloud computing.
(04 marks)

d) Name and briefly explain the different platforms of cloud architecture.
(06 marks)

e) For each of the following scenarios, select the appropriate type of Cloud computing service you explain above (IV)
(03 Marks)

i. Using a cloud based HRM system to manage the internal HRM in a company, instead of using an internally hosted HRM system.

ii. Deploy your Enterprise web application in an application server that's hosted in the cloud.

iii. A virtual container that is automatically created in the cloud when the load on an application increase.

-End of the Question Paper-