00326

Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Specialized in Software Engineering

Final Examination
Year 3, Semester 1(2023)

SE3020 – Distributed Systems

Duration: 2 Hours

May/June 2023

Instructions to Candidates:

- This paper has 4 questions.
- Answer all questions in the booklet given.
- The total marks for the paper is 100.
- This paper contains 7 pages, including the cover page.
- This paper includes 10 minutes Reading Time.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (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 and have security problems related to Trust, Firewalls, The Internet, Limited/non-existent interoperability between frameworks.

a) Describe SOA and prove how it is different from traditional RPC frameworks. (4 marks)

b) Compare Monolithic Architecture, SOA & Microservices. (6 marks)

c) Service Discovery in micro services means find the available microservices and their location. Illustrate service discovery in server side. (5 marks)

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

e) Refer the following information and compute the availability of the CPU as percentage. (2 marks)

MTBF= 250,000h
MTTR = 8H

f) Redundancy is simply the addition of information, resources, or time beyond what is needed for normal system operation. Explain four sections under redundancy that we could practice when handling fault tolerance. (4 marks)

Question 02 (25 Marks)

a) Assign the most appropriate distributed communication technology (Java RMI blocking, Java RMI with asynchronous callback functions, Java RMI based polling, socket programming) to solve each of the following problems. Briefly justify each answer that you give using only one or two sentences each. (8 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.

b) Identify and briefly explain the function of two components in the Java RMI framework. (4 Marks)

c) Refer the following interface and information given below.

(hint : π =22/7 , Area of a Sphere = $4\pi r^2$ Volume of a Sphere = $4/3\ \pi r^3$)

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

public interface SphereService extends Remote {
    public double calculateArea (double radius) throws
RemoteException;
    public double calculateVolume (double radius) throws
RemoteException;

}
```

(i) Provide java RMI code necessary to host server object at the url tcp://localhost/Sphereserver

(8 marks)

(ii) Provide the client code (sphereClient.java) necessary to connect with server.

(5 marks)

Question 03 **(25 Marks)**

a) You have been asked to develop an online supermarket system to buy grocery items online. The system should facilitate searching and purchasing of grocery items online. The customers make the payments using a credit card. The system uses a third party payment gateway to handle the payments. Once a particular purchase is made to buy a set of grocery items, the users should select the method of delivery (delivery or pick up). 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.

In the above mentioned online supermarket system 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) "From the perspective of composing Web services to execute business processes, orchestration is a more flexible paradigm". Briefly explain two advantages of over choreography. (3 marks)

c) Write a sample XML file for the following XML schema. (8 Marks)

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified">
 <xs:element name="Subjects">
  <xs:complexType>
   <xs:sequence>
    <xs:element ref="Subject" maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:complexType>
 </xs:element>
 <xs:element name="subject">
  <xs:complexType>
   <xs:sequence>
   <xs:attribute name="id" type="xs:int"/>
   <xs:element name="subject_name" type="xs:string"/>

<xs:element ref="lecturer"/>
   </xs:sequence>
  </xs:complexType>
 </xs:element>
 <xs:element name="lecturer">
  <xs:complexType>
   <xs:sequence>
    <xs:element name="firstname" type="xs:string"/>
    <xs:element name="lastname" type="xs:string"/>
   </xs:sequence>
  </xs:complexType>
 </xs:element>
</xs:schema>
```

d) Write a sample JSON object to represent the sample XML file that you wrote in part (c). (3 Marks)

e) Name two applications of XSL transformations. (2 Marks)

f) Write the output of the following XML file, transformed using the given XSL transformation file. (4 Marks)

XML file:

```
<?xml version="1.0" encoding="UTF-8"?>

<catalog>
    <cd>
            <title>Empire Burlesque</title>
            <artist>Bob Dylan</artist>
            <country>USA</country>
            <company>Columbia</company>
            <price>10.90</price>
            <year>1985</year>
    </cd>
    <cd>
            <title>Hide your heart</title>
              <artist>Bonnie Tyler</artist>
              <country>UK</country>
              <company>CBS Records</company>
              <price>9.90</price>
              <year>1988</year>
     </cd>
</catalog>
```

XSL transformation file:

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet version="1.0"
xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:template match="/">
 <html>
 <body>
  <h2>My CD Collection</h2>
  <table border="1">
   <tr bgcolor="#9acd32">
    <th>Title</th>
    <th>Artist</th>
    <th>Year</th>
   </tr>
   <xsl:for-each select="catalog/cd">
   <tr>
    <td><xsl:value-of select="title" /></td>
    <td><xsl:value-of select="artist" /></td>
    <td><xsl:value-of select="year" /></td>
```

```
    </tr>
    </xsl:for-each>
  </table>
 </body>
 </html>
</xsl:template>
</xsl:stylesheet>
```

Question 04 **(25 Marks)**

a) Which of the following are examples of Software as a Service (SAAS), Platform as a Service (PAAS) and Infrastructure as a Service (IAAS) in Cloud computing? (3 marks)

(i) A high end virtual machine with a GPU (graphics processing unit) being obtained from the cloud to train a Machine Learning model.

(ii) A cloud based online student management system being used.

(iii) An IOT (Internet of things) integration platform that is hosted in the cloud being used to build an IOT application.

b) Select the most appropriate cloud architecture for each of the following application, out of Private cloud, Public cloud and Hybrid cloud. (3 marks)

(i) Standard ecommerce application to be deployed by a start-up company that does not have a lot of capital

(ii) Hosting defense department data in a virtualized environment so that the employees connecting from remote locations can create virtual machines to process the data

(iii) Continue to use a University's existing in-house data-centers, without investing to buy additional hardware when there's additional peak-hour traffic during online exams in the exam time period.

c) Give two real-world examples where a specified service may be different from the derived service, when considering the fault tolerance of a software service. (2 marks)

d) Briefly explain the key problem of the single commit protocol that is solved by the two-phase commit protocol. (4 marks)

e) Briefly explain the concepts of drift and skew with regard to clock synchronization. (4 marks)

f) State one similarity and one difference each of Christian's and Berkerly clock synchronization algorithms. (4 marks)

g) State the key improvement of Vector clocks over Lamport clocks? What is the necessity of that improvement. (5 marks)

END OF THE EXAMINATION PAPER