GALWAY-MAYO INSTITUTE OF TECHNOLOGY

SEMESTER 1 EXAMINATIONS 2018/2019

MODULE: COMP08011 - Distributed Systems

PROGRAMME(S):
GA_KSOAG_H08 BACHELOR OF SCIENCE (HONOURS) IN COMPUTING IN SOFTWARE DEVELOPMENT

YEAR OF STUDY: 4

EXAMINER(S):

Dr. Patrick Mannion	(Internal)
Mr. Tom Davis	(External)
Dr. Des Chambers	(External)

TIME ALLOWED: 2 Hours

INSTRUCTIONS: **Answer 4 questions. All questions carry equal marks.**

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.
The use of programmable or text storing calculators is expressly forbidden.
Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

There are no additional requirements for this paper.

QUESTION 1 ***[TOTAL MARKS: 25]***

Q 1(a) **[13 Marks]**

Explain the importance of the following terms as they apply to distributed systems:

- Heterogeneity **(3 Marks)**
- Transparency **(3 Marks)**
- Scalability **(3 Marks)**
- Middleware **(2 marks)**
- Inter-Process Communication **(2 marks)**

Q 1(b) **[12 Marks]**

Compare and contrast each of the following Inter-Process Communication models, identifying the key differences between them. Your answer should provide an example of each model. Use diagrams where appropriate.

- Remote Procedure Call Model
- Object-Oriented Model
- Service-Based Model

[End of Question1]

QUESTION 2 ***[TOTAL MARKS: 25]***

Q 2(a) **[10 Marks]**

"Marshalling frameworks based on highly structured Unicode formats have largely supplanted serialisation and binary data transfer formats."

You are required to provide a critique of this statement. Your answer should compare Unicode and lower-level marshalling formats in terms of heterogeneity, extensibility and efficiency.

Q 2(b) **[10 Marks]**

"XML schema definitions in combination with data binding frameworks can greatly simplify Inter-Process Communication in heterogeneous distributed systems".

Provide a critique of this statement. Discuss the data modelling process, the concept of data binding, an externalisation framework and a utility for automatically generating the code for class definitions from a .xsd your answer.

Q 2(c) **[5 Marks]**

Explain using pseudocode (or Java code), how an object may be transferred from one process to another using a Unicode format. Your answer should include the operations performed by the client and the server.

[End of Question2]

QUESTION 3 ***[TOTAL MARKS: 25]***

Q 3(a) **[6 Marks]**

Describe the function of the following components of the RMI architecture, using diagrams where appropriate:

- Remote Objects **(3 Marks)**
- RMI URLs and the RMI Registry **(3 Marks)**

Q 3(b) **[13 Marks]**

Explain the procedure that is followed when creating a custom interface which specifies how a client process may interact with a Remote object. **(3 marks)**

Write out the Java code for a Remote interface which provides the functionality described below. **(10 marks)**

You have been tasked with creating a RMI Database Service for student records. You may assume that a serializable class definition Student.java is available. The methods in the interface should make use of this serializable class definition where possible.

The Database Service will have the following remotely accessible methods:

- getStudent – this method retrieves a single student record from the database. It takes an integer (student id) as an argument.
- getAllStudents – this method retrieves all student records from the database.
- addStudent – this method adds a new student to the database.
- deleteStudent – this method removes a single student record from the database. It takes an integer (student id) as an argument.

Q 3(c) **[6 Marks]**

Explain how a pass by reference may be simulated using the RMI framework. Use examples of Java code and/or pseudocode to support your answer.

[End of Question3]

QUESTION 4 ***[TOTAL MARKS: 25]***

Q 4(a) **[5 Marks]**

Explain the mapping between HTTP methods and CRUD operations in RESTful architectures.

Q 4(b) **[10 Marks]**

Assume that a RESTful service which allows CRUD operations on a student resource is available at the following URL: http://www.examplesite.com/students

Explain how a HTTP request may be made to this service to retrieve the details of a student called Jane in XML format. Use a diagram of the client-server interaction along with the text of a sample HTTP request and HTTP response to aid your explanation.

Q 4(c) **[10 Marks]**

Explain how annotations may be used in the JAX-RS/Jersey framework to facilitate deployment of a Java Object as a RESTful web resource. Use a sample annotated Java class with one method to support your answer. Your code sample should demonstrate the use of annotations specifying the HTTP method type handled, resource path, path parameters and MIME response type.

[End of Question4]

QUESTION 5 ***[TOTAL MARKS: 25]***

Q 5(a) **[9 Marks]**

Compare the following partitioning strategies for distributed databases:

- Range Partitioning
- Hash Partitioning
- List Partitioning

Q 5(b) **[9 Marks]**

State Brewer's CAP theorem and explain the meaning of each of the three systematic requirements to which it relates.

Q 5(c) **[7 Marks]**

Explain the purpose of WSDL in the context of distributed systems, giving examples. List and describe the four key aspects of a service which is described by WSDL.

[End of Question5]

[END OF EXAM]