DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET DUBLIN 8

DT211 BSc. (Honours) Degree in Computing

Year 4

DT228 BSc. (Honours) Degree in Computer Science

Year 4

Semester 1 Examinations 2013/2014

Distributed Systems

[DT211/4, DT228/4]

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Tuesday 7th January 1.00 p.m. - 3.00 p.m.

Attempt ***three*** out of ***four*** questions
Question **1** carries **34** marks
All other questions carry **33** marks each

1. (a) What is meant by the architectural model of a distributed system? Describe *two* architectural models of a distributed system and give examples of applications they may be suitable for.

(9 marks)

(b) A server program written in one language (for example C++) provides the implementation of an object that is intended to be accessed by clients that may be written in a different language (for example Java). The client and server computers may have different hardware, but all of them are attached to an internet.

Discuss the problems due to each of the *five* aspects of *heterogeneity* that need to be solved to make it possible for a client object to invoke a method on the server object.

(12 marks)

(c) Using sample code, show how to create a simple *TCP server* that will receive a Java object of type Student, where the Student class has *name, surname and studentID* attributes, all of which are java.lang.Strings.

Provide the code for the *TCP client* that would send the object.

(13 marks)

2. (a) A distributed EU Statistics application has statistic objects available to connecting clients. These remote objects allow a client to get:

- The main language of a country
- The population of a country
- The capital city of a country

Define the interface to the EU Statistics service in *Java RMI*.

(8 marks)

(b) Discuss the main *issues* that make *Remote Method Invocation (RMI)* different to normal invocation of local methods. You may use *Java RMI* terminology to help illustrate your answer.

(12 marks)

(c) Discuss the *three* different types of RMI *invocation semantics*.

(13 marks)

3. (a) Describe the factors affecting performance of the *two-phase commit* protocol.

(8 marks)

(b) Discuss the requirement for *atomicity* in transactions at a single server. You should use examples of possible errors to justify this requirement.

(12 marks)

(c) Describe the *publish-subscribe paradigm*. Using an example, demonstrate how *event-based systems* are implemented using callbacks in distributed object systems.

(13 marks)

4. (a) Describe the role played by the *verifier*, the *class loader* and the *security manager* in ensuring the security of Java applications

(8 marks)

(b) Write the code for the multi-threaded program described below.

1. The main thread starts off three threads to run concurrently.
2. While the three threads run concurrently, the first thread must be the first to finish and the second thread must be the second to finish i.e. the threads must wait for each other.
3. Each thread is responsible for doing the following inside its `run()` method:
    a. Multiplying up all the numbers from 1 to some specific number. The first thread multiplies all numbers from 1 to 10. The second thread multiplies all numbers from 1 to 20. The third thread multiplies all numbers from 1 to 30.
    b. Printing out the result of the multiplication.

(12 marks)

(c) Explain what is meant by *garbage collection* in a distributed system. Describe the *reference counting* algorithm for *distributed garbage collection*.

(13 marks)