W228/402

DUBLIN INSTITUTE OF TECHNOLOGY

DT228 BSc. (Honours) Degree in Computer Science

Year 4

WINTER EXAMINATIONS 2016/2017

DISTRIBUTED SYSTEMS [CMPU4021]

MS. EDINA HATUNIC-WEBSTER
DR. DEIRDRE LILLIS
MR. KEVIN FOLEY

THURSDAY 12TH JANUARY 1.00 P.M. – 3.00 P.M.

TWO HOURS

ATTEMPT **3 QUESTIONS.**
ALL QUESTIONS CARRY **EQUAL** MARKS.
ONE COMPLIMENTARY MARK IS AVAILABLE.

1. **(a)** What is meant by the *architectural model* of a distributed system? Describe and illustrate with examples, the *mobile code* architectural model.

(8 marks)

(b) Provide Java code to *multicast* a UDP message from a client to a group.

(12 marks)

(c) Discuss in detail *group communication*. Your answer should cover the programming model, key distinctions and key areas of application.

(13 marks)

2. **(a)** Describe *four* criteria for selecting *middleware*, which can be used generically for choosing the most appropriate software for a particular area.

(8 marks)

(b) Explain and provide examples for three types of threading problems which may arise if concurrent threads execution is not synchronised when accessing shared data.

(12 marks)

(c) You need to write the code for the multi-threaded Java program described below. The main thread starts off *two* threads to run concurrently. Each thread is responsible for doing the following inside its `run()` method:

- The first thread must add all numbers from 1 to 2016.
- The second thread must add all numbers from 1 to 2017.
- Each thread should print out the result of the addition.

You must ensure that while the two 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.

(13 marks)

3. **(a)** The *RMIPower* interface provides two remote methods that calculate powers:

square: A method that accepts as a parameter an integer, squares it, and returns a `BigInteger` (as in `java.math.BigInteger`)

power: A method that accepts as a parameter two integers, calculates their power, and returns a `BigInteger`

Define the interface for the *RMIPower* service in Java RMI.

(8 marks)

(b) A software team wishes to develop a distributed application using Java RMI. Part of the design specification includes the following:

- Initially the *rmiregistry* will be used as the naming service. However, future system changes may involve migrating to a new naming service. The application should be designed in such a way as to minimise the impact of this possible change.
- It is foreseen that there will be numerous updates of remote objects once the application has been deployed. Clients will need access to these updated remote objects with minimal disruption.
- Remote objects will need to proactively contact the clients when certain events occur.

Discuss the facilities you would use to address each of the above three design criteria explaining how they would meet the design specifications.

(12 marks)

(c) Explain the core technologies of the *web service* approach for middleware and Internet-wide distributed computing, and provide an analysis of its strengths and weaknesses when compared with competing approaches.

(13 marks)

4. **(a)** Describe and compare *two* alternative approaches to external data representation and marshalling.

(8 marks)

(b) Using sample code, show how to create a TCP server that will receive a Java object of type *Student*, where the Student class has *name*, *homeAddress* and *studentNo* attributes, all of which are *java.lang.String*.

(12 marks)

(c) With the help of a diagram discuss the operations of *two-phase commit protocol* in distributed transactions.

(13 marks)