Programme Code: TU856(DT228), TU857(DT211C), TU858(DT282)
Module Code: CMPU 4021
CRN: 22417, 32475, 25775

TECHNOLOGICAL UNIVERSITY DUBLIN

CITY CAMPUS

DT228/TU858 BSc. (Honours) Degree in Computer Science
DT211C/TU857 BSc. (Honours) Degree in Computer Science (Infrastructure)
DT282/TU858 BSc. (Honours) Degree in Computer Science (International)

Year 4

SUPPLEMENTAL EXAMINATIONS 2021/22

Internal Examiners
Dr. Edina Hatunic-Webster
Dr. Paul Doyle

External Examiners
Ms. Sanita Tifentale
Ms. Pauline Martin
Ms. Pamela O'Brien

Duration: 2 hours
Date:

Instructions
Attempt **3 questions**
All questions carry **equal** marks
One complimentary mark is available

1. (a) Describe *mobile code and mobile data* software architectural models and give examples of systems they are suitable for.

(8 marks)

(b) The code shown below is a partial implementation of a server that takes a message from the user and sends it to *a group* of clients.
Complete the Java implementation of this code, and write a client that can receive the message. Note that several client processes should be able to run concurrently, with *all* of them receiving the message.

```
import java.net.*;
import java.io.*;

public class  Q1b{
 public static void main(String[] args) {
   try {
      int port = 3110;
      BufferedReader inputStr = new BufferedReader(new
                                   InputStreamReader(System.in));
      DatagramSocket socket = new DatagramSocket();

      InetAddress group = // WRITE THE MISSING CODE

      while(true) {
            System.out.print("Enter message :/> ");
            String message = inputStr.readLine();
            socket.send(new DatagramPacket(
                               message.getBytes(),
                               message.length(),
                               group, port));}
      } catch (Exception e) {}
  }}
```

(12 marks)

(c) Describe the main usage of *indirect communication* and discuss *group* communication as an example of an indirect communication paradigm.

(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) Describe the Message Oriented Middleware (MOM) paradigm and discuss its advantages and disadvantages. Give examples of MOM middleware.

(12 marks)

(c) Explain the *three* different types of RMI *invocation semantics*. Using examples show how they are used to provide fault tolerance.

(13 marks)

3. **(a)** Describe the states that a *thread* can be in while running inside a process in a Java Virtual Machine (JVM).

(8 marks)

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

- The main thread starts off three threads to run concurrently.
- Each thread is responsible for doing the following inside its `run()` method:
    - Adding up all the numbers from 1 to some specific number.
    - Printing out the result of the addition.
    - The first thread must add all numbers from 1 to 300; the second must add all numbers from 1 to 30; the third must add all numbers from 1 to 3.

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.

(12 marks)

(c) Compare *web services* and the *distributed object model*. Use examples where necessary.

(13 marks)

4. **(a)** Explain *serial equivalence* in terms of concurrent transactions.

(8 marks)

(b) Explain the term *transparency* in relation to distributed systems, and using as examples *four* different types of transparency, show how they *are* or *are not* provided for by some distributed applications.

(12 marks)

(c) Design a distributed object system for a system offering a *rugby-score-service* service that provides scores to client applications in real time, as scores change. Justify the choice of design. Evaluate the strengths and weaknesses of your design.

(13 marks)