



DUBLIN INSTITUTE OF TECHNOLOGY

DT228 BSc. (Honours) Degree in Computer Science

**DT282 BSc. (Honours) Degree in Computer Science
(International)**

Year 4

WINTER EXAMINATIONS 2017/2018

DISTRIBUTED SYSTEMS [CMPU4021]

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THURSDAY 11TH JANUARY

2.00 P.M. – 4.00 P.M.

TWO HOURS

ATTEMPT **3** QUESTIONS

ALL QUESTIONS CARRY **EQUAL** MARKS

ONE COMPLIMENTARY MARK IS AVAILABLE

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1. (a) Describe *two* design requirements for distributed architectures. Illustrate using at least one example for each description. (8 marks)

- (b) A server program written in one language (e.g., C++) provides the implementation of an object that is intended to be accessed by clients that may be written in a different language (e.g., 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.

Provide one example for solving problems of heterogeneity.

(12 marks)

- (c) Using sample code, show how to create a simple TCP server that will receive a Java object of type *Patient*, where the *Patient* class has *name*, *address* and *patientID* attributes, all of which are `java.lang.String`.

(13 marks)

2. (a) Explain the different thread states and what is meant by thread starvation.

(8 marks)

- (b) Explain the operation of a *distributed garbage collection* algorithm based on reference counting. Discuss how it handles failures.

(12 marks)

- (c) Suggest a design for a *notification mailbox service* which is intended to store notifications on behalf of multiple subscribers, allowing subscribers to specify when they require notifications to be delivered.

Evaluate the strengths and weaknesses of your design.

(13 marks)

3. (a) Explain the need for external data representation and marshalling in distributed systems.

Outline at least *two* approaches to external data representation and marshalling.

(8 marks)

- (b) Describe the differences between the datagram communication protocol and the stream communication protocol, outlining at least two issues associated with each.

(12 marks)

- (c) The code shown is a partial implementation of a server that broadcast the time to the clients every few seconds.

Complete the implementation of this code, and write a client that can receive the message (i.e. the time) by passively listening for messages on a `MulticastSocket`. Multiple client processes should be able to run concurrently, with *all* of them receiving the message.

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

public class q2C{

    public static void main(String[] args) {

        try {
            DatagramSocket socket = new DatagramSocket(12345);
            DatagramPacket packet;
            InetAddress addrToSendTo = // WRITE THE MISSING CODE
            while(true) {
                byte[] buffer = new Date().toString().getBytes();
                packet = new DatagramPacket(buffer, buffer.length, addrToSendTo, port);
                socket.send(packet);
                // sleep for a second
                try {
                    Thread.sleep((long)(Math.random() * 3000));
                } catch (InterruptedException e) { }
            } catch (Exception e) {}
        }
    }
}
```

(13 marks)

4. (a) Explain the purpose of UDDI. What are the *four* different data structures that support UDDI? Describe their uses.

(8 marks)

- (b) Explain the core technologies of the *web service* approach as middleware and Internet-wide distributed computing and discuss its strengths and weaknesses when compared with competing approaches.

(12 marks)

- (c) Discuss why security is critical for networked Java applications and in particular for Java *mobile code* such as Java applets. Explain in detail the role and composition of the Java *sandbox* in providing this security

(13 marks)