

This question paper consists of 6 printed pages, each of which is identified by the Code Number COMP2221.

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School of Computing

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COMP2221

Networks

Answer all 3 questions

Time allowed: 2 hours

This is an open book examination. This means that you may take with you any written or printed materials into the examination room. You are unlikely to win any credit in any question for reproduction or simple rephrasing of notes.

Question 1

- (a) Some applications favour the use of TCP over UDP, and others are more suited to using UDP rather than TCP. Why is this? **[2 marks]**
- (b) Consider the range of IP addresses denoted 100.128.54.0/22.
- (i) Is this a classful or classless range of addresses? **[1 mark]**
 - (ii) What key advantage do classless address ranges have over classful ones? **[1 mark]**
 - (iii) Does the address 100.128.52.127 belong to this range? Explain your answer. **[2 marks]**
- (c) A student is trying to write a client application that accesses the server at `dict.org` to translate English words into Spanish, one word at a time. Their first attempt is a class called `NetworkTranslator` and is given in the Appendix. Inspect the code, then answer the following questions.
- (i) Assuming the code works as intended, describe the procedure by which instances of `NetworkTranslator` translates words using the service provided by `dict.org`. Include in your answer the meaning of the number 2628 that appears in line 12. **[4 marks]**
 - (ii) Describe how you think the corresponding server application might communicate with a single client to achieve the desired result. You do not need to consider how the translation is actually achieved. **[4 marks]**
 - (iii) As written the code will fail to compile. Why is this, and what would you do to rectify the problem? **[3 marks]**
 - (iv) Both the input and output streams are buffered. Why is this normally desirable for networked applications? Does it make sense for both the reader and writer to be buffered in this particular application? **[3 marks]**

[question 1 total: 20 marks]

Question 2

(a) A server application is designed to read temperature measurements from a given device and stream the temperature values to the network at a regular 2-second interval. It is decided that a UDP multicast architecture will be used.

(i) Describe a server class, which is called `TemperatureServer`, with the following minimal functionality:

- A constructor method that initialises the multicast communication given an IP address `myIP` and port `myPort`.
- A method that transmits the temperature data to the network at the required interval.

In each case you should state the `java.net` classes, and the methods from those classes, that are required. A fully coded Java solution is not required. **[6 marks]**

(ii) What are the requirements for the IP address and port number that the server uses for multicast communication? **[2 marks]**

(b) A corresponding client application is designed to receive the data streamed by the server.

(i) Explain the network communication architecture by which the client receives data from the server. State the relevant `java.net` classes, and their methods, where required. **[6 marks]**

(ii) State two advantages of a multicast architecture for the client application described here. **[2 marks]**

(c) A second multicast server streams wind speed data with the same 2 second interval.

(i) Describe how the design of the client application could be extended to read from both streams of data. State the relevant `java.net` method. **[2 marks]**

(ii) Describe how the client can separate the streams of data that it receives. State relevant `java.net` methods. **[2 marks]**

[question 2 total: 20 marks]

Question 3

- (a) What is flow control trying to achieve, and how does this differ from congestion control? **[2 marks]**
- (b) In principle, is it possible to have flow control with UDP? Explain your answer. **[2 marks]**
- (c) TCP congestion control employs a variable congestion window CongWin that expands and contracts in response to network congestion. Suppose that initially $\text{CongWin}=1$ in units of the maximum segment size, and the threshold between slow start and congestion avoidance is 3 in the same units.
- (i) Describe the increase in CongWin for the first 3 round trips between the client and the server, assuming no packet loss. Explicitly state when the congestion avoidance phase commences and why. **[4 marks]**
- (ii) Suppose a packet loss is now detected. What is the corresponding sequence of events? **[2 marks]**
- (d) Shown in Fig. 1 is a configuration of four routers A, B, C and D, and four destination networks w, x, y and z. The initial routing table for A is:

Destination	Next router	No. hops
w	-	1
x	B	2
y	B	3
z	B	4

- (i) What is the purpose of a routing table? **[2 marks]**
- (ii) Suppose D sends the following advertisement to A:

Destination	Next router	No. hops
w	A	2
x	A	3
y	C	2
z	-	1

What is the resulting routing table for A? Explain your calculations. **[4 marks]**

- (iii) Suppose the link between routers B and C is broken. Describe the subsequent sequence of events according to the routing information protocol. You do not need to calculate any new routing tables. **[4 marks]**

[question 3 total: 20 marks]

[grand total: 60 marks]

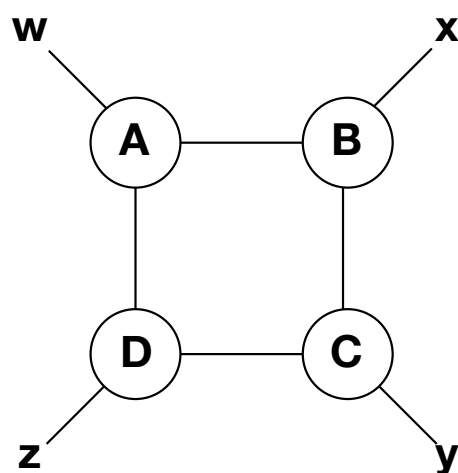


Figure 1: Figure for Question 3. The capital letters in circles denote routers, the lower-case letters at the ends of lines represent destination networks.

Appendix: NetworkTranslator.java

```
1 import java.io.*;
2 import java.net.*;
3
4 public class NetworkTranslator
5 {
6     private Socket socket = null;
7     private BufferedWriter writer = null;
8     private BufferedReader reader = null;
9
10    public void translateWords( String[] words )
11    {
12        socket = new Socket( "dict.org", 2628 );
13
14        writer = new BufferedWriter(
15            new OutputStreamWriter(
16                socket.getOutputStream(), "UTF-8" ) );
17
18        reader = new BufferedReader(
19            new InputStreamReader(
20                socket.getInputStream(), "UTF-8" ) );
21
22        for( String word : words )
23        {
24            // Send the request to translate a word.
25            writer.write( "DEFINE fd-eng-spa " + word + "\r\n" );
26            writer.flush();
27
28            // Print each line returned by the server.
29            for( String line=reader.readLine(); line!=null;
30                line=reader.readLine() )
31            {
32                if( line.startsWith("250 ") ) break; // Last line.
33                if( line.startsWith("552 ") ) break; // Unknown word.
34                System.out.println(line);
35            }
36        }
37    }
38
39    public static void main( String[] args )
40    {
41        NetworkTranslator translator = new NetworkTranslator();
42        translator.translateWords( args );
43    }
44 }
```