FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	CSC2B10 COMPUTER SCIENCE 2B
CAMPUS	AUCKLAND PARK CAMPUS (APK)
	MAIN EXAM MEMO

DATE: 2020-11-30 **SESSION:** 14:00 - 16:00

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MODERATOR: MR J.L. DU TOIT

DURATION: 120 MINUTES **MARKS:** 100

Please read the following instructions carefully:

1. Answer **all** the questions
2. Write *clearly* and *legibly*.
3. You may use a non-programmable calculator to answer the questions.
4. This paper consists of 11 pages.

QUESTION 1

(a) From a *service* perspective, describe the internet along with an example? [02]

Solution: Must include description and example - Else max 1 mark for both
1 mark for each point with an example
- infrastructure that provides services to applications: Web, VoIP, email, games, e-commerce, social nets, ect ✓
- provides programming interface to apps: hooks that allow sending and receiving app programs to "connect" to Internet. It provides service options, analogous to postal service ✓

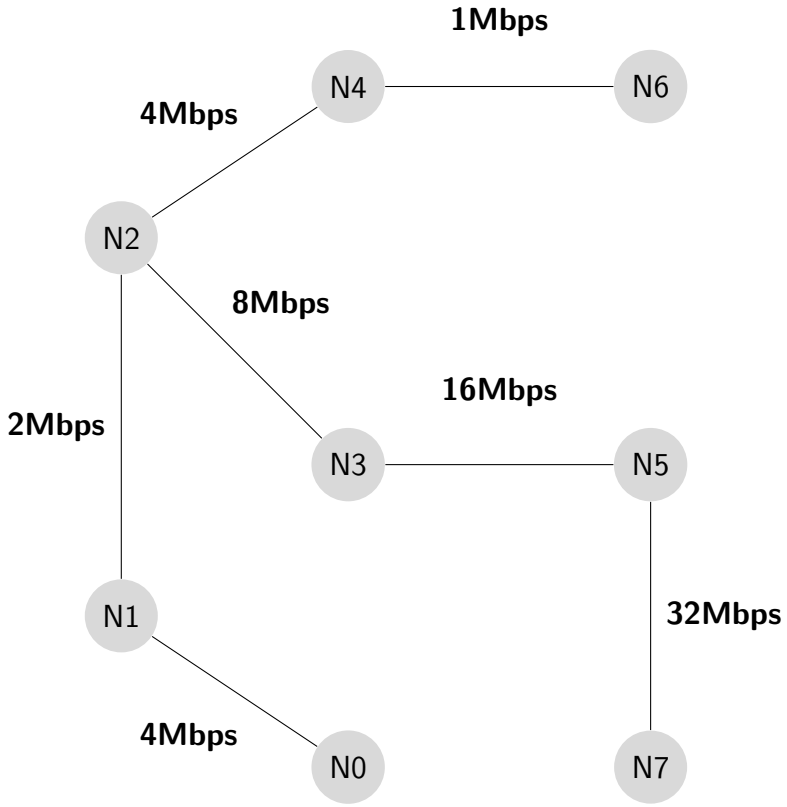
(b) Briefly *describe* how **FDM** works. [03]

Solution:
Frequency division multiplexing ✓ divides the full bandwidth among users in continuous frequency bands ✓. So each user has continuous bandwidth, which is good for persistent ✓ connection.

Total: 5

QUESTION 2

Assume there is a copper network with 8 nodes (N0, N1, N2, N3, N4, N5, N6 and N7) and the transmission rates between these nodes are as follows:



It is also determined that the distances between the nodes are as follows: (Note that all working out must be shown, failure to do this may result in the student receiving zero for the question)

- N0-N1: 10km
- N1-N2: 20km
- N2-N3: 15km
- N2-N4: 5km
- N4-N6: 10km
- N3-N5: 25km
- N5-N7: 30km

Answer the following questions (Do not round off):

(a) *Determine* the **approximate transmission rate** when communicating between N0 and N7. [1]

Solution:
It will be at 2 Mbps. ✓ 0 - for anything else

(b) Taking this **approximate transmission rate** into account, how *long* (in seconds) will it take to transfer a 100 MegaByte **file** from node N0 to N7? [02]

Solution: if they use a different throughput, max of 1 mark
100*8 = 800 Megabits (1 mark) ✓
800 / 2 = 400 seconds (1 mark) (no if they use their own throughput) ✓

(c) If it is determined that the copper installed in this network **propagates** a signal at a speed of 250 000 km/s. *Calculate* the **propagation delay** for communications between N0 to N7. [03]

Solution:
10 + 20 + 15 + 25 + 30 = 55 km (1 marks) ✓ Either wrong or right
55 / 250000 = 0.00022 seconds (2 marks) ✓ ✓

(d) Assuming that there is no nodal processing delay or queueing delay, *calculate* the **total time** taken to transfer a 50 MegaByte file from from N0 to N7? [04]

Solution:
Transmission delay = 400/4 + 400/2 + 400/8 + 400/16 + 400/32 = 100 + 200 + 50 + 25 + 12.5 = 387.5 seconds (2 marks) ✓ 1 - for the values and 1 - for the sum
Total = 387.5 + 0.00022 = 387.50022 seconds (2 marks) ✓ ✓ (1 mark if use their own values) ✗ ✗

Total: 10

QUESTION 3

(a) Within computer networks, we often have complex systems, *briefly* describe two *mechanisms* that deal with the complexity? [02]

Solution:

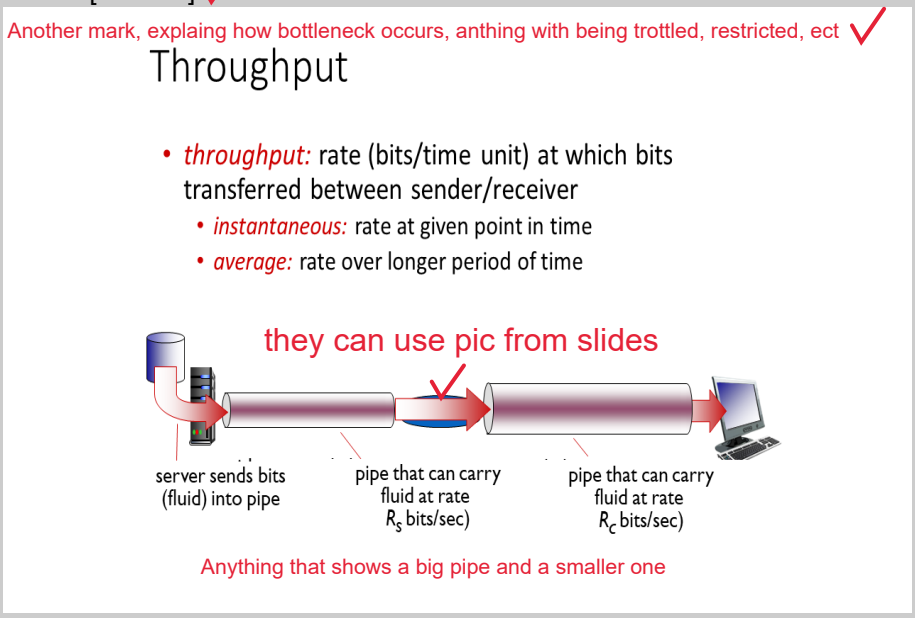
- abstraction - explicit structure allows identification, relationship of complex system's pieces ✓
  Must have description, max one mark iof they don'f have it
- Modularization - Breaks the system up yo mitigate the complexity [1 mark, must have description] ✓

(b) With aid of a diagram, *briefly describe* **throughput** and its relation to bottleneck. [03]

Solution:

throughput: rate (bits/time unit) at which bits transferred between sender/receiver [1 mark] ✓

Another mark, explaing how bottleneck occurs, anthing with being trottled, restricted, ect ✓



Anything that shows a big pipe and a smaller one

✗ mark for diagram

~~Student should explain bottleneck with regards to the maximum throughput [1 mark]. The smallest throughput will be the bottleneck.~~

Total: 5

QUESTION 4

(a) Within the *application layer*, there are different architectures, list and provide a short description of **two** architectures within the application layer. [04]

Solution: max 4

max 4 marks - can list any two Client server – popular today - including data-centre/cloud computing, anything about a client and a server communicating. ✓ ✓

client - server - one sending host and one recieving(single provider), typical web server setup

Peer – to –peer: No super powerful server – no one provider, uTorrent example. ✓ ✓

Hybrid of client server and P2P – You get the strengths for them and they of cover each others weaknesses ✓ ✓

(b) What is the role of a **socket**? [01]

Solution: any 1 fact for 1 mark

Max 1 mark -process sends/receives messages to/from its socket
-socket analogous to door
-sending process shoves message out door
-sending process relies on transport infrastructure on other side of door which brings message to socket at receiving process

Total: 5

QUESTION 5

(a) Name and briefly *describe* the two ways multiplexing can be achieved at the **transport layer**. [04]

Solution:

- Connection-oriented multiplexing, where TCP is used to establish a dedicated connection with a 4 tuple (source port and IP with destination port and IP).
- Connection-less multiplexing, where UDP is used to exchange information.

(b) *Name* three (3) mechanisms in the transport layer that help facilitate reliability **and** provide a reason for why they are needed. [06]

Solution:

(2 marks each) max 6 marks

1. Acknowledgements are used to confirm packet delivery
2. Timers are used to ensure delivery
3. Sequence numbers are used to ensure in order delivery
4. Pipelining is used to ensure efficient delivery
5. Checksums are used to ensure integrity

Total: 10

QUESTION 6

The table below represents the payload of a UDP segment. Calculate the **sum** of the following two 16-bit integers, along with their associated 1s complement **checksum**:

Note that all working out must be shown, failure to do this may result in the student receiving zero for the question

Number 1	1	1	0	1	1	0	1	0	0	1	1	0	1	0	1	1
Number 2	1	0	0	1	0	0	0	0	1	1	1	1	0	1	0	0
Sum (1)	0	1	1	0	1	0	1	1	0	1	0	1	1	1	1	1
Wrap around	0	1	1	0	1	0	1	1	0	1	1	0	0	0	0	0
Checksum	1	0	0	1	0	1	0	0	1	0	0	1	1	1	1	1

OR

Solution:

(-1 mark if missing wrap around)

1001 0100 1001 1111

Total: 5

QUESTION 7

(a) *Discuss* the network layer functions of *forwarding* and *routing*. Your discussion should include an **explanation** of what happens at the network level to facilitate these functions. Make use of a **diagram** to support your answer. [06]

Solution:

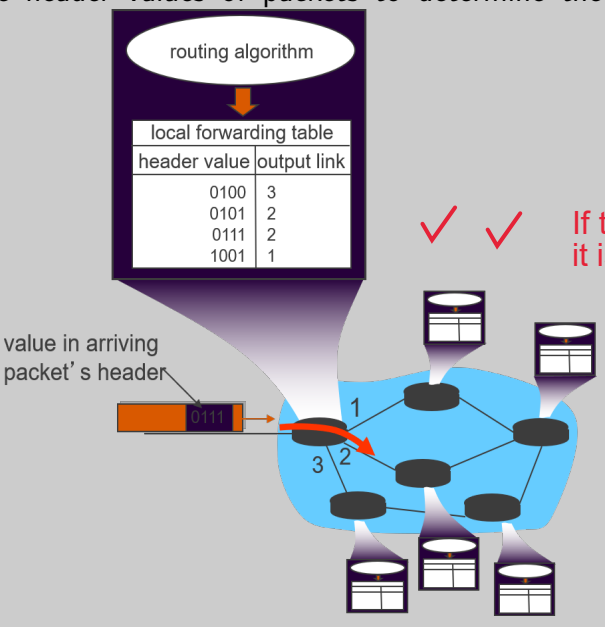
(Define (2), Explain (2), Diagram (2))

Forwarding - move packets from router's input to appropriate output (1) Local

Routing - determine the route taken by packets from source to destination (1) Global

Router has a local forwarding table (created by a routing algorithm) (1) Explaining

Examines the header values of packets to determine the appropriate output The two



If they copy and paste, it is okay

link(1)

(b) *Discuss* what **DHCP** is and how it works by referring to a **client-server** scenario. [04]

Solution:

Dynamic Host Configuration Protocol (1)

Max 3 Marks for any of the following (3):

Allows a host to dynamically obtain its IP address from a network server when it joins a network

In a client-server scenario a host broadcasts a DHCP discover message.

DHCP server responds with DHCP offer message.

Host requests IP address: DHCP request

DHCP server respons with DHCP ack message.

Total: 10

QUESTION 8

Given the following **IP address** and **CIDR**, answer the questions that follow (Note that all working out must be shown, failure to do this may result in the student receiving zero for the question):

172.51.37.39/27

(a) Provide this address in **binary** notation. [02]

Solution:
10101100 00110011 00100101 00100111

Must show working out - if no then 0
No half marks

(b) How many hosts can this network **accommodate**? [02]

Solution:
32 - 27 = 5
2^5 = 32-2=30

(c) Assuming classful addressing was used, what **class** does this address belong to? [02]

Solution:
Class B.

(d) Calculate the **network address** of this block in dotted decimal notation. [02]

Solution:
001**00000** = 32
172.51.37.32

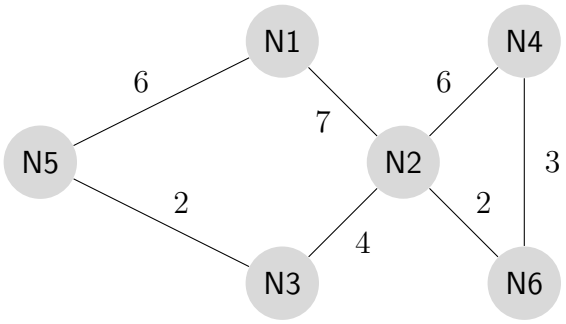
(e) Calculate the **broadcast address** of this block in dotted decimal notation. [02]

Solution:
00**11111** = 63
172.51.37.63

Total: 10

QUESTION 9

Given the below network **routing graph** (with costs), answer the following questions that follow (Note that all working out must be shown, failure to do this may result in the student receiving zero for the question):



(a) What is the path with the **least cost** when communicating between N4 and N5. Is this the **only** cost effective path? [02]

Solution:
N4-N6-N2-N3-N5 (1 mark)
Yes (1 mark)

(b) Given the local datagram **forwarding table** for node N2 below and the destination address is 196.83.37.91, which link will this packet be forwarded to? Please ensure to show all your calculations. [03]

Destination Address range	Output Link Interface
11000100 01010011 00100101 01011***	N1
11000100 01010011 00100101 010110**	N3
11000100 01010011 00100101 010111**	N4
Otherwise	N6

Solution:
IP in binary: 11000100 01010011 00100101 01011011 (2marks)
Link N3 (1 mark)
They just have to convert the last one

Total: 5

QUESTION 10

(a) Within the context of the **data link layer**, *describe* how random access MAC protocols work. Under which **network circumstances** are random access MAC protocols **efficient**? Give a **reason** for your answer. [05]

Solution:

- When a node has a packet to send it can transmit at full channel data rate(1) circumstance
- Two or more transmitting nodes = collision (1)
- Random Access MAC protocol specifies how to detect and recover from collisions (1)
- (Examples include ALOHA, slotted ALOHA, CSMA, CSMA/CD, CSMA/CA) Max 1 mark
- Random Access MAC is efficient at a low load, because a single node can fully utilize teh channel (2)

(b) Discuss what **PPP** is and **what** it is typically used for. [05]

Solution:

- Point to point protocol (2)
- Commonly used to establish a direct connection between two nodes (1)
- Connect computers using serial cable, phone link etc (1)
- Most ISPs use PPP for customers' dial-up access to the Internet(1)

Total: 10

QUESTION 11

(a) You have been approached by the South African government to create an **Android** mobile application which will handle confidential information. **Which two** security best-practice principles would be your main focus in the creation of the app? Give a **reason** for your answer. [03]

Solution:
(2 marks for the principle, 1 mark for the reason)

- Encrypt your data
- Detect insecure devices
- Authenticate users and keys using bio metrics
- Communicate securely (SSL)
- Testing
- Audit third party libraries
- REASON - any valid reason: Confidentiality, integrity, privacy etc.

(b) **Briefly discuss** how the **Ping** command works. [02]

Solution:

- Ping tests if a remote host is alive.
- Uses ICMP protocol. Must provide either hostname or IP address as parameter for this command.

Total: 5

QUESTION 12

Provide Java source code for a **UDP Client** that sends a message (entered by the user) to a UDP server that runs on port 9494. The client should receive the server response and print it out to the user.

Solution:

Ignore letters

```
1  import java.io.*;
2  import java.net.*;
3  class UDPClient
4  {
5    public static void main(String args[])
6    {
7      try
8      {
9        BufferedReader inFromUser =
10           new BufferedReader(new InputStreamReader(System.in)); //1
11       DatagramSocket clientSocket = new DatagramSocket();
12       InetAddress IPAddress = InetAddress.getByName("localhost");
13       byte[] sendData = new byte[1024];  //1
14       byte[] receiveData = new byte[1024];   //1
15       String sentence = inFromUser.readLine();
16       sendData = sentence.getBytes(); //1
17       DatagramPacket sendPacket =
18           new DatagramPacket(sendData, sendData.length, IPAddress,
                9494);  //1
19       clientSocket.send(sendPacket);  //1
20       DatagramPacket receivePacket = new DatagramPacket(receiveData
             , receiveData.length); //1
21       clientSocket.receive(receivePacket);  //1
22       String modifiedSentence = new String(receivePacket.getData())
             ;    //1
23       System.out.println("FROM SERVER:" + modifiedSentence);    //1
24       clientSocket.close();
25     }
26     catch(IOException io)
27     {
28       System.err.println(io.getMessage());
29     }
30   }
31 }
```

Total: 10

QUESTION 13

The code below illustrates a **TCP server** that handles client requests including the return of a specified png file. Fill in the missing code for sections A to G. Clearly label your answers.

```
1  public class TCPHandler implements Runnable {
2    private Socket          connectionToClient;
3    private BufferedReader  txtin;
4    private PrintWriter     txtout;
5    public TCPHandler(Socket newConnectionToClient) {
6      try {
7        connectionToClient = newConnectionToClient;
8        InputStream is = __( A (1 marks) )__; // Setup text in stream
9        txtin = new BufferedReader(new InputStreamReader(is));
10       // Setup text out stream
11       txtout = new PrintWriter(/*Omitted*/);
12     }
13     catch (IOException ex)  { ex.printStackTrace(); }
14   }
15   public void run() {
16     boolean processing = true;
17     try {
18       while (processing) {
19         String message = __( B (1 marks) )__; // Get client message
20         StringTokenizer msgTokens = new StringTokenizer(message);
21         String command = msgTokens.nextToken().toUpperCase();
22         switch (command) {
23           case "GREETING": {
24             String name = __( C (1 marks) )__;
25             sendResponse("HI " + name);
26             break;
27           }
28           case "GETFILE": {
29             String fileID = msgTokens.nextToken();
30             String fileName = fileID +".png";
31             File fileToReturn = new File("data/server/"+fileName);
32             if(fileToReturn.exists())
33             {
34               txtout.println(__( D (1 marks) )__);//send the file
                     size to the client
35               txtout.flush();
36
37               FileInputStream fis = new FileInputStream(fileToReturn)
                     ;
38               byte[] buffer = new byte[1024];
39               int n= 0;
40               while(__( E (2 marks) )__)
41               {
42                 __( F (2 marks) )__
43                 dos.flush();
44               }
45               fis.close();
46               System.out.println("File sent to client");
47             }
```

```
48            break;
49            }
50            case "PARTING": {
51              processing = false;
52              sendResponse("BYE");
53              break;
54            }
55            default: {
56              sendResponse("ERROR");
57            }
58          }
59        }
60      }
61      catch (IOException ex) { ex.printStackTrace(); }
62      finally { // Cleanup
63        try {
64          __( G (2 marks) )__
65        }
66        catch (IOException ex) { ex.printStackTrace(); }
67      }
68    }
69    private void sendResponse(String response) {
70      txtout.println(response);
71      txtout.flush();
72    }
73  }
```

Solution:

Question	Code	Mark
A	connectionToClient.getInputstream()	1
B	txtin.readline()	1
C	msgTokens.nextToken()	1
D	fileToReturn.length()	1
E	(n=fis.read(buffer))>0	2
F	dos.write(buffer,0,n);	2
G	connectionToClient.close()	2

Total: 10

The End!