FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE CSC2B10
COMPUTER SCIENCE 2B

CAMPUS AUCKLAND PARK CAMPUS (APK)

SSA EXAM MEMO

DATE: 02-12-2021 **SESSION:** 08:00 - 10:00

ASSESSOR(S): MR. T MOODLEY
MS. M FOURIE

MODERATOR: DR. J.L. DU TOIT

DURATION: 120 MINUTES **MARKS:** 100

Please read the following instructions carefully:

1. Downloading and Reading time: 08:00 - 08:10
2. Writing time: - 08:10 - 10:10
3. Upload time: 10:10 - 10:40 (No extra time will be awarded)
4. Test support is available on Discord: Please see the email sent to you
5. Answers may be typed or hand-written and photographed.
6. Where possible, provide answers in the form of a list.

7. Where possible, upload your submission as a single PDF document.
8. Please DO NOT compress (ZIP, RAR, etc.) your submission.
9. Write *cleanly* and *legibly*.
10. You may use a non-programmable calculator to answer the questions.
11. This paper consists of 11 pages.
12. Upload all of your answers before the close of the submission time at 10:40

QUESTION 1

(a) According to the table below, provide an appropriate description for each property under the appropriate column. (1 mark for each description) ***Write down the letter and the correct answer next to it. e.g. (f) Foo*** [3]

Type of network	**Hybrid Fibre Coaxial Cable Network**	**Satellite**
Directionality of Medium	**Guided**	**Unguided**
Material of Medium	Coaxial Cable and Fiber Optics	Radio Waves
Transmission speed	10s of Mbps	**kbps to 45Mbps**

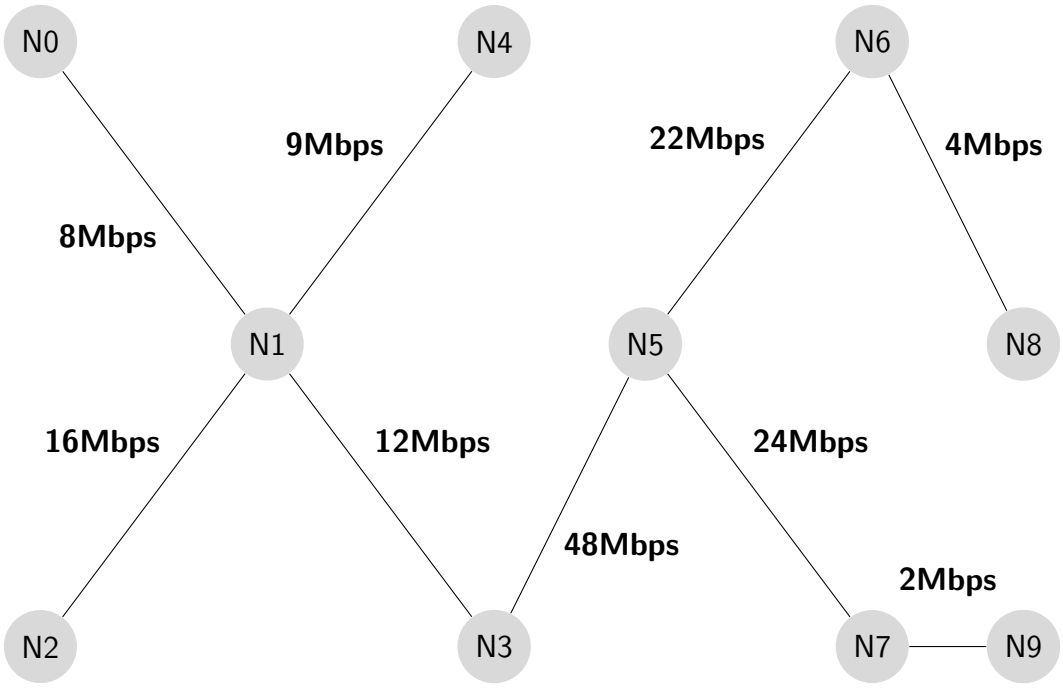
(b) The internet consists of various layers and service models, why should we layer within the internet? [02]

Solution:
- dealing with complex systems: - explicit structure allows identification, relationship of complex system's pieces - layered reference model for discussion - modularization eases maintenance, updating of system - change of implementation of layer's service transparent to rest of system

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: 20km
- N1-N2: 24km
- N1-N3: 4km
- N1-N4: 8m
- N3-N5: 6km
- N5-N6: 28km
- N5-N7: 32km
- N6-N8: 30km
- N7-N9: 12km

Answer the following questions:

(a) *Determine* the **approximate transmission rate** when communicating between N0 and N8. [1]

Solution:
It will be at 4 Mbps.

(b) Taking this **approximate transmission rate** into account, how *long* (in seconds) will it take to transfer a 40 MegaByte **file** from node N0 to N8? [02]

Solution:
36*8 = 320 Megabits (1 mark)
320 / 4 = 80 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 50 000 km/s. *Calculate* the **propagation delay** for communications between N0 to N8. [03]

Solution:
20 + 4 + 6 + 28 + 30 = 88 km (1 marks)
88 / 50 000 = 0.00176 seconds (2 marks)

(d) Assuming that there is no nodal processing delay or queueing delay, *calculate* the **total time** taken to transfer a 40 MegaByte file from from N0 to N8? [04]

Solution:
Transmission delay = 320/8 + 320/12 + 320/48 + 320/22 + 320/4 = 40 + 26.67 + 6.67 + 14.54 + 80 = 167.88 seconds (2 marks)
Total = 167.88 + 0.00176 = 167.88176 seconds (2 marks) (1 mark if use their own values)

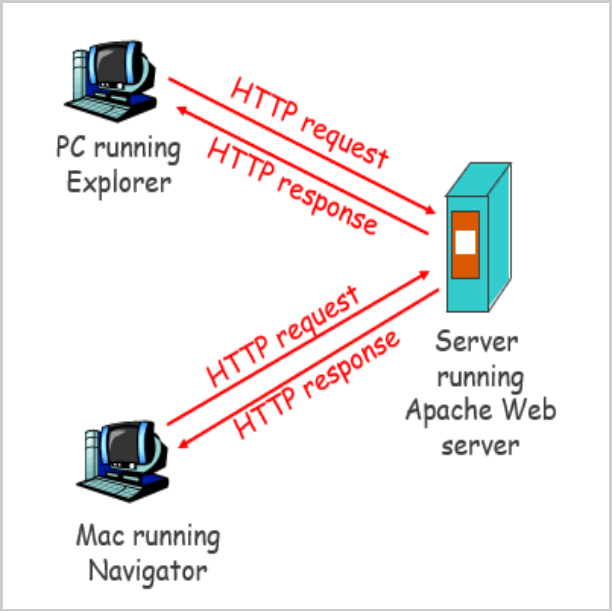
Total: 10

QUESTION 3

Using a diagram discuss how the HTTP protocol works. Be sure to label and refer back to your diagram in your answer.

Solution:

HTTP: hypertext transfer protocol Web's application layer protocol client/server model client: browser that requests, receives, "displays" Web objects server: Web server sends objects in response to requests



Total: 5

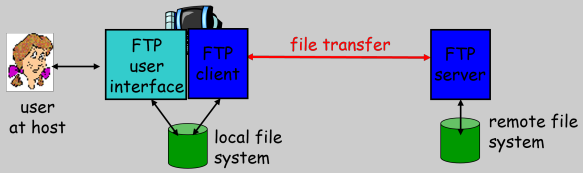
QUESTION 4

(a) *Discuss* the FTP protocol **and** draw a diagram to support your answer. [05]

Solution:

Any 3 valid facts: (3 marks)
-transfer file to/from remote host
-client/server model
-client:side that initiates transfer (either to/from remote)
-server:remote host
-ftp: RFC 959
-ftp server: port 21

2 marks for the diagram:



Total: 5

QUESTION 5

(a) RDT 2.0 has a fatal flaw, *discuss* this flaw and how we can mitigate this fatal flaw. [04]

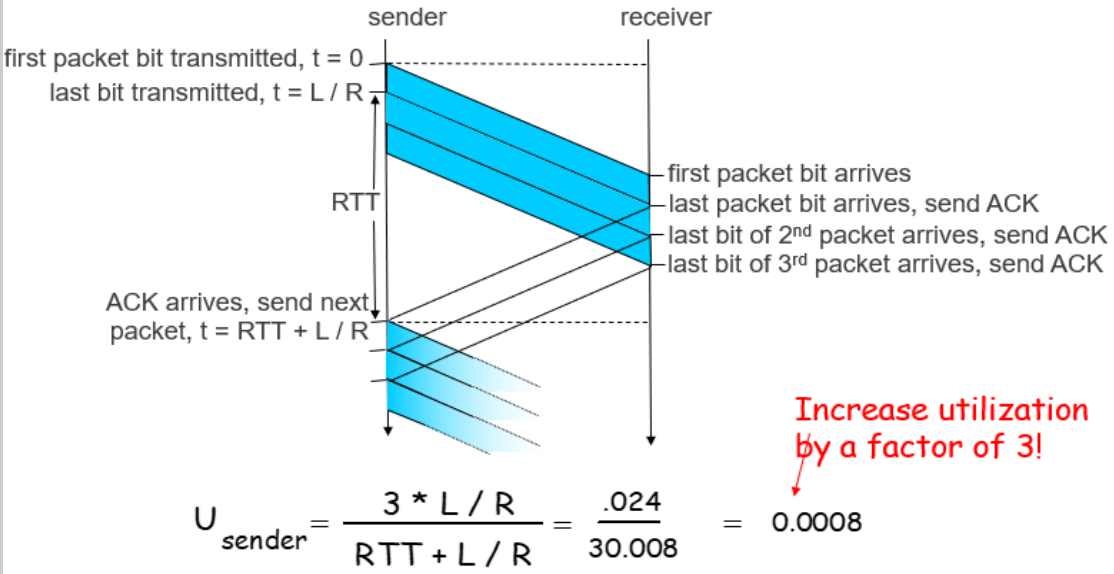
Solution:

What happens if ACK/NAK corrupted?
sender doesn't know what happened at receiver!
can't just retransmit: possible duplicate

Handling duplicates: sender retransmits current pkt if ACK/NAK garbled
sender adds sequence number to each pkt
receiver discards (doesn't deliver

(b) Using a diagram *discuss* the performance improvement that RDT 3.0 *stop and wait* operation yields. [06]

Solution:



$$U_{sender} = \frac{3 * L / R}{RTT + L / R} = \frac{.024}{30.008} = 0.0008$$

Total: 10

QUESTION 6

The table below represents the payload of a UDP segment. Calculate the **sum** of the following three 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	0	0	0	1	0	1	0	1	0	1	1	0	1	0	1	1
Number 2	1	0	1	0	1	0	0	0	1	1	1	0	1	0	0	1
Number 3	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	1
Sum (1 wrap)	1	1	0	1	1	1	1	0	0	0	1	1	1	1	0	1
Wrap around	1	1	0	1	1	1	1	0	0	0	1	1	1	1	0	1
Checksum	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0

Solution:

0010 0001 1100 0010

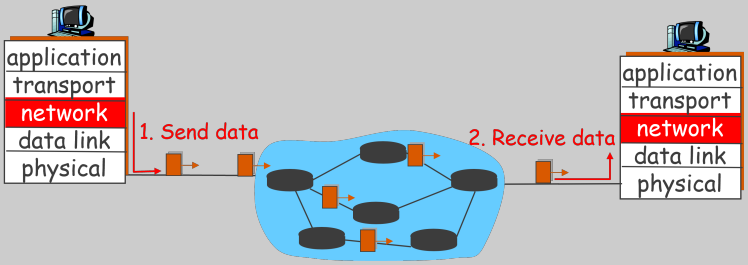
Total: 5

QUESTION 7

(a) In the network layer, we have what is called virtual circuits and datagram networks. *Fully discuss* **datagram networks** and how they work. *Draw* a diagram to support your answer. [08]

Solution:
(Any valid 6 facts = 6 marks description, 2 marks for diagram)

- No call setup at network layer
- Routers: no state about end-to-end connections
- No network-level concept of "connection"
- Packets forwarded using destination host address
- Packets between same source-dest pair may take different paths
- Data exchange among computers
- "Elastic" service, no strict timing req.
- "Smart" end systems (computers) - can adapt, perform control, error recovery
- Simple inside network, complexity at "edge"
- Many link types: different characteristics and uniform service difficult



(b) Name **two** reasons for IPv6. [02]

Solution:
(1 mark per item, max 2)

- Initial motivation: 32-bit address space soon to be completely allocated - Early 1990's
- Header format helps speed processing/forwarding
- Header changes to facilitate Quality of Service.

Total: 10

QUESTION 8

Given the following **IP address** and **computer number**, answer the questions that follow:

UJ wants 63 computers with an IP address of *222.8.34.21*

(a) What is the **CIDR** for this network? [02]

Solution:
$2^6 = 64$ So it will be $32 - 6 =$
26

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

Solution:
11011110 00001000 00100010 00010101

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

Solution:
Class C.

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

Solution:
00**000000** = 0
222.8.34.0

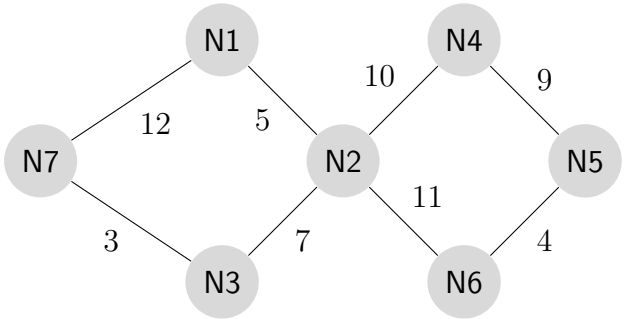
(e) Calculate the **broadcast address** of this block in dotted decimal notation. [02]

Solution:
00**111111** = 63
222.8.34.63

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 N7 and N5. Is this the **only** cost effective path? [02]

Solution:
N7-N3-N2-N6-N5 = 25 (1 mark)
Yes (1 mark)

(b) Given the local datagram **forwarding table** for node N2 below and the destination address is 74.4.125.246, which link will this packet be forwarded to? Please ensure to show all your calculations. [03]

Destination Address range	Output Link Interface
01001011 00000100 01111101 111101**	N1
01001011 00000100 01111101 11111***	N2
01001011 00000100 01111101 1111****	N3
Otherwise	N4

Solution:
IP in binary: 01001011 00000100 01111101 11110110 (2marks)
Link N1 (1 mark)

Total: 5

QUESTION 10

(a) *Discuss* the random access MAC protocol: **CSMA**. *Explain* how this protocol can be improved to consider collisions? [06]

Solution:

CSMA Discuss - 3 marks:

CSMA - Carrier Sence Multiple Access - listen before transmit:

If channel sensed idle: transmit entire frame

If channel sensed busy, defer transmission

Considering Collisions - 3 marks max:

CSMA/CD (Collision Detection): carrier sensing, deferral as in CSMA.

collisions detected within short time

colliding transmissions aborted, reducing channel wastage

collision detection: easy in wired LANs: measure signal strengths, compare transmitted, received signals

difficult in wireless LANs: received signal strength overwhelmed by local transmission strength

(b) There are many different Ethernet Standards. *Define* Ethernet and *discuss* the Fast Ethernet Standard. [04]

Solution:

- Fast Ethernet is a collective term for a number of Ethernet standards that carry traffic at the nominal rate of 100 Mbit/s, against the original Ethernet speed of 10 Mbit/s.
- Of the fast Ethernet standards 100BASE-TX is by far the most common and is supported by the vast majority of Ethernet hardware currently produced.
- Fast Ethernet was introduced in 1995 and remained the fastest version of Ethernet for three years before being superseded by gigabit Ethernet.

Total: 10

QUESTION 11

(a) You have been approached by a seller of second-hand books to create a mobile app to sell their books and manage purchases. *Provide* **two** reasons why the **Android** platform would be a good choice for the creation of this app. [02]

Solution:
(1 mark each, max 2 marks)

- It is a truly open free development platform based on Linux and open source
- A component-based architecture inspired by Internet mashups
- Large developer community
- Tons of built-in services out of the box
- Automatic management of the application life cycle
- High-quality graphics and sound
- Portability across a wide range of current and future hardware
- Software updates over the air.

(b) *Briefly discuss* what a web service is and how it works. [03]

Solution:
(3 marks max:)

- Piece of software that is available over the Internet
- Typically makes use of XML.
- Requires a client and a service.
- Therefore: A web service is programmatically available application logic that is exposed over the Internet

Total: 5

QUESTION 12

Provide Java source code for a **UDP Server** that runs on port 2021 and receives a greeting message from a UDP client. The server then appends the words "So nice to meet you!" to the client's message and sends it back to the client.

Solution:

```
1  import java.io.*;
2  import java.net.*;
3  class UDPServer {
4    public static void main(String args[])
5    {
6      try
7      {
8        DatagramSocket serverSocket = new DatagramSocket(2021); //1
9        byte[] receiveData = new byte[1024];
10       byte[] sendData = new byte[1024];
11       while(true)
12       {
13         DatagramPacket receivePacket =
14             new DatagramPacket(receiveData, receiveData.length);
                   //1
15         serverSocket.receive(receivePacket);        //1
16         String sentence = new String( receivePacket.getData()); //
               1
17         System.out.println("RECEIVED: " + sentence);
18         InetAddress IPAddress = receivePacket.getAddress(); //1
19         int port = receivePacket.getPort();    //1
20         String appendedSentence =  sentence + " So nice to meet you
               !";  //1
21         sendData = appendedSentence.getBytes();  //1
22         DatagramPacket sendPacket =
23             new DatagramPacket(sendData, sendData.length, IPAddress
                   , port);//1
24         serverSocket.send(sendPacket);          //1
25         }
26     }
27     catch(IOException io)
28     {
29       System.err.println(io.getMessage());
30     }
31   }
32 }
```

Total: 10

QUESTION 13

The code below illustrates a **TCP client** that receives a binary file using the getfile() method. Fill in the missing code for sections A to I. Clearly label your answers.

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

class TCPBinGet
{
  public void getfile(String address, int port, String filename, int
      length)
  {
    File newFile = new File(filename);
    FileOutputStream fos = null;
    Socket fileSocket = null;
    try
    {
      fileSocket = __( A (1 marks) )__;
      InputStream is = __( B (1 marks) )__;
      fos = new FileOutputStream(newFile);
      byte[] buffer = new byte[512];
      int n = 0;
      int totalBytes = __( C (1 marks) )__;
      while (totalBytes != length)
      {
        __( D (2 marks) )__;
        __( E (1 marks) )__;
        fos.flush();
        __( F (1 marks) )__;
      }
    }
    catch (FileNotFoundException ex) { ex.printStackTrace(); }
    catch (IOException ex) { ex.printStackTrace(); }
    finally
    {
      if(__( G (1 marks)) )__
      {
        try { __( H (1 marks) )__; }
        catch (IOException e) { e.printStackTrace(); }
      }
      if (fos != null)
      {
        try {__( I (1 marks) )__ ; }
        catch (IOException e) { e.printStackTrace(); }
      }
    }
  }
}
```

Solution:

Question	Code	Mark
A	new Socket(address, port)	1
B	new FileOutputStream(newFile);	1
C	0	1
D	n = is.read(buffer, 0, buffer.length)	2
E	fos.write(buffer, 0, n);	1
F	fos.flush();	1
G	totalBytes += n	1
H	fileSocket.close()	1
I	fos != null	1

Total: 10

The End!