



FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE IT28X97 / IT00297
DATA COMMUNICATION

CAMPUS APK

EXAM MAY 2019

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ASSESSOR(S)

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INTERNAL MODERATOR

NONE

EXTERNAL MODERATOR

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DURATION 2 HOURS

MARKS 100

NUMBER OF PAGES: 5 (cover page included)

INSTRUCTIONS

ANSWER ALL THE QUESTIONS
WRITE NEATLY AND LEGIBLY
PLEASE NUMBER IN SEQUENCE

REQUIREMENTS

NONE

1. (1 mark) Linux or Windows? Motivate.
2. (3 marks) Your Linux computer is starting to run really slow to the point where it is barely usable. You have a terminal window open which is sluggish, but responsive. Briefly explain how you can investigate this problem and terminate the offending application.
3. (2 marks) Under the `/proc` directory there are a large number of numbered directories (for example `/proc/1`, `/proc/1286` and `/proc/1290`). Briefly explain the what these are and the type of information that can be found inside each of these directories.
4. Provide English descriptions of the following bash commands:
 - (a) (2 marks) `sudo apt-get install apache2` (including the ‘sudo’)
 - (b) (1 mark) `head -10 README.MD`
 - (c) (3 marks) `cat names1.txt names2.txt | sort | tee names3.txt`
 - (d) (2 marks) `ln -s /var/www/test.com/index.html /home/john/index.html`
 - (e) (3 marks) `for i in *.log; do tail -5 $i >> statusfile; done;`
5. (4 marks) You are looking for a pdf file in the local file system that contains “dns” in its filename. Give a command that will search for this file on the local filesystem but redirect all “permission denied” errors to `/dev/null` so that only successful matches are displayed.
6. (3 marks) Assume that the line “server=enabled” was not present in a configuration file, “config.conf”. Give a Linux command to append it to the end of the file (i.e. without using an editor such as vi or gedit).
7. Consider the following script and answer the questions that follow (note that the numbers are not part of the script itself):

```
1: #!/bin/bash
2: function show_usage {
3:     echo "Usage: $0 <textfile>"
4:     exit 1
5: }
6: if [ $# -ne 1 ] || [ ! -f $1 ]; then
7:     show_usage
8: fi

9: exec 0<$1
10: counter=1
11: while read line; do
12:     echo "$counter: $line"
13:     counter=$((counter+1))
14: done
```

- (a) (2 marks) Explain what the purpose of this script is.
- (b) (10 marks) Explain in detail how the script works by referring to the line numbers.
- (c) (2 marks) The text file “names” contains people’s names on separate lines. Assuming that the script above is called “number.sh”, the following command is executed:

```
$ ./number.sh names | sort -k 2 > newnames
```

Explain what this command will do (note that the `-k 2` parameter sorts using the second field, where fields are separated with white space).

- (d) (2 marks) In order to execute the script without specifying bash, it needs to be executable. Give the Linux command to make it executable for the current user:
8. (6 marks) The Internet uses IP addresses, while LANs make use of MAC addresses to deliver packets. Explain how the Internet addresses are translated into MAC addresses and vice versa.
9. Figure 1 shows a network architecture of a company with four interconnected networks (labeled network 1 to 4). The diagram shows three routers (R1, R2 and R3) and five nodes (N1, N2, N3, N4 and N5). The NICs and last two octets of each IP for each node/router is also shown (for example, N1 has a single NIC labelled eth0 and an allocated IP of 192.168.11.2). Answer the following questions.
- (a) (4 marks) Give the shortest feasible routing table for node **N1** (“destination”, “gateway”, “genmask” and “iface” fields).
 - (b) (8 marks) Give the shortest feasible routing table for router **R2** (“destination”, “gateway”, “genmask” and “iface” fields).
 - (c) **N3** has the following erroneous IP table:

Destination	Gateway	Genmask	Iface
192.168.12.0	0.0.0.0	255.255.255.0	eth0
0.0.0.0	192.168.12.22	0.0.0.0	eth0

Assuming that every other node is correctly configured and N3 ignores ICMP redirect, explain what will happen in each of the following scenarios: (i) N3 sends a ping to N1; (ii) N3 tries to access a network printer on the same (192.168.12.0) subnet; (iii) N3 attempts a Google search and (iv) tries to access a file server on N5.
 - (d) (4 marks) A lightning strike damages **eth0** on router **R1**. Explain the effect that this will have on each node (N1, N2, N3, N4 and N5).
 - (e) (7 marks) Network **4** needs to be subnetted into two sub-networks (4a and 4b) of 100 nodes each. Show how this can be done by drawing an updated diagram to show the changes to N4. Clearly show the network IP address of each subnet and a router R4 connecting the two subnets with the necessary IP addresses to connect the newly created subnets.

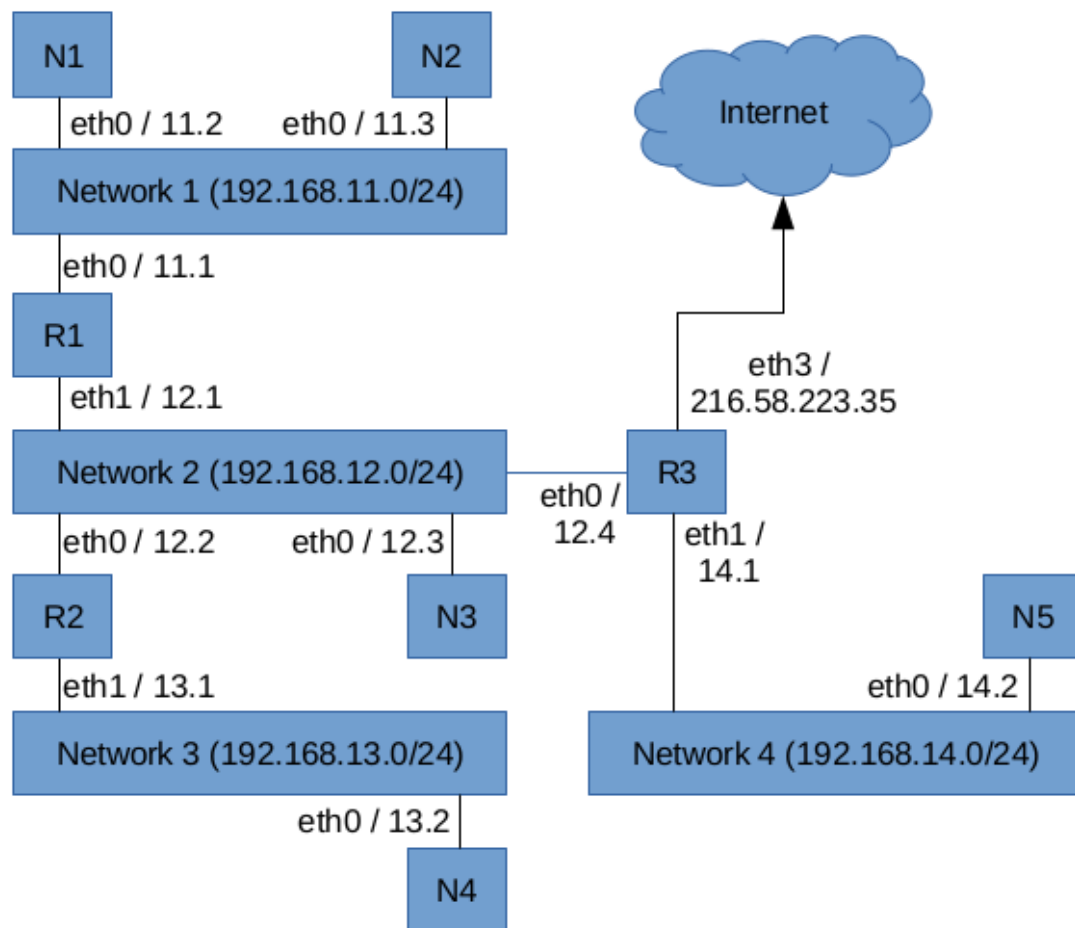


Figure 1: Hypothetical network

10. (2 marks) Provide **two** reasons why packets are used for communication as opposed to a constant stream of data from start to finish.
11. (4 marks) The 7-layer OSI model is based on a technique called “enveloping”. Briefly discuss what enveloping is and the primary advantage of this technique.
12. The “ssh” utility is a useful tool to administer servers on a network infrastructure. Answer the following question on “ssh”:
 - (a) (1 mark) In what way is “ssh” different than “telnet”.
 - (b) (5 marks) A legacy client/server application communicates insecurely using a TCP connection. The legacy client applications connects to IP 191.167.12.20 on port 8900. Briefly explain how communication can be made secure using “ssh”. Give the command that needs to be executed and explain how the legacy app needs to change its connection details.
13. You want to increase the security in your home using a Raspberry PI and a webcam. As a proof-of-concept you have a single camera linked to the PI that can be used to take a picture using the bash command:

```
$ fswebcam -r 1024x768 --jpeg 85 -D 1 web-cam-shot.jpg
```

The picture is then stored in the current directory as `web-cam-shot.jpg`. The Raspberry PI is connected to a local network which has access to the Internet. The Raspberry PI has a static IP of 192.168.0.14.

Answer the following:

- (a) (8 marks) Explain how you would go about setting up the Raspberry PI to detect intruders and how the user can be notified of the situation. Use diagrams, pseudo-code and mention any technology that can be considered/researched enhance the security configuration above.
 - (b) (3 marks) After setting up the system and testing it on your local network, you find that you cannot access the Raspberry PI outside the network on 192.168.0.14. Explain why this is the case and two possible ways how this can be fixed.
14. (8 marks) Security within the Information Technology environment increasingly important. Discuss at least **four** kinds of security threats that plague these environments as well as method(s) that can be used to guard against each of these threats (1 mark for the threat; 1 mark for the method to curb it).