

Administration of Operating Systems

DO2003

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9⁰⁰–13⁰⁰

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75% of Part 1 \Rightarrow 3
Grade: 75% of Part 2 \Rightarrow 4
75% of Part 3 \Rightarrow 5

To get grade 4 you must have passed grade 3,
to get grade 5 you must have passed grade 3 and 4.

Tools allowed:

Pencil and eraser.

Dictionary, as long as it is a paper one and there are no notes in it.

Other tools according to central regulations.

Important! Read the instructions on next page before you start!

Make sure you fill the answer sheet form carefully – it will be read by a machine so avoid changing your mind. I suggest you think about your answers first, note them down on the question form, and only transfer them to the answer sheet afterwards: when you are sure of them. If you make a mistake, you need to *erase* the wrong answer.

Mark your selection with an “**X**” in the chosen box, corner to corner.

Make sure you put your personal ID number in the “ID” part of the answer sheet (encode “T” and “N” in personal ID number as 1).

You need to hand in all the answer sheets. The one you have received is for *Part 1* and *Part 2*. Answers to *Part 3* are to be given on a separate paper – but make sure you sign this paper as well!

You are free to keep or throw away the questions form.

In *Part 1*, exactly one of the four alternatives is always correct. You get 1 point if you mark it, and 0 points otherwise. There are no negative points for wrong answers.

In *Part 2*, you need to match numbers 1-4 against A-F letters. In most cases there exists a letter that corresponds to each number, but it is **not** guaranteed! You get 1 point for each correct match, and **-1** point for each incorrect match. Therefore, if you are not sure of your answer, it might be a good idea to leave some answers empty (this is always 0 points).

In *Part 3*, you are supposed to show both a deep understanding of the topic and some critical thinking. Therefore, we are interested in your thoughts on the subject, including an explanation of *why* do you think so.

Good Luck!

Part 1

1. Which of the following options correctly describes the meaning of 755 numeric permission specification for file `info.txt`?
 - (a) Owner can read, write, and execute the file; group and others can execute the file.
 - (b) Owner can read and write the file; group and others can read the file.
 - (c) Owner, group, and others can read, write, and execute file.
 - (d) Owner can read, write, and execute the file; group and others can read and execute the file.
2. Which statement about filesystems in GNU/Linux is correct?
 - (a) The “journaling” feature in `ext3` increases performance at the cost of reliability.
 - (b) The `ext3` filesystem is not case-sensitive.
 - (c) All filesystems in GNU/Linux are case-sensitive.
 - (d) The “journaling” feature in `ext3` increases reliability at the cost of performance.
3. Which network utility sends an `ICMP ECHO_REQUEST` packet to a remote host and waits to see if the remote host responds back?
 - (a) `ping`
 - (b) `dig`
 - (c) `ifconfig`
 - (d) `traceroute`
4. Consider the following utilities and their corresponding descriptions:
`ls`: Lists files
`cat`: Displays the content of a file
`rm`: Deletes files but not directories
`cp`: Copies files and directories
`mv`: Renames a file or a directory
`grep`: Searches for a string
`file`: Identifies the contents of a file
Which of the corrections below is the right one?
 - (a) Neither `mv` nor `cp` work with directories.
 - (b) `rm` can be used to deletes both files and directories.
 - (c) `ls` only lists directories, not files.
 - (d) Descriptions for `grep` and `cat` have been switched.

5. Which of the following utilities can be used to display, from a given file, only the lines that contain the word “exam”?
- (a) `sort`
 - (b) `grep`
 - (c) `cat`
 - (d) `diff`
6. Which of the following statements about NFS is correct?
- (a) NFS can only be used if all computers in the network run GNU/Linux.
 - (b) The use of NFS usually results in an increased storage needs.
 - (c) The `/etc/exports` file lists the directory hierarchies that the system exports.
 - (d) The most important benefit of NFS is reduced need for hard disk space to store configurations.
7. You have just installed a new disk into your machine. Assume you have not modified the `/etc/fstab` file yet. Which command could you use to mount a new filesystem?
- (a) `mount <devicename> <mountpoint>`
 - (b) `mount`
 - (c) `mount <mountpoint>`
 - (d) `mount <devicename>`
8. Select the correct statement about the Linux kernel.
- (a) Kernel is an optional package in Linux systems.
 - (b) The kernel is responsible for providing GUI.
 - (c) The kernel consists of two parts: device drivers and utility programs.
 - (d) System administrator can recompile Linux kernel to support a specific hardware device.

9. There is a missing statement in the pseudo-code below.

```
while test-command do
  if test-command
    commands
  elif test-command
    commands
  else
    commands
  fi
done
```

Which statement is missing?

- (a) else
- (b) then
- (c) do
- (d) fi

10. What is the expected output of the following commands:

```
$ cd ../
$ pwd
```

- (a) /home/ide
- (b) It depends on what the working directory was before the user issued those commands.
- (c) /home/\$USER
- (d) /

11. There are different software components involved in sending and receiving emails. Which of the following lists only the ones that are *required* for successfully sending an email?

- (a) Mail Transfer Agent and Mail Delivery Agent
- (b) MUA and MDA
- (c) MUA and MTA
- (d) Mail User Agent, Mail Transfer Agent and Mail Delivery Agent

12. Imagine you are an IT administrator in a company called “TheGreatest”. Your company has recently acquired a competitor, called “TheBestest”. Your task is to setup the web pages in such a way that both `www.thegreatest.com` and `www.thebestest.com` show the same contents and use the same physical machine (with just a single IP address). Which of the following techniques will you use?
- (a) Common Gateway Interface
 - (b) Virtual hosts
 - (c) Type maps
 - (d) Multiviews
13. Which of the following statements about `samba` is correct?
- (a) The `smb.conf` specifies the directories that should be shared, but does not allow to specify access rights.
 - (b) The `smb.conf` specifies access rights, but does not allow to specify the directories that should be shared.
 - (c) A `samba` server is used share filesystems and printers between Windows and GNU/Linux systems.
 - (d) A `samba` server is used share filesystems, but not printers, between Windows and GNU/Linux systems.
14. What can you say about running a command using `sudo`?
- (a) The `sudo` utility logs all commands it executes.
 - (b) The `sudo` utility logs the username of a user who issues the `sudo` command.
 - (c) When you run `sudo`, it requests the password of the current user.
 - (d) All of the answers are correct
15. The user `ide` issues `cd docs/report/../course/../../` in the command line. Which is the new working directory?
- (a) `/docs`
 - (b) `/home`
 - (c) It is not possible to determine the new working directory from the provided information.
 - (d) `/home/ide`

16. Select the correct statement about shell variables and parameters
- (a) `$0` parameter stores the value of the first command-line argument to a script or utility.
 - (b) `$?` parameter holds the total number of arguments on the command line.
 - (c) `$#` variable stores the exit status of the last command.
 - (d) The `$*` and `$@` parameters work in a very similar way, and are interchangeable in many context.
17. Which of the following statements is **incorrect**?
- (a) Higher level package management tools, such as `aptitude`, rely on `apt` which, itself, relies on `dpkg` to manage the packages in the system.
 - (b) The `apt` utility installs packages, in the form of `.deb` files, that have been downloaded using `dpkg`.
 - (c) `dpkg` can be used to install, remove, and manage dependencies of software packages
 - (d) `apt` downloads package headers and packages from servers called repositories.
18. Which command can be used to delete a file in a manner similar to the `rm` command?
- (a) `cp file | /dev/null`
 - (b) `mv file > /dev/null`
 - (c) `mv file | /dev/null`
 - (d) None of the listed commands will work.

19. The `su` (substitute user) command is used to run a new shell as another user. Imagine the following interaction:

```
$ ls template*
ls: No match.
$ touch template.sh
$ su -l root
Enter password for root: xxxxxxxx
# touch template2.sh
# exit
$ whoami
ide
```

Who owns files `template.sh` and `template2.sh`?

- (a) root owns both files.
 - (b) ide owns `template.sh` and root owns `template2.sh`.
 - (c) ide owns `template2.sh` and root owns `template.sh`.
 - (d) ide owns both files.
20. You are logged in as user `ide`. The results of running `ls -la` is:

```
drwxr-xr-x 1 ide ide    0 2012-03-29 15:20 .
dr-xr-xr-x 1 ide ide    0 2012-03-29 15:20 ..
-rw-rw-r-- 1 ide ide   65 2012-03-29 15:47 file.txt
-rw---x--x 1 ide ide   10 2012-03-29 15:34 file.bkp
```

What is the expected output for each of the following commands?

```
$ cp file.txt file.bkp
$ mv file.txt file.bkp
```

- (a) Both commands will fail because `file.bkp` already exists.
- (b) The `cp` command will work but the command `mv` will fail because `file.bkp` already exists.
- (c) Both commands will fail because the user `ide` can't write in `file.bkp`.
- (d) Both commands will overwrite `file.bkp` with the contents of `file.txt`.

21. Select the correct statement about `/etc/network/interfaces` file.
- (a) In a typical Ubuntu installation this file is both readable and writable by all users.
 - (b) It is an utility for managing network interface configurations.
 - (c) In a typical Ubuntu installation such a file does not exist.
 - (d) It is a file specifying configuration information for network interfaces.
22. As a system administrator, you want to create an alias for the `rm` command which will make it more difficult for users to accidentally delete files or directories. Which command would add to the `/etc/profile` file?
- (a) `alias rm='rm -i'`
 - (b) `alias rm='rm -v'`
 - (c) `alias rm='rm -f'`
 - (d) `alias rm='rm -r'`
23. Which of the following is not a valid conditional expression?
- (a) `test $# -eq 0`
 - (b) `[$# < 1]`
 - (c) `[$# -eq 0]`
 - (d) `test $# -eq 0 && $# -lt 3`
24. The user's home directory contains only two files, named `grades.txt` and `exam.txt`, respectively. After executing `cp exam.txt ./exam.bkp` command, what file(s) will the home directory contain?
- (a) None of the other answers is correct.
 - (b) It will contain two files: `grades.txt` and `exam.txt`, but only if the working directory is not user's home directory.
 - (c) It will contain two files `grades.txt` and `exam.txt`, but only if the working directory is user's home directory.
 - (d) It will contain files `grades.txt`, `exam.txt` and `exam.bkp`, regardless of the working directory.

25. Which of the following is the correct statement about job control?
- (a) Job control commands allow to suspend a running program or to kill running or suspended programs.
 - (b) `fg` moves a foreground job to the background.
 - (c) Bash assigns a job number to commands you run, but only to those started in the background.
 - (d) To launch a command line as a background process, you add the percent sign `%` at the end of a command line.

26. A user, logged on `ubuntuhost` system, issues the following command:

```
$ ssh ide@ubuntuserver cat list.txt | grep Monday
```

Which of the following statements is true?

- (a) The `grep` command will be performed on the `ubuntuserver` system.
 - (b) The `grep` command will be performed on the `ubuntuhost` system.
 - (c) The user will use the same username on both local and remote system.
 - (d) Both `grep` and `cat` commands will be performed on the `ubuntuhost` system.
27. Select the correct statement about FTP
- (a) FTP stands for “File Transfer Protocol,” because it is a protocol designed for transferring files between computer systems.
 - (b) FTP can only be used as a command-line utility.
 - (c) FTP should only be used for publicly available contents, since it is not possible to provide security and/or encryption.
 - (d) FTP uses two separate connections, one for sending data from the client to the server, and the other for sending data from the server to the client.

28. You have noticed a script called `script` in one of your directories, but you don't remember what does it do. So, you try:

```
$ cat script
#!/bin/bash
SRCD="/home/"
TGTD="/var/backups/"
OF=home-$(date +%Y%m%d).tgz
tar -cZf $TGTD$OF $SRCD
```

Which of the following best describes the functionality of this script?

- (a) It creates a backup of `/home` directory in `/var/backups`
 - (b) It lists the size of each user's home directory
 - (c) It creates a backup of current user's home directory
 - (d) It deletes all files in the `/var/backups` directory
29. Like many other shells, BASH uses a number of standard variables. One of them is `$PATH`. Which of the following correctly describes the meaning of this variable?
- (a) It contains the list of directories from which current user is allowed to execute commands.
 - (b) It contains the current working directory.
 - (c) It contains the list of directories to be searched when executing commands for which the user has not provided a full path.
 - (d) It contains the a list of utility names to be searched when executing commands for which the user has not provided a full path.
30. Which utility or method would you use to notify system users that a new printer is available and how to access it?
- (a) Use the `wall` utility.
 - (b) Use email notification.
 - (c) Use the `dmesg` utility.
 - (d) Use the `write` utility.

31. Select the answer that matches the command with the correct description:
- (a) `cat chapter[12].txt | report.txt`
Creates a file named `report.txt` with the contents of files `chapter1.txt` and `chapter2.txt` only.
 - (b) `sort grades.txt | grade_list.txt`
Creates a file named `grade_list.txt` that contains lines from `grades.txt` file, in alphabetical order.
 - (c) `cat chapter[12].txt > report.txt`
Creates a file named `report.txt` with the contents of every file starting with “chapter”.
 - (d) `sort grades.txt > grade_list.txt`
Creates a file named `grade_list.txt` that contains lines from `grades.txt` file, in alphabetical order.
32. One of the difficulties with setting up Apache server as a regular (non-root) user is that:
- (a) the default port has to be changed, since an Apache server listens on port 80 by default, and this port can only be used by `root`.
 - (b) it requires recompilation of the Linux kernel.
 - (c) it is not possible to configure Apache so that it can be started by regular user.
 - (d) one needs to configure Apache in such a way that it acquires root privileges after it starts.
33. `$ sort list > temp`
`$ lpr temp`
`$ rm temp`
- The commands above are equivalent to
- (a) `list > sort > lpr`
 - (b) `sort list | rm list | lpr`
 - (c) `sort list | lpr`
 - (d) `cat list > sort > lpr`

34. In a small company, a computer running Ubuntu delivers Internet access for a private network. Which of the following can provide that kind of functionality:
- (a) NIS
 - (b) BIND
 - (c) NAT
 - (d) NFS
35. Which server would you setup to keep common administrative files in a central database, accessible by multiple computers?
- (a) BIND
 - (b) exim4
 - (c) NIS
 - (d) NFS
36. Which command would you use to find out which utilities are available for editing files?
- (a) `find editor`
 - (b) `grep editor`
 - (c) `apropos editor`
 - (d) `which editor`
37. Which command can be used in the `vi` editor to save changes to the current file and exit?
- (a) `:q!`
 - (b) `:wq`
 - (c) ESC
 - (d) `i`
38. To assign a value to a variable in BASH, you use `variable=value` syntax. Consider the following assignment:

```
$ student=john
```

Which of the answers below is correct?

- (a) `echo "$student"` will output `$student`
- (b) `echo "$student"` will output `john`
- (c) `echo '$student'` will output `john`
- (d) `echo $student` will output `student`

39. You have executed the following commands, in order to understand the configuration of the environment:

```
$ cd ~
$ pwd
/home/ide
$ ls -l
-rwxr--r-- 1 ide ide 123 Jan 11 11:11 script.sh
$ echo $PATH
/usr/local/bin:/usr/bin:/bin:/usr/local/games:/home/ide:/usr/games
```

You know that there are (at least) four ways to run a shell script from the command line:

```
$ script.sh
$ bash script.sh
$ ./script.sh
$ /home/ide/script.sh
```

Which of those four ways will result in an error message?

- (a) All four of them.
 - (b) None of those four.
 - (c) Only `script.sh`
 - (d) Only `bash script.sh`
40. Which of the following information is **not** included in the `ls -l` output for a regular file:
- (a) name of the file
 - (b) access permissions
 - (c) file size
 - (d) name of the user who created this file

Part 2

1. Here are parts of four configuration files

- (1)

```
<Directory />
    Options -Indexes +FollowSymLinks
    AllowOverride None
</Directory>
<VirtualHost *:80>
    DocumentRoot /www/example1
    ServerName www.example1.com
</VirtualHost>
<VirtualHost *:80>
    DocumentRoot /www/example2
    ServerName www.example2.com
</VirtualHost>
```
- (2)

```
[homes]
    comment = Home Directories
    browseable = no
    writable = yes
    valid users = %S
    create mode = 0664
    directory mode = 0775
```
- (3)

```
HostbasedAuthentication no
PasswordAuthentication yes
PermitEmptyPasswords no
X11Forwarding yes
PrintMotd yes
UsePrivilegeSeparation yes
PermitRootLogin no
```
- (4)

```
listen_address=120.111.222.111
pasv_address=127.0.0.1
connect_from_port_20=NO
ftp_data_port=20
listen_port=21
pasv_min_port=49152
pasv_max_port=65535
ssl_enable=YES
connect_timeout=60
data_connection_timeout=120
idle_session_timeout=120
anonymous_enable=YES
anon_root=/disk01/ftp/
```

Match those files with appropriate servers

- (a) named
- (b) samba
- (c) vsftpd
- (d) apache
- (e) exim
- (f) sshd

2. Imagine the following interaction:

```
[~/aos]$ ls
a1 a2
[~/aos]$ cat a1
cat: a1: Permission denied
[~/aos]$ (1)
[~/aos]$ cat a1
This is a1
[~/aos]$ (2)
[~/aos]$ ls
ls: cannot open directory .: Permission denied
[~/aos]$ cat a2
This is a2
[~/aos]$ (3)
chmod: invalid mode: *****
Try 'chmod --help' for more information.
[~/aos]$ (4)
[~/aos]$ cat a2
cat: a2: Permission denied
```

Choose appropriate commands that have been executed in positions marked (1), (2), (3) and (4).

- (a) `chmod a+r a*`
- (b) `chmod urwx a2`
- (c) `chmod 111 .`
- (d) `chmod 123 a*`
- (e) `chmod 000 .`
- (f) `chmod u=wx a2`

3. For each of the following scripts

```
(1) NUMBERS="2 3 5 7 11"
    res=0
    for number in $NUMBERS
    do
        echo -n "$number "
    done
```

```
(2) NUMBERS="2 3 5 7 11"
    res=0
    for number in $NUMBERS
    do
        let "res += $number"
    done
```

```
(3) NUMBERS="2 3 5 7 11"
    res=0
    for number in $NUMBERS
    do
        let "res += $number"
        echo -n "$res "
    done
```

```
(4) NUMBERS="2 3 5 7 11"
    res=0
    for number in $NUMBERS
    do
        let "res += $number"
    done
    echo res
```

select the best description of what they do

- (a) does not print anything
- (b) prints the word "res" one time
- (c) prints the first five prime numbers
- (d) prints "28"
- (e) prints "2 5 10 17 28"
- (f) prints the word "number" five times

4. Match the following commands

- (1) `cp a* b`
- (2) `rm b*`
- (3) `cat a*`
- (4) `ls a a*`

with messages that those commands can result in, and reasons for those errors

- (a) `permission denied` means that there exists at least one file starting with `a`, but you do not have read permissions to it
- (b) `permission denied` means that there exists at least one file starting with `a`, but you do not have write permissions to it
- (c) `target 'b' is not a directory` means that there is exactly one file starting with `a`
- (d) `no match` means that there are no files starting with `b`
- (e) `target 'b' is not a directory` means that there is more than one file starting with `a`
- (f) `no such file or directory` means that there is no file with name `a`, although there may be files starting with `a`

5. Match the following tasks that require `root` access

- (1) reading files in `/etc`
- (2) modifying files in `/etc`
- (3) killing own processes
- (4) restarting the system

with the rationale for not allowing regular users to perform them

- (a) can only be done by `root` because it could cause termination of processes belonging to other users
- (b) being able to access contents of most files, for example `/etc/passwd`, would be a huge security risk
- (c) this is something users other than `root` are allowed to do
- (d) killing processes can make system unstable
- (e) only selected files require `root` access, those that are critical to the security of the system, for example `/etc/shadow`
- (f) most files require `root` access, since almost all services can be configured in such a way that they pose security risks

6. Imagine the following needs within a small company:

- (1) a web page with dynamic contents and separate views for inside and outside visitors
- (2) a way for employees to access company's IT resources (including files, email, computational power, software, etc) from outside in a secure way
- (3) a file server, i.e. a place where files can be stored and accessed easily from every machine within the company
- (4) a way to store various information, for example employee phone book, customer contact information, public certificates and security keys, etc.

Which of the following servers would be best candidates for installation in this company?

- (a) ldap
- (b) samba
- (c) sshd
- (d) shorewall
- (e) dhcp
- (f) apache

7. You have four tasks that need to be done:

- (1) A file called `proof.txt` contains important information and you want to make sure you do not overwrite this information by accident
- (2) An employee has been fired from the company you work in, and you need to check if he has an account in the system and remove that account if necessary
- (3) Somebody has started an unauthorised http daemon on your server, and you want to find out who it is
- (4) You have noticed that users have problems removing files that contain `*`, `&` and `$` characters, so you want to rename all such files by replacing those problematic characters with `_`

For each task, choose a utility from the list below that can be used to solve this task (among others, i.e. this utility does not necessarily need to solve the task by itself, but it can be part of the solution):

- (a) `cat`
- (b) `find`
- (c) `tail`
- (d) `ps`
- (e) `chmod`
- (f) `rm`

8. Match the following commands

- (1) `cp /home/slawek/a ../b`
- (2) `cp ../a ../b`
- (3) `cp ../a /home/slawek/b`
- (4) `cp /a /b`

with descriptions of their arguments

- (a) destination is both absolute and relative path
- (b) source is neither absolute nor relative path
- (c) source is an absolute path, while destination is a relative path
- (d) both source and destination are absolute paths
- (e) source is a relative path, while destination is an absolute path
- (f) both source and destination are relative paths

9. For each of the tasks described below

- (1) set up a web server
- (2) uninstall the ssh server
- (3) list installed software packages
- (4) make sure software is up to date and latest security updates are installed

select an appropriate command to perform this task

- (a) `apt-get update`
- (b) `apt-get install apache`
- (c) `dpkg -l`
- (d) `apt-get remove sshd`
- (e) `apt-get upgrade`
- (f) this is not possible to do with just one command

10. You need to print a list of subdirectories, together with the amount of disk space that each subdirectory occupies, properly sorted. Order the elements below correctly. *Hint:* the full command consists of four parts.

- (a) `grep "/.*/"`
- (b) `grep -v "/.*/"`
- (c) `du -k |`
- (d) `sort -n`
- (e) `|`
- (f) `du -k >`

Part 3

1. Find problems in the following script. For every one you find, explain *why* is it a problem *and* how can it be fixed. Observe that there are both problems that clearly errors (i.e. things that will cause the script to not work at all or not do what is intended to do), as well as smaller “imperfections”. Try to find as many as possible of both kinds.

```
x=0
y=1
z=2

while filename in *
then
    echo "$filename" > grep " "
    if ( $? -eq y )
    then
        $newname='echo fname | tr " " "_'
        mv "$fname" "$newname"
        let "$x = 1"
    done
done

if [ number -eq "$z" ]
then
    echo "1 file renamed."
else
then
    echo "2 files renamed."
fi
```

2. Suppose you have been hired by a small company as an IT administrator. The company has no network infrastructure whatsoever, but they want you to change that. Assuming you have decided to use GNU/Linux, describe which services would you install, how would you configure them, and in what order would you work on that (i.e. which ones do you consider most important). You can decide upon the details of the company. It is also up to you what their needs are, as long as you motivate how those needs influence your decisions. Feel free to also describe why have you decided that some services are *not* going to be useful for your company. Maximum 1 page.

3. Assume there is a file called `runme` in the current directory and you know it contains a bash script. Describe different commands you can use to run this script (*hint*: you should know at least three). Explain also what conditions need to be fulfilled for each of those ways to work or fail.
4. Explain what does the shell special character “|” mean, how does it work, and what can it be used for.
5. Describe differences between graphical user interface (GUI) and command line user interface (CLI). What are the major advantages and disadvantages of each method?