

Administration of Operating Systems

DO2003

22nd of August 2012

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.

Also, please read the questions carefully, since some of them are similar, but not necessarily exactly the same as in the previous exams!

Good Luck!

Part 1

1. What is stored in `/etc/shadow` file on a modern GNU/Linux system?
 - (a) List of users but not their passwords.
 - (b) List of passwords, but no usernames.
 - (c) List of users, and their encrypted passwords.
 - (d) List of users and their passwords in clear text.

2. Which of the following is included in the `ls -l` output for a regular file:
 - (a) name of the user who owns this file.
 - (b) name of the user who last modified this file.
 - (c) name of the user who holds the copyright to the file contents.
 - (d) name of the user who created this file.

3. You wanted to add a directory `/prog` to the `$PATH` variable, but you have mistyped the command *and received an error message*. Which of the following could you have typed?
 - (a) `PATH=/prog`
 - (b) `$PATH=/prog:$PATH`
 - (c) `PATH=/prog:$PATH`
 - (d) `PATH=/prog:PATH`

4. 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) It will contain three files: `grades.txt`, `grades.bkp` and `exam.txt`, but only if the working directory is user's home directory.
 - (b) It will contain three files: `grades.txt`, `grades.bkp` and `exam.txt`, but only if the working directory is *not* user's home directory.
 - (c) It will contain three files: `grades.txt`, `exam.txt` and `exam.bkp`, regardless of the working directory.
 - (d) It will contain two files: `grades.txt` and `exam.txt`, but only if the working directory is user's home directory.

5. After executing the following command in the BASH command prompt:

```
NAME=slawek
```

Which of the answers below is correct?

- (a) `echo "NAME"` will output `slawek`
- (b) Neither of the other options is correct.
- (c) `echo "$name"` will output `name`
- (d) `echo "name"` will output `slawek`

6. 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) `do`
- (b) `else`
- (c) `then`
- (d) `fi`

7. After executing the following commands:

```
~$ ls -l
total 4
drwxrwxr-x 2 ide ide 1024 2011-12-12 09:28 .
drwxrwxr-x 2 ide ide 4096 2011-12-12 09:28 MyDocs
-rw----- 1 ide ide  556 2011-12-12 09:29 exam_grades
-rw-rw-r-- 1 ide ide 4523 2011-12-12 09:30 prac_exam
-rw-rw-r-- 1 ide ide 1234 2011-12-12 09:29 theo_exam
$ mv exam* ~/MyDocs/
```

what is the expected output of the `ls` command?

- (a) `exam_grades MyDocs`
 - (b) `MyDocs exam_grades prac_exam theo_exam`
 - (c) `MyDocs prac_exam theo_exam`
 - (d) It depends on which user is executing the commands.
8. Which of the following statements about `samba` is correct?
- (a) The `smb.conf` does not allow to specify neither the directories that should be shared nor access rights.
 - (b) The `smb.conf` allows to specify access rights, but not the directories that should be shared.
 - (c) The `smb.conf` allows to specify both the directories that should be shared and access rights.
 - (d) The `smb.conf` allows to specify the directories that should be shared, but not access rights.

9. 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 to be searched when executing commands for which the user has not provided a full path.
- (b) It contains the current working directory.
- (c) It contains the a list of utility names to be searched when executing commands for which the user has not provided a full path.
- (d) It contains the list of directories from which current user is allowed to execute commands.

10. `$ sort list > temp`
`$ head temp > result`
`$ rm temp`

The commands above are equivalent to

- (a) `cat list | sort | head`
- (b) `cat < list | sort > result`
- (c) `sort list | rm list | head`
- (d) `cat list | sort | head > result`

11. For the following list of commands

```
sort grades.txt > grade_list.txt
sort grades.txt | grade_list.txt
cat chapter[12].txt | report.txt
cat chapter?.txt > report.txt
```

Select a description below that matches *one* of those commands:

- (a) Creates a file named `report.txt` with the contents of every file starting with “chapter”.
- (b) Creates a file named `grade_list.txt` that contains lines from `grades.txt` file, starting with the best grades.
- (c) Creates a file named `grade_list.txt` that contains lines from `grades.txt` file, in alphabetical order.
- (d) Creates a file named `report.txt` with the contents of files `chapter1.txt` and `chapter2.txt` only.

12. In a small company, a computer running Ubuntu provides a simple file and printer server. Which of the following can provide that kind of functionality:
- (a) `apache`
 - (b) `samba`
 - (c) `shorewall`
 - (d) `bind`
13. Which of the following utilities can be used to display, from a given file, only the lines that *do not* contain the word “Linux”?
- (a) `cat`
 - (b) `tail`
 - (c) `diff`
 - (d) `grep`
14. The user `ide` issues `cd /docs/./report/./course/./pictures/` in the command line. Assuming there is no error message, what is the new working directory?
- (a) `/home/ide/pictures`
 - (b) It is not possible to determine the new working directory from the provided information.
 - (c) `/pictures`
 - (d) `/docs/pictures`

15. After executing the following commands:

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

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

- (a) `ide` owns both files.
 - (b) `ide` owns `template2.sh` and `root` owns `template.sh`.
 - (c) `ide` owns `template.sh` and `root` owns `template2.sh`.
 - (d) `root` owns both files.
16. Which command can be used in the `vi` editor to exit without saving changes?
- (a) `a`
 - (b) `:wq`
 - (c) `ZZ`
 - (d) `:q!`
17. Which of the following statements is true?
- (a) `dpkg` downloads package headers and packages from servers called repositories.
 - (b) None of the other options is true.
 - (c) The `apt-get` utility downloads and installs software packages.
 - (d) Higher level package management tools, such as `dpkg`, rely on `aptitude` to manage the packages in the system.

18. Which of the following describes the firewall capabilities of modern GNU/Linux system?
- (a) System administrator needs to configure `firestarter` before users can take advantage of hardware firewall.
 - (b) In a typical setup, non-root users are allowed to modify `iptables` rules.
 - (c) `iptables` supports TCP, but not UDP.
 - (d) Thanks to the technique called *connection tracking*, Linux firewall can understand application-layer protocols and therefore support multi-connection protocols like FTP.
19. You are logged in as user `ide` and want to delete a `/home/ide/MyDocs/` directory, which contains files and but no subdirectories. Which command can you use to delete the this directory and its contents, regardless of what is your current working directory?
- (a) `rmdir MyDocs/`
 - (b) `rm -r MyDocs`
 - (c) `rm -r /home/ide/MyDocs/*`
 - (d) `rm -R ~/MyDocs`
20. Which of the following commands will never result in an error message?
- (a) `cd ..`
 - (b) `ls -l`
 - (c) All of them can result in an error message.
 - (d) `rm abc`
21. Select the *incorrect* statment about shell variables and parameters
- (a) `$#` parameter holds the total number of arguments on the command line.
 - (b) `$*` variable holds all command line arguments.
 - (c) `$1` variable holds the name of currently executing command.
 - (d) `$?` variable holds the exit status of the last command.

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

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

You know that there are (at least) four general 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 execute the script *in this particular setting*?

- (a) all four of them.
 - (b) only `bash script.sh`
 - (c) neither of those four.
 - (d) only `./script.sh`
23. 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="/usr/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 `/usr/backups`
- (b) It creates a backup of `/home` directory in `/var/backups`
- (c) It lists the size of each user's home directory
- (d) It deletes all files in the `/var/backups` directory

24. Which method would you use to notify system users that you are going to reboot the system in two weeks?
- (a) Send a message using the `wall` utility.
 - (b) Put information in `/etc/passwd` file.
 - (c) Send a message using email and put information in the `/etc/motd` file.
 - (d) Send a message using the `grep` utility.
25. Which of the following statements correctly describes a drawback of NFS protocol?
- (a) It can be used for sharing disk resources in a heterogeneous network.
 - (b) The protocol is obsolete.
 - (c) Not all disk operations can be efficient mapped into a distributed environment.
 - (d) It is not possible to limit users' access to certain files.
26. You have created an alias as follows: `alias ls='ls -a'`. Which of the following can be an output of the `ls -l` command?
- (a) This command will result in an error message, since an option has already been provided in the alias definition.
 - (b) `./ ../ dir/ script.sh`
 - (c) Neither of the other answers.
 - (d) `dir/ script.sh`
27. The user `ide`, logged in on host `ubuntu`, issues the following command:

```
$ ssh -p 2020 sat@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 `ubuntu` system.
- (c) The connection will use a standard port for SSH service.
- (d) The user is going to use the same username on both local and remote system.

28. Select an *incorrect* statement about DNS:
- (a) DNS maps domain names to IP addresses, but not IP addresses to domain names.
 - (b) `bind` is one of the commonly used implementations of the DNS protocol.
 - (c) *DNS spoofing* occurs when a DNS server receives non-authentic data, and later supplies it to its clients.
 - (d) In `https://mail.student.hh.se/zimbra/`, the “mail” part is a host-name.
29. Which statement about `ext3` filesystem is correct?
- (a) None of the other answers is correct.
 - (b) Maximum size of a file is 1GB.
 - (c) `prac_exam`, `Prac_exam`, and `PRAC_EXAM` all refer to the same file.
 - (d) Filenames cannot be longer than 32 characters.
30. Free software, as defined by Richard Stallman’s Free Software Foundation, means that
- (a) users are not allowed to modify the software source code.
 - (b) authors must distribute the software free of charge.
 - (c) users are required to share any modifications they make to the software source code.
 - (d) users are allowed to modify the software source code.
31. Which command is used to remove a software package but keep its configuration files?
- (a) `aptitude purge <package name>`
 - (b) `aptitude uninstall <package name> --keep-config`
 - (c) `aptitude remove <package name>`
 - (d) `aptitude reinstall <package name>`
32. Which application layer protocol uses TCP?
- (a) FTP
 - (b) SMTP
 - (c) All three of them.
 - (d) HTTP

33. Symbolic link

- (a) can only point to a directory, not a file.
- (b) does not occupy any space on the hard drive.
- (c) can only point to a file, not a directory.
- (d) can point to a non-existent file or directory.

34. A network information service (NIS) in a small local network allows

- (a) to centralise user and system configuration data, making administration easier.
- (b) sharing of local directory hierarchies across multiple computers.
- (c) users to access network resources anonymously.
- (d) easy interaction between users in the form of real-time text messaging and conferencing.

35. When using the `sudo` utility

- (a) a command will be executed as another user
- (b) you need to know the `root` password
- (c) a command will be executed as the `root` user
- (d) you will never be asked for a password

36. You have taken over administration of an `apache` web server from a colleague who has left the company. You notice that it is possible to use this `apache` to download files from users' home directories. There are many possible causes for this, and also many possible fixes. Which of the following *cannot* possibly help with this problem?

- (a) Add `Options -FollowSymLinks` to the configuration file.
- (b) Change configuration option `AllowOverride` from `All` to `None`.
- (c) Change the permissions on the `/home` directory.
- (d) Change `DocumentRoot` parameter in the configuration file.

37. SMTP, the protocol for sending email messages,

- (a) requires users to log in using username and password.
- (b) does not allow data encryption.
- (c) allows users to use both data encryption and authentication.
- (d) does not allow user authentication.

38. What can you say about the following utilities and their corresponding descriptions?

`ls`: Lists files
`cat`: Displays the content of a file
`rm`: Renames files and directories
`cp`: Copies files and directories
`mv`: Renames a file or a directory
`grep`: Searches for a string

- (a) The description about `rm` is incorrect.
 - (b) There is no utility named `grep`.
 - (c) All descriptions are correct.
 - (d) `ls` only lists directories.
39. 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 -f'`
- (b) `alias rm='rm -r'`
- (c) `alias rm='rm -v'`
- (d) `alias rm='rm -i'`

40. Which of the following numeric permission specifications fits the provided descriptions?

- (a) 755: Owner can read, write, and execute file; group and others can write and execute the file.
- (b) 764: Owner can read, write, and execute file; neither group nor others can execute the file.
- (c) 644: Owner and group can read and write the file; others can read the file.
- (d) 777: Owner, group, and others can read but not write the file.

Part 2

1. 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 firewall protecting the network from outside attacks

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

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

2. Imagine you have a file called 'students.txt' containing 100 lines, with one name per line. You want to create a new file called `selected.txt` which would contain students' names from line 21 to line 30 (based on the original file). Use the following command:

```
$ (1) (2) | (3) (4)
```

Match the elements below to positions (1), (2), (3) and (4):

- (a) `head -n30 <`
- (b) `selected.txt`
- (c) `tail -n80 >`
- (d) `head -n10 >`
- (e) `tail -n80 <`
- (f) `students.txt`

3. You have an account, `student1`, on the computer `ide1.example.com` and another account, `student2`, on another computer `ide2.example.com`. There is no account `student1` on `ide2.example.com` and no account `student2` on `ide1.example.com`.

Assume that you are logged into `ide1.example.com` and you attempt the following commands:

1. `ssh ide2.example.com`
2. `ssh student2@ide2.example.com`
3. `ssh user=student2 ide2.example.com`
4. `ssh ide2.example.com -l student2`

Select the appropriate description and result of each of those commands.

- (a) Attempt to log into `ide2.example.com` computer using the username `student1`, which will not work.
- (b) Attempt to log into `ide2.example.com` computer using the `login_name` option set to `student2`, which will work.
- (c) Attempt to log into `ide2.example.com` computer using the username `student1`, which will work.
- (d) Attempt to log into `ide2.example.com` computer using the username `student2`, which not will work.
- (e) Attempt to log into `ide2.example.com` computer using the username `student2`, which will work.
- (f) Attempt to log into `user=student2` computer and execute the command `ide2.example.com`, which will not work.

4. Your home directory contains the files

```
s1.txt s21.txt s22.dat s22.txt script  
script1.sh script2.sh scriptab.sh script.sh s.txt
```

Match the following commands

1. `ls *.*`
2. `ls script?.sh`
3. `ls s?*.txt`
4. `ls s[12]*`

with their respective output

- (a) `script1.sh script2.sh`
- (b) `s1.txt s21.txt s22.dat s22.txt`
- (c) All files
- (d) `s1.txt s21.txt s22.txt`
- (e) `script1.sh script2.sh scriptab.sh script.sh`
- (f) All files except `script`

5. File `months.txt` looks as follows:

```
January
February
March
April
May
June
July
August
September
October
November
December
```

Match the following results:

```
1.
November
December
2.
September
December
3.
October
November
December
4.
September
October
November
December
```

with commands used to generate them:

- (a) `sort months.txt | head -5 | tail -3`
- (b) `grep -vi "s" months.txt | tail -2`
- (c) `tail -3 months.txt`
- (d) `head -3 months.txt`
- (e) `grep ".er" months.txt | grep -v "o"`
- (f) `cat months.txt | tail -c36`

6. For each of the following items

1. `ifconfig eth0`
2. `ifconfig`
3. `ping`
4. `/etc/hosts`

select the appropriate description

- (a) Holds a list of hosts allowed to remotely access the computer.
 - (b) Utility that tests network connections.
 - (c) Display the hardware address, the assigned IP address and the hostname of `eth0` computer.
 - (d) Utility that can be used to bring up a network interface.
 - (e) Holds local mappings of hostnames to IP addresses.
 - (f) Display information about `eth0` interface, including the hardware address as well as the IP address assigned to it.
7. The `ls -l` command allows you to obtain information about files or directories. Match the numbers above the line with the letter indicating what kind of information this part of the line contains.

```
    -1-      -2- -3-  -4-  
-rw-r--r-- 3 ide ide 2048 2010-08-12.13:15 ide
```

- (a) Owner of the file.
- (b) Size of the file.
- (c) Access permissions for users in the `ide` group.
- (d) Group the file is associated with.
- (e) The name of the file.
- (f) Access permissions for users not in the `ide` group.

8. Here are parts of four configuration files

1.

```
[homes]
    comment = Home Directories
    browseable = no
    writable = yes
```

2.

```
Port 22
HostbasedAuthentication no
PasswordAuthentication yes
PermitEmptyPasswords no
X11Forwarding yes
PrintMotd yes
UsePrivilegeSeparation yes
PermitRootLogin no
```

3.

```
listen_address=120.111.222.111
pasv_address=127.0.0.1
listen_port=51
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/
```

4.

```
<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>
```

Match those files with appropriate servers and corresponding observations

- (a) `samba` server.
- (b) `sshd` server. Settings prevent users from logging in using regular passwords.
- (c) `vsftpd` server. Settings prevent users from remotely accessing the server using default ftp port.
- (d) `apache` server.
- (e) `sshd` server. Settings allow users to log in using regular passwords.
- (f) `vsftpd` server. Settings allow users to remotely access the server using the default ftp port.

9. Match the following commands

- (1) `chmod u+x file`
- (2) `chmod a+w file`
- (3) `chmod g+rw file`
- (4) `chmod g=rw,o=r file`

with appropriate descriptions

- (a) Sets execute permission for the owner
- (b) Sets write permission for group and others
- (c) Removes group execute permission, sets read and write permission for group and sets read permission for others
- (d) Sets read and write permission for group
- (e) Sets write permission for everybody
- (f) Sets execute permission for group

10. Considering the following interaction:

```
$ ls
file.txt -file.txt
$ bash
$ unset PATH
$ echo $PATH
(1)
$ rm -file.txt
(2)
$ exit
$ (3)
Try 'rm ./-file.txt' to remove the file '-file.txt'.
Try 'rm --help' for more information.
$ (4)
$ ls
file.txt
```

Select the appropriate command or output message corresponding to positions marked (1), (2), (3) and (4).

- (a) `mv -file.txt > /dev/null`
- (b) `rm -- -file.txt`
- (c) `bash: rm: No such file or directory`
- (d) `rm -file.txt`
- (e) Empty line. The variable no longer has a value.
- (f) `/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin`

Part 3

1. Find problems in the following script. For every one you find, explain both what is wrong and how can it be fixed. Observe that there are both clear errors (i.e. things that will make the script not work as intended), as well as smaller “imperfections”. Try to find as many as possible of both kinds.

```
#!/bin/bash
if [-z "$0"]; then
echo usage: $0 directory
exit
end if
AAA=$1
DEST=HOME"/BACKUP/"
FILENAME=${date+%Y%m%d}.tgz
if [! -d "$DEST"]; then
mkdir $DEST
end if
tar -xzvf $DEST$FILENAME $AAA
```

2. Booting is the process of reading the Linux kernel into memory and running it. Describe the main steps while booting a system.
3. Explain the concepts of relative and absolute pathnames. Provide examples. Justify why both are needed for efficient working environment. Give examples of problems/situations that would be unsolvable without one or the other.
4. 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.
5. Think about the following tasks:
 - (1) reading files in `/etc`
 - (2) modifying files in `/etc`
 - (3) changing file ownership
 - (4) modifying user groups
 - (5) killing own processes
 - (6) killing processes of other users
 - (7) restarting the system

Which of them require `root` access? Explain what is the rationale for this.