



Born2beRoot

Summary: This document is a System Administration related exercise.

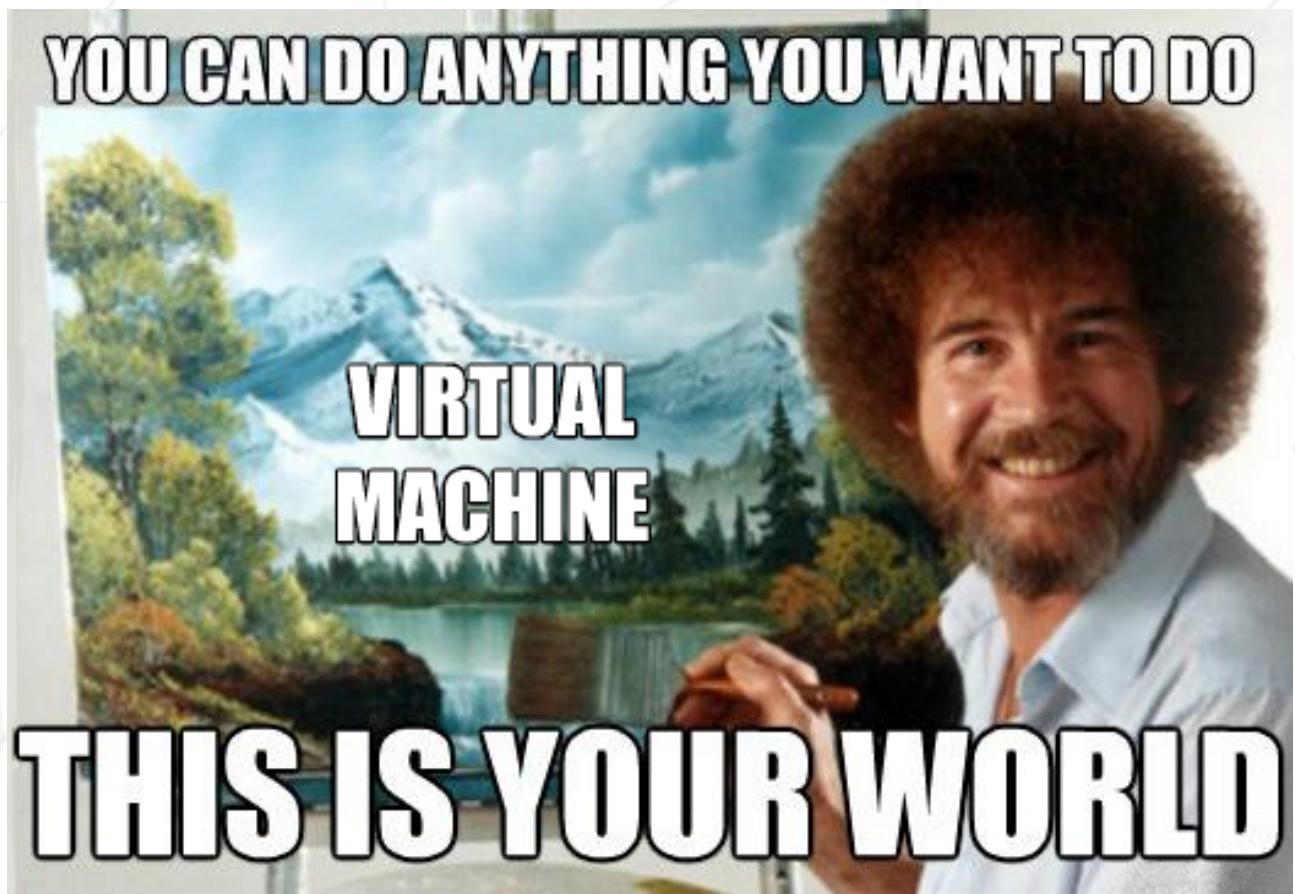
Version: 4

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Chapter I

Preamble



Chapter II

Introduction

This project aims to introduce you to the wonderful world of virtualization.

You will create your first machine in **VirtualBox** (or **UTM** if you can't use **VirtualBox**) using specific instructions. Then, at the end of this project, you will be able to set up your own operating system while implementing strict rules.

Chapter III

General guidelines

- The use of `VirtualBox` (or `UTM` if you can't use `VirtualBox`) is mandatory.
- You only have to submit a `signature.txt` file at the root of your repository. You must paste the signature of your machine's virtual disk in it. Go to Submission and peer-evaluation for more information.
- The use of snapshots is prohibited.

Chapter IV

AI Instructions

● Context

This project is designed to help you discover the fundamental building blocks of your ICT training.

To properly anchor key knowledge and skills, it's essential to adopt a thoughtful approach to using AI tools and support.

True foundational learning requires genuine intellectual effort — through challenge, repetition, and peer-learning exchanges.

For a more complete overview of our stance on AI — as a learning tool, as part of the ICT curriculum, and as an expectation in the job market — please refer to the dedicated FAQ on the intranet.

● Main message

- 👉 Build strong foundations without shortcuts.
- 👉 Really develop tech & power skills.
- 👉 Experience real peer-learning, start learning how to learn and solve new problems.
- 👉 The learning journey is more important than the result.
- 👉 Learn about the risks associated with AI, and develop effective control practices and countermeasures to avoid common pitfalls.

● Learner rules:

- You should apply reasoning to your assigned tasks, especially before turning to AI.

- You should not ask for direct answers to the AI.
- You should learn about 42 global approach on AI.

● **Phase outcomes:**

Within this foundational phase, you will get the following outcomes:

- Get proper tech and coding foundations.
- Know why and how AI can be dangerous during this phase.

● **Comments and example:**

- Yes, we know AI exists — and yes, it can solve your projects. But you're here to learn, not to prove that AI has learned. Don't waste your time (or ours) just to demonstrate that AI can solve the given problem.
- Learning at 42 isn't about knowing the answer — it's about developing the ability to find one. AI gives you the answer directly, but that prevents you from building your own reasoning. And reasoning takes time, effort, and involves failure. The path to success is not supposed to be easy.
- Keep in mind that during exams, AI is not available — no internet, no smartphones, etc. You'll quickly realise if you've relied too heavily on AI in your learning process.
- Peer learning exposes you to different ideas and approaches, improving your interpersonal skills and your ability to think divergently. That's far more valuable than just chatting with a bot. So don't be shy — talk, ask questions, and learn together!
- Yes, AI will be part of the curriculum — both as a learning tool and as a topic in itself. You'll even have the chance to build your own AI software. In order to learn more about our crescendo approach you'll go through in the documentation available on the intranet.

✓ **Good practice:**

I'm stuck on a new concept. I ask someone nearby how they approached it. We talk for 10 minutes — and suddenly it clicks. I get it.

✗ **Bad practice:**

I secretly use AI, copy some code that looks right. During peer evaluation, I can't explain anything. I fail. During the exam — no AI — I'm stuck again. I fail.

Chapter V

Mandatory part

This project consists of setting up your first server by following specific rules.



Since it is a matter of setting up a server, you will install the minimum of services. For this reason, a graphical interface is of no use here. It is therefore forbidden to install X.org or any other equivalent graphics server. Otherwise, your grade will be 0.

You must choose as an operating system either the latest stable version of Debian (no testing/unstable), or the latest stable version of Rocky. Debian is highly recommended if you are new to system administration.



Setting up Rocky is quite complex. Therefore, you don't have to set up KDump. However, SELinux must be running at startup and its configuration has to be adapted for the project's needs. AppArmor for Debian must be running at startup too.

You must create at least 2 encrypted partitions using LVM. Below is an example of a possible partitioning:

```
wil@wil:~$ lsblk
NAME      MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
sda        8:0    0   8G  0 disk
└─sda1     8:1    0  487M 0 part  /boot
└─sda2     8:2    0   1K  0 part
└─sda5     8:5    0  7.5G 0 part
  └─sda5_crypt 254:0  0  7.5G 0 crypt
    ├─wil--vg-root 254:1  0  2.8G 0 lvm   /
    ├─wil--vg-swap_1 254:2  0  976M 0 lvm   [SWAP]
    └─wil--vg-home  254:3  0  3.8G 0 lvm   /home
sr0       11:0   1 1024M 0 rom
wil@wil:~$ _
```



During the defense, you will be asked a few questions about the operating system you chose. For instance, you should know the differences between aptitude and apt, or what SELinux or AppArmor is. In short, understand what you use!

An SSH service will be running on the mandatory port 4242 in your virtual machine. For security reasons, it must not be possible to connect using SSH as root.



The use of SSH will be tested during the defense by setting up a new account. You must therefore understand how it works.

You have to configure your operating system with the UFW (or firewalld for Rocky) firewall and thus leave only port 4242 open in your virtual machine.



The example shows arbitrary disk sizes. You need to determine the appropriate size for each partition to ensure proper operation while avoiding unnecessary disk usage.



Your firewall must be active when you launch your virtual machine. For Rocky, you have to use firewalld instead of UFW.

- The `hostname` of your virtual machine must be your login ending with 42 (e.g., wil42). You will have to modify this hostname during your evaluation.
- You have to implement a strong password policy.
- You have to install and configure `sudo` following strict rules.
- In addition to the root user, a user with your login as username has to be present.
- This user has to belong to the `user42` and `sudo` groups.



During the defense, you will have to create a new user and assign it to a group.

To set up a strong password policy, you have to comply with the following requirements:

- Your password has to expire every 30 days.
- The minimum number of days allowed before the modification of a password will be set to 2.

- The user has to receive a warning message 7 days before their password expires.
- Your password must be at least 10 characters long. It must contain an uppercase letter, a lowercase letter, and a number. Also, it must not contain more than 3 consecutive identical characters.
- The password must not include the name of the user.
- The following rule does not apply to the root password: The password must have at least 7 characters that are not part of the former password.
- Of course, your root password has to comply with this policy.



After setting up your configuration files, you will have to change all the passwords of the accounts present on the virtual machine, including the root account.

To set up a strong configuration for your `sudo` group, you have to comply with the following requirements:

- Authentication using `sudo` has to be limited to 3 attempts in the event of an incorrect password.
- A custom message of your choice has to be displayed if an error due to a wrong password occurs when using `sudo`.
- Each action using `sudo` has to be archived, both inputs and outputs. The log file has to be saved in the `/var/log/sudo/` folder.
- The TTY mode has to be enabled for security reasons.
- For security reasons too, the paths that can be used by `sudo` must be restricted. Example:
`/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/snap/bin`

Finally, you have to create a simple script called `monitoring.sh`. It must be developed in `bash`.

At server startup, the script will display some information (listed below) on all terminals and every 10 minutes (take a look at `wall`). The banner is optional. No error must be visible.

Your script must always be able to display the following information:

- The architecture of your operating system and its kernel version.
- The number of physical processors.
- The number of virtual processors.
- The current available RAM on your server and its utilization rate as a percentage.
- The current available storage on your server and its utilization rate as a percentage.
- The current utilization rate of your processors as a percentage.
- The date and time of the last reboot.
- Whether LVM is active or not.
- The number of active connections.
- The number of users using the server.
- The IPv4 address of your server and its MAC (Media Access Control) address.
- The number of commands executed with the `sudo` program.



During the defense, you will be asked to explain how this script works. You will also have to interrupt it without modifying it. Take a look at cron.

This is an example of how the script is expected to work:

```
Broadcast message from root@wil (tty1) (Sun Apr 25 15:45:00 2021):  
  
#Architecture: Linux wil 4.19.0-16-amd64 #1 SMP Debian 4.19.181-1 (2021-03-19) x86_64 GNU/Linux  
#CPU physical : 1  
#vCPU : 1  
#Memory Usage: 74/987MB (7.50%)  
#Disk Usage: 1009/2Gb (49%)  
#CPU load: 6.7%  
#Last boot: 2021-04-25 14:45  
#LVM use: yes  
#Connections TCP : 1 ESTABLISHED  
#User log: 1  
#Network: IP 10.0.2.15 (08:00:27:51:9b:a5)  
#Sudo : 42 cmd
```

Below are two commands you can use to check some of the subject's requirements:

For Rocky:

```
[root@wil will]# head -n 2 /etc/os-release
NAME="Rocky Linux"
VERSION="8.7 (Green Obsidian)"
[root@wil will]# sestatus
SELinux status:                 enabled
SELinuxfs mount:               /sys/fs/selinux
SELinux root directory:        /etc/selinux
Loaded policy name:            targeted
Current mode:                  enforcing
Mode from config file:        enforcing
Policy MLS status:            enabled
Policy deny_unknown status:   allowed
Memory protection checking:   actual (secure)
Max kernel policy version:   33
[root@wil will]# ss -tunlp
Netid State  Recv-Q Send-Q  Local Address:Port  Peer Address:Port  Process
tcp    LISTEN  0      128      0.0.0.0:4242      0.0.0.0:*      users:(("sshd",pid=28429,fd=6))
tcp    LISTEN  0      128      [::]:4242        [::]:*        users:(("sshd",pid=28429,fd=4))
[root@wil will]# firewall-cmd --list-service
ssh
[root@wil will]# firewall-cmd --list-port
4242/tcp
[root@wil will]# firewall-cmd --state
running
[root@wil will]# _
```

For Debian:

```
root@wil:~# head -n 2 /etc/os-release
PRETTY_NAME="Debian GNU/Linux 10 (buster)"
NAME="Debian GNU/Linux"
root@wil:/home/wil# /usr/sbin/aa-status
apparmor module is loaded.
root@wil:/home/wil# ss -tunlp
Netid State  Recv-Q Send-Q  Local Address:Port  Peer Address:Port
tcp    LISTEN  0      128      0.0.0.0:4242      0.0.0.0:*      users:(("sshd",pid=523,fd=3))
tcp    LISTEN  0      128      [::]:4242        [::]:*        users:(("sshd",pid=523,fd=4))
root@wil:/home/wil# /usr/sbin/ufw status
Status: active

To                         Action    From
--                         ----     ---
4242                       ALLOW     Anywhere
4242 (v6)                   ALLOW     Anywhere (v6)
```

Chapter VI

Bonus part

Bonus list:

- Set up partitions correctly so you get a structure similar to the one below:

```
# lsblk
  NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
  sda        8:0    0 30.8G  0 disk
  └─sda1     8:1    0  500M  0 part /boot
  └─sda2     8:2    0    1K  0 part
  └─sda5     8:5    0 30.3G  0 part
    └─sda5_crypt 254:0  0 30.3G  0 crypt
      ├─LVMGroup-root 254:1  0   10G  0 lvm   /
      ├─LVMGroup-swap 254:2  0   2.3G  0 lvm   [SWAP]
      ├─LVMGroup-home 254:3  0    5G  0 lvm   /home
      ├─LVMGroup-var   254:4  0    3G  0 lvm   /var
      ├─LVMGroup-srv   254:5  0    3G  0 lvm   /srv
      ├─LVMGroup-tmp   254:6  0    3G  0 lvm   /tmp
      └─LVMGroup-var--log 254:7  0   4G  0 lvm   /var/log
  sr0        11:0   1 1024M  0 rom
```

- Set up a functional WordPress website with the following services: lighttpd, MariaDB, and PHP.
- Set up a service of your choice that you think is useful (NGINX / Apache2 excluded!). During the defense, you will have to justify your choice.



The example shows arbitrary disk sizes. You need to determine the appropriate size for each partition to ensure proper operation while avoiding unnecessary disk usage.



To complete the bonus part, you have the possibility to set up extra services. In this case, you may open more ports to suit your needs. Of course, the UFW/Firewalld rules have to be adapted accordingly.



The bonus part will only be assessed if the mandatory part is **PERFECT**. Perfect means the mandatory part has been integrally done and works without malfunctioning. If you have not passed **ALL** the mandatory requirements, your bonus part will not be evaluated at all.

Chapter VII

Submission and peer-evaluation

You only have to turn in a `signature.txt` file at the root of your `Git` repository. You must paste in it the signature of your machine's virtual disk. To get this signature, you first have to open the default installation folder (it is the folder where your VMs are saved):

- Windows: `%HOMEDRIVE%%HOMEPATH%\VirtualBox VMs\`
- Linux: `~/VirtualBox VMs/`
- MacM1: `~/Library/Containers/com.utmapp.UTM/Data/Documents/`
- MacOS: `~/VirtualBox VMs/`

Then, retrieve the signature from the `".vdi"` file (or `".qcow2"` for UTM users) of your virtual machine in `sha1` format. Below are 4 command examples for a `rocky_serv.vdi` file:

- Windows: `certUtil -hashfile rocky_serv.vdi sha1`
- Linux: `sha1sum rocky_serv.vdi`
- For Mac M1: `shasum rocky.utm/Images/disk-0.qcow2`
- MacOS: `shasum rocky_serv.vdi`

This is an example of what kind of output you will get:

- `6e657c4619944be17df3c31faa030c25e43e40af`



Please note that your virtual machine's signature may be altered after your first evaluation. To solve this problem, you can duplicate your virtual machine or use save state.



It is of course FORBIDDEN to turn in your virtual machine in your `Git` repository. During the defense, the signature of the `signature.txt` file will be compared with the one of your virtual machine. If the two of them are not identical, your grade will be 0.



The use of snapshots is FORBIDDEN. During the defense, if any snapshot is detected, your grade will be 0.

During the evaluation, a brief **modification of the project** may occasionally be requested. This could involve a minor behavior change, a few lines of code to write or rewrite, or an easy-to-add feature.

While this step may **not be applicable to every project**, you must be prepared for it if it is mentioned in the evaluation guidelines.

This step is meant to verify your actual understanding of a specific part of the project. The modification can be performed in any development environment you choose (e.g., your usual setup), and it should be feasible within a few minutes — unless a specific timeframe is defined as part of the evaluation.

You can, for example, be asked to make a small update to a function or script, modify a display, or adjust a data structure to store new information, etc.

The details (scope, target, etc.) will be specified in the **evaluation guidelines** and may vary from one evaluation to another for the same project.



```
0010 01 11 111 001 000  11 01 10  1 0000 01 1  1010 111 11 0 000
011 00 1 0000  1 0000 0  01 0100 1 0 010 10 01 1 0  0001 0 010 000
00 111 10  111 0010  001100 001100 001100
```