

## Command Part

Refresh package lists and upgrade the system.:

```
Activities Terminal 00:28 30 أيس اya@aya-VirtualBox: ~

aya@aya-VirtualBox:~$ sudo apt update
[sudo] password for aya:
Hit:1 http://eg.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 https://eg.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://packages.ros.org/ros2/ubuntu jammy InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Hit:5 http://eg.archive.ubuntu.com/ubuntu jammy-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
381 packages can be upgraded. Run 'apt list --upgradable' to see them.

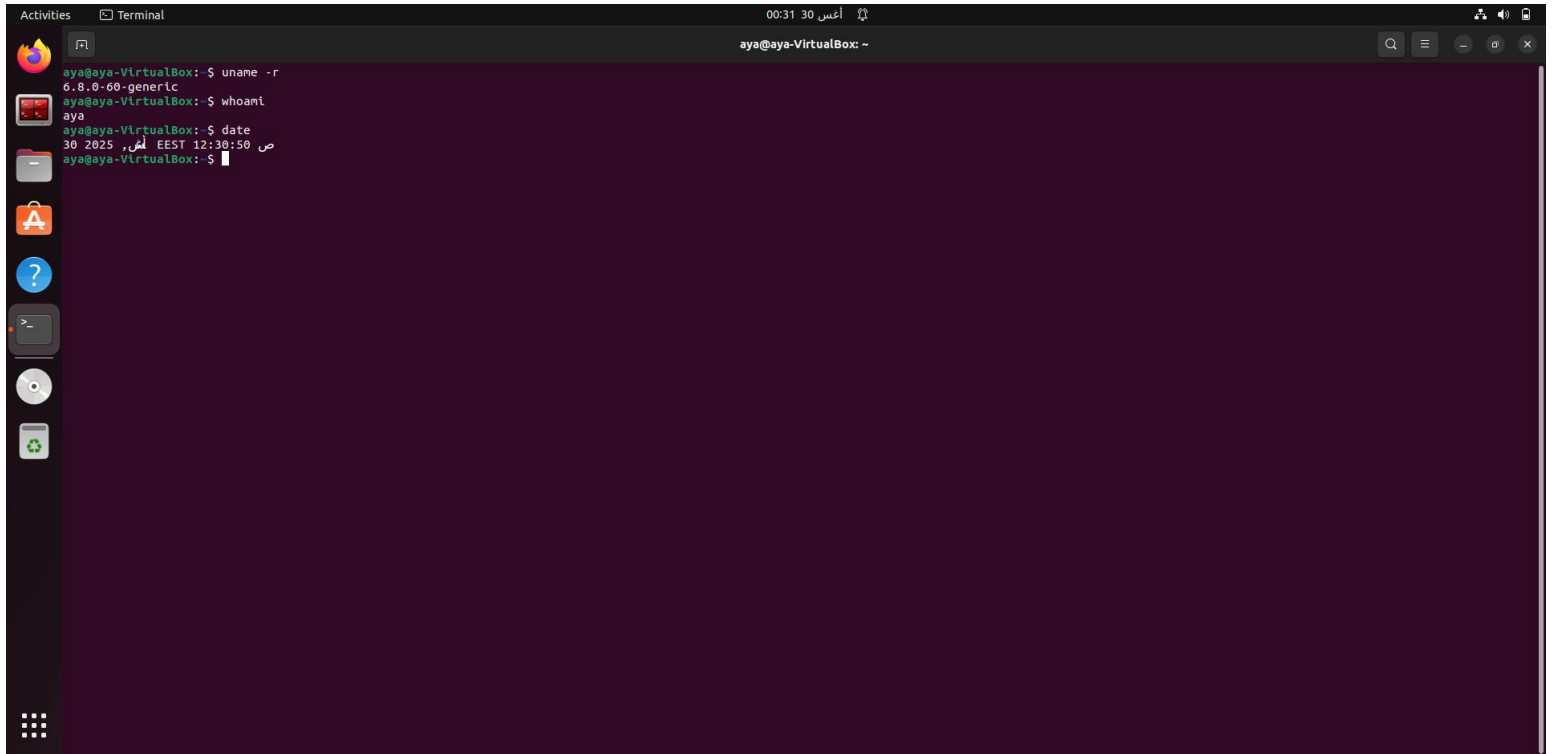
aya@aya-VirtualBox:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done

Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
libpcl-stereo1.12 libopencv4.5d-jni libopencv-videot4.5d libzvt-common
liburiparser1 libde265-dev libopencv-objdetect4.5d libopencv-videot-dev
libopencv-superres4.5d libopencv-objdetect-dev libopencv-contrib4.5d
libopencv-superres-dev libopencv-contrib-dev libpcl-keypoints1.12
opencv-data libheif1 libpcl-common1.12 libopencv-imgcodecs4.5d
libpcl-recognition1.12 libpcl-sample-consensus1.12 libopencv-imgcodecs-dev
libjs-jquery-ui libpathplan4 libopenexr-dev graphviz libbson1 libgvp2
libgvc6 libopencv-videot4.5d libpcl-people1.12 libpcl-tracking1.12
libopencv-shape4.5d libopencv-video-dev libopencv4.5-java libopenexr25
libopencv-shape-dev libpcl-features1.12 python3-scipy libpcl-filters1.12
python3-opencv libopencv-highgui4.5d libcgraph6 libopencv-core4.5d
libopencv-stitching4.5d libopencv-highgui-dev libopencv-core-dev
libswscale-dev libopencv-stitching-dev libcdt5 libpcl-surface1.12
libpcl-lti1.12 libavcodec58 libpcl-visualization1.12 libpcl-ml1.12
libavutil56 libpcl-kdtree1.12 libswscale libpcl-search1.12 libheif-dev
libopencv-viz4.5d libavutil-dev libopencv-viz-dev libopencv-features2d4.5d
libopencv-dev liblab-gamut1 libopencv-features2d-dev libswresample3
libopencv-dnn4.5d libpcl-outofcore1.12 libopencv-dnn-dev libopencv-ml4.5d
libpcl-segmentation1.12 libpcl-apps1.12 libavformat58 libzvt0
libopencv-ml-dev libopencv-calib3d4.5d libpcl-registration1.12
libopencv-flann4.5d libopencv-calib3d-dev libpcl-dev
libopencv-videotab4.5d libopencv-lingproc4.5d libopencv-flann-dev
libpcl-octree1.12 libpcl-dev libavformat-dev libopencv-videotab-dev
libavcodec-dev libopencv-lingproc-dev libde265-0 libpnlx2 libopencv-photo4.5d
libswresample-dev liburiparser-dev libopencv-photo-dev
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following NEW packages will be installed:
  linux-headers-6.8.0-79-generic linux-hwe-6.8.0-79 linux-image-6.8.0-79-generic linux-modules-6.8.0-79-generic linux-modules-extra-6.8.0-79-generic
  linux-tools-6.8.0-79-generic
The following packages have been kept back:
  libman-sss
```

```
Activities Terminal 00:29 30 أيس اya@aya-VirtualBox: ~

Setting up ros-humble-ros2lifecycle (0.18.13-1jammy.20250719.041924) ...
Setting up ros-humble-rqt-bag-plugins (1.1.5-1jammy.20250719.043857) ...
Setting up ros-humble-rviz-default-plugins (11.2.19-1jammy.20250728.091100) ...
Setting up ros-humble-geometry2 (0.25.16-1jammy.20250728.072610) ...
Setting up ros-humble-ros2component (0.18.13-1jammy.20250719.042424) ...
Setting up ros-humble-rviz2 (11.2.19-1jammy.20250728.102649) ...
Setting up ros-humble-rqt-action (2.0.1-3jammy.20250719.040650) ...
Setting up ros-humble-rqt-common-plugins (1.2.0-1jammy.20250719.043927) ...
Setting up ros-humble-ros2cli-common-extensions (0.1.1-4jammy.20250719.043107) ...
Setting up ros-humble-ros-core (0.10.0-1jammy.20250719.043315) ...
Setting up ros-humble-ros-base (0.10.0-1jammy.20250728.072758) ...
Setting up ros-humble-desktop (0.10.0-1jammy.20250728.103041) ...
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu3) ...
Processing triggers for libc-bin (2.35-0ubuntu3.10) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for dbus (1.12.20-2ubuntu4.1) ...
Processing triggers for mailcap (3.70+nm1ubuntu1) ...
Processing triggers for linux-image-6.8.0-79-generic (6.8.0-79.79-22.04.1) ...
/etc/kernel/postinst.d/dkms:
* dkms: running auto installation service for kernel 6.8.0-79-generic
...done.
/etc/kernel/postinst.d/initramfs-tools:
update-initramfs: Generating /boot/initrd.img-6.8.0-79-generic
/etc/kernel/postinst.d/vboxadd:
VirtualBox Guest Additions: Building the modules for kernel 6.8.0-79-generic.
update-initramfs: Generating /boot/initrd.img-6.8.0-79-generic
/etc/kernel/postinst.d/rz-update-grub:
Sourcing file /etc/default/grub
Sourcing file /etc/default/grub.d/init-select.cfg
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-6.8.0-79-generic
Found initrd image: /boot/initrd.img-6.8.0-79-generic
Found linux image: /boot/vmlinuz-6.8.0-60-generic
Found initrd image: /boot/initrd.img-6.8.0-60-generic
Found linux image: /boot/vmlinuz-6.8.0-40-generic
Found initrd image: /boot/initrd.img-6.8.0-40-generic
Mentis86+ needs a 16-bit boot, that is not available on EFI, exiting
Warning: os-prober will not be executed to detect other bootable partitions.
Systems on them will not be added to the GRUB boot configuration.
Check GRUB_DISABLE_OS_PROBER documentation entry.
Adding boot menu entry for UEFI Firmware Settings ...
done
aya@aya-VirtualBox:~$
```

Verify system details: kernel version, user, time:

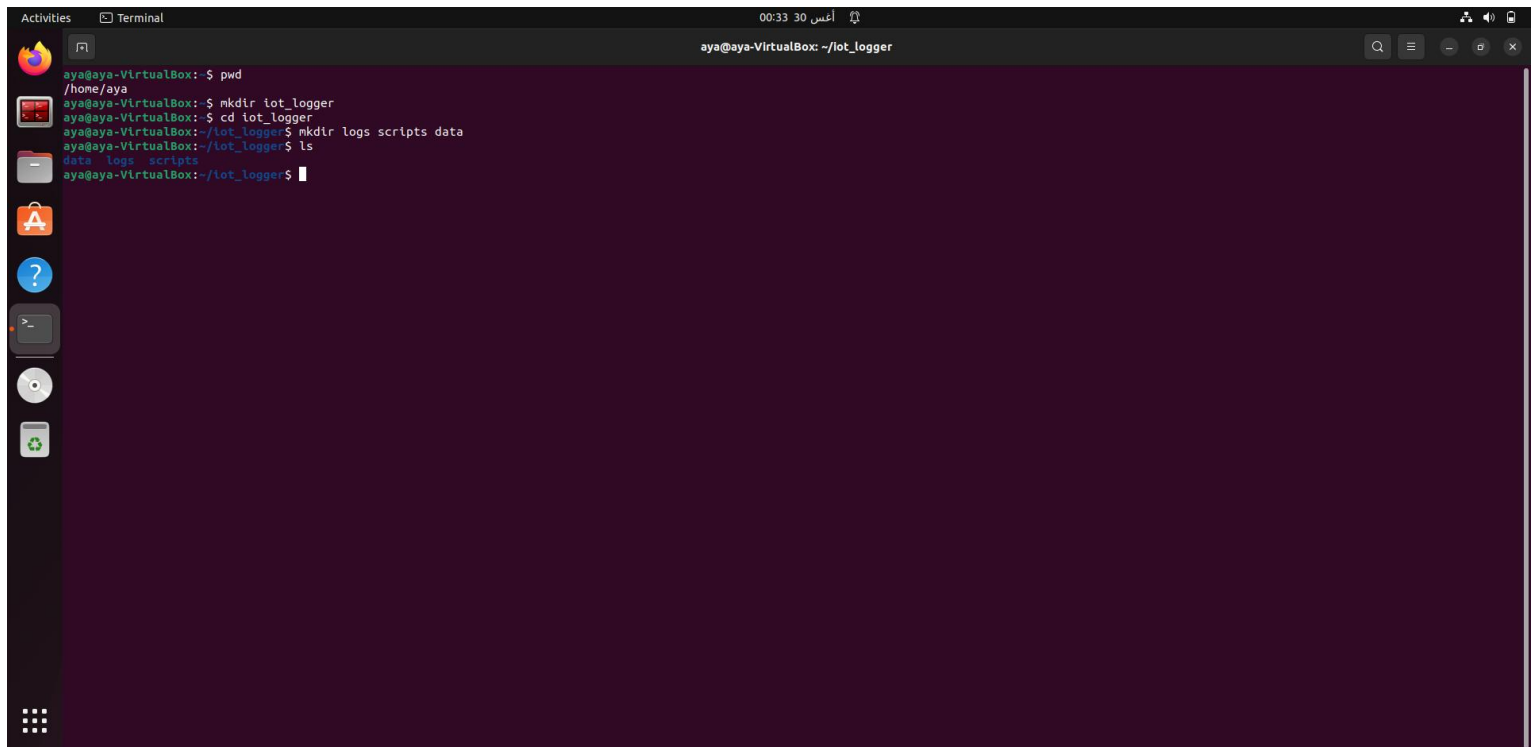


A terminal window titled "Terminal" is open, showing the following commands and output:

```
aya@aya-VirtualBox:~$ uname -r
6.8.0-60-generic
aya@aya-VirtualBox:~$ whoami
aya
aya@aya-VirtualBox:~$ date
30 2025 ١٢ ص EEST 12:38:56
aya@aya-VirtualBox:~$
```

The terminal window has a dark purple background. The left sidebar shows various application icons, including the Dash icon, Home icon, Files icon, and others. The top bar displays the system clock as 00:31 30 أغسطس.

Create /home//iot\_logger with subdirectories: logs, scripts, data:



```
aya@aya-VirtualBox: ~$ pwd
/home/aya
aya@aya-VirtualBox: ~$ mkdir iot_logger
aya@aya-VirtualBox: ~$ cd iot_logger
aya@aya-VirtualBox: ~/iot_logger$ mkdir logs scripts data
aya@aya-VirtualBox: ~/iot_logger$ ls
data  logs  scripts
aya@aya-VirtualBox: ~/iot_logger$
```

The image shows a terminal window with a dark purple background. The window title is "aya@aya-VirtualBox: ~/iot\_logger". The terminal output shows the following commands and their results:

- `pwd` returns `/home/aya`.
- `mkdir iot_logger` creates the directory `iot_logger`.
- `cd iot_logger` changes the current directory to `~/iot_logger`.
- `mkdir logs scripts data` creates three subdirectories: `logs`, `scripts`, and `data`.
- `ls` lists the contents of the current directory, showing `data`, `logs`, and `scripts`.

## Open-Ended Questions

Draw or describe the Linux architecture layers (hardware → kernel → shell → user space). Where do system calls fit?

- Linux is built in layers. At the bottom is the hardware (CPU, memory, disk, devices), which provides raw resources. Above it sits the kernel, the core of Linux, which manages those resources and makes sure programs can share them safely. Programs in user space (like the shell, browsers, or editors) cannot touch hardware directly, so they use system calls to ask the kernel for services, such as reading files, creating processes, or sending data over the network. The shell is just one user program that lets us type commands, which are then executed through these system calls.

Explain the purpose of these directories: /, /bin, /sbin, /usr, /etc, /var.

- In Linux, the root directory / is the starting point of the entire file system, and every file or directory branches from it, like the C:\ in Windows. The /bin directory contains essential user commands such as ls and cp, while /sbin holds important system administration commands like shutdown and fdisk that are mostly used by the root user. The /usr directory stores user system resources, including installed software, libraries, and documentation, with subfolders like /usr/bin for applications. System-wide configuration files are located in /etc, for example /etc/passwd for user accounts. The /var contains variable data that changes during system operation, such as logs in /var/log, mail, and job spools.

Why does Linux treat everything as a file? Explain the difference between a program and a process

- Linux treats everything as a file to provide a simple and consistent way of accessing resources. Whether it is a text document, a device like a hard disk, or even information about running processes, all are represented as files that can be opened, read, or written using the same system calls. This design keeps the system flexible and easy to manage. A **program**, on the other hand, is a file containing instructions stored on disk, while a **process** is a running instance of that program in memory with its own resources and process ID.