

Capstone Task – IoT Sensor Data Logger on Raspberry Pi

(Day 1 – Phase 1: System Update & Directory Setup)

Tasks:

- Refresh package lists and upgrade the system.

```
es Terminal 20:47
saleh@saleh
saleh@saleh-VirtualBox:~$ sudo apt update
[sudo] password for saleh:
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Hit:2 http://eg.archive.ubuntu.com/ubuntu jammy InRelease
Get:3 http://eg.archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:4 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metadata [54.5 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 DEP-11 Metadata [208 B]
Get:6 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 Metadata [126 kB]
Get:7 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 DEP-11 Metadata [208 B]
Get:8 http://eg.archive.ubuntu.com/ubuntu jammy-backports InRelease [127 kB]
Get:9 http://eg.archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [2,881 kB]
Get:10 http://eg.archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [870 kB]
Get:11 http://eg.archive.ubuntu.com/ubuntu jammy-updates/main amd64 DEP-11 Metadata [112 kB]
Get:12 http://eg.archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 DEP-11 Metadata [212 B]
Get:13 http://eg.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [1,227 kB]
Get:14 http://eg.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [782 kB]
Get:15 http://eg.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 DEP-11 Metadata [359 kB]
Get:16 http://eg.archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 DEP-11 Metadata [940 B]
Get:17 http://eg.archive.ubuntu.com/ubuntu jammy-backports/main amd64 DEP-11 Metadata [7,060 B]
Get:18 http://eg.archive.ubuntu.com/ubuntu jammy-backports/restricted amd64 DEP-11 Metadata [212 B]
Get:19 http://eg.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-11 Metadata [25.8 kB]
Get:20 http://eg.archive.ubuntu.com/ubuntu jammy-backports/multiverse amd64 DEP-11 Metadata [212 B]
Fetched 6,830 kB in 4s (1,657 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
281 packages can be upgraded. Run 'apt list --upgradable' to see them.
saleh@saleh-VirtualBox:~$ sudo apt update -y
Hit:1 http://eg.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://security.ubuntu.com/ubuntu jammy-security InRelease
Get:3 http://eg.archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Hit:4 http://eg.archive.ubuntu.com/ubuntu jammy-backports InRelease
Get:5 http://eg.archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [870 kB]
Get:6 http://eg.archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [2,881 kB]
Get:7 http://eg.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [1,227 kB]
Get:8 http://eg.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [782 kB]
Fetched 5,888 kB in 3s (1,719 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
281 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

- Verify system details: kernel version, user, time.

```
saleh@saleh-VirtualBox:~$ uname -r
6.8.0-78-generic
saleh@saleh-VirtualBox:~$ whoami
saleh
saleh@saleh-VirtualBox:~$ date
30 2025 , ١٥ EEST 08:32:39 م
```

- Create /home/<username>/iot_logger with subdirectories: logs, scripts, data.

```
saleh@saleh-VirtualBox:~$ cd /home/saleh
saleh@saleh-VirtualBox:~$ mkdir -p iot_logger/{logs,scripts,data}
saleh@saleh-VirtualBox:~$ ls -R iot_logger
iot_logger:
data logs scripts

iot_logger/data:

iot_logger/logs:

iot_logger/scripts:
saleh@saleh-VirtualBox:~$
```

Open-Ended Questions:

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

Hardware: Processor, RAM, permanent storage, and peripheral devices.

Kernel: Linux's main component; it handles hardware, manages memory, runs processes, and oversees devices.

System Calls: Serve as the kernel and user program interfaces (such as open(), read(), and write()).

Shell: Command interpreters such as bash and zsh that turn user commands into system calls.

User Space: Programs and applications that communicate with the shell or use libraries directly.

-System calls are placed between the user space and the kernel (as they enable programs to invoke services from the kernel).

- ***Explain the purpose of these directories: /, /bin, /sbin, /usr, /etc, /var?***

/ → Root directory that serves as the entry point for the Linux file system.

/bin → Essential user binaries that must be available in single-user mode (/bin/ls, /bin/cp, /bin/mv).

/sbin → System binaries (/sbin/reboot, /sbin/ifconfig), used largely by the root or administrator.

/usr → User programs and their accompanying libraries (/usr/bin, /usr/lib).

/etc → Configuration files (for example, /etc/passwd, /etc/ssh/sshd_config).

/var → Variable files such as logs, spool files, and caches.

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

Linux has a universal file system where everything is a file: regular files, directories, devices, sockets, and pipes. This abstraction makes it easier to interact with everything: all is read and writable.

Examples:

/dev/sda → hard disk

/dev/tty → terminal

/proc/cpuinfo → CPU information

Program: an array of instructions (Python script, binary executable). It lives on disk.

Process: a program's instance that is running (has memory, PID, and state).