



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Assignment 2:

Operating Systems

CertHE Computing Skills for Workplace

Computer Architecture and Operating Systems.

ACCA4022_LON

DR. Redhwan Al-Amri (Lecturer)

University of Wales Trinity Saint David

(London Campus)

Student Name: Abdirahman mahdi

Student Number:2429936

Group: 01

Date:

Table of Contents

Introduction	1
1. Key functions of general Operating Systems	1
Systems	1
1.1 Process and Processor Management	1
1.2 Memory Management	3
1.3 File System Management	4
1.4 Security and Protection	5
2. Use of Windows OS CLI commands.	7
3. Use of Linux OS CLI commands.	15
4. Use of Windows OS scripts.	20
Script: System Health Check	20
Key Features Demonstrated	22
5. Use of Linux OS scripts.	23
Script: Log File Analyzer	23
Key Features Demonstrated	25
Conclusion	26
References	27
Appendices	29
Tutorial Activity on OS Types from OS Tutorial 1	29
1. LinkedIn Learning course:	29
2. Cisco Network Academy:	30
3. Cisco Network Academy : Operating Systems Basics	32

Introduction

1. Key functions of general Operating Systems

1.1 Process and Processor Management

Process Management deals with the processes creation, execution, scheduling, and termination. The processor needs to divide the available time for execution among several programs. It is the job of the operating system to keep an eye on the state of the process and resource usage. The Windows Task Manager gives real-time data on the applications and background processes along with the resource usage of these applications [1]. There is another way of doing process management using PowerShell, where the command Get-Process is used to get information on the processes running on the local computer [2].

macOS has an application called Activity Monitor which lets the user view the details of the processes and sort them using columns as well as see the CPU activity. According to Apple Inc., the Activity Monitor can display the details of processes, CPU time and memory usage as well as being able to quit the misbehaving processes [3].

```
PS C:\Windows\system32> tasklist /FI "STATUS eq RUNNING" /FO TABLE
```

Image Name	PID	Session Name	Session#	Mem Usage
csrss.exe	15176	Console	2	7,100 K
dwm.exe	3120	Console	2	129,724 K
sihost.exe	16120	Console	2	30,740 K
svchost.exe	16320	Console	2	38,984 K
taskhostw.exe	11088	Console	2	19,900 K
ctfmon.exe	15920	Console	2	21,780 K
pc-client.exe	12072	Console	2	62,700 K
ChsIME.exe	8148	Console	2	7,912 K
svchost.exe	9948	Console	2	24,212 K
RuntimeBroker.exe	16488	Console	2	55,776 K
RuntimeBroker.exe	17292	Console	2	29,992 K
SCNotification.exe	12692	Console	2	58,840 K
SettingSyncHost.exe	12116	Console	2	5,776 K
SecurityHealthSystray.exe	4856	Console	2	9,728 K
RtkAudUService64.exe	17100	Console	2	11,012 K
OneDrive.exe	12280	Console	2	84,240 K
Creative Cloud.exe	13724	Console	2	75,088 K
Creative Cloud UI Helper.exe	14436	Console	2	56,404 K
AdobeIPCBroker.exe	2880	Console	2	11,572 K
Adobe Desktop Service.exe	14204	Console	2	91,684 K
dllhost.exe	11748	Console	2	16,736 K
Creative Cloud Helper.exe	8832	Console	2	32,628 K
CoreSync.exe	13280	Console	2	33,900 K
MyPCUserSession.exe	12196	Console	2	53,536 K
jucheck.exe	17296	Console	2	15,996 K
AdobeCollabSync.exe	12368	Console	2	936 K
acrotray.exe	13708	Console	2	4,088 K
msedge.exe	19236	Console	2	234,824 K

Tasklist displays all running processes in Windows. “/FI “STATUS eq RUNNING” is used for filtering out running processes from the list of all the processes. “/FO TABLE” is an option that outputs the information in a tabular form. Process Name, PID (Process ID), session, and memory are some of the useful information provided in the output.

1.2 Memory Management

Memory management manages how RAM and virtual memory are allocated to processes. Isolation among processes should be maintained while efficient allocation of physical memory should be done by the OS. Microsoft clarifies that memory-performance data in Windows is found via performance counters which can be seen in applications like Task Manager [4]. This helps in comparing the memory performance across all processes with total memory performance.

The Activity Monitor tool on macOS gives Memory Pressure, Physical Memory, Memory Used, compressed memory, cached files, and swap details [5]. Linux offers similar command line access through free and top command line applications. Memory management thus enables multitasking and helps in detecting poor performance, application misuse, and lack of sufficient RAM.

```
PS C:\Windows\system32> Get-ChildItem -Force
```

d	27/07/2026	07:14	98888	mbp1.dll
-a----	27/04/2026	15:28	235008	XamlTileRender.dll
-a----	07/12/2019	09:08	3584	XAudio2_8.dll
-a----	12/05/2025	10:26	638976	XAudio2_9.dll
-a----	27/07/2026	07:14	1049088	XblAuthManager.dll
-a----	12/05/2025	10:26	93696	XblAuthManagerProxy.dll
-a----	12/05/2025	11:03	114688	XblAuthTokenBrokerExt.dll
-a----	25/05/2026	01:50	1291264	XblGameSave.dll
-a----	12/05/2025	10:26	159744	XblGameSaveExt.dll
-a----	07/12/2019	09:08	39936	XblGameSaveProxy.dll
-a----	25/05/2026	01:50	33792	XblGameSaveTask.exe
-a----	12/05/2025	10:26	70144	XboxGipRadioManager.dll
-a----	12/05/2025	10:26	72704	xboxgipsvc.dll

The command Get-ChildItem -Force will show all files and folders in the chosen location including the hidden and the system objects. With the use of the -Force parameter, it is possible to show the objects which are hidden from the user view by default.

1.3 File System Management

File systems enable organization of data in terms of files and folders. Operations on files, like creation, read, copy, move and deletion of files, are handled by the OS, and permission dictates the users who have access to those files. Windows offers File Explorer for graphical interface management, as well as the command line interfaces such as `dir`. `Dir` is described in Microsoft documentation as a command for displaying files and subdirectories including details like size and modification date [6].

In Linux and macOS operating systems, commands like `ls`, `mkdir`, `cp`, `mv` and `chmod` along with file explorer graphical interface are used. The common concept is that the OS acts as an abstraction layer for the physical storage devices so that applications do not interact with storage sector directly. The most important aspect is the file permission and ownership.

```
PS C:\Windows\system32> Get-ChildItem -Directory
```

Mode	LastWriteTime		Length	Name
----	-----		-----	----
d-----	09/09/2025	15:30		%userprofile%
d-----	07/12/2019	09:49		0409
d-----	12/05/2025	10:42		AdvancedInstallers
d-----	07/12/2019	09:14		am-et
d-----	07/12/2019	09:14		AppLocker
d-----	24/09/2025	12:36		appraiser
d---s-	12/05/2025	10:42		AppV
d-----	08/09/2025	16:29		ar-SA
d-----	08/09/2025	16:29		bg-BG
d-----	07/08/2026	18:21		Boot
d-----	07/12/2019	09:14		Bthprops

`Get-ChildItem -Directory` command shows the directories of the chosen path only. By using `-Directory` switch, we are able to ignore the files and focus on directories within the Windows system.

1.4 Security and Protection

Security and protection measures prevent unauthorized access to resources available within the operating system and also maintain confidentiality, integrity, and availability. Windows offers account management, access control, and security functions, while Linux and macOS rely on users, groups, permissions, and privileges. The Get-Local User cmdlet in Windows PowerShell allows fetching local user accounts, both default and created [7].

Another aspect of security is that which prevents an application or user from performing certain actions. An ordinary user does not need automatic administrative privileges since an infected application would alter the system in its entirety. Thus, OS security ensures that authentication, authorization, and resource security take place. This can be shown through user accounts, groups, and permissions on files of the specific OS.

```
PS C:\Windows\system32> ipconfig /all
```

```
Host Name . . . . . : UOW3488
Primary Dns Suffix . . . . . : uni.local
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : uni.local
                                   wales.ac.uk

Ethernet adapter Ethernet:

   Connection-specific DNS Suffix  . : uni.local
   Description . . . . . : Intel(R) Ethernet Connection (17) I219-V
   Physical Address. . . . . : 08-BF-B8-F0-7E-0E
   DHCP Enabled. . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . : 10.81.14.15(Preferred)
   Subnet Mask . . . . . : 255.255.255.0
```

Use of the “ipconfig /all” command provides detailed information on the network configuration of the computer. Through the use of “/all,” one will be able to obtain information on the IP address, physical address, DNS settings, and whether the computer has DHCP or not.

2. Use of Windows OS CLI commands.

Windows Command Prompt and PowerShell both support command line administration and automation. The examples listed below will demonstrate the five required topics. PowerShell is particularly useful for administration as commands like Get-Process retrieve process objects that can be easily filtered and format

```
PS C:\Windows\system32> ping 8.8.8.8 -n 4
```

```
Pinging 8.8.8.8 with 32 bytes of data:  
Reply from 8.8.8.8: bytes=32 time=1ms TTL=117  
Reply from 8.8.8.8: bytes=32 time=1ms TTL=117  
Reply from 8.8.8.8: bytes=32 time=1ms TTL=117  
Reply from 8.8.8.8: bytes=32 time=1ms TTL=117
```

Ping 8.8.8.8 is a command used to determine if the computer is able to communicate with other computers through the network. The command is executed by sending packets to the destination and measuring the time taken for the reply.

```
PS C:\Windows\system32> tracert -d 8.8.8.8
```

```
Tracing route to 8.8.8.8 over a maximum of 30 hops
```

1	<1 ms	<1 ms	<1 ms	10.81.14.3
2	<1 ms	<1 ms	<1 ms	10.88.12.1
3	1 ms	1 ms	<1 ms	62.232.101.1
4	1 ms	1 ms	1 ms	212.19.73.225
5	1 ms	2 ms	2 ms	62.72.129.169

The tracert 8.8.8.8 command will trace the path taken by the packets as they traverse from your computer to their destination. The output will list each of the hops in the path, together with the time it takes for each one to respond.

```
PS C:\Windows\system32> whoami /user
```

```
USER INFORMATION
-----
```

User Name	SID
-----------	-----

The whoami command shows the name of the account that is logged into the system running the Windows OS. The usefulness of this command lies in its ability to determine which user account is logged on.

```
PS C:\Windows\system32> net user
```

```
User accounts for \\UOW3488
-----
Administrator      DefaultAccount      DMTAdmin
Guest               lapsadmin            svc_fusion
WDAGUtilityAccount
The command completed successfully.
```

The net user command is used to show the available user accounts in a Windows computer. This can be done by an administrator in order to manage user accounts in the system.

```
PS C:\Windows\system32> schtasks /query /fo TABLE
```

[illegible]

The `schtasks /query` command is used to display the schedule tasks of the Windows system. It gives data like the name of the task, when it will run next, and its status.

```
PS C:\Windows\system32> schtasks /query /fo LIST /v
```

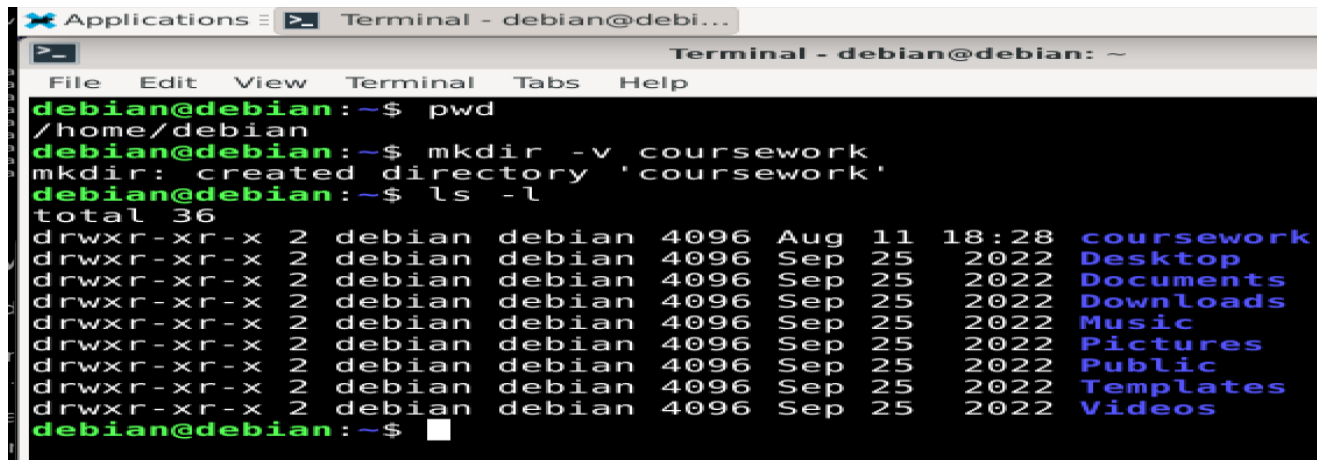
```
Days: N/A
Months: N/A
Repeat: Every: N/A
Repeat: Until: Time: N/A
Repeat: Until: Duration: N/A
Repeat: Stop If Still Running: N/A

HostName: UOW3488
TaskName: \Microsoft\Windows\Management\Provisioning\Retry
Next Run Time: N/A
Status: Disabled
Logon Mode: Interactive/Background
Last Run Time: 30/11/1999 00:00:00
Last Result: 267011
Author: N/A
Task To Run: %windir%\system32\ProvTool.exe /turn 5 /source ProvRetryTask
Start In: N/A
Comment: N/A
Scheduled Task State: Disabled
```

Schtasks /query /fo LIST /v command shows the scheduled tasks in the form of list. The parameter /fo LIST gives output in the form of list whereas the parameter /v gives more information about the task like task status, last run time, next run time, and the executable task program.

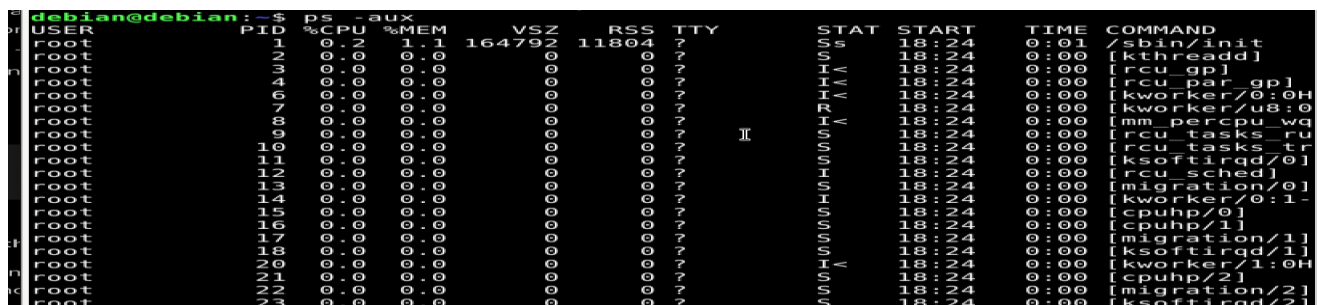
3. Use of Linux OS CLI commands

The Linux Command line Administration revolves around small utilities which can be combined by use of pipelines, redirection, and shell control structures. Bash supports conditionals and loops [9] whereas the normal Linux utilities support processes, files, networking, users and scheduling.

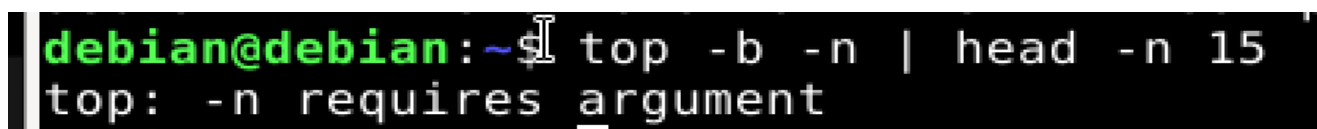


```
debian@debian:~$ pwd
/home/debian
debian@debian:~$ mkdir -v coursework
mkdir: created directory 'coursework'
debian@debian:~$ ls -l
total 36
drwxr-xr-x 2 debian debian 4096 Aug 11 18:28 coursework
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Desktop
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Documents
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Downloads
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Music
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Pictures
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Public
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Templates
drwxr-xr-x 2 debian debian 4096 Sep 25 2022 Videos
debian@debian:~$
```

The first Linux screenshot shows basic file and directory management commands. The `pwd` command displays the current working directory, while `mkdir -v coursework` creates a new folder called `coursework` and confirms that it has been created. The `ls -l` command then displays the contents of the current directory in a detailed list, including file permissions, ownership and other information.



```
debian@debian:~$ ps -aux
USER          PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root           1   0.2  1.1 164792 11804 ?        Ss   18:24   0:01 /sbin/init
root           2   0.0  0.0      0     0 ?        Ss   18:24   0:00 [kthreadd]
root           3   0.0  0.0      0     0 ?        Ss   18:24   0:00 [rcu_gp]
root           4   0.0  0.0      0     0 ?        Ss   18:24   0:00 [rcu_par_gp]
root           6   0.0  0.0      0     0 ?        Ss   18:24   0:00 [kworker/0:0H]
root           7   0.0  0.0      0     0 ?        Ss   18:24   0:00 [kworker/u8:0]
root           8   0.0  0.0      0     0 ?        Ss   18:24   0:00 [mm_percpu_wq]
root          10   0.0  0.0      0     0 ?        Ss   18:24   0:00 [rcu_tasks_ru
root          11   0.0  0.0      0     0 ?        Ss   18:24   0:00 [rcu_tasks_tr
root          12   0.0  0.0      0     0 ?        Ss   18:24   0:00 [ksoftirqd/0]
root          13   0.0  0.0      0     0 ?        Ss   18:24   0:00 [rcu_sched]
root          14   0.0  0.0      0     0 ?        Ss   18:24   0:00 [migration/0]
root          15   0.0  0.0      0     0 ?        Ss   18:24   0:00 [kworker/0:1-
root          16   0.0  0.0      0     0 ?        Ss   18:24   0:00 [cpuhp/0]
root          17   0.0  0.0      0     0 ?        Ss   18:24   0:00 [cpuhp/1]
root          18   0.0  0.0      0     0 ?        Ss   18:24   0:00 [migration/1]
root          20   0.0  0.0      0     0 ?        Ss   18:24   0:00 [ksoftirqd/1]
root          21   0.0  0.0      0     0 ?        Ss   18:24   0:00 [kworker/1:0H]
root          22   0.0  0.0      0     0 ?        Ss   18:24   0:00 [cpuhp/2]
root          23   0.0  0.0      0     0 ?        Ss   18:24   0:00 [migration/2]
root          24   0.0  0.0      0     0 ?        Ss   18:24   0:00 [ksoftirqd/2]
```



```
debian@debian:~$ top -b -n | head -n 15
top: -n requires argument
```

The next screenshot shows process management commands in Linux. The `ps aux` command displays detailed information about the processes currently running, including the user, Process ID (PID), CPU usage, and memory usage. The `top -b -n 1 | head -n 15` command displays a snapshot of system activity and limits the output to the first 15 lines, making it easier to view the most important process information.

```
debian@debian:~$ ping -c 4 google.com
PING google.com (142.251.29.100) 56(84) bytes of data.
64 bytes from uv-in-f100.1e100.net (142.251.29.100): icmp_seq=1 ttl=113 time=9.73 ms
64 bytes from uv-in-f100.1e100.net (142.251.29.100): icmp_seq=2 ttl=113 time=11.6 ms
64 bytes from uv-in-f100.1e100.net (142.251.29.100): icmp_seq=3 ttl=113 time=9.69 ms
64 bytes from uv-in-f100.1e100.net (142.251.29.100): icmp_seq=4 ttl=113 time=12.3 ms
```

The `ping -c 4 google.com` is a command used to perform a test of network connectivity between the Linux system and Google. The use of `-c 4` specifies that only four packets be sent to check the connection. The output displays the success of packet transmission and the response time.

```
debian@debian:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 12:5e:9d:e1:6b:4d brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.3/24 brd 192.168.64.255 scope global dynamic noprefixroute enp0s1
        valid_lft 85334sec preferred_lft 85334sec
    inet6 fd1e:838e:5965:2429:cc76:347e:9cb4:2e3d/64 scope global temporary dynamic
        valid_lft 603737sec preferred_lft 85334sec
    inet6 fd1e:838e:5965:2429:105e:9dff:fe1:6b4d/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591975sec preferred_lft 604775sec
    inet6 fe80::105e:9dff:fe1:6b4d/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
```

The command `'ip addr show'` gives an output of the network interfaces available in the Linux system. This will give an output of the IP addresses, status of the interface, and network configuration.

```
debian@debian:~$ id -u
1000
```

The command `id -u` will show the number that corresponds to the User ID (UID) of the current user who is logged into the system. The output shown in the picture is 1000, which is the UID of the current user.

```
debian@debian:~$ crontab -l
crontab: invalid option -- 'l'
crontab: usage error: unrecognized option
usage: crontab [-u user] file
       crontab [ -u user ] [ -i ] { -e | -l | -r }
              (default operation is replace, per 1003.2)
       -e      (edit user's crontab)
       -l      (list user's crontab)
       -r      (delete user's crontab)
       -i      (prompt before deleting user's crontab)
debian@debian:~$
```

Crontab is the command used for creating and managing scheduled tasks on Linux. This command can be used to schedule the running of commands and scripts at certain periods of time or certain intervals.

```
debian@debian:~$ systemctl list-timer --all
Unknown command verb list-timer.
```

The “systemctl list-timers” command is used to see timer tasks that are scheduled on a Linux machine. It gives details like the next time the timer will execute, the last time it executed, and the associated service name.

4. Use of Windows OS scripts

File Counter

Enter a folder path:

Enter a folder path: C:\Windows

Number of items found: 32

Press any key to continue . . .

Enter first number: 60

Enter second number:50

Enter first number: 60

Enter second number:50

Total: 110

The total is greater than 100.

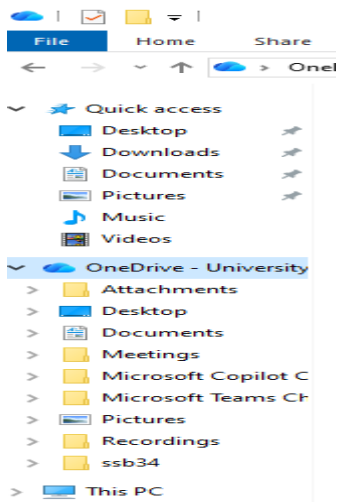
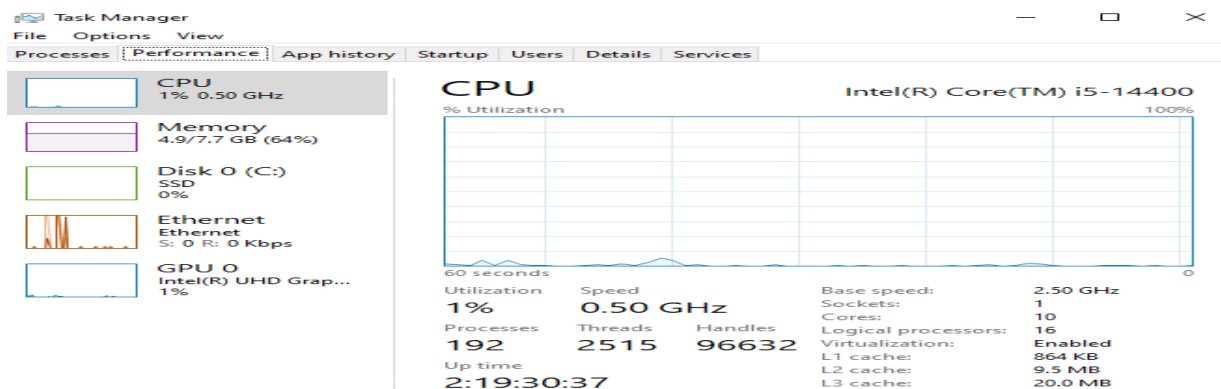
Press any key to continue . . .

Task Manager

File Options View

Processes Performance App history Startup Users Details Services

Name	Status	2% CPU	63% Memory	0% Disk	0% Network
Apps (6)					
> Microsoft Edge (15)		0%	1,063.0 MB	0 MB/s	0 Mbps
> pc-client		0%	54.2 MB	0 MB/s	0 Mbps
> Snipping Tool		0.6%	10.9 MB	0 MB/s	0 Mbps
> Task Manager		0.1%	23.1 MB	0 MB/s	0 Mbps
> Windows Explorer		0.4%	36.1 MB	0 MB/s	0 Mbps
> Windows PowerShell (2)		0%	35.7 MB	0 MB/s	0 Mbps
Background processes (83)					



Security at a glance

See what's happening with the security and health of your device and take any actions needed.



Virus & threat protection
No action needed.



Account protection
No action needed.



Firewall & network protection
No action needed.



App & browser control
The setting to block potentially unwanted apps is turned off. Your device may be vulnerable.

Turn on



Device security
View status and manage hardware security features



Device performance & health
No action needed.



Family options
Manage how your family uses their devices.

The above Windows script shows how commands can be automated to carry out several tasks. In the script, variables are used for data storage, user input is taken, calculations are done, there is use of an IF statement for decision making, and there is a FOR loop that allows for command repetition.

5. Use of Linux OS scripts.

```
echo "enter a number"
read num
result=$((num * 2))
if [ $result -gt 10 ]; then
echo "result is $result and is greater than 10"
else
echo "result is $result and is 10 or less"
fi
```

```
debian@debian:~$ bash fillecounter.sh
enter a number
8
result is 16 and is greater than 10
```

```
GNU nano 5.4
echo "counting from 1 to 5 "
for number in 1 2 3 4 5
do
echo "number: $number"
done
```

```
debian@debian:~$ bash loop.sh
counting from 1 to 5
number: 1
number: 2
number: 3
number: 4
number: 5
```

The Linux script demonstrates automation using Bash commands. It uses variables to store values, accepts user input, performs calculations, uses an if statement to make decisions, and uses a for loop to repeat commands. This shows how Linux scripts can automate multiple tasks and reduce the need to enter commands manually.

Conclusion

From this report, it can be seen that Windows, macOS, and Linux offer identical capabilities of an operating system but use different methods and interfaces. Processor and process management enables running of multiple programs in the shared environment of the CPU. Memory management allows controlling RAM and virtual memory. File management offers persistent and organized storage, whereas security and protection limit access to certain users and processes. GUI applications such as Windows Task Manager and macOS Activity Monitor make all those features accessible for users. Command line interface of Linux provides detailed control.

Windows and Linux CLI section shows how administration can become reproducible and accurate through use of commands and switches. Windows PowerShell is great for administrative work due to ability to pipe and filter commands, although traditional commands like tasklist and ipconfig can still be used. Commands in Linux are modular, allowing to combine process, file and network tools. User management and scheduling commands show how operating systems enable restricted access and scheduled operations.

Scripting section demonstrates the concept of automation through scripts instead of individual commands. Batch and Bash scripts can receive user inputs, assign values to variables, do math, make decisions, and repeat commands in loop form. It means that regular actions such as system diagnostics, file listing, log analysis, and backup testing can be carried out in repeatable fashion. Practical screenshots that are requested in assessment should be taken by the student from his/her authorized computers and put into appropriate places.

References

- [1] Microsoft, "Troubleshoot processes by using Task Manager," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/troubleshoot/windows-server/support-tools/support-tools-task-manager>. [Accessed: Aug. 8, 2026].
- [2] Microsoft, "Get-Process," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/powershell/module/microsoft.powershell.management/get-process>. [Accessed: Aug. 8, 2026].
- [3] Apple, "View information about Mac processes in Activity Monitor," Apple Support, 2026. [Online]. Available: <https://support.apple.com/en-gb/guide/activity-monitor/actmntr1001/mac>. [Accessed: Aug. 8, 2026].
- [4] Microsoft, "Memory Performance Information," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/windows/win32/memory/memory-performance-information>. [Accessed: Aug. 8, 2026].
- [5] Apple, "View memory usage in Activity Monitor on Mac," Apple Support, 2026. [Online]. Available: <https://support.apple.com/en-gb/guide/activity-monitor/actmntr1004/mac>. [Accessed: Aug. 8, 2026].
- [6] Microsoft, "dir," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/windows-server/administration/windows-commands/dir>. [Accessed: Aug. 8, 2026].
- [7] Microsoft, "Get-LocalUser," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/powershell/module/microsoft.powershell.localaccounts/get-localuser>. [Accessed: Aug. 8, 2026].
- [8] Microsoft, "Windows Commands," Microsoft Learn, 2026. [Online]. Available: <https://learn.microsoft.com/en-us/windows-server/administration/windows-commands/windows-commands>. [Accessed: Aug. 8, 2026].
- [9] GNU Project, "Bash Reference Manual," GNU, 2025. [Online]. Available: <https://www.gnu.org/software/bash/manual/>. [Accessed: Aug. 8, 2026].
- [10] Linux man-pages project, "crontab(1)," man7.org, 2026. [Online]. Available: <https://man7.org/linux/man-pages/man1/crontab.1p.html>. [Accessed: Aug. 8, 2026].
- [11] GNU Project, "Shell Arithmetic," Bash Reference Manual, 2025. [Online]. Available: https://www.gnu.org/software/bash/manual/html_node/Shell-Arithmetic.html. [Accessed: Aug. 8, 2026].