

OPERATING SYSTEMS

MASTER IN COMPUTER SCIENCE & BUSINESS TECHNOLOGY

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Github: https://github.com/operard/opsys_parallel/blob/master/mcsbt/README.md

https://github.com/operard/opsys_parallel/blob/master/mcsbt/README.md

← → ↻

github.com/operard/opsys_parallel/blob/master/mcsbt/README.md

Apps

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MASTER IN COMPUTER SCIENCE & BUSINESS TECHNOLOGY

Session 1

- Operating Systems Review.

https://github.com/operard/opsys_parallel/blob/master/mcsbt/opsys_session1.pdf

Session 2

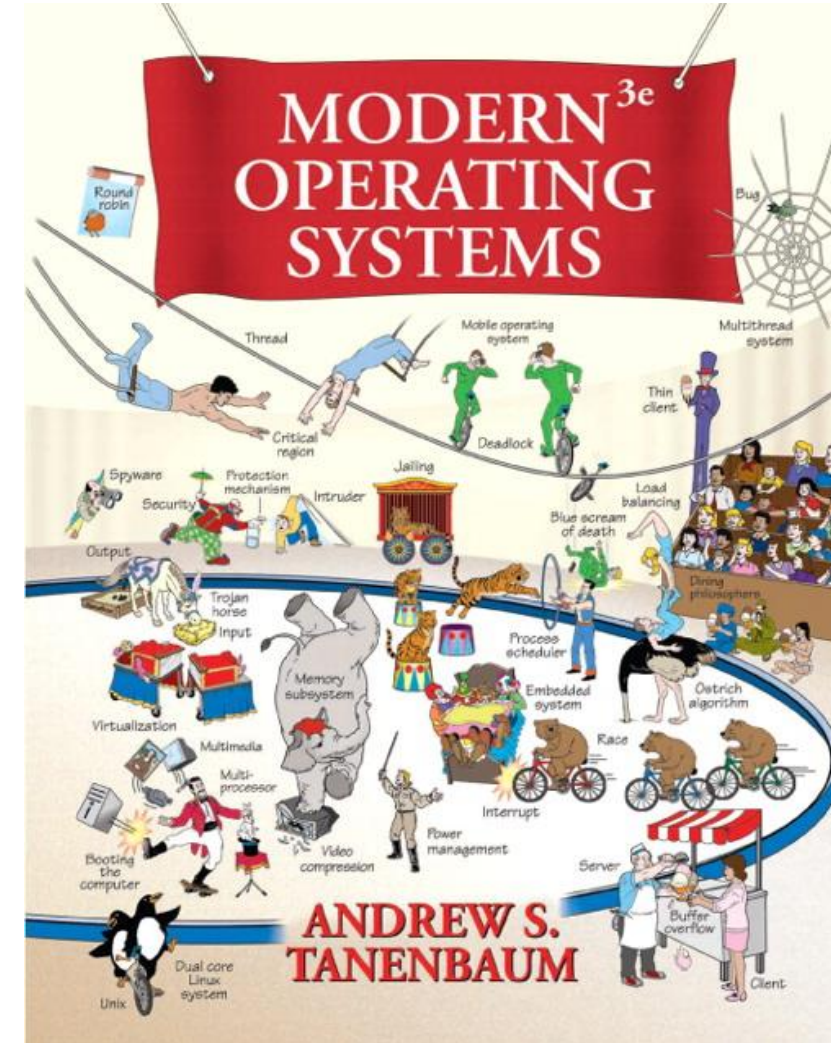
Session 3

Session 4

Books References

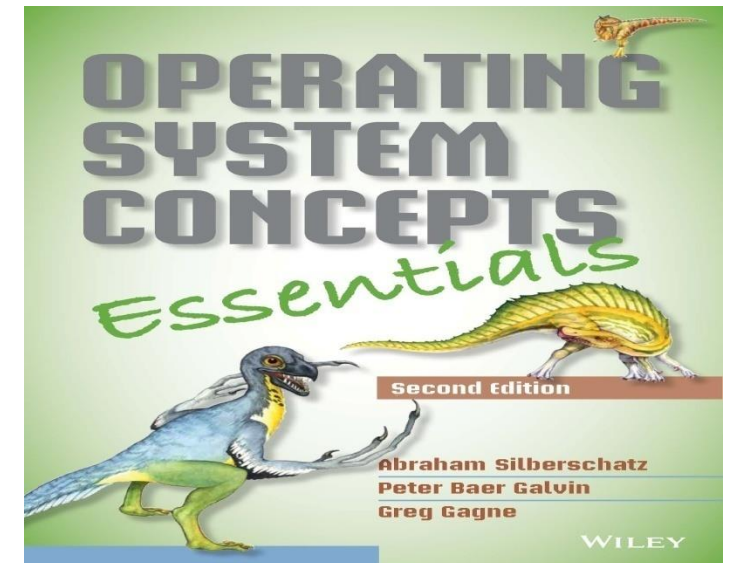
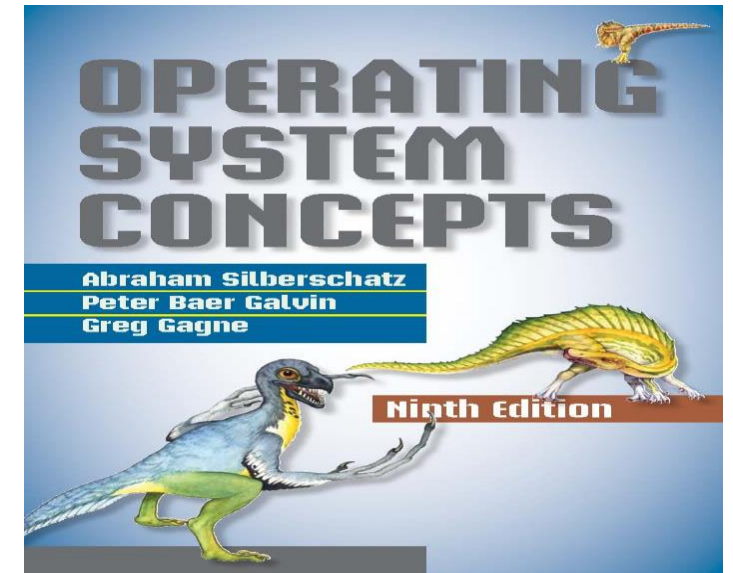
Operating Systems book

- A free online version of “Modern Operating Systems” can be downloaded from:
- <https://github.com/gramasaurus/opsys/blob/master/Modern.Operating.Systems.3rd.Edition.pdf>
- https://github.com/gramasaurus/opsys/blob/master/MOS_3e_SM.pdf



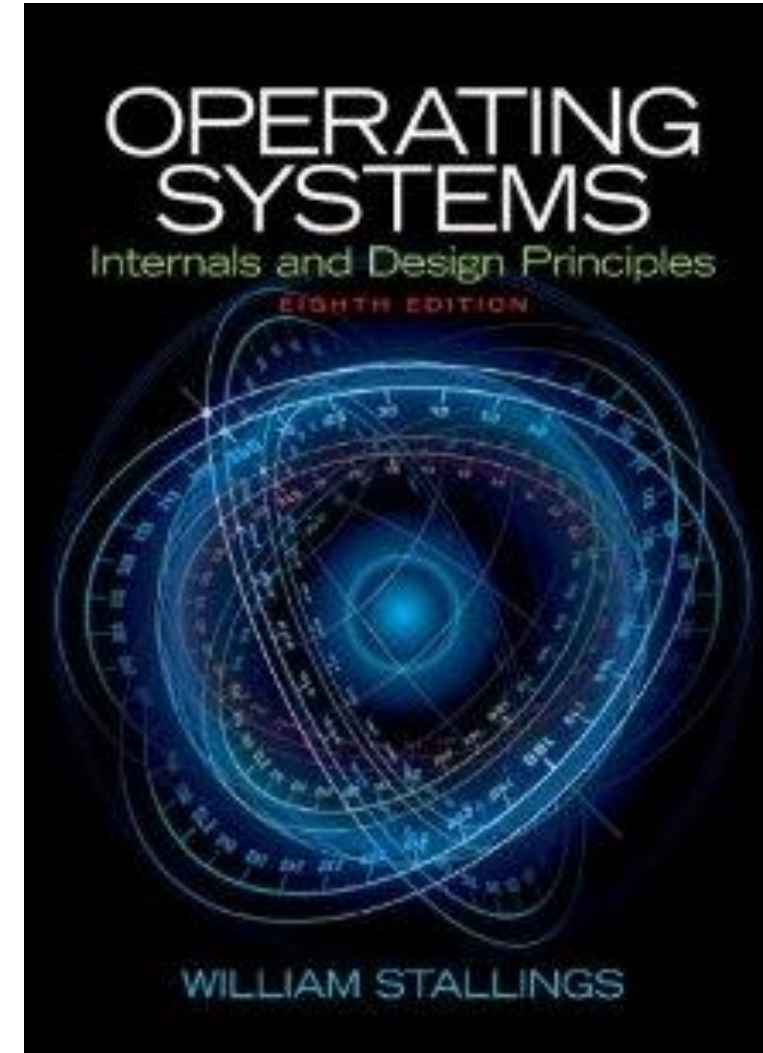
Other links (1)

- A. Silberschatz, P. B. Galvin, and G. Gagne, “Operating Systems Concepts (Essentials)”, 9th Edition, John Wiley & Sons, 2012.
- <http://codex.cs.yale.edu/avi/os-book/>
- <https://www.os-book.com/OSE2/index.html>
- <https://www.os-book.com/OS9/index.html>
- <https://www.os-book.com/OS10/index.html>



Other links (2)

- W. Stallings, “Operating Systems: Internals and Design Principles”, 8th ed, Pearson, 2015.
- <http://williamstallings.com/OperatingSystems/>



Current Syllabus

Syllabus

- **Session 1**

- What is an Operating System?
- History of Operating Systems
- Computer Hardware
- File System
- Operating Systems

- **Session 2**

- System Calls
- Monolithic Systems
- Virtual Machines
- Process Model
- Cloud Google Shell *Practice
- Process Life Cycle

Syllabus

- **Session 3**

- **Interprocess Communication**
- Producer-Consumer problem
- Deadlock
- Banker's Algorithm

- **Session 4**

- **Concurrency, synchronization and Scheduling**
- Read and Write problem
- Monitors
- Semaphores
- **Dining Philosophers Problem *Practice**

Syllabus

- **Session 5**
 - **Concurrency, synchronization and Scheduling**
 - Process Scheduler
 - Scheduler Algorithms: FCFS, SJF,
 - Python FCFS *practice
- **Session 6**
 - **Memory Management**
 - Address space
 - Dynamic address
 - Segmentation, Paging
 - Replacement policies: FIFO, LRU
 - **LRU python code *practice**

Syllabus

- **Session 7**

- **File systems**
- ownership and permissions
- changing and removing permissions
- Access modes
- file creation mask
- moving around the file system
- wild cards
- **File testing *practice**

- **Session 8**

- **Input Output I/O**
- overhead, latency, bandwidth
- Direct Memory Access DMA
- Sync and Async I/O
- **Redirection *practice**

Syllabus

- **Session 9**
 - **Multimedia**
 - Browser support
 - Multimedia formats
 - Multimedia operating systems
- **Session 10**
 - **Network**
 - TCP/IP Network model
 - **The routing table *practice**

Syllabus

- **Session 11**
 - **Security and Encryption**
 - Phishing
 - Trojan Horse
 - XSS Attacks
 - **my unsecure bank *practice**
- **Session 12**
 - **Exam**

New Syllabus

Syllabus

- **Session 1**
 - Operating Systems Summary
- **Session 2**
 - Operating Systems Example Labs
 - Linux
 - Windows
 - MacOS
- **Session 3**
 - Processes & Threads

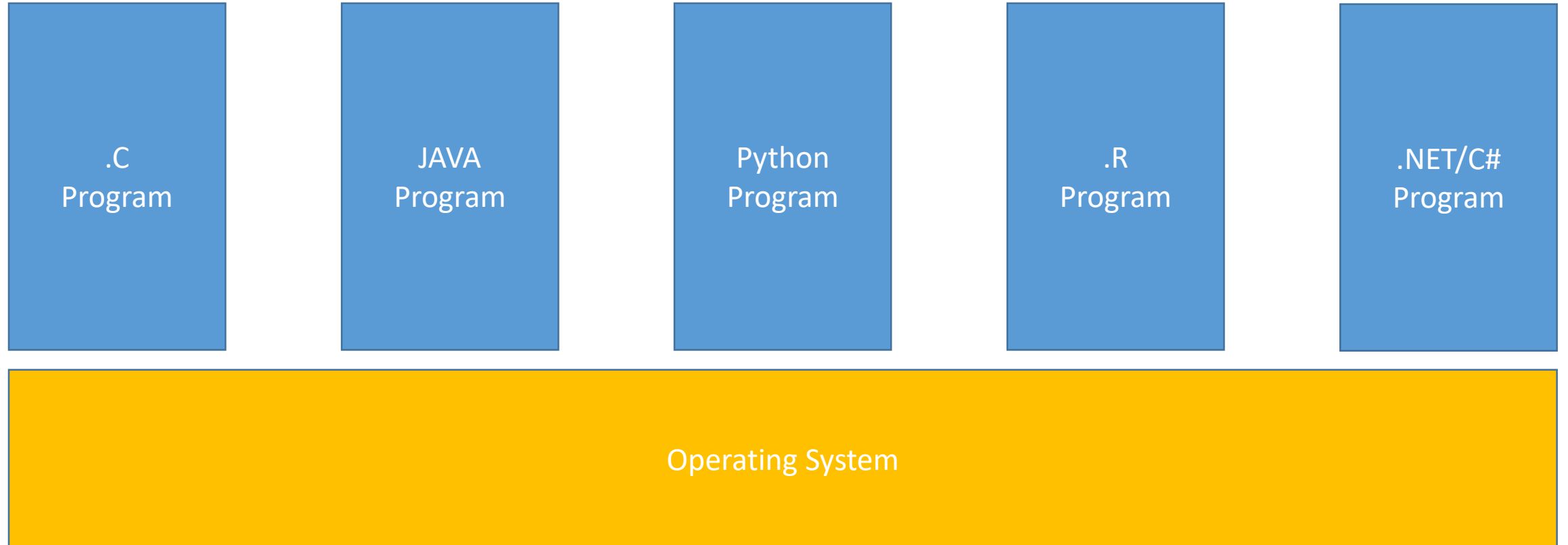
Syllabus

- **Session 4**
 - **Interprocess Communication**
 - Producer-Consumer problem
 - Concurrency & Scheduling
- **Session 5**
 - **Memory Management**

Why must you study Operating Systems?

- Understand how computers work under the hood .
- How could My App work faster ?
- Magic to provide infinite CPUs, memory, devices, and networked computing.
- Tradeoffs between performance and functionality, division of labor between HW and SW
- Combine language, hardware, data structures, algorithms, money, art, luck, and hate/love
- Operating systems are key components in many systems.

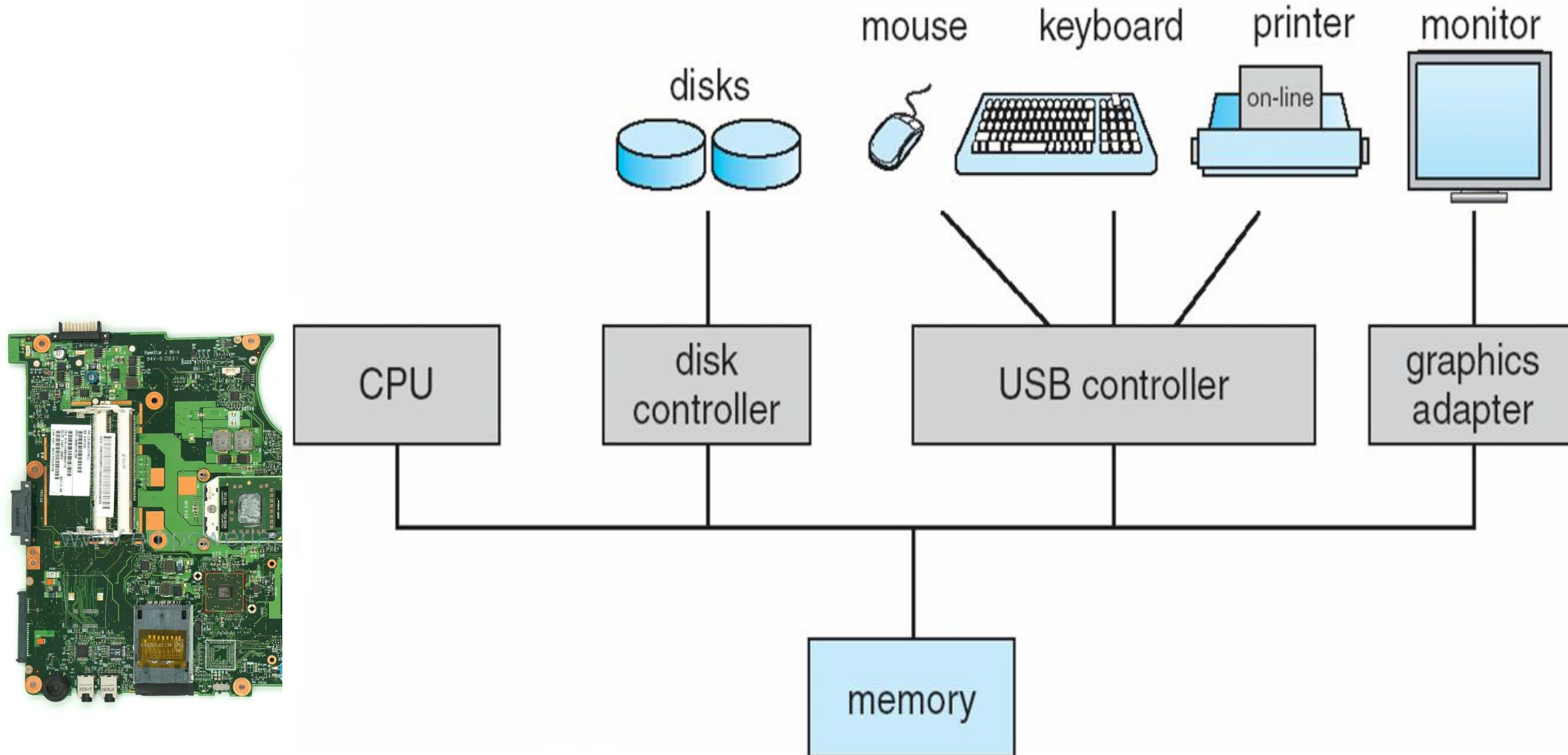
Which programming languages do you use?



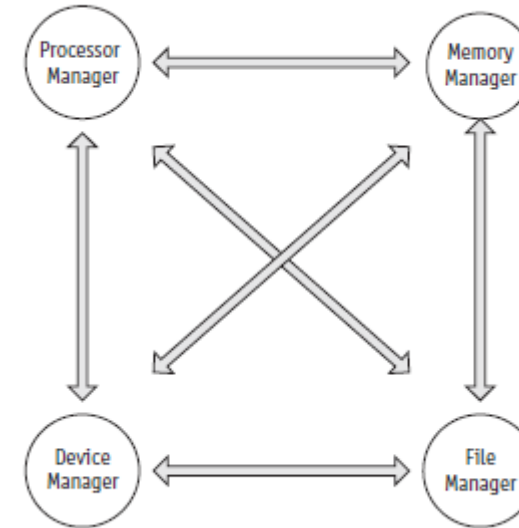
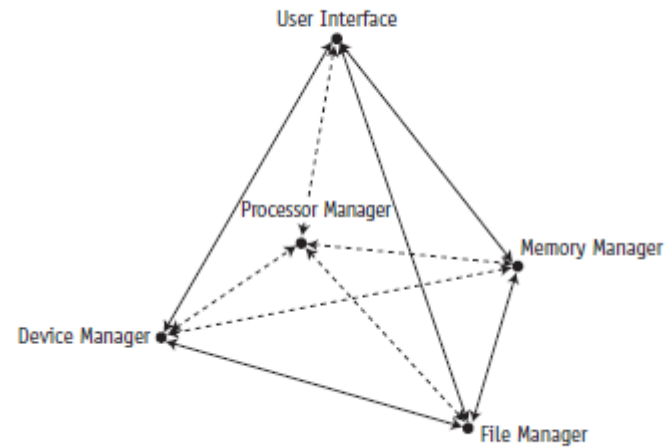
What is an Operating System (1)?

- A modern computer consists of:
 - One or more processors
 - Main memory
 - Disks
 - Printers
 - Various input/output devices.
- Managing all these varied components requires a layer of software – the **Operating System (OS)**.

Computer Hardware Organization



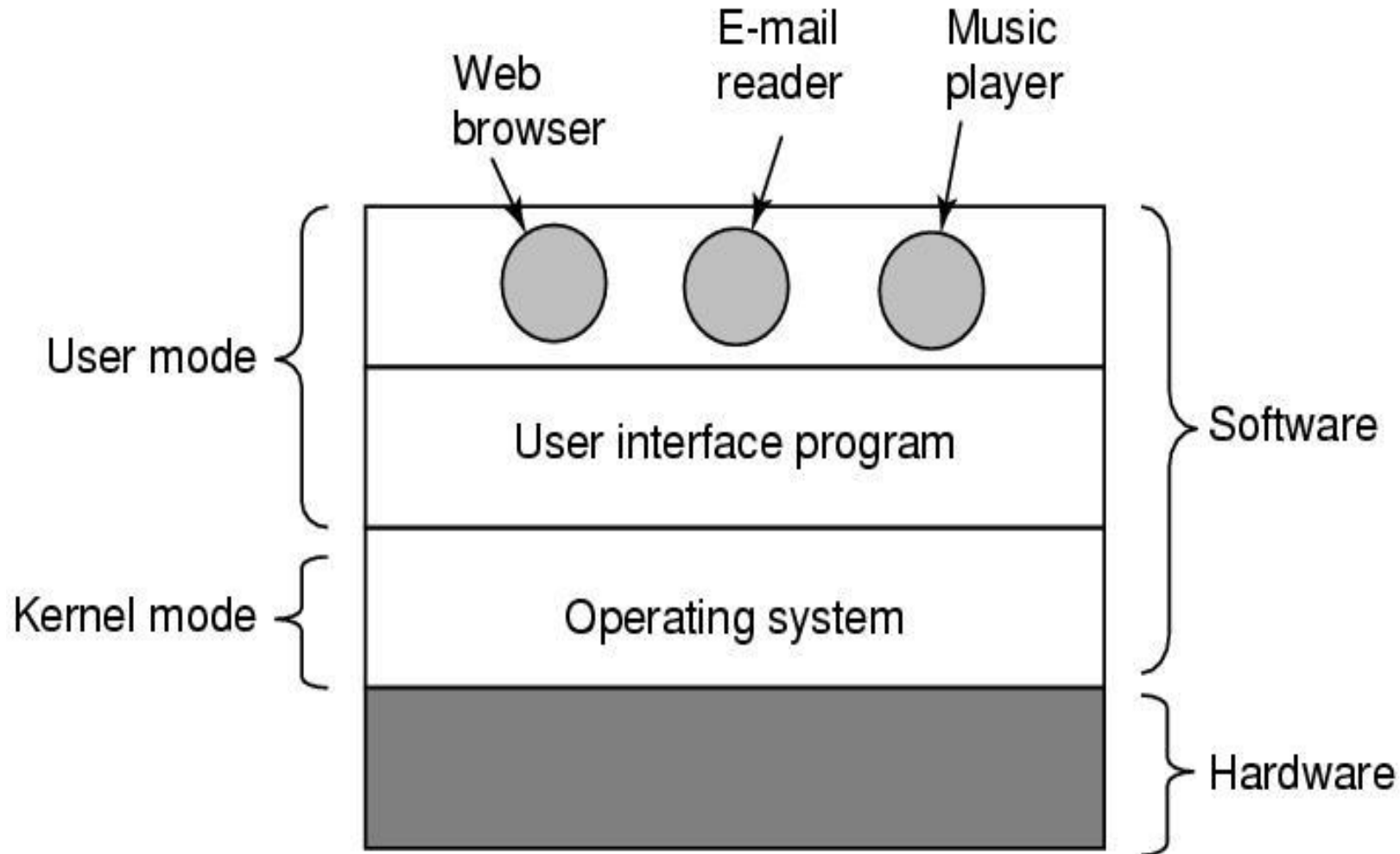
Standalone Operating Systems



What is an Operating System (2)?

- An Operating System is a program that acts as an intermediary/interface between a user of a computer and the computer hardware.
- OS goals:
 - Control/execute user/application programs.
 - Make the computer system convenient to use.
 - Ease the solving of user problems.
 - Use the computer hardware in an efficient manner.

Where does the OS fit in?



Services provided by an OS

- Facilities for program creation
 - editors, compilers, linkers, debuggers, etc.
- Program execution
 - loading in memory, I/O and file initialization.
- Access to I/O and files
 - deals with the specifics of I/O and file formats.
- System access
 - resolves conflicts for resource contention.
 - protection in access to resources and data.

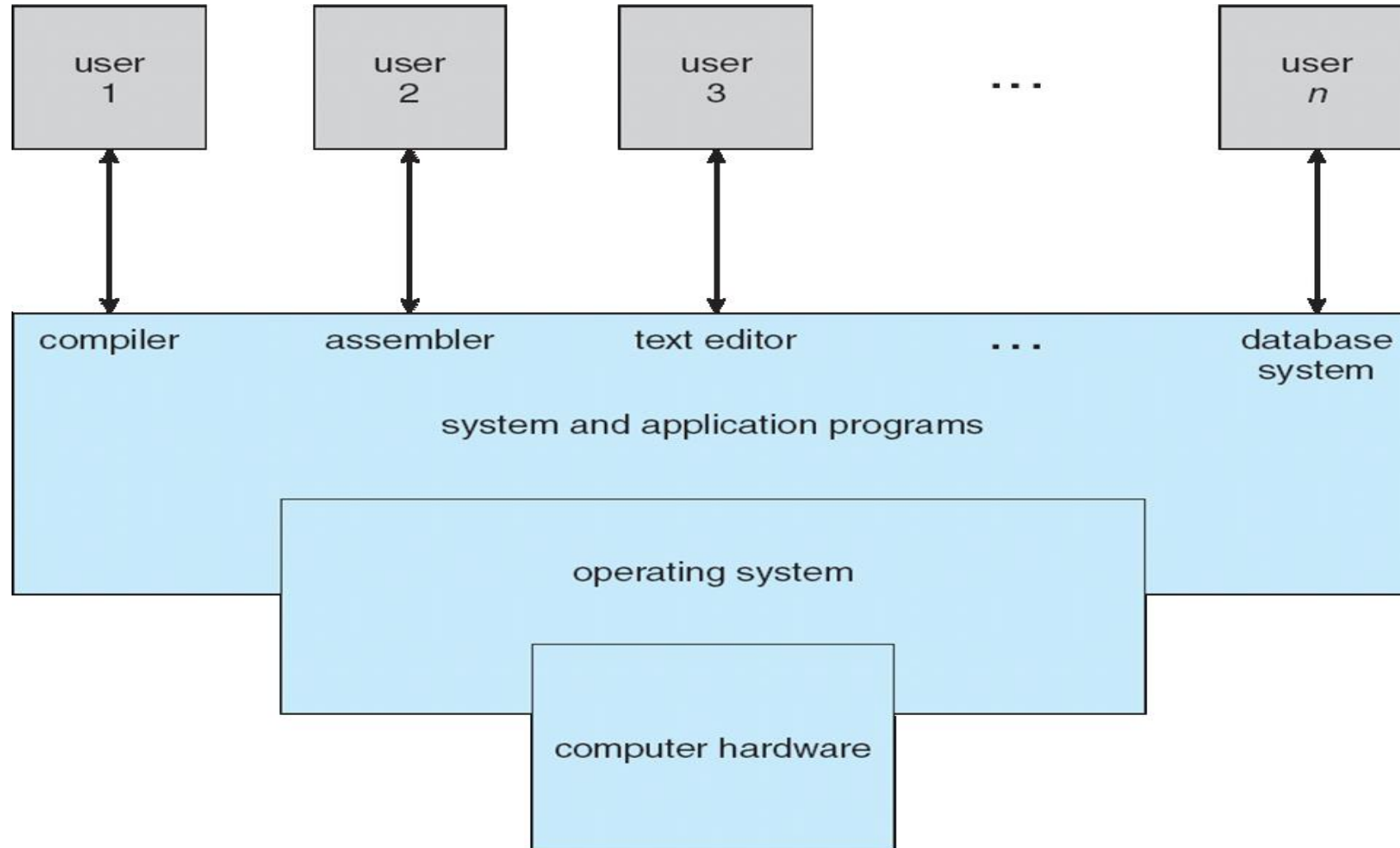
Why are Operating Systems Important?

- Important to understand and know how to correctly use when writing user applications.
- Large and complex systems that have a high economic impact and result in interesting problems of management.
- Few actually involved in OS design and implementation but nevertheless many general techniques to be learned and applied.
- Combines concepts from many other areas of Computer Science: Architecture, Languages, Data Structures, Algorithms, etc.

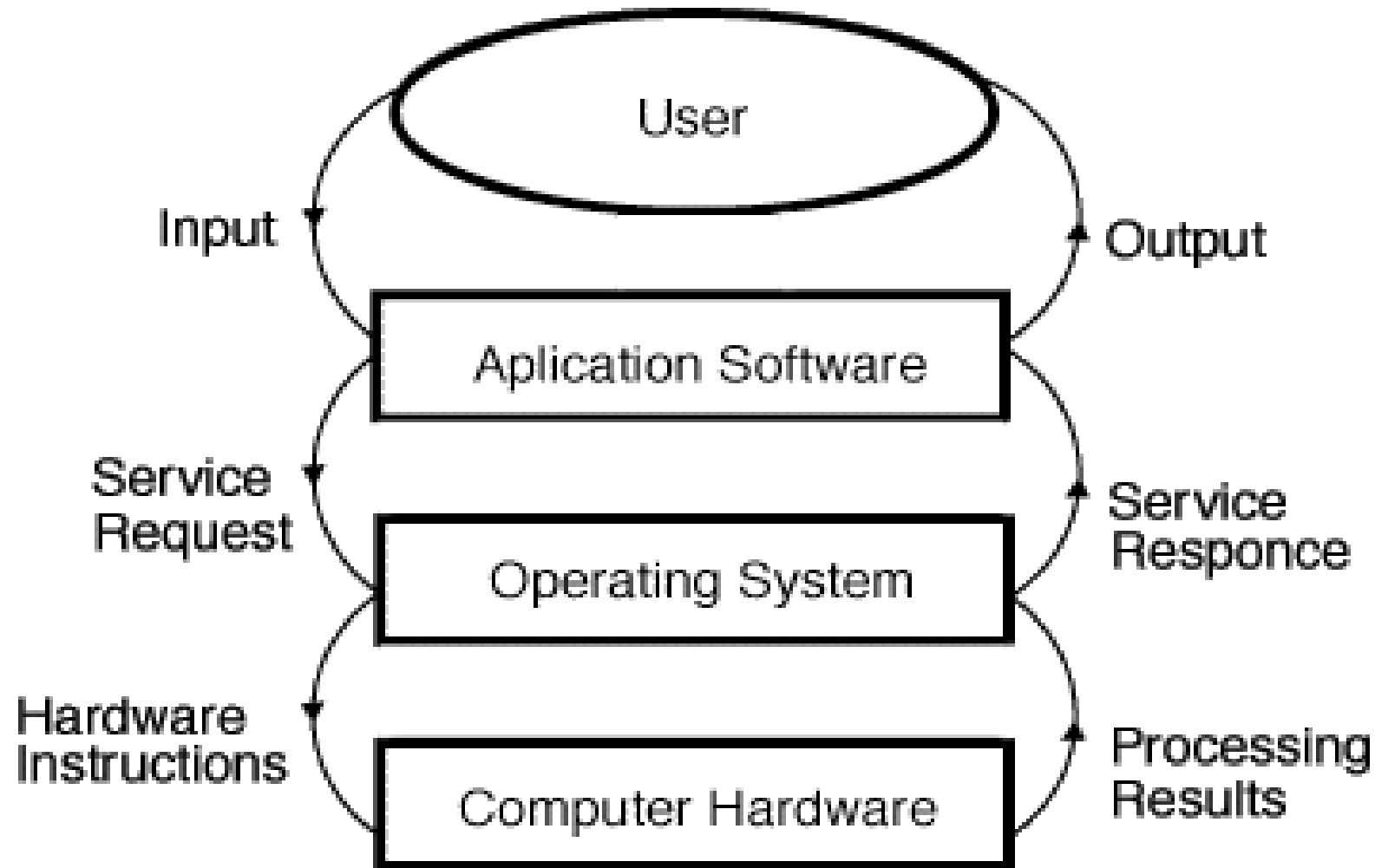
Computer System Components

1. Hardware – provides basic computing resources (CPU, Memory, I/O devices, Communication).
2. Operating System – controls and coordinates use of the hardware among various application programs for various users.
3. System & Application Programs – ways in which the system resources are used to solve computing problems of the users (Word processors, Compilers, Web browsers, Database systems, Video games).
4. Users – (People, Machines, other computers).

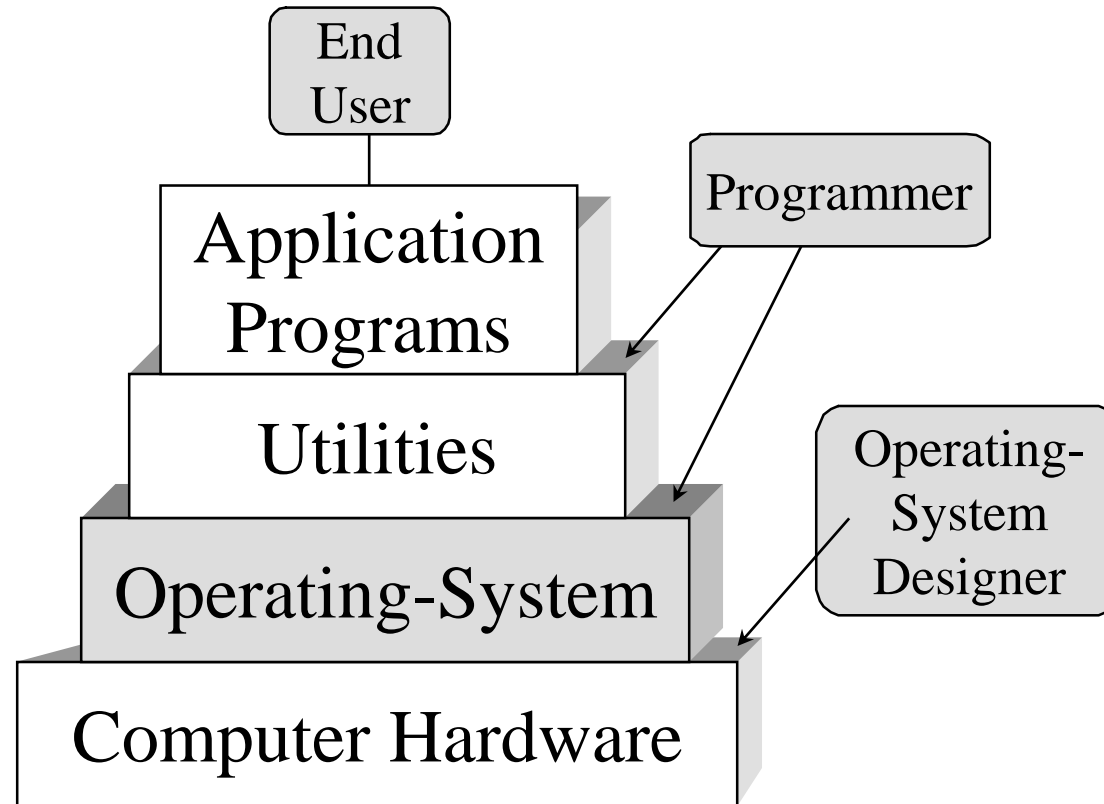
Static View of System Components



Dynamic View of System Components



Layers of a Computer System

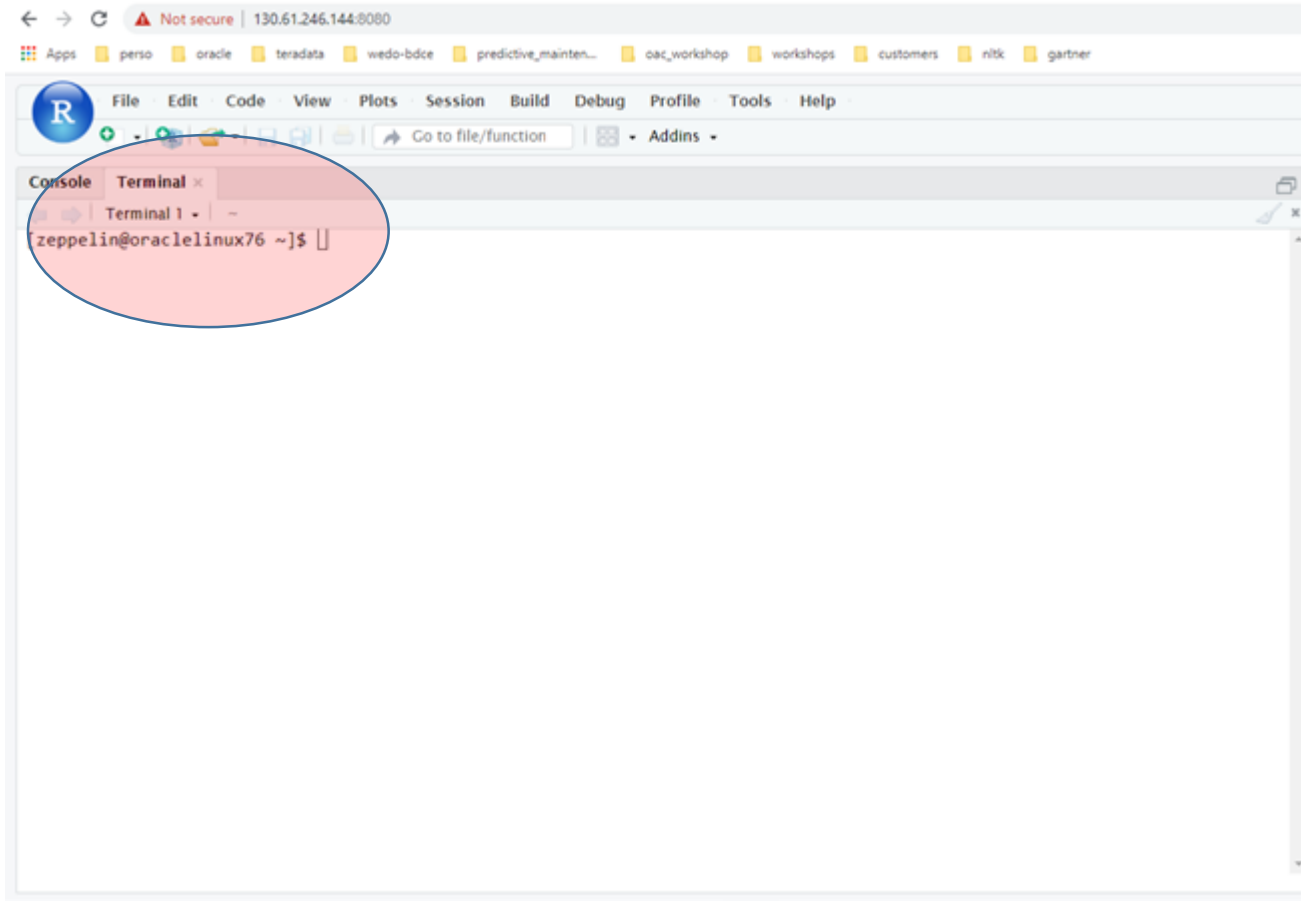


Linux OS

Environment for Hands-on-Lab

- IP: 130.61.246.144
- RSTUDIO: 8080
- USERS: workshop001 /etc.... / workshop020
- PWD: Welcome2020#
- URL: <http://130.61.246.144:8080/>

Lab 1: check environment



- Connect to Terminal
- Execute command in Terminal

You need help ?

■ The Linux equivalent of HELP is man (manual)

- ◆ Use man -k <keyword> to find all commands with that keyword
- ◆ Use man <command> to display help for that command
 - Output is presented a page at a time. Use **b** for to scroll backward, **f** or a space to scroll forward and **q** to quit

Common command

- pwd - print (display) the working directory
- cd <dir> - change the current working directory to *dir*
- ls - list the files in the current working directory
- ls -l - list the files in the current working directory in long format

- who or w
 - ◆ List who is currently logged on to the system
- whoami
 - ◆ Report what user you are logged on as
- ps
 - ◆ List your processes on the system
- ps aux
 - ◆ List all the processes on the system
- echo "A string to be echoed"
 - ◆ Echo a string (or list of arguments) to the terminal

Who's Logged On Right Now?

- The w command lists all users logged on right now

```
5:16pm up 2 days, 8:46, 1 user, load average: 0.00, 0.00, 0.00
USER      TTY      FROM          LOGIN@      IDLE        JCPU        PCPU        WHAT
neale     ttyp0    websurfer.reston 4:28pm     1.00s       0.52s       0.18s       w
```

Execute Next commands

- ◆ Get help on the ls command
- ◆ Find out who else is on the system
- ◆ What is your current directory
- ◆ Redirect the output of the ls -l / command to ls.output and see what you get

Execute Process Command

- **ps -ef | more**
- **ps aux**
- **ps -e f**
- **top (tape “q” to quit the process)**

Linux Device Handling

- **Devices are the way Linux talks to the world**
- **Devices are special files in the `/dev` directory**
(try `ls /dev`)

<code>/dev/ttyx</code>	TTY devices
<code>/dev/hdb</code>	IDE hard drive
<code>/dev/hdb1</code>	Partition 1 on the IDE hard drive
<code>/dev/dasda</code>	ECKD/CKD/FBA DASD
<code>/dev/dasda1</code>	Partition 1 on DASD
<code>/dev/null</code>	The null device ("hole")
<code>/dev/zero</code>	An endless stream of zeroes
<code>/dev/mouse</code>	Mouse (not <code>/390</code>)

Device and Drivers

■ Each `/dev` file has a major and minor number

- ◆ Major defines the device type
- ◆ Minor defines device within that type
- ◆ Drivers register a device type

brw-r--r--	1	root	root	64,	0	Jun	1	1999	/dev/mnda
crw-r--r--	1	root	root	5,	0	Jan	5	09:18	/dev/tty

Device Type:
b - block
c - character

Major no.

Minor no.

Special Files - /proc

- **Information about internal Linux processes are accessible to users via the /proc file system (in memory)**

/proc/cpuinfo	CPU Information
/proc/interrupts	Interrupt usage
/proc/version	Kernel version
/proc/modules	Active modules

```
cat /proc/cpuinfo
vendor_id       : IBM/S390
# processors    : 1
bogomips per cpu: 86.83
processor 0: version = FF, identification = 045226, machine = 9672
```


File System

- You can view what file systems are mounted using either:

- mount
- df -h
- cat /etc/fstab

■ mount

- ◆ Mounts a file system that lives on a device to the main file tree
- ◆ Start at Root file system
 - Mount to root
 - Mount to points currently defined to root
- ◆ /etc/fstab used to establish boot time mounting

/dev/dasda1	/	ext2	defaults,errors=remount-ro	0	1
/dev/dasdb1	/bin	ext2	defaults,errors=remount-ro	0	1
/dev/dasdc1	/usr	ext2	defaults,errors=remount-ro	0	1
/dev/dasdd1	/usr/local	ext2	defaults,errors=remount-ro	0	1
/dev/dasde1	/usr/man	ext2	defaults,errors=remount-ro	0	1
/dev/dasdf1	/home	ext2	defaults,errors=remount-ro	0	1
/dev/dasdg1	swap	swap	defaults	0	0
none	/proc	proc	defaults	0	0

Environment Variables

■ Using Environment Variables:

- ◆ echo \$VAR
- ◆ cd \$VAR
- ◆ cd \$HOME
- ◆ echo "You are running on \$SYSTEMNAME"

■ Displaying - use the following commands:

- ◆ set (displays local & environment variables)
- ◆ export

■ Variables can be retrieved by a script or a program

Creating file and directories

- **Files can be created in a number of ways**

- ◆ The output of a command
- ◆ Being edited using vi or your favorite editor
- ◆ By using the touch command which creates an empty file or updates the modification and access time information of an existing file

- **Directories are created using the mkdir command**

File Permissions

- The long version of a file listing (ls -l) will display the file permissions:

```
-rwxrwxr-x 1 rvdheij rvdheij 5224 Dec 30 03:22 hello
-rw-rw-r-- 1 rvdheij rvdheij 221 Dec 30 03:59 hello.c
-rw-rw-r-- 1 rvdheij rvdheij 1514 Dec 30 03:59 hello.s
drwxrwxr-x 7 rvdheij rvdheij 1024 Dec 31 14:52 posixuft
:
-rw-r--r-- 1 neale users 1039 2009-09-10 12:47 a.a
drwxr-xr-x 5 neale users 4096 2011-08-16 20:34 benchmark
drwxr-xr-x 2 neale users 4096 2009-07-30 08:55 bin
drwxr-xr-x 3 neale users 4096 2009-05-16 12:17 BINUTILS
-rw-r--r-- 1 neale users 3776 2012-02-24 09:32 bluefin.cs
```

Permissions

Owner

Group

File Commands

- **cp <fromfile> <tofile>**
 - ◆ Copy from the <fromfile> to the <tofile>
- **mv <fromfile> <tofile>**
 - ◆ Move/rename the <fromfile> to the <tofile>
- **rm <file>**
 - ◆ Remove the file named <file>
- **mkdir <newdir>**
 - ◆ Make a new directory called <newdir>
- **rmdir <dir>**
 - ◆ Remove an (empty) directory

Change File Permissions

- Use the chmod command to change file permissions
 - ◆ The permissions are encoded as an octal number

User			Group			Other		
Read r	Write w	Execute x	Read r	Write w	Execute x	Read r	Write w	Execute x
400	200	100	40	20	10	4	2	1

```
chmod 0755 file # Owner=rwx Group=r-x Other=r-x
chmod 0500 file2 # Owner=r-x Group=--- Other=---
chmod 0644 file3 # Owner=rw- Group=r-- Other=r--

chmod +x file # Add execute permission to file for all
chmod u-r file # Remove read permission for owner
chmod a+w file # Add write permission for everyone
```

More Commands

- awk - a file processing language that is well suited to data manipulation and retrieval of information from text files
- chown - sets the user ID (UID) to owner for the files and directories named by pathname arguments. This command is useful when from test to production

```
chown -R apache:httpd /usr/local/apache
```

More Commands

- diff - attempts to determine the minimal set of changes needed to convert a file specified by the first argument into the file specified by the second argument
- find - Searches a given file hierarchy specified by path, finding files that match the criteria given by expression

Search Command

- **grep** - Searches files for one or more pattern arguments. It does plain string, basic regular expression, and extended regular expression searching

```
find ./ -name "*.c" | xargs grep -i "fork"
```

In this example, we look for files with an extension "c" (that is, C source files). The filenames we find are passed to the xargs command which takes these names and constructs a command line of the form: `grep -i fork <file.1>...<file.n>`. This command will search the files for the occurrence of the string "fork". The "-i" flag makes the search case insensitive.

Kill Process

■ kill - sends a signal to a process or process _group

- ◆ You can only kill your own processes unless you are root

```
UID          PID    PPID    C  STIME TTY          TIME CMD
root         6715    6692    2  14:34 ttty0        00:00:00 sleep 10h
root         6716    6692    0  14:34 ttty0        00:00:00 ps -ef
[root@penguinvm log]# kill 6715
[1]+  Terminated                  sleep 10h
```

Replace String

- **sed** - applies a set of editing subcommands contained in a script to each argument input file

```
find ./ -name "*.c,v" | sed 's/,v//g' | xargs grep "PATH"
```

This finds all files in the current and subsequent directories with an extension of `c,v`. `sed` then strips the `,v` off the results of the `find` command. `xargs` then uses the results of `sed` and builds a `grep` command which searches for occurrences of the word `PATH` in the C source files.

Archive command

■ tar - manipulates archives

- ◆ An archive is a single file that contains the complete contents of a set of other files; an archive preserves the directory hierarchy that contained the original files.

```
tar -tzf imap-4.7.tar.gz
imap-4.7/
imap-4.7/src/
imap-4.7/src/c-client/
imap-4.7/src/c-client/env.h
imap-4.7/src/c-client/fs.h
```

Viewing Files

- cat **"Concatenate"**
- more **Display one page at a time**
- less **Variant of `more`**
- **Editors**
 - ◆ vi Visual editor, the default
 - ◆ `the` XEDIT/KEDIT/ISPF clone
 - ◆ `xedit` X windows text editor
 - ◆ emacs Extensible, Customizable Self-Documenting Display Editor
 - ◆ `pico` Simple display-oriented text editor
 - ◆ `nedit` X windows Motif text editor

Windows OS

Windows Terminal: cmd

```
Command Prompt
c:\Windows\WinSxS\amd64_microsoft-windows-p...rastructureconsumer_31bf3856ad364e35_10.0.17763.1_none_a4a27884889b78d9\Ru1
es.System.CPU.xml

C:\Users\operard>help dir
Displays a list of files and subdirectories in a directory.

DIR [drive:][path][filename] [/A[:attributes]] [/B] [/C] [/D] [/L] [/N]
  [/O[:sortorder]] [/P] [/Q] [/R] [/S] [/T[:timefield]] [/W] [/X] [/4]

  [drive:][path][filename]
      Specifies drive, directory, and/or files to list.

  /A      Displays files with specified attributes.
attributes  D Directories          R Read-only files
              H Hidden files        A Files ready for archiving
              S System files         I Not content indexed files
              L Reparse Points       O Offline files
              - Prefix meaning not

  /B      Uses bare format (no heading information or summary).
  /C      Display the thousand separator in file sizes. This is the
          default. Use /-C to disable display of separator.
  /D      Same as wide but files are list sorted by column.
  /L      Uses lowercase.
  /N      New long list format where filenames are on the far right.
  /O      List by files in sorted order.
sortorder  N By name (alphabetic)    S By size (smallest first)
              E By extension (alphabetic) D By date/time (oldest first)
              G Group directories first - Prefix to reverse order

  /P      Pauses after each screenful of information.
  /Q      Display the owner of the file.
```

You need help ?

- The Windows Command for Help:
- `help [<Command>]`
- `[<Command>] /?`
- Example: `help dir`

Common command

Windows Command	Comments
cd	print the working directory
cd <dir>	
dir	List the files in the current working directory
tasklist	List your processes on the system
echo "a string to be echoed"	Echo a string to the terminal

Execute Next commands

- Execute: **help dir**
- Execute: **dir**
- Redirect the output of **dir /A** command to **dir_output.txt**
 - **dir /A > dir_output.txt**
- Execute: **notepad dir_output.txt**

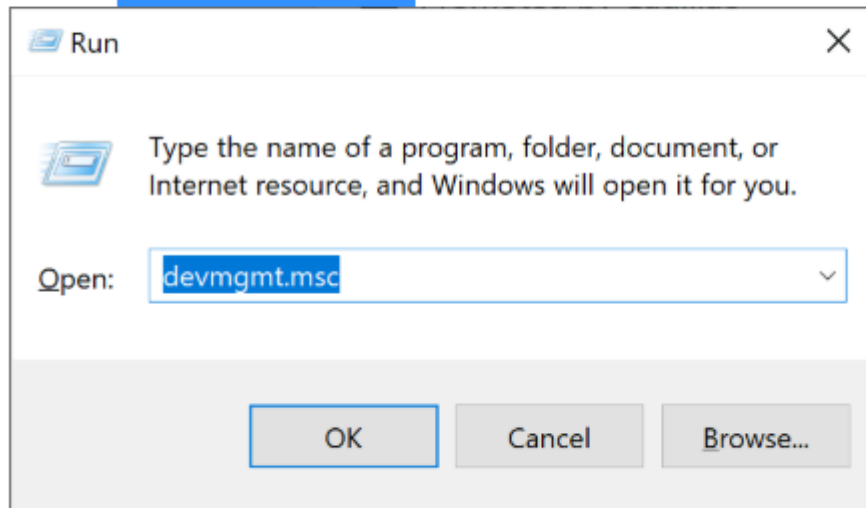
Execute Process Command

- Execute to show your processes: **tasklist** | **more**

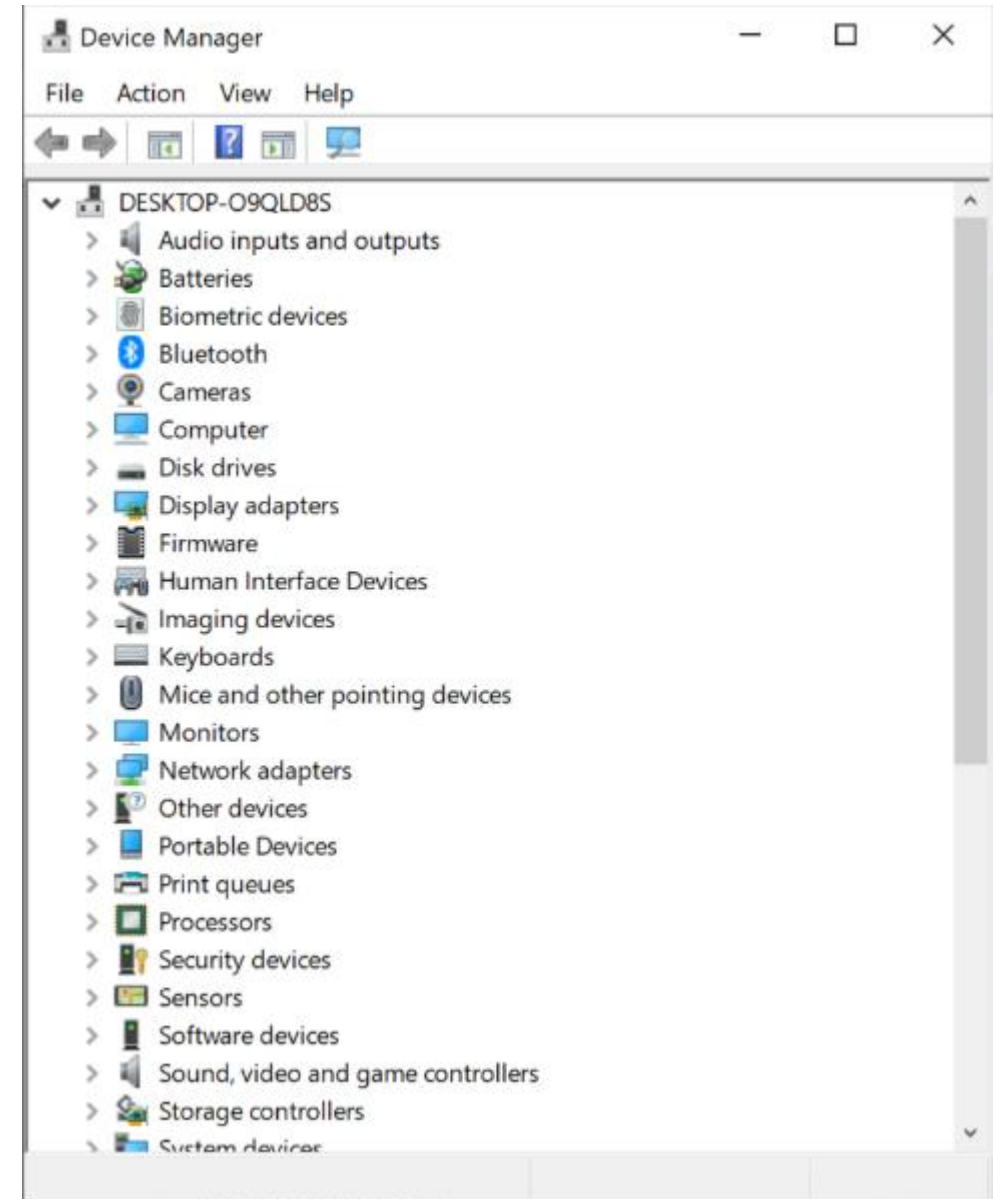
Windows Device Manager

To Start Device Manager

- Open the “Run” dialog box by pressing and holding the Windows key, then press the R key (“Run”).
- Type `devmgmt.msc`.

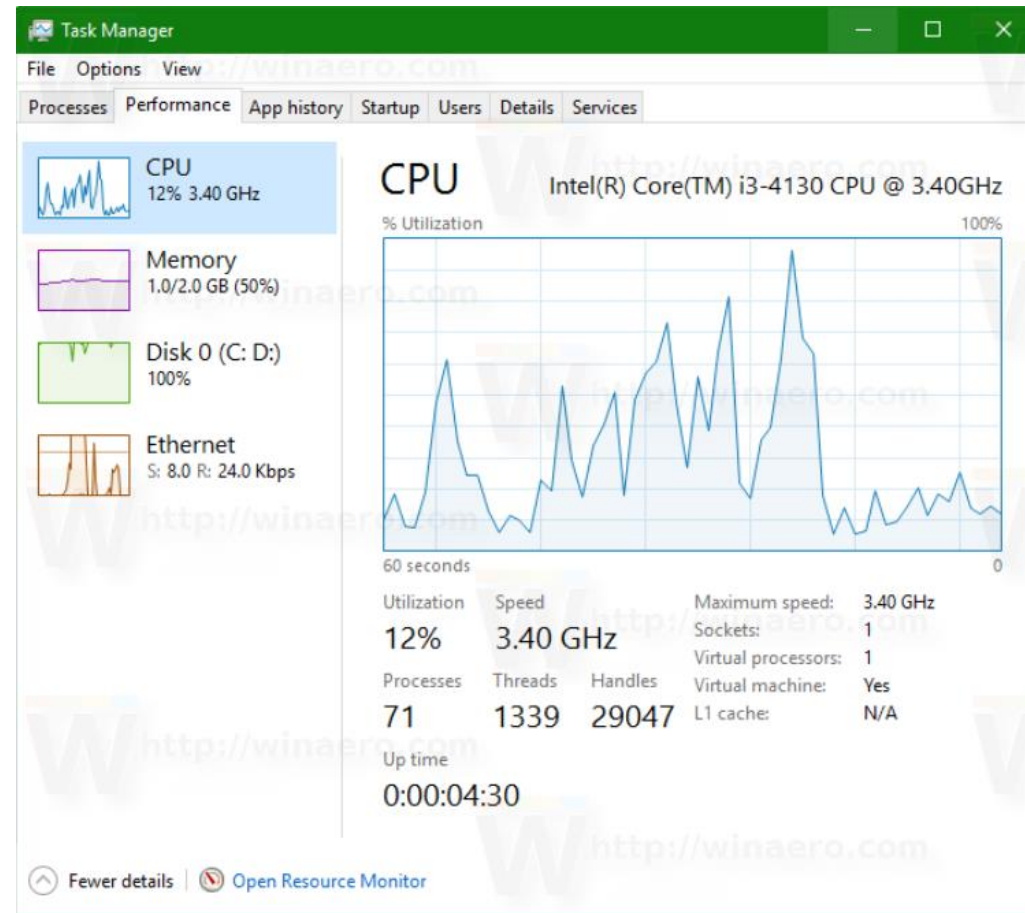


- Click OK.



Check Windows CPU Info

- Execute next command:
 - `wmic cpu get caption, deviceid, name, numberofcores, maxclockspeed, status`
- Or use the TaskManager tool:



Windows File System

- **You can view what file systems are mounted using either:**
 - **mountvol c: /L**
- **If you have another drive D:**
 - **mountvol d: /L**

Environment Variables

- Display variable:
 - Execute: **set**
 - set variable
 - set variable=string
 - set "variable=string"
 - set "variable="
- Using Environment Variables:
 - echo %TEMP%
 - cd %TEMP%
 - echo "the env var TEMP is: %TEMP%"

Creating file and directories

- Create a new file:
 - Execute: **type nul > your_file.txt**
 - Execute: **notepad your_file.txt**
- Create a directory
 - Execute: **mkdir test**
- Remove a directory
 - Execute: **rmdir test**

File Commands

- Copy a file to other file:
 - **copy <fromfile> <tofile>**
- Move or rename a file:
 - **move <fromfile> <tofile>**
- Remove a file:
 - **del <file>**
- Create/delete a directory:
 - **mkdir <directory>**
 - **rmdir <directory>**

More Commands

- To compare 2 files (fc):
 - **fc C:\Users\Martin\Desktop\FCsample.txt C:\Users\Martin\Desktop\FCexercise.txt**
- To search a file (for example secret.doc):
 - **dir secret.doc /s /p**
- To search a text in a file:
 - **find "martin hendrikx" C:\Users\Martin\Desktop\exercise.txt**

Kill Process

- To kill a process:
 - **taskkill**

Check File Permissions in Windows

- Read the next link:
 - <https://protechguides.com/how-to-check-folder-permissions-on-windows/>

Compress command

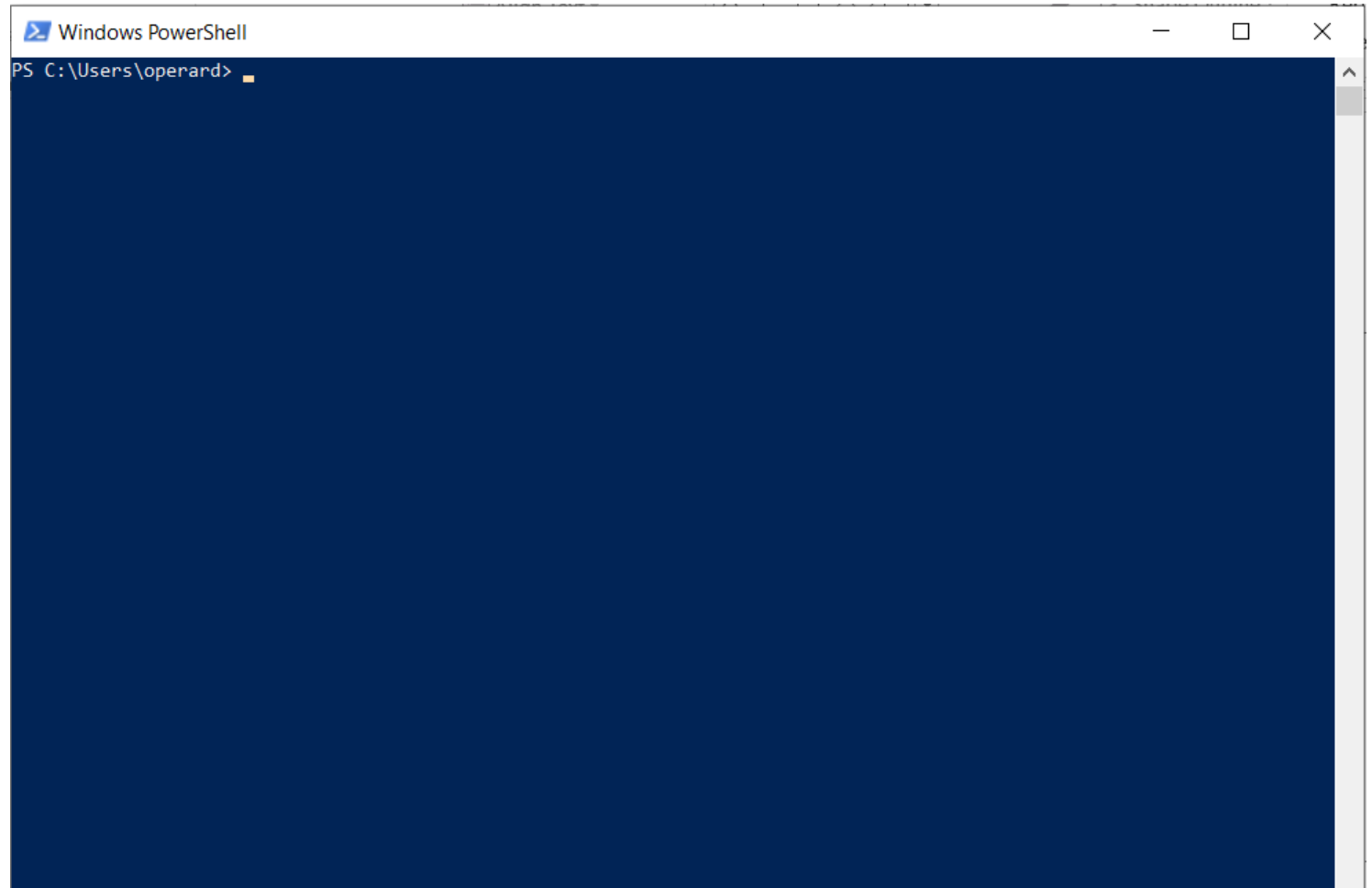
- Here is the *unzip*: <http://gnuwin32.sourceforge.net/packages/unzip.htm>
- There is a ZIP command as well: <http://gnuwin32.sourceforge.net/packages/zip.htm>
- Use winzip, zip, gzip, 7-Zip, winrar, ...etc....

Viewing Files

- Concatenate:
 - Use **copy** command
 - Use **type** command:
 - `echo hi > a.txt`
 - `echo bye > b.txt`
 - `type a.txt b.txt > c.txt`
 - `type c.txt`
- Display one page at a time:
 - `more`
- Editors:
 - Notepad
 - Notepad++

New Command Tool in Windows 10

- Windows powershell



Task Manager

Task Manager

File Options View

Processes Performance App history Startup Users Details Services

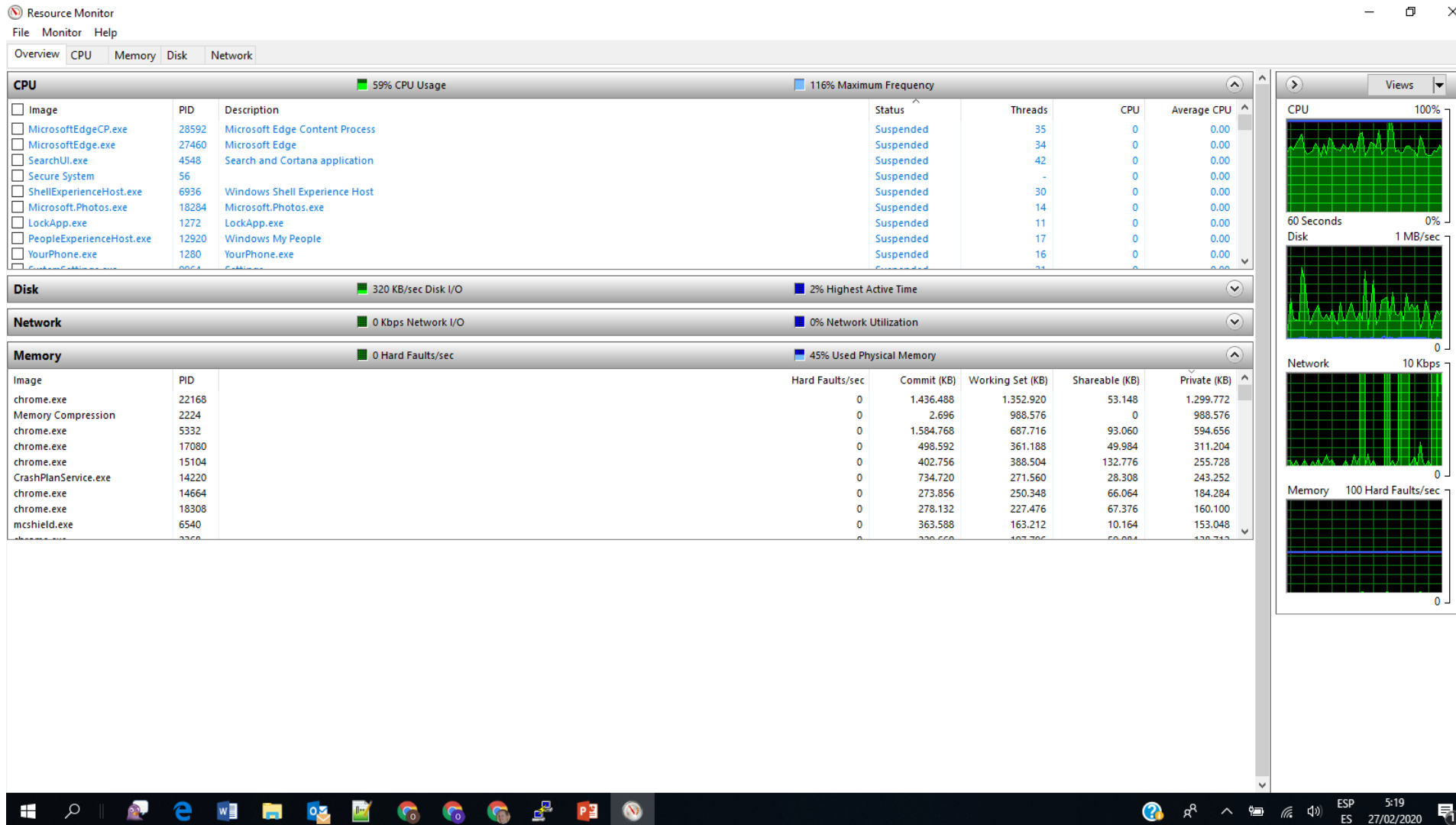
Name	Status	67% CPU	46% Memory	2% Disk	0% Network	2% GPU	GPU engine	Power usage	Power usage t...
Apps (13)									
> Windows Explorer		2,8%	68,8 MB	0 MB/s	0 Mbps	0%		Low	
> Task Manager		4,6%	39,9 MB	0 MB/s	0 Mbps	0%		Low	
> SSH, Telnet and Rlogin client (3...		0%	0,4 MB	0 MB/s	0 Mbps	0%		Very low	
> SSH, Telnet and Rlogin client (3...		0%	0,5 MB	0 MB/s	0 Mbps	0%		Very low	
> SSH, Telnet and Rlogin client (3...		0%	0,5 MB	0 MB/s	0 Mbps	0%		Very low	
> SSH, Telnet and Rlogin client (3...		0%	0,5 MB	0 MB/s	0 Mbps	0%		Very low	
> SSH, Telnet and Rlogin client (3...		0%	0,4 MB	0 MB/s	0 Mbps	0%		Very low	
> Resource and Performance Mo...		3,1%	57,1 MB	0,1 MB/s	0 Mbps	0%		Low	
> Notepad++ : a free (GNU) sourc...		0%	0,8 MB	0 MB/s	0 Mbps	0%		Very low	
> Microsoft Word (32 bit) (3)		0%	14,4 MB	0 MB/s	0 Mbps	0%		Very low	
> Microsoft PowerPoint (32 bit) (2)		0%	101,5 MB	0 MB/s	0 Mbps	0%	GPU 0 - 3D	Very low	
> Microsoft Outlook (32 bit)		0,5%	66,1 MB	0,1 MB/s	0 Mbps	0,1%	GPU 0 - 3D	Very low	
> Google Chrome (114)		12,9%	4.898,2 MB	0 MB/s	0 Mbps	0,8%	GPU 0 - 3D	Moderate	
Background processes (120)									
WMI Provider Host		0%	32,8 MB	0 MB/s	0 Mbps	0%		Very low	
WMI Provider Host		0%	35,9 MB	0 MB/s	0 Mbps	0%		Very low	
Windows Wireless LAN 802.11 E...		0%	0,5 MB	0 MB/s	0 Mbps	0%		Very low	
> Windows Shell Experience Host	🟢	0%	0 MB	0 MB/s	0 Mbps	0%	GPU 0 - 3D	Very low	
Windows Security notification i...		0%	0,2 MB	0 MB/s	0 Mbps	0%		Very low	
> Windows Security Health Service		0%	2,3 MB	0 MB/s	0 Mbps	0%		Very low	
> Windows My People	🟢	0%	0 MB	0 MB/s	0 Mbps	0%		Very low	
Windows Driver Foundation - U...		0%	0,8 MB	0 MB/s	0 Mbps	0%		Very low	
Windows Defender SmartScreen		0%	4,8 MB	0 MB/s	0 Mbps	0%		Very low	

^ Fewer details

End task

Windows taskbar: 5:20 27/02/2020

Execute Process Command: resmon



PSTools Suite

- <https://docs.microsoft.com/en-us/sysinternals/downloads/pstools>

Process Monitor

- <https://docs.microsoft.com/en-us/sysinternals/downloads/procmon>

ProcessExplorer

- <https://docs.microsoft.com/en-us/sysinternals/downloads/process-explorer>

Check Threads

Process Explorer - Sysinternals: www.sysinternals.com [OPERARD-ES\operard]

File Options View Process Find Users Help

Process	CPU	Private Bytes	Working Set	PID	Description	Company Name
svchost.exe		2.632 K	9.924 K	11308	Host Process for Windows S...	Microsoft Corporation
svchost.exe		6.260 K	8.972 K	17800	Host Process for Windows S...	Microsoft Corporation
svchost.exe		1.776 K	7.260 K	3632	Host Process for Windows S...	Microsoft Corporation
svchost.exe		2.692 K	6.712 K	21516	Host Process for Windows S...	Microsoft Corporation
svchost.exe	0.03	5.656 K	17.164 K	19772	Host Process for Windows S...	Microsoft Corporation
svchost.exe		2.436 K	8.412 K	23452	Host Process for Windows S...	Microsoft Corporation
svchost.exe		1.388 K	4.944 K	24392	Host Process for Windows S...	Microsoft Corporation
svchost.exe		2.332 K	9.124 K	22364	Host Process for Windows S...	Microsoft Corporation
svchost.exe		2.936 K	7.568 K	20452	Host Process for Windows S...	Microsoft Corporation
lsass.exe		1.316 K	2.940 K	1004		Microsoft Corporation
lsass.exe	< 0.01	24.512 K	20.840 K	1020	Local Security Authority Proc...	Microsoft Corporation
fontdrvhost.exe		6.292 K	4.476 K	828		Microsoft Corporation
csrss.exe	0.18	2.452 K	5.736 K	844		Microsoft Corporation
winlogon.exe	< 0.01	3.628 K	14.792 K	944		Microsoft Corporation
fontdrvhost.exe		18.988 K	21.400 K	748		Microsoft Corporation
dwm.exe	1.58	88.252 K	78.688 K	1284		Microsoft Corporation
explorer.exe	2.79	202.600 K	222.756 K	13700	Windows Explorer	Microsoft Corporation
SecurityHealthSystray.exe		1.884 K	9.228 K	14956	Windows Security notificatio...	Microsoft Corporation
CrashPlanDesktop.exe	< 0.01	28.976 K	53.684 K	6260	Code42 CrashPlan	Code42, Inc.
CrashPlanDesktop.exe		19.688 K	20.140 K	7608	Code42 CrashPlan	Code42, Inc.
CrashPlanDesktop.exe	0.04	60.800 K	52.648 K	16472	Code42 CrashPlan	Code42, Inc.
EpePcMonitor.exe	< 0.01	1.440 K	4.532 K	15388	McAfee Drive Encryption Mo...	McAfee, Inc.
Toast32.exe		1.300 K	4.320 K	15444	McAfee Data Protection Noti...	McAfee, Inc.
TecoResident.exe	0.03	2.516 K	11.908 K	15652	Resident module of eco Utility	TOSHIBA
TCrdMain.exe		28.040 K	31.604 K	16192	TOSHIBA Flash Cards Main	TOSHIBA
TCrdKBB.exe		1.268 K	6.176 K	15712	TCrdKBB Application	TOSHIBA
TDUSrv64.exe		1.468 K	6.924 K	16076	TOSHIBA Display Utility Serv...	TOSHIBA
TPwrMain.exe		3.292 K	11.432 K	15844	TOSHIBA Power Saver	TOSHIBA
RAVCpl64.exe		4.784 K	13.068 K	16328	Realtek HD Audio Manager	Realtek Semiconductor Corp.
ScanToPCActivationApp.exe		3.316 K	14.828 K	15600	ScanToPCActivationApp	Hewlett-Packard Development Company, L.P.
ScanToPCActivationApp.exe	< 0.01	5.020 K	17.784 K	15764	ScanToPCActivationApp	Hewlett-Packard Development Company, L.P.
DesktopScreenShare.exe		2.844 K	11.404 K	13088	DesktopScreenShare.exe	Microsoft Corporation
ONENOTEM.EXE		1.632 K	3.592 K	9652	Send to OneNote Tool	Microsoft Corporation
OUTLOOK.EXE	0.63	264.876 K	225.772 K	8488	Microsoft Outlook	Microsoft Corporation
notepad++.exe	0.04	25.504 K	21.220 K	4032	Notepad++ : a free (GNU) so...	Notepad++
WINWORD.EXE	0.07	68.220 K	93.116 K	3252	Microsoft Word	Microsoft Corporation
PUTTY.EXE	< 0.01	4.796 K	16.352 K	2128	SSH, Telnet and Rlogin client	Simon Tatham
PUTTY.EXE	0.01	4.704 K	13.720 K	4768	SSH, Telnet and Rlogin client	Simon Tatham
PUTTY.EXE	< 0.01	3.688 K	17.636 K	22896	SSH, Telnet and Rlogin client	Simon Tatham
PUTTY.EXE	< 0.01	2.572 K	15.544 K	17424	SSH, Telnet and Rlogin client	Simon Tatham
PUTTY.EXE	< 0.01	3.932 K	17.468 K	18216	SSH, Telnet and Rlogin client	Simon Tatham
POWERPNT.EXE	0.31	378.680 K	223.500 K	22992	Microsoft PowerPoint	Microsoft Corporation
splwow64.exe		9.912 K	17.896 K	6192	Print driver host for applica...	Microsoft Corporation
Taskmgr.exe	5.95	45.620 K	77.436 K	20392		Microsoft Corporation
procexp.exe		3.604 K	10.700 K	8180	Sysinternals Process Explorer	Sysinternals - www.sysinter...
procexp64.exe	9.13	31.160 K	50.748 K	4080	Sysinternals Process Explorer	Sysinternals - www.sysinter...
AmptEx.exe		2.080 K	8.564 K	13720	Alps Pointing-device Driver f...	Alps Electric Co., Ltd.

WINWORD.EXE:3252 Properties

Security Environment .NET Assemblies .NET Performance Strings
Image Performance Performance Graph GPU Graph Threads TCP/IP

Count: 29

TID	CPU	Cycles Delta	Start Address
17152	0.05	6.024.252	WINWORD.EXE+0x10d4
12732	< 0.01	441.386	EpMPApi.dll!exp_DetachHandlers+0...
25132	< 0.01	126.572	ntdll.dll!RtlAcquirePebLock+0x5f0
10252			mso.dll!Ordinal9267+0x25e
14132			mso.dll!_MsoFinitOffice@20+0x1d
1300			mso.dll!Ordinal1981+0x1001
17984			mso.dll!Ordinal3004+0x2af
21680			mso.dll!Ordinal1981+0x1001
19056			mso.dll!Ordinal7857+0x42d
10032			mso.dll!Ordinal1981+0x1001
17924			mso.dll!Ordinal1981+0x1001
12488			ntdll.dll!RtlAcquirePebLock+0x5f0

Thread ID: 17152 Stack Module

Start Time: 15:27:56 24/02/2020

State: Wait:UserRequest Base Priority: 8

Kernel Time: 0:00:18.812 Dynamic Priority: 10

User Time: 0:00:15.734 I/O Priority: Normal

Context Switches: 4,493,195 Memory Priority: 5

Cycles: 690,796,905,098 Ideal Processor: 2

Permissions Kill Suspend

OK Cancel

CPU Usage: 64.67% Commit Charge: 53.96% Processes: 361 Physical Usage: 47.34%

Mac OS

You need help ?

■ The Linux equivalent of HELP is man (manual)

- ◆ Use man -k <keyword> to find all commands with that keyword
- ◆ Use man <command> to display help for that command
 - Output is presented a page at a time. Use **b** for to scroll backward, **f** or a space to scroll forward and **q** to quit

Common command

- pwd - print (display) the working directory
- cd <dir> - change the current working directory to *dir*
- ls - list the files in the current working directory
- ls -l - list the files in the current working directory in long format

- who or w
 - ◆ List who is currently logged on to the system
- whoami
 - ◆ Report what user you are logged on as
- ps
 - ◆ List your processes on the system
- ps aux
 - ◆ List all the processes on the system
- echo "A string to be echoed"
 - ◆ Echo a string (or list of arguments) to the terminal

Who's Logged On Right Now?

- The w command lists all users logged on right now

```
5:16pm up 2 days, 8:46, 1 user, load average: 0.00, 0.00, 0.00
USER      TTY      FROM          LOGIN@      IDLE        JCPU        PCPU        WHAT
neale     ttyp0    websurfer.reston 4:28pm      1.00s       0.52s       0.18s       w
```

Execute Next commands

- ◆ Get help on the ls command
- ◆ Find out who else is on the system
- ◆ What is your current directory
- ◆ Redirect the output of the ls -l / command to ls.output and see what you get

Execute Process Command

- **ps -ef | more**
- **ps aux**
- **ps -e f** **NOT WORKING in MacOS**
- **top** (tape “q” to quit the process)

Linux Device Handling

- **Devices are the way Linux talks to the world**
- **Devices are special files in the `/dev` directory**
(try `ls /dev`)

<code>/dev/ttyx</code>	TTY devices
<code>/dev/hdb</code>	IDE hard drive
<code>/dev/hdb1</code>	Partition 1 on the IDE hard drive
<code>/dev/dasda</code>	ECKD/CKD/FBA DASD
<code>/dev/dasda1</code>	Partition 1 on DASD
<code>/dev/null</code>	The null device ("hole")
<code>/dev/zero</code>	An endless stream of zeroes
<code>/dev/mouse</code>	Mouse (not <code>/390</code>)

Device and Drivers

■ Each `/dev` file has a major and minor number

- ◆ Major defines the device type
- ◆ Minor defines device within that type
- ◆ Drivers register a device type

brw-r--r--	1	root	root	64,	0	Jun	1	1999	/dev/mnda
crw-r--r--	1	root	root	5,	0	Jan	5	09:18	/dev/tty

Device Type:
b - block
c - character

Major no.

Minor no.

Special Files - /proc

- **Information about internal Linux processes are accessible to users via the /proc file system (in memory)**

/proc/cpuinfo	CPU Information
/proc/interrupts	Interrupt usage
/proc/version	Kernel version
/proc/modules	Active modules

NOT WORKING in MacOS

```
cat /proc/cpuinfo
vendor_id       : IBM/S390
# processors    : 1
bogomips per cpu: 86.83
processor 0: version = FF, identification = 045226, machine = 9672
```

Check CPU Info

- `sysctl -n machdep.cpu.brand_string`
- `sysctl -a | grep machdep.cpu`
- `sysctl -a | grep machdep.cpu | grep core_count`
- `sysctl -a | grep machdep.cpu | grep thread_count`

File System

- You can view what file systems are mounted using either:

- mount
- df -h
- cat /etc/fstab

■ mount

- ◆ Mounts a file system that lives on a device to the main file tree
- ◆ Start at Root file system
 - Mount to root
 - Mount to points currently defined to root
- ◆ /etc/fstab used to establish boot time mounting

/dev/dasda1	/	ext2	defaults,errors=remount-ro	0	1
/dev/dasdb1	/bin	ext2	defaults,errors=remount-ro	0	1
/dev/dasdc1	/usr	ext2	defaults,errors=remount-ro	0	1
/dev/dasdd1	/usr/local	ext2	defaults,errors=remount-ro	0	1
/dev/dasde1	/usr/man	ext2	defaults,errors=remount-ro	0	1
/dev/dasdf1	/home	ext2	defaults,errors=remount-ro	0	1
/dev/dasdg1	swap	swap	defaults	0	0
none	/proc	proc	defaults	0	0

Environment Variables

■ Using Environment Variables:

- ◆ echo \$VAR
- ◆ cd \$VAR
- ◆ cd \$HOME
- ◆ echo "You are running on \$SYSTEMNAME"

■ Displaying - use the following commands:

- ◆ set (displays local & environment variables)
- ◆ export

■ Variables can be retrieved by a script or a program

Creating file and directories

- **Files can be created in a number of ways**

- ◆ The output of a command
- ◆ Being edited using vi or your favorite editor
- ◆ By using the touch command which creates an empty file or updates the modification and access time information of an existing file

- **Directories are created using the mkdir command**

File Permissions

- The long version of a file listing (ls -l) will display the file permissions:

```
-rwxrwxr-x 1 rvdheij rvdheij 5224 Dec 30 03:22 hello
-rw-rw-r-- 1 rvdheij rvdheij 221 Dec 30 03:59 hello.c
-rw-rw-r-- 1 rvdheij rvdheij 1514 Dec 30 03:59 hello.s
drwxrwxr-x 7 rvdheij rvdheij 1024 Dec 31 14:52 posixuft
:
-rw-r--r-- 1 neale users 1039 2009-09-10 12:47 a.a
drwxr-xr-x 5 neale users 4096 2011-08-16 20:34 benchmark
drwxr-xr-x 2 neale users 4096 2009-07-30 08:55 bin
drwxr-xr-x 3 neale users 4096 2009-05-16 12:17 BINUTILS
-rw-r--r-- 1 neale users 3776 2012-02-24 09:32 bluefin.cs
```

Permissions

Owner

Group

File Commands

- **cp** <fromfile> <tofile>
 - ◆ Copy from the <fromfile> to the <tofile>
- **mv** <fromfile> <tofile>
 - ◆ Move/rename the <fromfile> to the <tofile>
- **rm** <file>
 - ◆ Remove the file named <file>
- **mkdir** <newdir>
 - ◆ Make a new directory called <newdir>
- **rmdir** <dir>
 - ◆ Remove an (empty) directory

Change File Permissions

- Use the chmod command to change file permissions
 - ◆ The permissions are encoded as an octal number

User			Group			Other		
Read r	Write w	Execute x	Read r	Write w	Execute x	Read r	Write w	Execute x
400	200	100	40	20	10	4	2	1

```
chmod 0755 file # Owner=rwx Group=r-x Other=r-x
chmod 0500 file2 # Owner=r-x Group=--- Other=---
chmod 0644 file3 # Owner=rw- Group=r-- Other=r--

chmod +x file # Add execute permission to file for all
chmod u-r file # Remove read permission for owner
chmod a+w file # Add write permission for everyone
```

More Commands

- awk - a file processing language that is well suited to data manipulation and retrieval of information from text files
- chown - sets the user ID (UID) to owner for the files and directories named by pathname arguments. This command is useful when from test to production

```
chown -R apache:httpd /usr/local/apache
```

More Commands

- diff - attempts to determine the minimal set of changes needed to convert a file specified by the first argument into the file specified by the second argument
- find - Searches a given file hierarchy specified by path, finding files that match the criteria given by expression

Search Command

- **grep** - Searches files for one or more pattern arguments. It does plain string, basic regular expression, and extended regular expression searching

```
find ./ -name "*.c" | xargs grep -i "fork"
```

In this example, we look for files with an extension "c" (that is, C source files). The filenames we find are passed to the xargs command which takes these names and constructs a command line of the form: `grep -i fork <file.1>...<file.n>`. This command will search the files for the occurrence of the string "fork". The "-i" flag makes the search case insensitive.

Kill Process

■ kill - sends a signal to a process or process _group

- ◆ You can only kill your own processes unless you are root

```
UID          PID    PPID    C  STIME TTY          TIME CMD
root         6715    6692    2  14:34 ttty0        00:00:00 sleep 10h
root         6716    6692    0  14:34 ttty0        00:00:00 ps -ef
[root@penguinvm log]# kill 6715
[1]+  Terminated                  sleep 10h
```

Replace String

- **sed** - applies a set of editing subcommands contained in a script to each argument input file

```
find ./ -name "*.c,v" | sed 's/,v//g' | xargs grep "PATH"
```

This finds all files in the current and subsequent directories with an extension of `c,v`. `sed` then strips the `,v` off the results of the `find` command. `xargs` then uses the results of `sed` and builds a `grep` command which searches for occurrences of the word `PATH` in the C source files.

Archive command

■ tar - manipulates archives

- ◆ An archive is a single file that contains the complete contents of a set of other files; an archive preserves the directory hierarchy that contained the original files.

```
tar -tzf imap-4.7.tar.gz
imap-4.7/
imap-4.7/src/
imap-4.7/src/c-client/
imap-4.7/src/c-client/env.h
imap-4.7/src/c-client/fs.h
```

Viewing Files

- cat **"Concatenate"**
- more **Display one page at a time**
- less **Variant of `more`**
- **Editors**
 - ◆ vi Visual editor, the default
 - ◆ `the` XEDIT/KEDIT/ISPF clone
 - ◆ `xedit` X windows text editor
 - ◆ emacs Extensible, Customizable Self-Documenting Display Editor
 - ◆ `pico` Simple display-oriented text editor
 - ◆ `nedit` X windows Motif text editor

Monitoring Tool

- Use Activity Monitor

