

Operating Systems

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Lecture 2:

Resources and operations over them.

**Case study: Linux CLI,
working with files.**

Resources of computer

- Processors
- Memory
- Devices
- Information

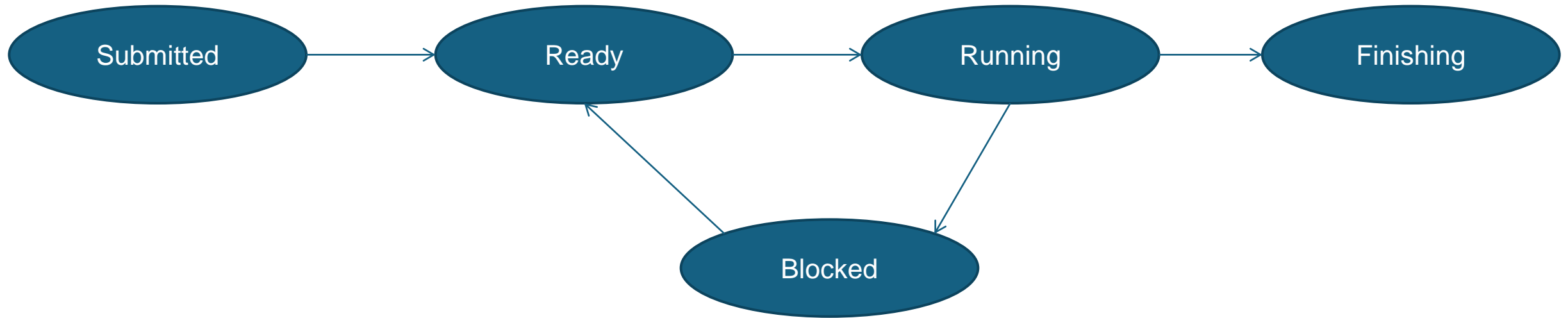
Operations over resources

- Allocate
- Deallocate (free)
- Track (supervise)
- Schedule (plan)

Formula of OS: 4x4

	Processors	Memory	Devices	Information
Allocate	PA	MA	DA	IA
Free	FP	FM	FD	FI
Track	TP	TM	TD	TI
Schedule	SP	SM	SD	SI

Process scheduling – switching process states



Virtual Memory Concept

Process virtual memory



Memory
mapping



Physical
RAM



Swapping



Swapping
Area of HD

Drivers of Devices

- Byte devices
- Block devices
- Graphical devices
- Controllers and Channels
- Asynchronous IO
- Interrupts of Devices
- Driver Interfaces

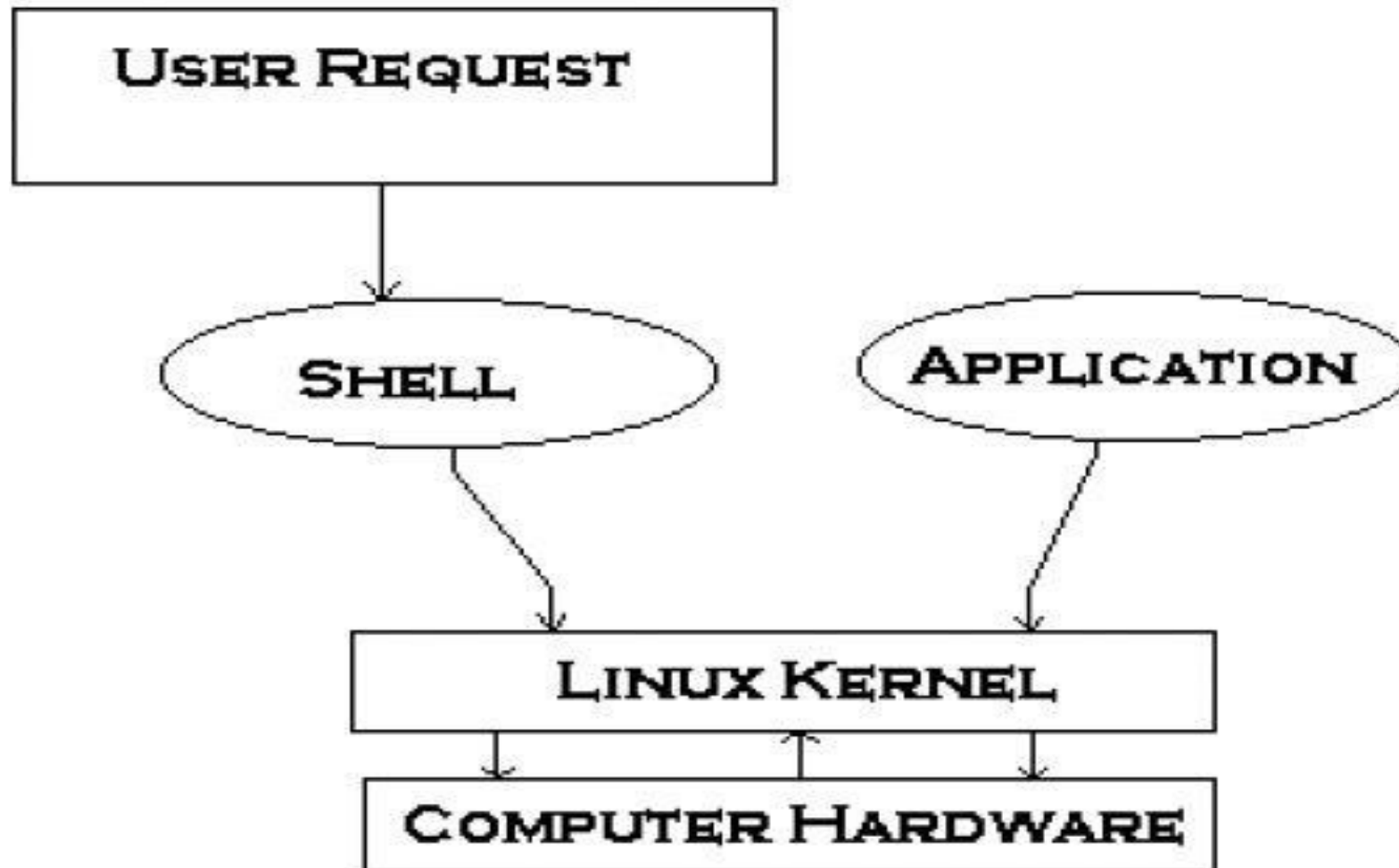
File System

- Volume, Directory, and File
- File Structure of HD
- Allocation of device space
- Mapping of files
- File Descriptor
- Basic operations: read, write, seek
- Buffering

CLI

- Unix/Linux – Shell: sh, csh, ksh, bash, etc
- MS-DOS for Windows
- Principles of CLI: command, arguments, and options
- Batch files and scripts
- Advantages of CLI
- Modern script languages: Perl, Ruby, etc

Linux command line mode



Basic concepts

- Kernel, Daemons, and Applications
- Username, password, and group
- Terminals and Shells
- XWindow and Desktops

Bootup Ubuntu

- BIOS — Boot Sector Loader
- (UEFI — Unified Extensible Firmware Interface)
- MBR — the boot loader
- Bootloader — grub
- Kernel — vmlinuz
- Initial RAM disk image — initrd
- systemd

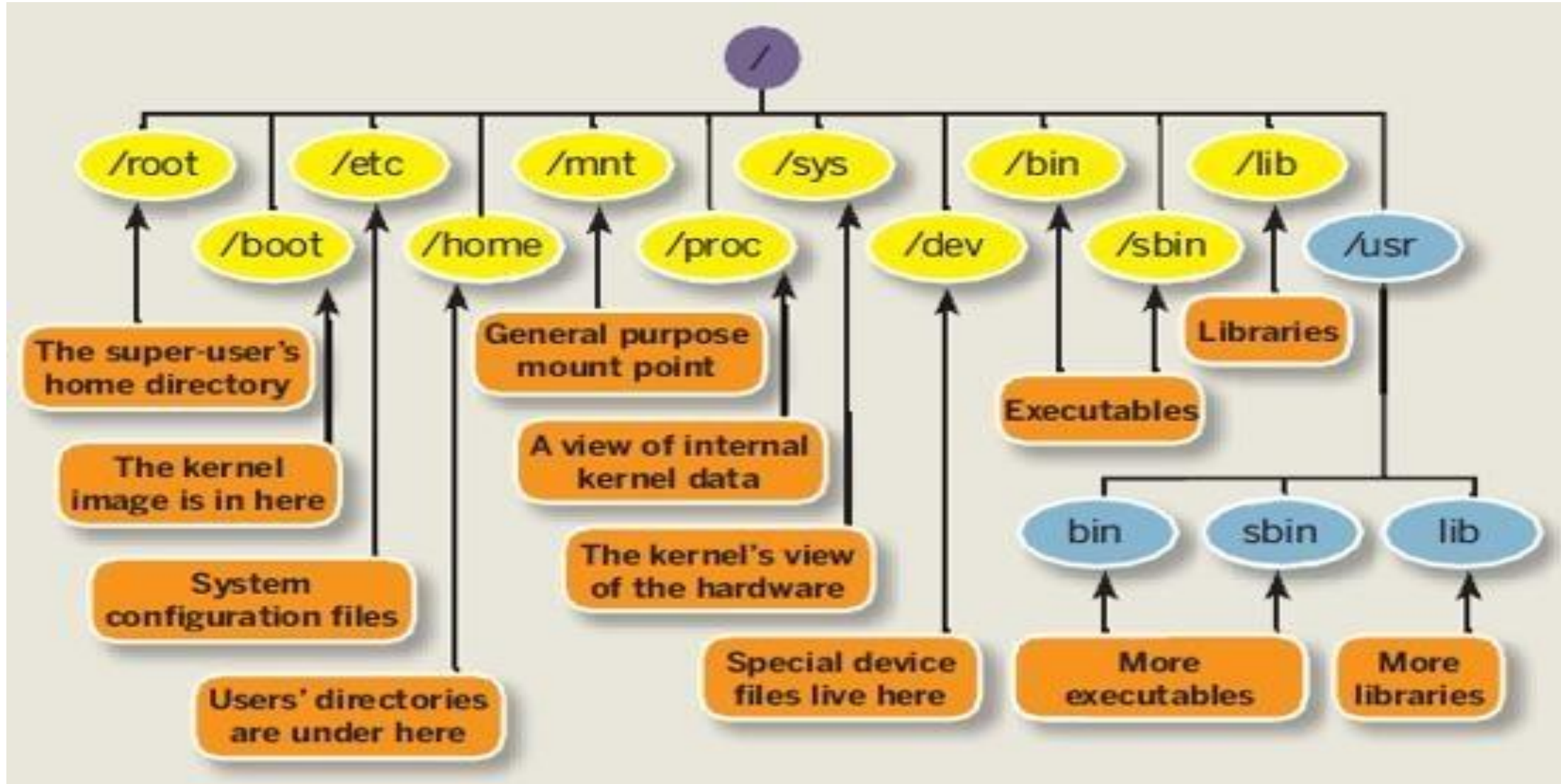
Start CLI

- Virtual terminal: Ctrl-Alt-Fi
- Terminal window: Ctrl-Alt-t
- Username
- Password
- /etc/passwd: UID and GID, shell, working directory
- Configuration files: .profile, .bashrc, .bash_logout
- First commands: whoami, pwd, ls, ps, who, exit

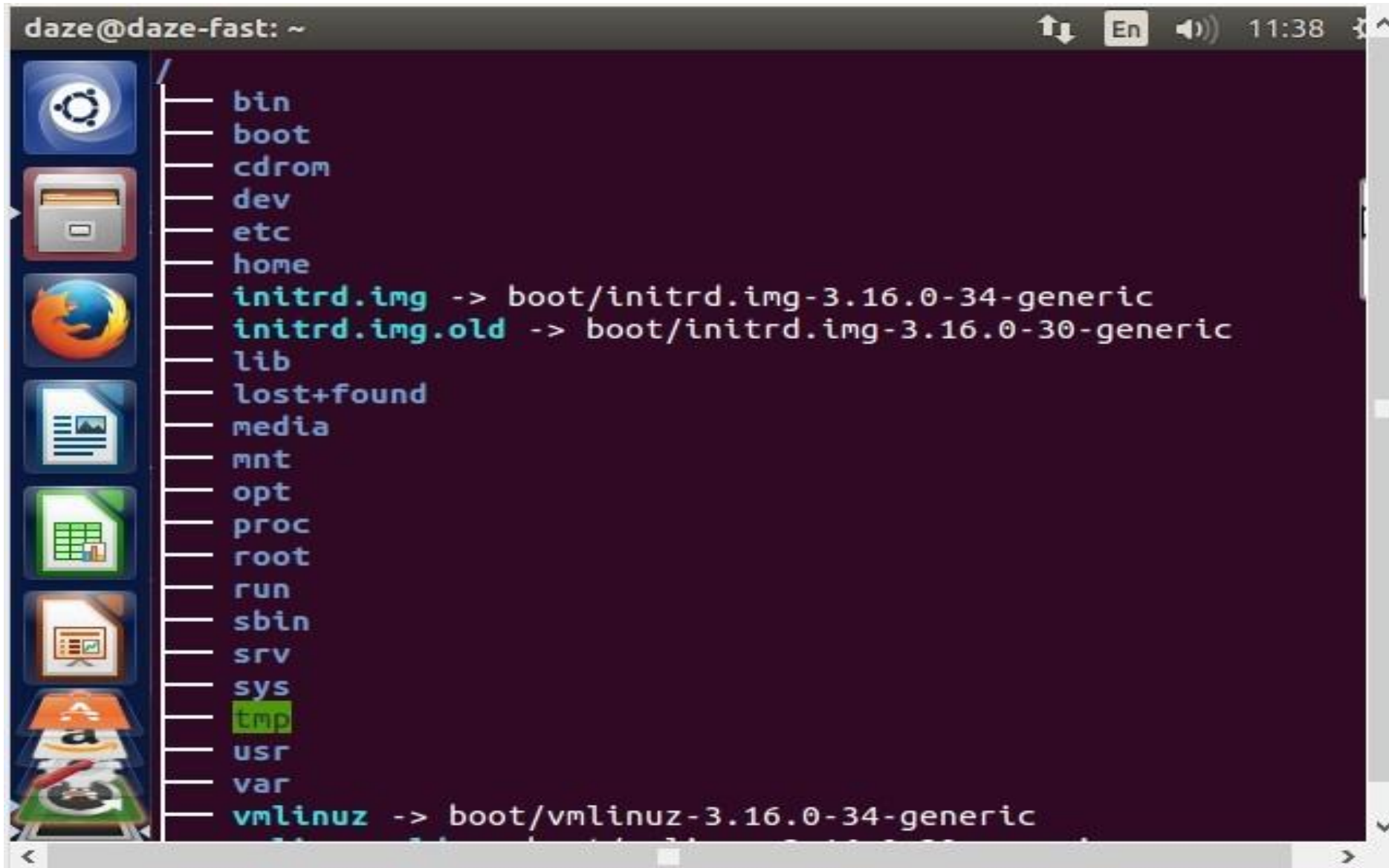
Shell work

- Output an invitation (prompt) “>”
- Input command line
- If internal command, start it
- Otherwise, find executable file and start it
- Output results of command line processing
- Help: man, info

Linux filesystem



Filesystem example



Absolute and relative file names

- `/home/student/Documents/poem.pdf`
- `/etc/rc5.d/S99rc.local`
- Working directory `/home/student`
- `.profiles`
- `../../etc/rc5.d/S99rc.local`

Unified tree

- Devices as files */dev*
- Hard disk */dev/sda1*
- *mount* – attach volume to the tree
- *umount* – detach volume from the tree
- Scheme of mounting */etc/mtab*
- Free space *df*

Basic commands

- pwd – print working directory
- cd – change directory
- ls – list directory
- cat – output file (concatenate)

>ls -al

>cd /etc

>cat passwd



daze@daze-fast:~\$

daze@daze-fast:~\$

daze@daze-fast:~\$

daze@daze-fast:~\$

daze@daze-fast:~\$

daze@daze-fast:~\$ pwd

/home/daze



daze@daze-fast:~\$ ls

a Documents examples.desktop Pictures Templates
Desktop Downloads Music Public Videos



daze@daze-fast:~\$ ls -l

total 48

-rw-rw-r--	1	daze	daze	15	anp.	28	11:57	a
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Desktop
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Documents
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Downloads
-rw-r--r--	1	daze	daze	8980	anp.	27	10:29	examples.desktop
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Music
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Pictures
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Public
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Templates
drwxr-xr-x	2	daze	daze	4096	anp.	27	11:27	Videos

daze@daze-fast:~\$ cat a

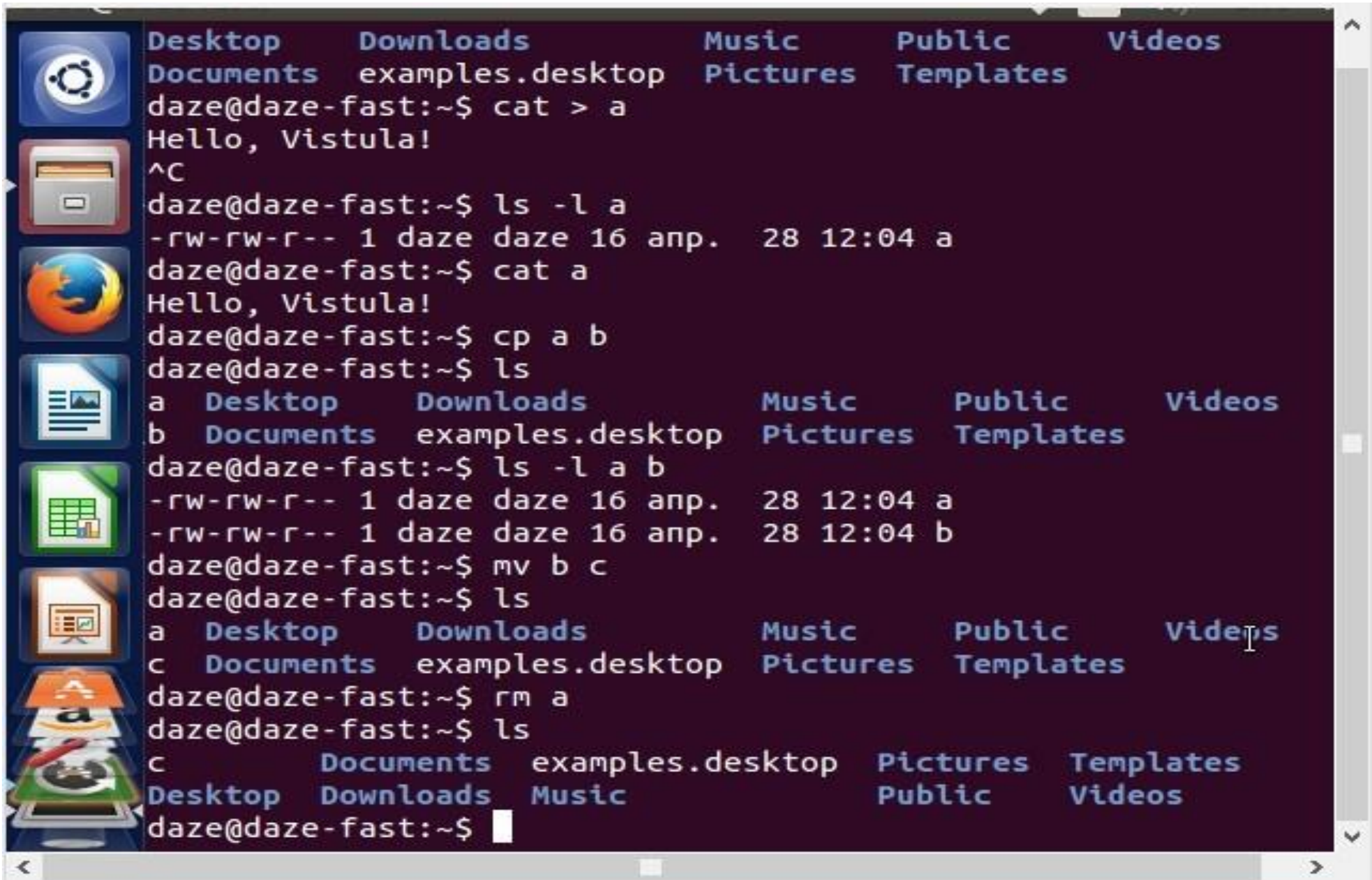
hello, Vistula

daze@daze-fast:~\$



More commands

- touch – create file
- cp – copy file
- mv – move (rename) file
- rm – remove
- mkdir – create directory
- rmdir – remove directory

A terminal window with a dark purple background and white text. On the left side, there is a vertical sidebar with icons for Ubuntu (dash), Files, Firefox, LibreOffice Writer, LibreOffice Calc, LibreOffice Impress, and a stack of papers. The terminal text shows a series of commands and their outputs. The first command is 'cat > a', which creates a file 'a' containing 'Hello, Vistula!'. The second command is '^C', which interrupts the process. The third command is 'ls -l a', which shows the file's permissions and details. The fourth command is 'cat a', which displays the file's content. The fifth command is 'cp a b', which creates a copy of 'a' as 'b'. The sixth command is 'ls', which lists the files in the current directory. The seventh command is 'ls -l a b', which shows the details for both files. The eighth command is 'mv b c', which renames 'b' to 'c'. The ninth command is 'ls', which lists the files. The tenth command is 'rm a', which removes file 'a'. The eleventh command is 'ls', which lists the files. The twelfth command is 'ls', which lists the files. The thirteenth command is 'ls', which lists the files. The fourteenth command is 'ls', which lists the files. The fifteenth command is 'ls', which lists the files. The sixteenth command is 'ls', which lists the files. The seventeenth command is 'ls', which lists the files. The eighteenth command is 'ls', which lists the files. The nineteenth command is 'ls', which lists the files. The twentieth command is 'ls', which lists the files. The twenty-first command is 'ls', which lists the files. The twenty-second command is 'ls', which lists the files. The twenty-third command is 'ls', which lists the files. The twenty-fourth command is 'ls', which lists the files. The twenty-fifth command is 'ls', which lists the files. The twenty-sixth command is 'ls', which lists the files. The twenty-seventh command is 'ls', which lists the files. 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The ninety-sixth command is 'ls', which lists the files. The ninety-seventh command is 'ls', which lists the files. The ninety-eighth command is 'ls', which lists the files. The ninety-ninth command is 'ls', which lists the files. The hundredth command is 'ls', which lists the files.

```
Desktop Downloads Music Public Videos
Documents examples.desktop Pictures Templates
daze@daze-fast:~$ cat > a
Hello, Vistula!
^C
daze@daze-fast:~$ ls -l a
-rw-rw-r-- 1 daze daze 16 anp. 28 12:04 a
daze@daze-fast:~$ cat a
Hello, Vistula!
daze@daze-fast:~$ cp a b
daze@daze-fast:~$ ls
a Desktop Downloads Music Public Videos
b Documents examples.desktop Pictures Templates
daze@daze-fast:~$ ls -l a b
-rw-rw-r-- 1 daze daze 16 anp. 28 12:04 a
-rw-rw-r-- 1 daze daze 16 anp. 28 12:04 b
daze@daze-fast:~$ mv b c
daze@daze-fast:~$ ls
a Desktop Downloads Music Public Videos
c Documents examples.desktop Pictures Templates
daze@daze-fast:~$ rm a
daze@daze-fast:~$ ls
c Documents examples.desktop Pictures Templates
Desktop Downloads Music Public Videos
daze@daze-fast:~$
```



```
daze@daze-fast:~$  
daze@daze-fast:~$  
daze@daze-fast:~$  
daze@daze-fast:~$ mkdir dima  
daze@daze-fast:~$ ls  
c          Documents          Music      Templates  
Desktop    Downloads          Pictures   Videos  
dima       examples.desktop    Public  
daze@daze-fast:~$ cd dima  
daze@daze-fast:~/dima$ pwd  
/home/daze/dima  
daze@daze-fast:~/dima$ mkdir papers  
daze@daze-fast:~/dima$ mkdir presentations  
daze@daze-fast:~/dima$ mkdir soft  
daze@daze-fast:~/dima$ touch x  
daze@daze-fast:~/dima$ ls -l  
total 12  
drwxrwxr-x 2 daze daze 4096 anp. 28 12:08 papers  
drwxrwxr-x 2 daze daze 4096 anp. 28 12:08 presentations  
drwxrwxr-x 2 daze daze 4096 anp. 28 12:09 soft  
-rw-rw-r-- 1 daze daze 0 anp. 28 12:09 x  
daze@daze-fast:~/dima$ rmdir presentations  
daze@daze-fast:~/dima$ ls  
papers soft x  
daze@daze-fast:~/dima$
```

File name patterns

- * any string
- ? any character
- ls p*
- ls ??
- ls a?b

How systemd starts up the system

- Activate all units that are dependencies of `default.target` (as well as recursively all dependencies of dependencies).
- Usually, `default.target` is simply an alias of `graphical.target` or `multi-user.target`, depending on whether the system is configured for a graphical UI or only for a text console.
- To enforce minimal ordering between the units pulled in, a number of well-known target units are available, as listed on `systemd.special`.

Switching target

- `systemctl list-units --type target`
- `systemctl isolate multi-user.target`
- `systemctl isolate graphical.target`

Switching default target

- `systemctl get-default`
- `sudo systemctl set-default multi-user.target`
- `sudo systemctl reboot`
- `sudo systemctl set-default graphical.target`
- `sudo reboot`

Start/stop service

- `systemctl list-unit-files --type service --all`
- `systemctl status apache2`
- `sudo systemctl enable apache2`
- `sudo systemctl disable apache2`