# Introduction to Unix

Spring 2025

# Operating System

⋄: Software that goes-in-between user(s) + hardware

⋄: Objective

▶ Using a computing system without much hassle

▶ Efficient use of the hardware

⋄: Continual Resource Management

▶ Central Processor Units (CPUs)

▶ Short-term, volatile, main memory

▶ Secondary or long term memory including disks, flash memories.

▶ I/O devices including Network Interface Cards - NICs

# UNIX OS

- Late sixties at Bell Laboratories (mostly written in assembly).
- Early seventies the system was re-written using C.
- Many changes since that time:
  1. Major revision by UC-Berkeley (in the 80s)
  2. Redevelopment for SPARCprocs by SUN Micro—*Solaris* (90s)
  3. Release of LINUX and ongoing development (90s, 00s and 10s)

- Unix/LINUX (in various versions and releases) are now used not only in servers but also in workstations, PCs, Tablets and devices.

- If you do not have it in your own machine, *get it now*!

# How to Obtain LINUX/Unix?

There are 3 ways:

▶ *Virtualization*: from the OS of your choice install LINUX using a virtualization tool such as *Virtual Box* or *VM Player*.

▶ *Dual Boot*: chop a portion of your disk (possibly with gparted) and install LINUX on the second partition (while maintaing your initial installation).

▶ *The* `h@ck3r` *Way*: erase everything you have on your machine and install LINUX. Then, proceed to re–install any other OS you may want with LINUX using *Virtual Box* or *VM Player*.

▶ Web Sources:
  – *Virtual Box* and
  – *VM Player*.

# Fundamental Characteristics of Unix

- ▶ Multiple Users Simultaneously

- ▶ Multi-tasking, concurrent processes, time-sharing

- ▶ Security mechanisms

- ▶ Networking support

- ▶ Monolithic structure:
  1. Kernel
  2. Shells (c, bash, bourne, korn, t, etc.)
  3. System Programs

- ▶ *System Calls* allow interaction with kernel services in terms of *C* functions.

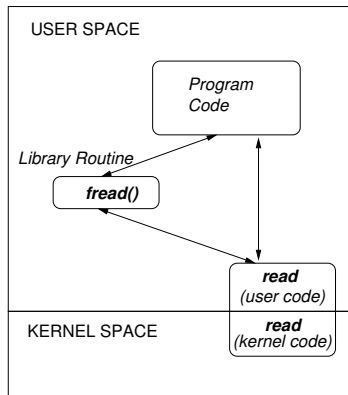- ▶ Scripting capabilities: one can "program" the shell.

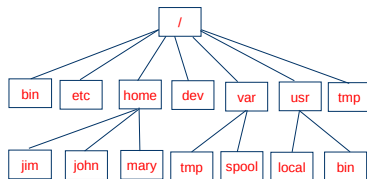# System Calls and Library Routines

- library call:
  ```
  nread = fread(unputbuff, OBJSIZE, numberobjs, fileprt);
  ```
- low-level system call:
  ```
  nread = read(filedes, inputbuf, BUFSIZE);
  ```

# Unix File System (UFS) – Hierarchical Logical Structure



- ▶ Root directory (/)
- ▶ Current directory (/.)
- ▶ Parent directory (/..)
- ▶ Absolute and relative Paths
- ▶ Files and Links
- ▶ Devices

# User Account

- ▶ User name (*userid*) and password (*pass*)
- ▶ Shell is available as soon as a user gets authorized
- ▶ User groups (*users*, *group*, *others*)
- ▶ (Initial) Working directory

```
antoulas@sazerac's password:
Linux sazerac 2.6.24-23-generic #1 SMP Mon Jan 26 00:13:11 UTC 2009 i686

The programs included with the Ubuntu system are free software; the exact
    distribution terms for each program are described in the individual files
    in /usr/share/doc/*/copyright.
Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable
    law.

To access official Ubuntu documentation, please visit: http://help.ubuntu.com/
Last login: Mon Jan  7 01:25:54 2008
antoulas@sazerac:~$
```

## Basic Commands in Unix

| | |
|---|---|
| `man` | display manual page |
| `ls` | listing of the current dir |
| `pwd` | print working directory |
| `cd` | change current directory to |
| `mkdir` | create a new directory |
| `rmdir` | purge an existing directory |
| `cp` | copy a file/directory |
| `mv` | move a file/directory to |
| `rm` | remove a file/directory |
| `cat` | display content of a file |
| `lpr` | print out a file |
| `vi` | tty text editor |

## The "man" command

```
antoulas@sazerac:~/set001$ man pwd
PWD(1)                            User Commands                            PWD(1)

NAME
       pwd - print name of current/working directory

SYNOPSIS
       pwd [OPTION]...

DESCRIPTION
       Print the full filename of the current working directory.
       -L, --logical
              use PWD from environment, even if it contains symlinks
       -P, --physical
              avoid all symlinks
       --help display this help and exit
       --version
              output version information and exit

       NOTE: your shell may have its own version of pwd, which usually super
       sedes the version described here.  Please refer to your  shell's  docu
       mentation for details about the options it supports.

AUTHOR
       Written by Jim Meyering.
```

## The "man" command

```
REPORTING BUGS
       Report pwd bugs to bug-coreutils@gnu.org
       GNU coreutils home page: <http://www.gnu.org/software/coreutils/>
       General help using GNU software: <http://www.gnu.org/gethelp/>

COPYRIGHT
       Copyright       2009  Free Software Foundation, Inc.  License GPLv3+: GNU
       GPL version 3 or later <http://gnu.org/licenses/gpl.html>.
       This is free software: you are free  to  change  and  redistribute  it.
       There is NO WARRANTY, to the extent permitted by law.

SEE ALSO
       getcwd(3)
       The  full  documentation for pwd is maintained as a Texinfo manual.  If
       the info and pwd programs are properly installed at your site, the c o m
       mand
        info coreutils 'pwd invocation'
       should give you access to the complete manual.

GNU coreutils 7.4                    October 2009                        PWD(1)
```

# The "man -k" command

```
antoulas@sazerac:~/set001$ man -k mar
amarok (1)              - The audio player for KDE
amarokcollectionscanner (1) - Collection Scanner for Amarok
amarokmp3tunesharmonydaemon (1) - Handles AutoSync for the MP3Tunes service i...
apt-mark (8)            - mark/unmark a package as being automatically-installed
Glib::BookmarkFile (3pm) - Parser for bookmark files
Glib::Markup (3pm)      - Wrapper for markup handling functions in GLib
ispell-wrapper (1)      - smart wrapper for ispell
kbookmarkmerger (1)     - A program for merging a given set of bookmarks into th...
mbadblocks (1)          - tests a floppy disk, and marks the bad blocks in the FAT
pbmtonokia (1)          - convert a portable bitmap to Nokia Smart Messaging For...
pnmarith (1)            - perform arithmetic on two portable anymaps
pnmmargin (1)           - add a border to a portable anymap
sane-lexmark (5)        - SANE backend for Lexmark X1100/X1200 Series scanners
sane-tamarack (5)       - SANE backend for Tamarack flatbed scanners
sk98lin (4)             - Marvell/SysKonnect Gigabit Ethernet driver v6.21
sockatmark (3)          - determine whether socket is at out-of-band mark
time (1)                - run programs and summarize system resource usage
Xmark (1)               - summarize x11perf results
antoulas@sazerac:~/set001$
antoulas@sazerac:~/set001$ apropos amarok
amarok (1)              - The audio player for KDE
amarokcollectionscanner (1) - Collection Scanner for Amarok
amarokmp3tunesharmonydaemon (1) - Handles AutoSync for the MP3Tunes service i...
antoulas@sazerac:~/set001$
```

# Command "ls" (-a -l -r)

```
antoulas@sazerac:~/set001/Samples$ ls
aaa   bbbb   Set-01.ppt   zzz
antoulas@sazerac:~/set001/Samples$ ls -a
.  ..  aaa  bbbb  .getout  .myprofile  Set-01.ppt  zzz
antoulas@sazerac:~/set001/Samples$ ls -ls
total 10348
    4 -rw-r--r-- 1 antoulas _developer       15 2010-02-15 22:45 aaa
    4 -rw-r--r-- 1 antoulas _developer     1200 2010-02-15 22:48 bbbb
10336 -rw------- 1 antoulas _developer 10583040 2010-02-15 22:49 Set-01.ppt
    4 -rw-r--r-- 1 antoulas _developer       72 2010-02-15 22:45 zzz
antoulas@sazerac:~/set001/Samples$ ls -lsr
total 10348
    4 -rw-r--r-- 1 antoulas _developer       72 2010-02-15 22:45 zzz
10336 -rw------- 1 antoulas _developer 10583040 2010-02-15 22:49 Set-01.ppt
    4 -rw-r--r-- 1 antoulas _developer     1200 2010-02-15 22:48 bbbb
    4 -rw-r--r-- 1 antoulas _developer       15 2010-02-15 22:45 aaa
antoulas@sazerac:~/set001/Samples$
```

File that is "interpreted" when the shell starts:

- bash $\implies$ .bashrc/.bash_profile/.profile
- csh $\implies$ .cshrc
- tcsh $\implies$ .tcshrc
- ......

# Access Rights

▶ Every file/catalog belongs to the user that has created it.

▶ Every user belongs to at lest one group (*postgrads*, *undergrads*, *dep*, *users*, etc)

▶ Every file is named with at 10 characters
  - ▶ -  rwx  r-x  r-x
       user   group   others
  - ▶ 1st character is either "d" (directory) or "-" (file)
  - ▶ Three groups of characters — read/write/execute options

# Permission Rules for files/directories

|   | File | Directory |
|---|------|-----------|
| r | Read or Copy a file | Read content in directory |
| w | Change or delete a file | Add or delete entries (files) in directory using commands |
| x | Run executable file | Reference or move to directory (without seeing names of other files) |

# Command "ls" (-d -R -t)

```
pubsrv1:/tmp>ls
hsperfdata_reserv   junk                output26675         sh5720
hsperfdata_root     mysql.sock          output26935
pubsrv1:/tmp>ls -d junk
junk
pubsrv1:/tmp>ls -dl junk
drwx------   2 antoulas other        238 Feb 16 00:07 junk
pubsrv1:/tmp>ls -R junk/
junk/:
aaa    bbbb
pubsrv1:/tmp>ls -lsRa junk/
junk/:
total 64
  16 drwx------   2 antoulas other        238 Feb 16 00:07 .
  16 drwxrwxrwt   5 root     sys          590 Feb 16 00:45 ..
  16 -rw-------   1 antoulas other         16 Feb 16 00:07 aaa
  16 -rw-------   1 antoulas other         59 Feb 16 00:07 bbbb
```

▶ *Sticky bit*: When the sticky bit is set, only the file's owner,
  the directory's owner, or the superuser can rename or delete
  items in question.

# Command "ls" (-d -R -t)

```
pubsrv1:/tmp>ls -ltR
.:
total 64
drwx------    2 antoulas  other        238 Feb 16 00:07 junk
drwxr-xr-x    2 root      root         117 Feb 15 02:24 hsperfdata_root
-rw-r--r--    1 vfisikop  doctoral       0 Jan 27 14:29 output26935
-rw-r--r--    1 vfisikop  doctoral       0 Jan 27 14:27 output26675
drwxr-xr-x    2 reserv    other        177 Jan 24 16:22 hsperfdata_reserv
srwxrwxrwx    1 mysql     mysql          0 Jan 24 16:22 mysql.sock
-rw-------    1 root      root         849 Jan 24 16:22 sh5720

./junk:
total 32
-rw-------    1 antoulas  other         59 Feb 16 00:07 bbbb
-rw-------    1 antoulas  other         16 Feb 16 00:07 aaa

./hsperfdata_root:
total 0

./hsperfdata_reserv:
total 64
-rw-------    1 reserv    other      32768 Feb 14 16:58 611
pubsrv1:/tmp>
```