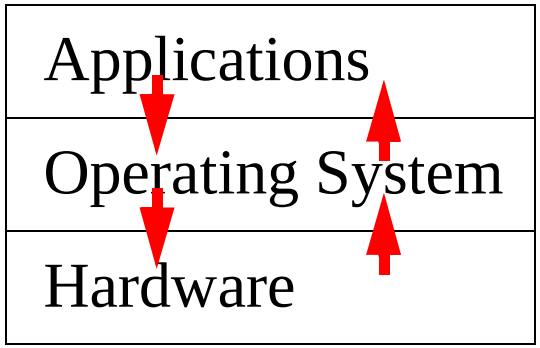
# CS 126 Lecture P2: Introduction to Unix

# Outline

- **Background**
- Files
- Processes
- Interactions
- Conclusion

# Operating Systems




- What does an OS do?
  - Make lives easy: hides low level details of bare machine
  - Make lives fair: arbitrate competing resource demands
- What we learn here: the interfaces by OS to upper layer
  - User interface
  - Programmer's interface
  - Command line vs. graphical user interface (more later)

# Operating systems

**Multics**

timesharing
file system, protection
virtual machines

**OS/360**

**Macintosh**

windows, mouse

**DOS**

PC standard OS

**UNIX/Linux**

- C language, bootstrapped implementation
- integrated command structure
- simplified, integrated file system
- used by most programmers

**Windows**

[OS definition under litigation]

# A Brief History

- Multics (65-70)
  - Ambitious OS project at MIT
  - Pioneered most of the innovations in modern OS
  - A little ahead of its time
- Unix
  - Thompson and Ritchie (69): simplicity and elegance
  - AT&T (70-80s):
    continued development and “shepherding” it out of AT&T
  - Berkeley (“BSD”) (78-93): maturation (e.g. TCP/IP)
  - Various flavors of commercial Unix (80-90s):
    convergence and fragmentation
  - Linux (91-): new life

# Outline

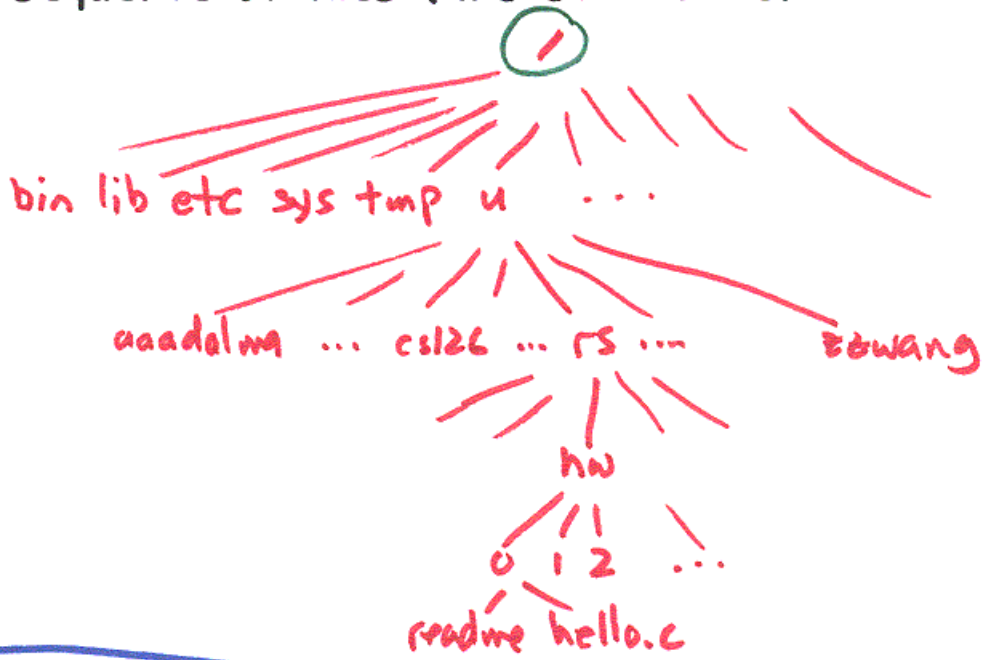
- ~~Background~~
- **Files**
  - A simple and powerful abstraction for storage (disks)
  - Extended for things beyond disks
- Processes
- Interactions
- Conclusion

# File System

- "Everything in UNIX is a file"
- Abstract mechanism for "permanent" storage

**file:**
sequence of bytes

**directory:** "/" **(like folders)**
sequence of files (and directories)




**filename:**
sequence of directory names
on the path from "/" to the file

**A Hierarchical Name Space: Same as folders and files on Windows or MacOS**

# File manipulation commands

| | |
|---|---|
| cat, more | show the contents |
| cp | copy |
| rm | remove (delete) |
| mv | move (rename) |
| ls | list file names |
| mkdir, rmdir | create, delete directory |
| pwd | name of current directory |
| cd | change directory |

"." current directory
".." parent directory
"~" my home directory
"~xx" xx's home directory

| | |
|---|---|
| chmod | change permissions mode |

"*" any sequence of characters

DON'T TYPE "rm *"

# Outline

- ~~Background~~
- ~~Files~~
- **Processes**
  - An abstraction for the processor (CPU)
  - “Everything” (almost every command) is a process
- Interactions
- Conclusion

## Some Unix commands

| | |
|---|---|
| lpr | output to printer |
| man, apropos | online documentation |
| grep, awk, sed | pattern search (stay tuned) |
| sort | sort the lines |
| diff | show differences |
| cal, date, time | time utilities |
| mail, news, pine | communication |
| bc, dc | calculators |
| cc, lcc, gcc | C compile |
| gs, xv | view graphics |
| history | past commands typed |

- Over 2500 "standard" commands
- Thousands more "available" programs

| | |
|---|---|
| emacs, tex, latex | text in and out |
| netscape | access web |

- A Unix "command" is the same as a Windows "program"
- Instead of clicking its icon under Windows, we simply type its name to invoke it on a command line.

# Multiprocessing

- Abstraction provided by operating system
  - multiple "virtual" machines for your use
  - outgrowth of 1960s "time-sharing"
  - not found on 1st-generation PC OS's

Multiple windows "active"??

Ex:

```
emacs hello.c &
```

ampersand indicates "do this in the background"

- alternatively, could use ctrl-z (and bg)

```
% emacs hello.c &
[1] 18439
% netscape &
[2] 18434
% jobs
[1]   + Running                 emacs hello.c
[2]   - Running                 netscape
%
```

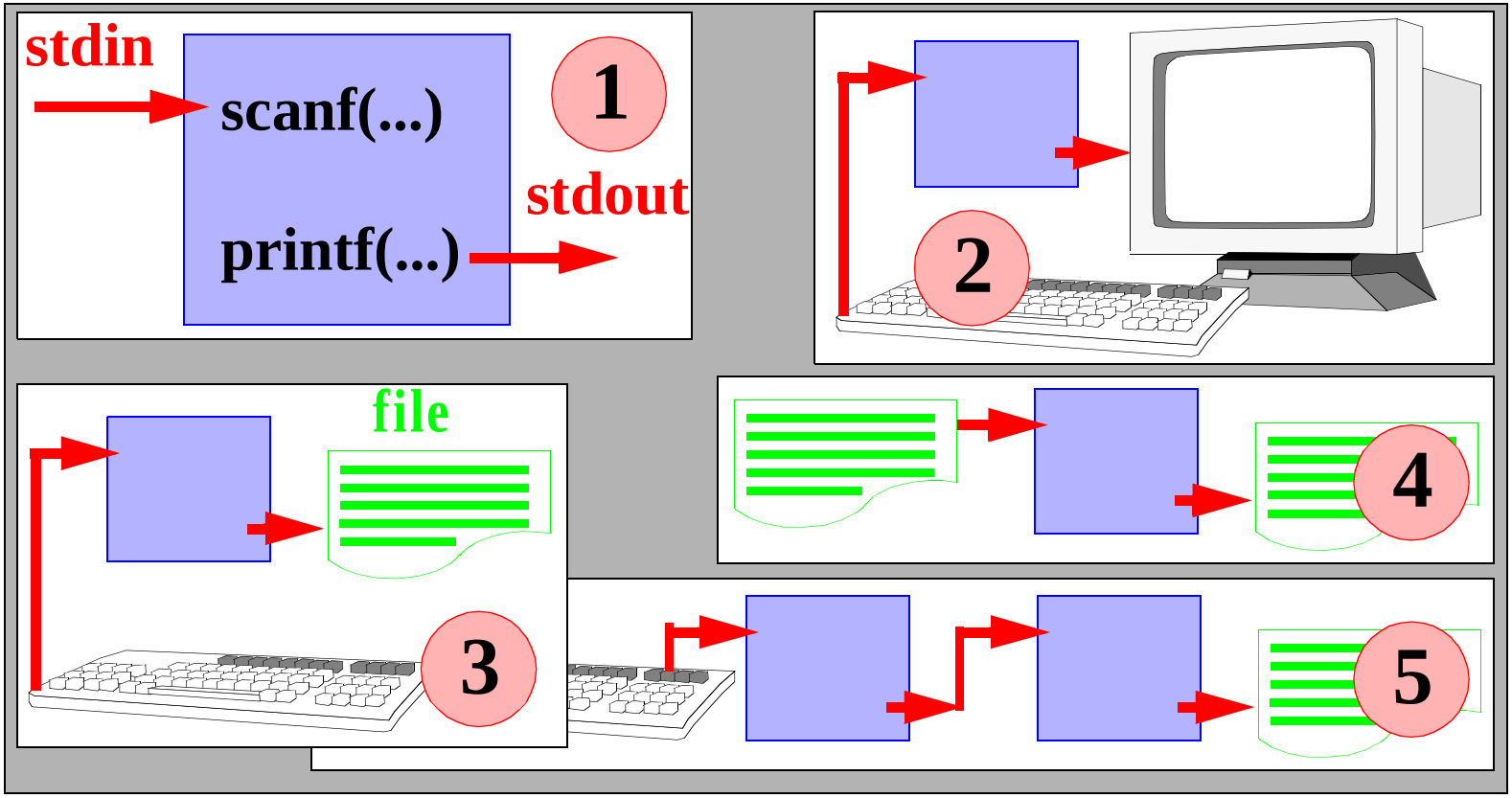
For COS126

- one window for editor
- one window for UNIX commands
  - lcc, a.out, ls, cp
  - [one window for output]

# Outline

- ~~Background~~
- ~~Files~~
- ~~Processes~~
- **Interactions**
  - (between files and processes)
- Conclusion

# I/O Redirection and Pipes




- 1: “Standard I/O”, 2: default attachment, 3: redirect output
- 4: redirect both input and output, 5: pipes

# Filters and pipes

- Standard Input, Standard Output


- abstract files for command interfaces

**Redirection:**

- standard input from file
- standard output to file

```
a.out > saveanswer
sort < myfile > myfilesorted
```

3 on prev. slide

4 on prev. slide

**Piping:**

- connect standard output of one command to standard input of the next

```
ls | wc -l > outputfile
plotprog | lpr
gamblerall | avg
```

5 on prev. slide

Don't confuse redirection and piping

```
plotprog > lpr
```

# C Shell (/bin/csh)

```
#!/bin/csh -f
printf "Hello world! Give me a number:\n"
set n = $<
printf "Thanks! I've always been fond of %d\n" $n
```

Don't worry about the details here.

- The program that's running inside your terminal window
- Much more than just manipulating files and launching commands
- It's an "interpreter", with its own powerful programming language!
- Try your first "csh script"?

# Shell

## Command interface to UNIX

- Just another programming language
  - sequences of instructions

```
mv file1 tmp; mv file2 file1; mv tmp file2
```

  - variables

```
printenv
```

  - arguments, flags

```
ls -lt *.c
```

  - conditional
  - looping
  - ...

"EXTENSIBLE"

- add a new command with

```
cc avg.c
mv a.out avg
```

- also can add new commands with

```
chmod 755 doit
doit
```

where "doit" is a file with shell commands

**Primary use**

low-overhead "programming" to
manipulate files
invoke commands

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- **Conclusion**

# Choose Your Weapons Wisely

- C or Csh? “System programming” or “scripting”?
- Abstractions -- how to make big boxes using small ones
  - System programming (makes component boxes)
    - Compiled, rich types
    - Good for creating components which demand high performance or involve complex algorithms
  - Scripting (glues component boxes together)
    - Interpreted, manipulates strings, less efficient
    - Good for gluing together existing components
    - Rapid development for gluing and GUI