Operating Systems and Using Linux

CMSC 104, Spring 2014

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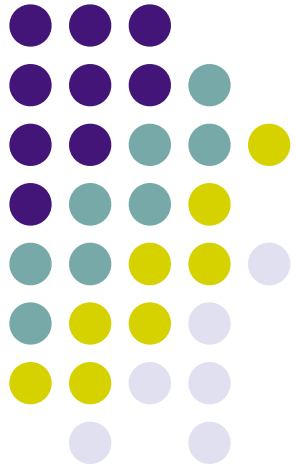
(thanks to John Park for slides)



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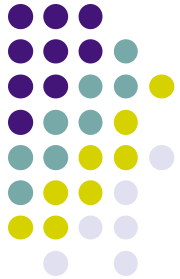


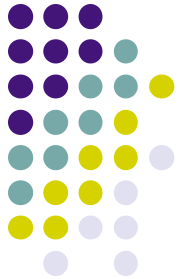
Topics

- What is an Operating System?
- Linux Overview
- Frequently Used Linux Commands

What is an Operating System?

- A computer program that:
  - Controls how the CPU, memory and I/O devices work together to execute programs
  - Performs many operations, such as:
    - Allows you to communicate with the computer (tell it what to do)
    - Controls access (login) to the computer
    - Keeps track of all processes currently running
- Often referred to as simply OS

What is an Operating System?



- Provides a uniform interface for users and programs to access changing, evolving hardware (H/W)
- Very different H/W platforms can support a common OS (partially custom-written, of course) (standard “PC”, Sony PSP can both run Linux)
- One H/W platform can support multiple OSs
  - E.g.: Latest Macs can run MacOS *or* Windows

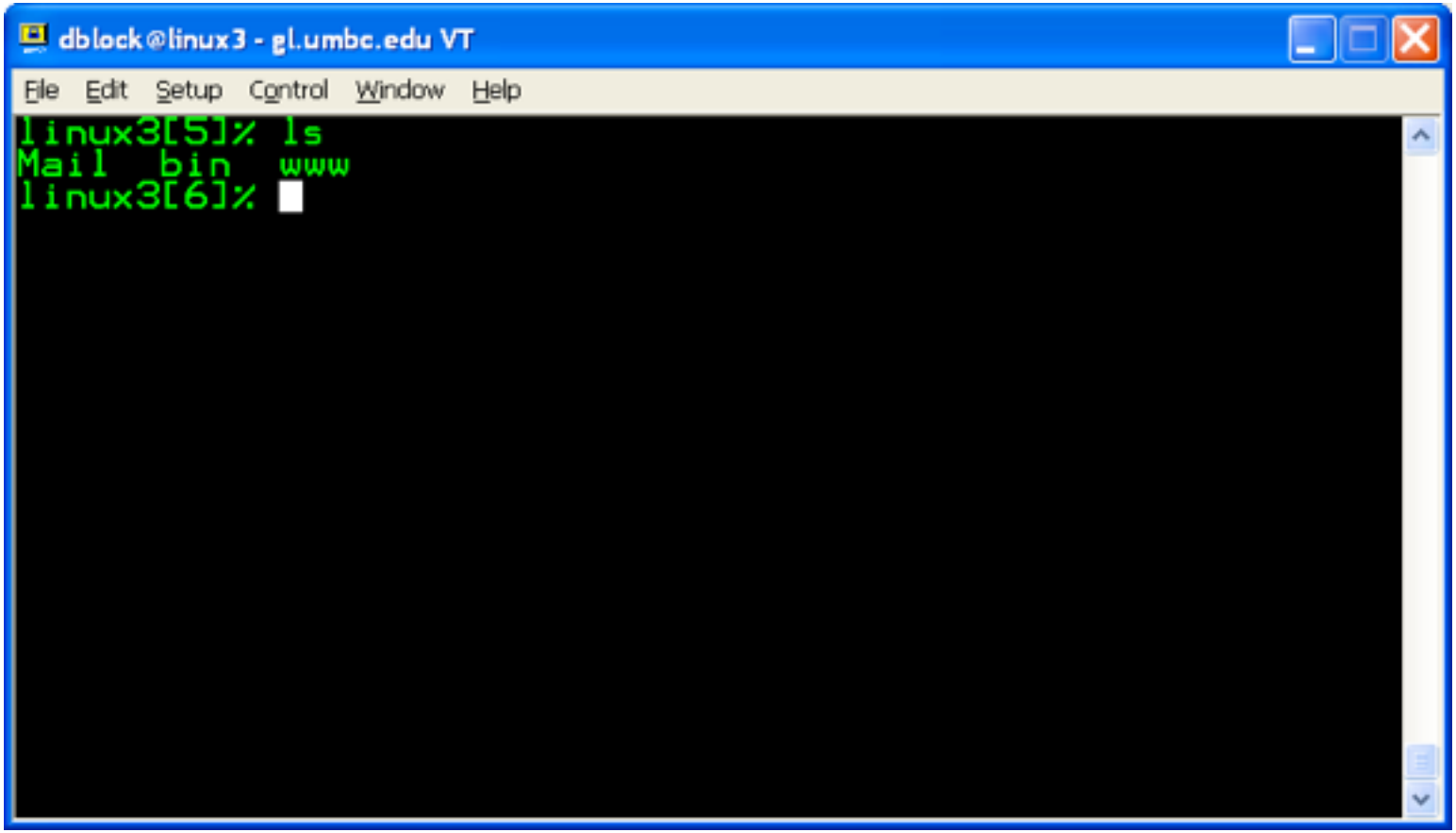
How Do I Communicate With the Computer Using the OS?

- You communicate using the particular OS's **user interface.**
  - **Graphical User Interface (GUI)** – Windows, Mac OS, Linux
  - **Command-driven interface** - DOS, UNIX, Linux
- We will be using the **Linux** operating system, which is very similar to UNIX. Notice that it is listed as both GUI and Command-driven.

GUI vs. Command-driven

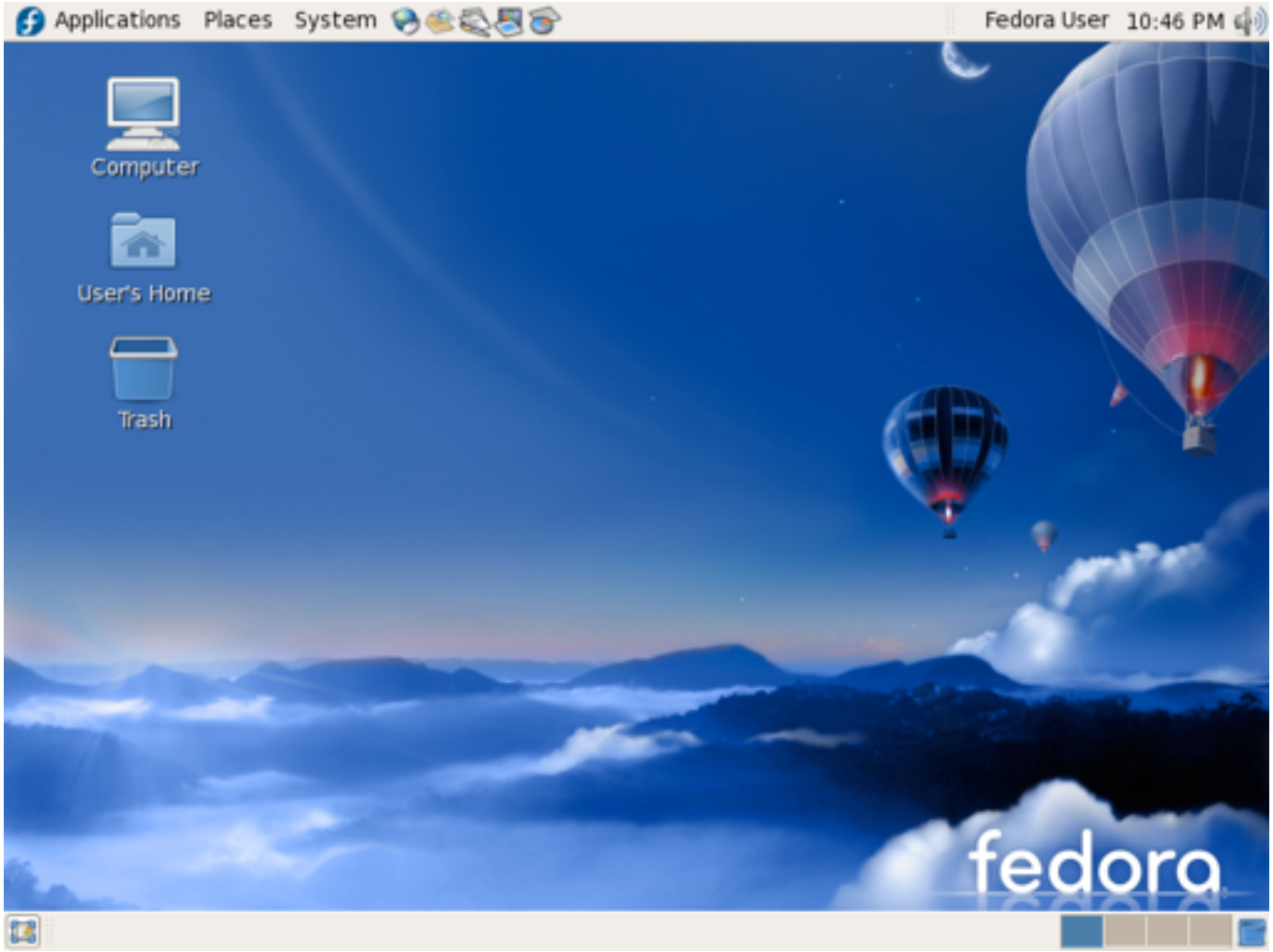
- We will be using both the GUI version of Linux and the Command-driven Interface.
- When you connect to GL through TeraTerm, you are using only the Command-driven Interface.
- When you reboot the computer into Linux, you will use both the GUI and the Command-driven Interface.

Example of Command-driven



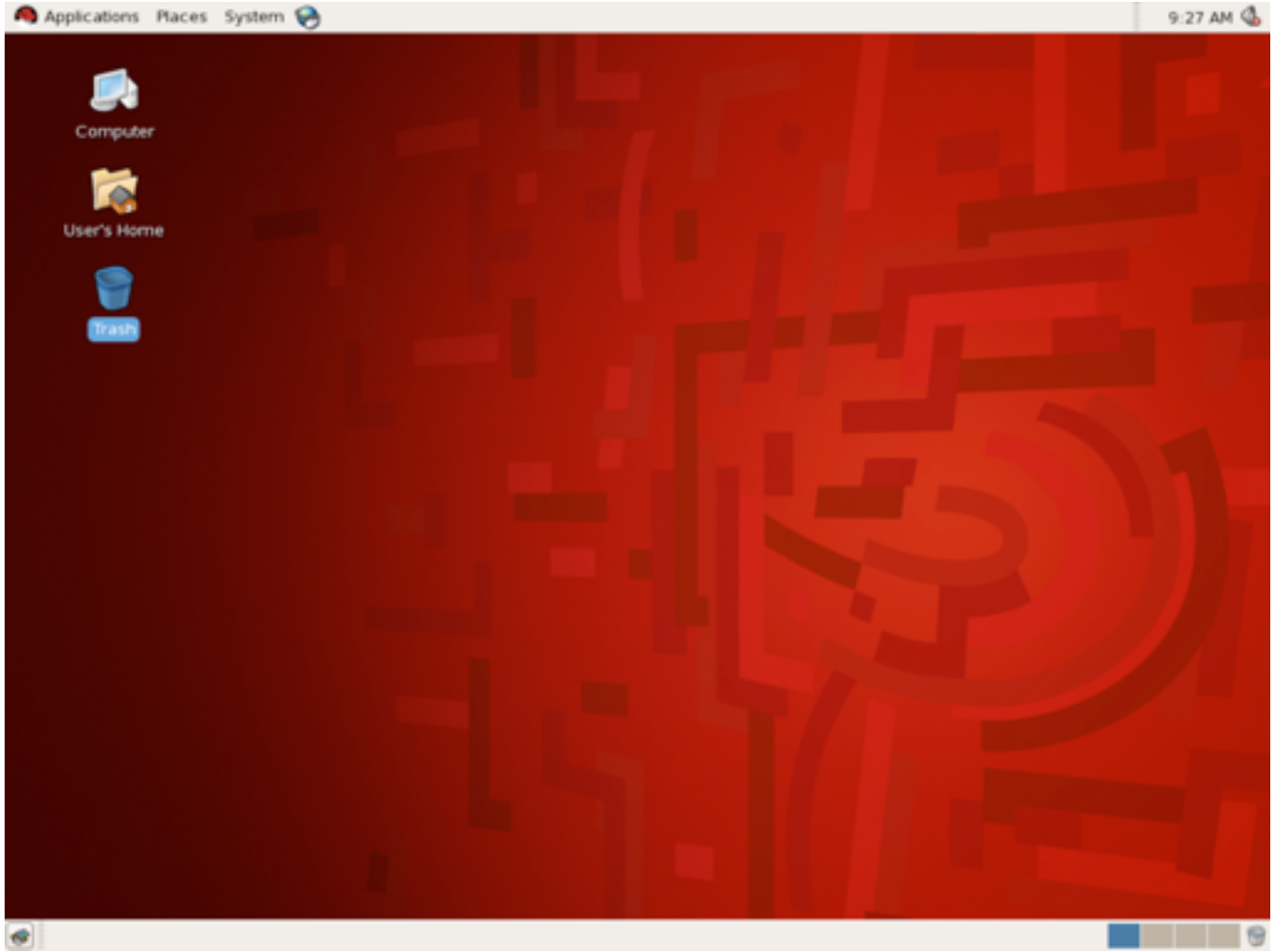
Screenshot of connection to linux3.gl.umbc.edu

Example of GUI



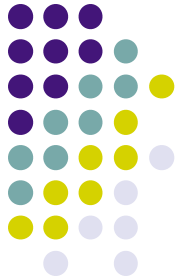
Screenshot of Fedora 7

Another Example of GUI



Screenshot of Red Hat Enterprise Linux (RHEL) 5

How Do I Communicate With the Computer Using the OS? (con't)



- When you **log in** to the Linux system here, a **user prompt** will be displayed:

```
linux#[1]% _
```

where # is the number of the Linux server to which you have connected. You may use any of the Linux servers: linux1, linux2 or linux3.

- The number in the brackets will change as you work. It is the "number" of the command that you are about to type.
- If this prompt is not on the screen at any time, you are not communicating with the OS.

Linux Overview

- Files and Filenames
- Directories and Subdirectories
- Abolute & Relative Pathnames, ‘.’, and ‘..’
- Why a Command Line?
- Frequently Used Commands
- The Shell(s)
- I/O Redirection and Pipes
- Command Line Editing &
- History

Files

- A file is a sequence of bytes.
- It can be created by
  - a text editor (XEmacs or Notepad)
  - a computer program (such as a C program)
- It may contain a program, data, a document, or other information .
- Files that contain other files are called directories (sometimes called folders).

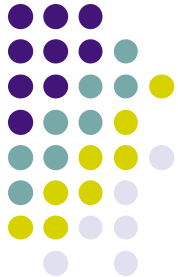
Linux Filenames

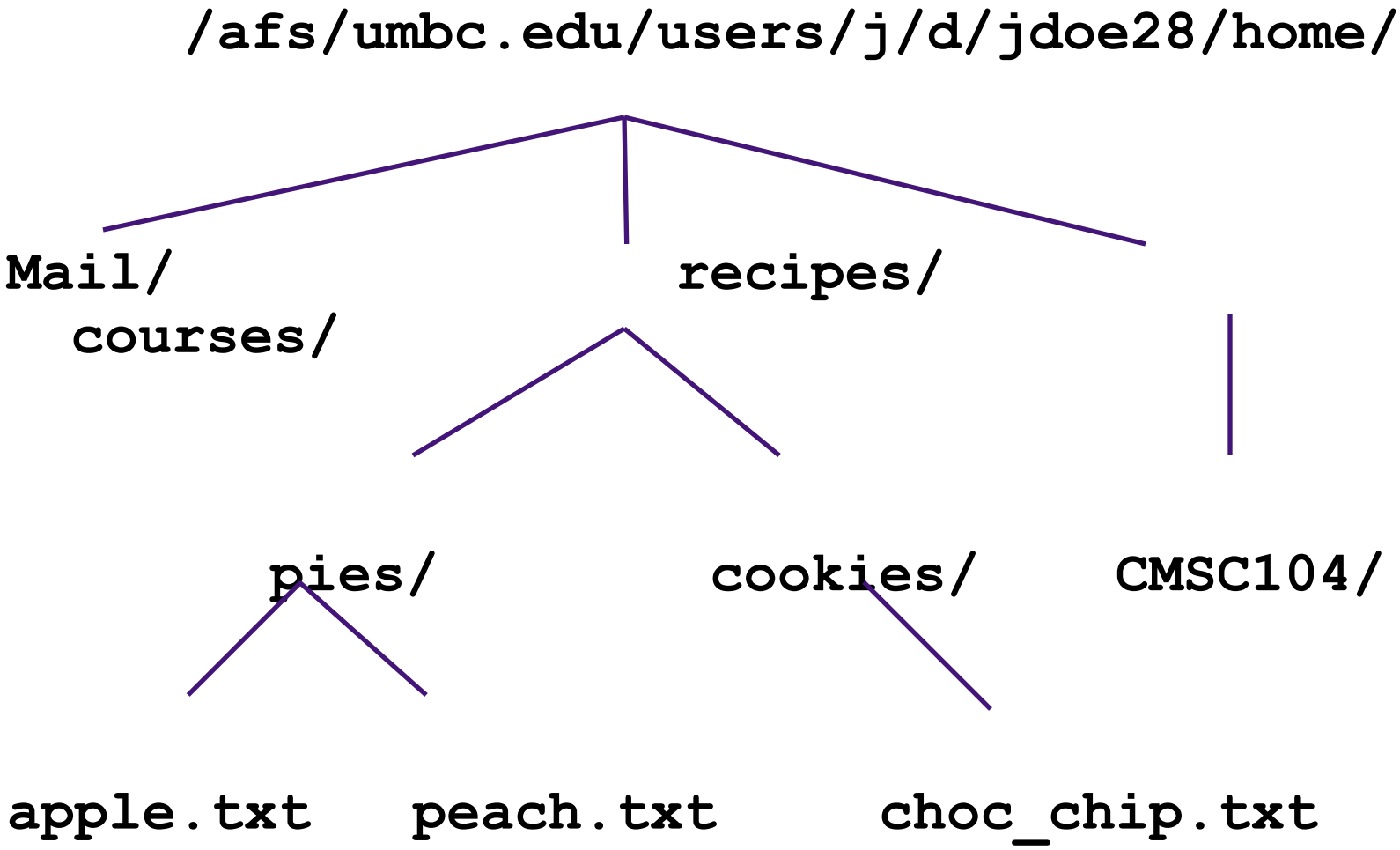
- Restrictions
  - Typically do not have spaces or other reserved characters
  - Have a maximum length (typically 255 characters but who wants to type that much!)
  - Are case sensitive
- For this class, you should stick with filenames that contain only letters (uppercase or lowercase), numbers, and the underscore (_) or hypen (-). No spaces!
- Some examples: **`firefox.exe`**, **`things2do.txt`**, **`dinner_menu.pdf`**

Directories

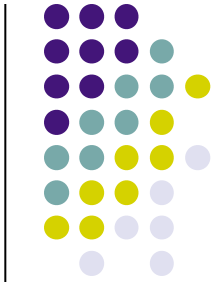
- Directories contain files or other directories called subdirectories. They may also be empty.
- Directories are organized in a hierarchical fashion.
- They help us to keep our files organized.

Example Directory Tree



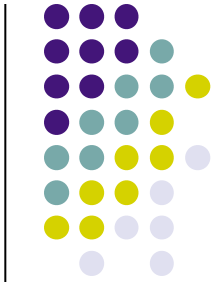


More Directories



- Your **home directory** is where you are located when you log in
  (e.g., /afs/umbc.edu/users/j/d/jdoe28/home/).
- The **current directory** is where you are located at any time while you are using the system.
- The **/** (pronounced “slash”) is the root directory in Linux.
- Files within the same directory must be given unique names.
- **Paths** allow us to give the same name to different files located in different directories.
- Each running program has a current directory and all filenames are implicitly assumed to start with the name of that directory unless they begin with a slash.

Absolute Path



- The absolute path is a path that contains the root directory and all other subdirectories you need to access the file
- It points to the same location in the directory tree regardless of the current working directory
- An example of an absolute path

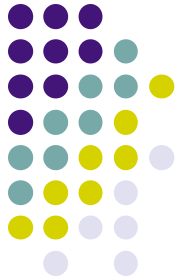
```
/afs/umbc.edu/users/j/d/jdoe28/home/recipes/
```

Starts with /

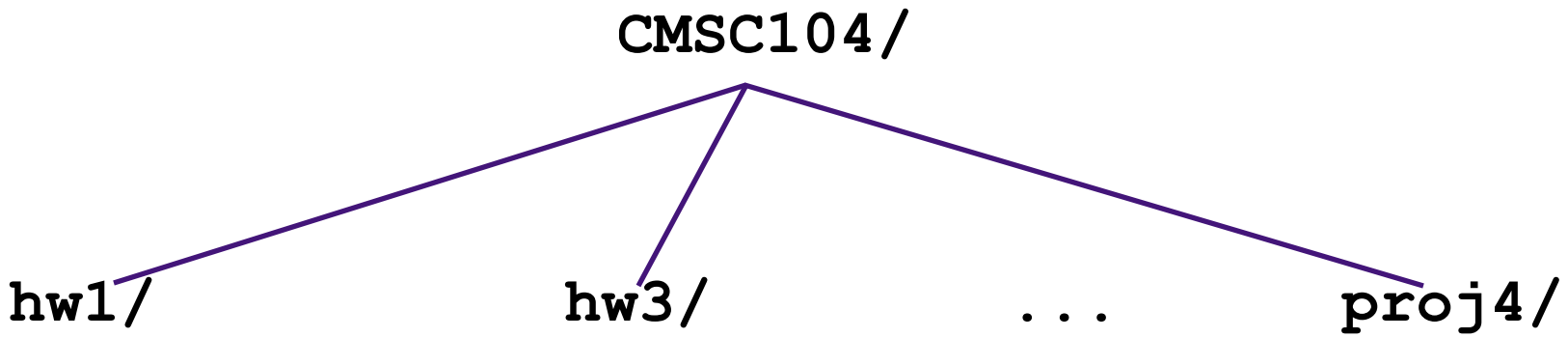
Relative Path

- The relative path is a partial path to a file in relation to the current working directory
- If inside of the home directory in the previous directory example, a relative path would be

Subdirectories



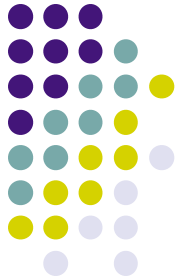
- Are used for organizing your files
- For example,
  - make a subdirectory for CMSC104
  - make subdirectories for each project



Moving in the Directory Tree

- . (dot) is the current directory.
- . . (dot-dot) is the parent directory.
- Use the Linux command `cd` to change directories.
- Use ".." to move up the tree (to "parent directory")
- Use the directory name to move down (to a "subdirectory" or "child directory").
- Use the absolute path to move anywhere.

Why a GUI?



- GUIs are sometimes better, because:
  - Give a good sense of “where I am”
  - Succinct visual summary of small sets
  - Easier to find “forgotten” target, then act on it
  - Simple to execute default behavior
    - Otherwise, often resort to complex “environments”

Why a Command Line?

- Command lines are sometimes better, because:
  - Easier to operate on large sets
  - Convenient if you remember filenames
  - Can act on multiple objects in disparate locations
  - Easier if no simple default behavior

What is a “Shell”?

- The “most important program in the OS” ☺
- Your primary means of controlling the OS
- On Linux, just another program!
  - Can use other shells: sh, csh, bash, tcsh
- Can be programmed to do complex tasks
- Every command (almost) is just running another program
- Main differences are in syntax, ease of use

Common Commands

- First things first: help!
  - “man” is for *manual*
- Directory operations:
  - pwd, cd, mkdir, rmdir
- File manipulation:
  - ls, rm, cp, mv, cat
- File perusal
  - cat, more, less, head, tail, file

Common Commands

- File editing
  - ed, emacs, sed
- Misc (pine, find, etc.)

- **`ctrl-c`**

- References:
  - Linux man page
  - Links from the 104 homepage
  - Books and the Internet

Wildcard Characters

- Can use patterns to specify, or *match,* filenames.
  - Useful when you don't remember exact name, or it is long
- Two wildcard characters are * and ?
- ? is used to represent any single character.
  - For example, **`ls hw?.txt`** would match the files **`hw1.txt`** and **`hw2.txt`** but not **`hw123.txt`**
- * is used to represent 0 or more characters.
  - For example, **`ls hw*.txt`** would match the files **`hw1.txt`** and **`hw2.txt`**, as well as **`hw.txt`**, **`hw123.txt`** and **`hw_assignment.txt`**

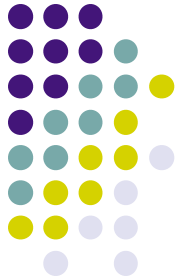
I/O Redirection

- All programs read from standard “channel”, write to standard “channel”
  - Called “file descriptors”
- Shell can manipulate these file descriptors before executing command (i.e., program)
- Devices and files treated similarly
- “<“: redirect input
- “>”: redirect output

I/O Redirection

- Examples:
  - % ls > my-files.txt
  - % wc < my-files.txt

Pipes



- Communications channel *between* two programs
  - Can think of as a temporary file that first program writes to, second program then reads from
- Syntax:

  % program1 | program2

- Example:

  % ls | wc

  will give you the number of files you have

Command Line Editing

- Allows command to be edited before being executed
- Uses subset of emacs commands:
  - Ctl-B, Ctl-F, Ctl-A, Ctl-E, <Backspace>, Ctl-D
- Allows previous commands to be recalled, then optionally edited
- Very convenient for:
  - Typos
  - Repetitive commands