

Operating Systems & File Structure

CMSC 104 Section 02
February 5, 2024

Administrative Notes

Some details about “files” and “directories” in various operating systems

“Back in the old days” - information in computers and networks was organized in terms of “files” and “directories”

- “Files” are resources stored on a computer that contain data, programs, configuration settings, etc.
 - Just a collection of things that you want to keep together and refer to by a single name
- “Directories” (sometimes called “folders”) are part of the system catalog structure; they contain references to file and other directories

Taken together, directories and files are ways of storing and referring to pretty much everything in the computer. They collectively make up the “file system”

These days...

Google popularized the idea of “search” instead of filesystems

- People don't have to understand directories, files, where things are stored and how to get to them
- As long as you know the name, you can just search for it and find it
- And that mostly works

But:

- Underneath it all, there is still a filesystem with directories and files
- And since this is “Computer Science” you need to learn how it works

Differences among operating systems

Each operating system does things slightly differently

Windows:

- The filesystem is “rooted” at a system device, most commonly a disk, “C” (or some other letter)
 - Every file has a path that starts at that drive
- If you’re starting from the MS Cloud - e.g., using OneDrive - the filesystem starts at “OneDrive” instead of “C”

Windows Examples

File Explorer window showing the contents of the Local Disk (C:).

Address bar: This PC > Local Disk (C:) >

Navigation pane (left): Intel, PerfLogs, Program Files, Program Files (x86), Users, Windows.

Name	Date modified	Type	Size
Intel	1/16/2024 2:14 AM	File folder	
PerfLogs	5/7/2022 1:24 AM	File folder	
Program Files	1/31/2024 8:01 PM	File folder	
Program Files (x86)	12/22/2023 11:29 AM	File folder	
Users	2/24/2023 9:18 AM	File folder	
Windows	1/16/2024 2:13 AM	File folder	

File Explorer window showing the contents of the Downloads folder.

Address bar: This PC > Local Disk (C:) > Users > aarse > Downloads >

Navigation pane (left): Earlier this week, Last week.

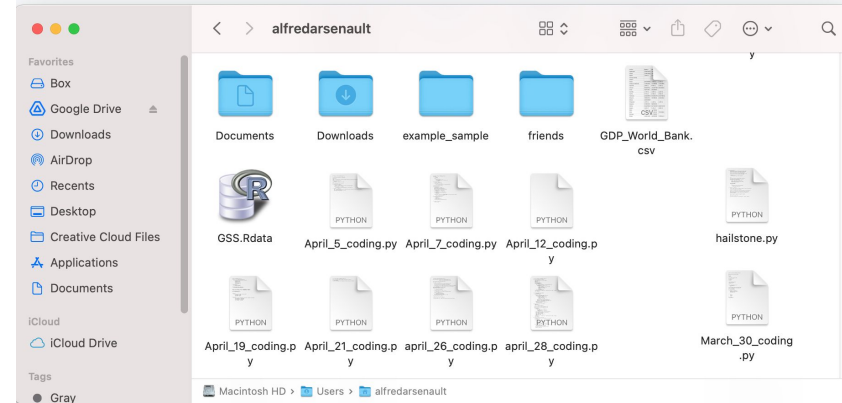
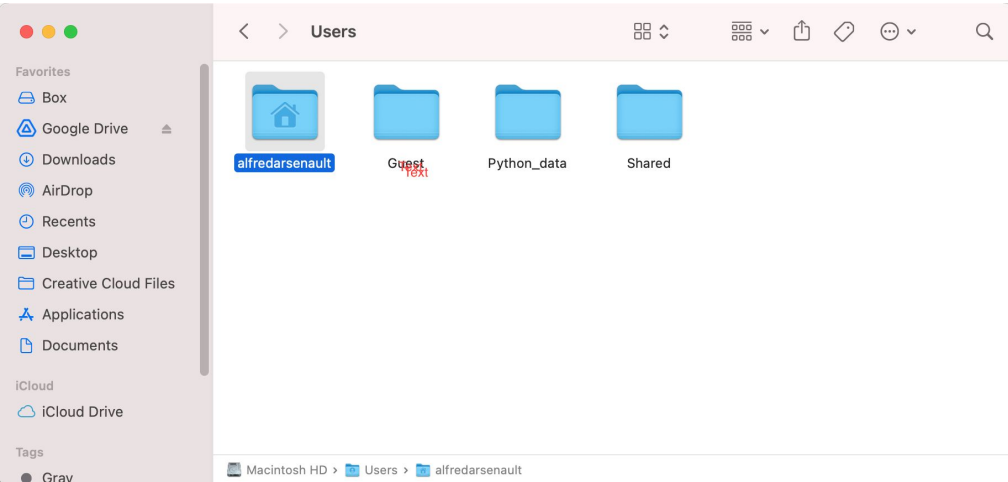
Name	Date modified	Type	Size
Correspondence (3)	2/1/2024 6:42 PM	Chrome HTML Do...	45 KB
AI_Arsenault_Jr_(37283)_01_28_2024_(Re...	1/31/2024 7:30 AM	Chrome HTML Do...	101 KB
Assign2_Das_INFO603	1/30/2024 4:41 PM	Jupyter Source File	3 KB
Assign1_Das_INFO603	1/30/2024 4:38 PM	Jupyter Source File	1 KB
CW2 (1)	1/29/2024 9:46 PM	Chrome HTML Do...	86 KB
CW2 (1).synctex	1/29/2024 9:46 PM	Compressed Archi...	24 KB
CW2 (1)	1/29/2024 9:46 PM	TeX Document	10 KB
CMSC104_Syllabus_Spring_24 (3)	1/28/2024 3:20 PM	Chrome HTML Do...	171 KB

Mac

The idea is the same

MacOS uses the term “folder” instead of directory because they thought it was understandable to the average person

Mac Examples



Mac “Finder” with directories/files shown in “Icon” mode - path name shown at bottom of window

GUIs vs Command lines

The Windows and Mac examples shared use “Graphical User Interfaces” or GUIs to present the files and directories

- You don't have to type anything to move around the system; just click on various icons
 - “Make it simple for the user”
- But you can do the same with command lines
- E.g., Windows PowerShell or Mac Terminal

Windows Examples

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\aaarse>
```

```
PS C:\Users\aaarse> cd python
PS C:\Users\aaarse\python> ls

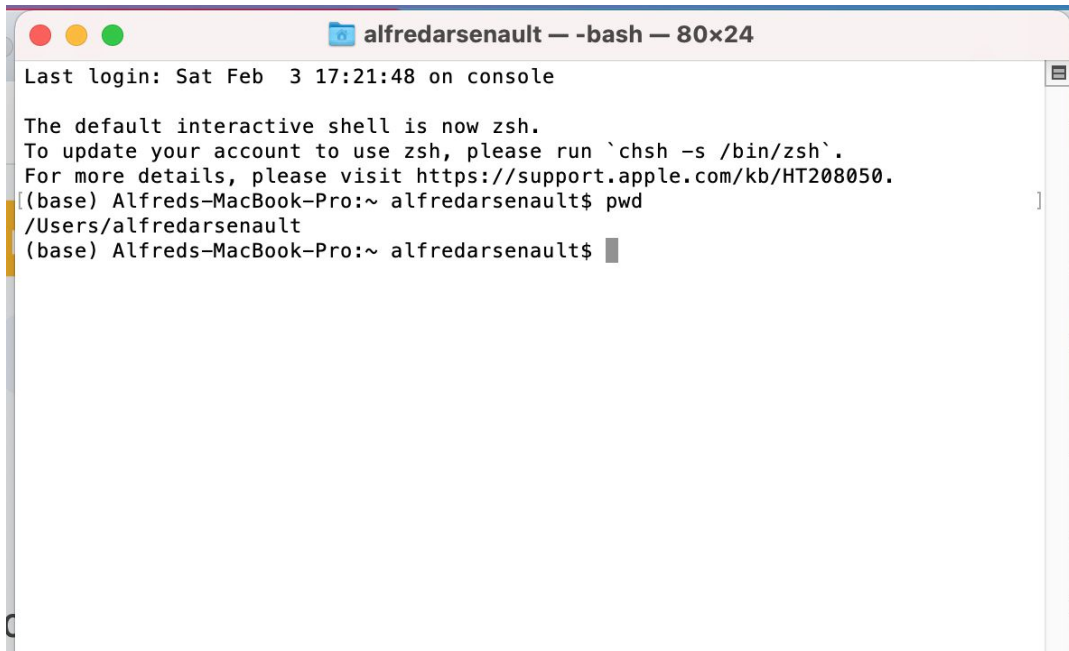
    Directory: C:\Users\aaarse\python

Mode                LastWriteTime         Length Name
----                -
-a-----         11/23/2022   8:46 AM        2601705 get-pip.py

PS C:\Users\aaarse\python>
```

Notice that Windows separates directories in the path with
backslash - \. Everybody else we care about uses forward
slash - /. Be careful, because that can cause some problems.

Mac Examples



```
alfredarsenault — -bash — 80x24
Last login: Sat Feb  3 17:21:48 on console

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
((base) Alfreds-MacBook-Pro:~ alfredarsenault$ pwd
/Users/alfredarsenault
(base) Alfreds-MacBook-Pro:~ alfredarsenault$ █
```

Navigating with command lines

You can't just click between directories/folders when using a command line, like PowerShell or Terminal

- You have to navigate using commands you type in
 - The specific set of commands you use in any operating system is called the “shell”
 - Mac uses “zsh” or “Z shell” by default
 - PowerShell is its own, Microsoft-specific shell
 - MSFT used to use the “Command shell” (cmd.exe)
 - Spoiler alert: gl.umbc.edu Linux systems use “bash” or the “Bourne-again shell” (it's a lame attempt at humor)
- The best thing to do is find a “cheat sheet” that identifies the commands to use on the system we care about

Linux directories

Note: many Linux implementations come with GUIs to make all of this easier. UMBC chooses not to use them for our Computer Science program - gl.umbc.edu - because you should learn how this really works “underneath the hood”

Linux filesystems are “rooted” in a global root, denoted by “/”

- Generally, average users are not permitted to access the global root because of the harm that could be caused if you accidentally changed it or deleted it

The “path” is how to get from the global root to each account’s “home” directory

Linux Examples

```
[arsenaul@linux2 ~]$ pwd
/afs/umbc.edu/users/a/r/arsenaul/home
[arsenaul@linux2 ~]$
```

Notice that Linux uses the forward slash to separate directories in the path

```
[arsenaul@linux2 ~/cs104]$ mkdir cw1
[arsenaul@linux2 ~/cs104]$ mkdir cw2
[arsenaul@linux2 ~/cs104]$ mkdir cw3
[arsenaul@linux2 ~/cs104]$ mkdir hw1
[arsenaul@linux2 ~/cs104]$ mkdir hw2
[arsenaul@linux2 ~/cs104]$ mkdir hw3
[arsenaul@linux2 ~/cs104]$ ls -l
total 15
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 cw1
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 cw2
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 cw3
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 hw1
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 hw2
drwxr-xr-x 2 arsenaul faculty 2048 Feb  3 10:12 hw3
-rw-r--r-- 1 arsenaul faculty 2049 Jan 29 18:48 submitrc
[arsenaul@linux2 ~/cs104]$
```

All of the “mkdir”, “cd” and “ls” commands are bash commands. The “-l” after “ls” means “give me the long version - the details.”

We'll explain what each of these letters and numbers means

Some Linux things to know:

Your home directory is always denoted by “~”

- Any time you type “cd ~” you go to your home directory. If you want to specify how to get to a file under your home directory, start with ~
 - You could also type the entire path, starting with /afs... but that’s a lot more work and it’s error-prone
- “..” means go up one directory in the filesystem. Wherever you are, go that that directory’s “parent” directory
-

Bash commands:

See e.g. <https://github.com/RehanSaeed/Bash-Cheat-Sheet>