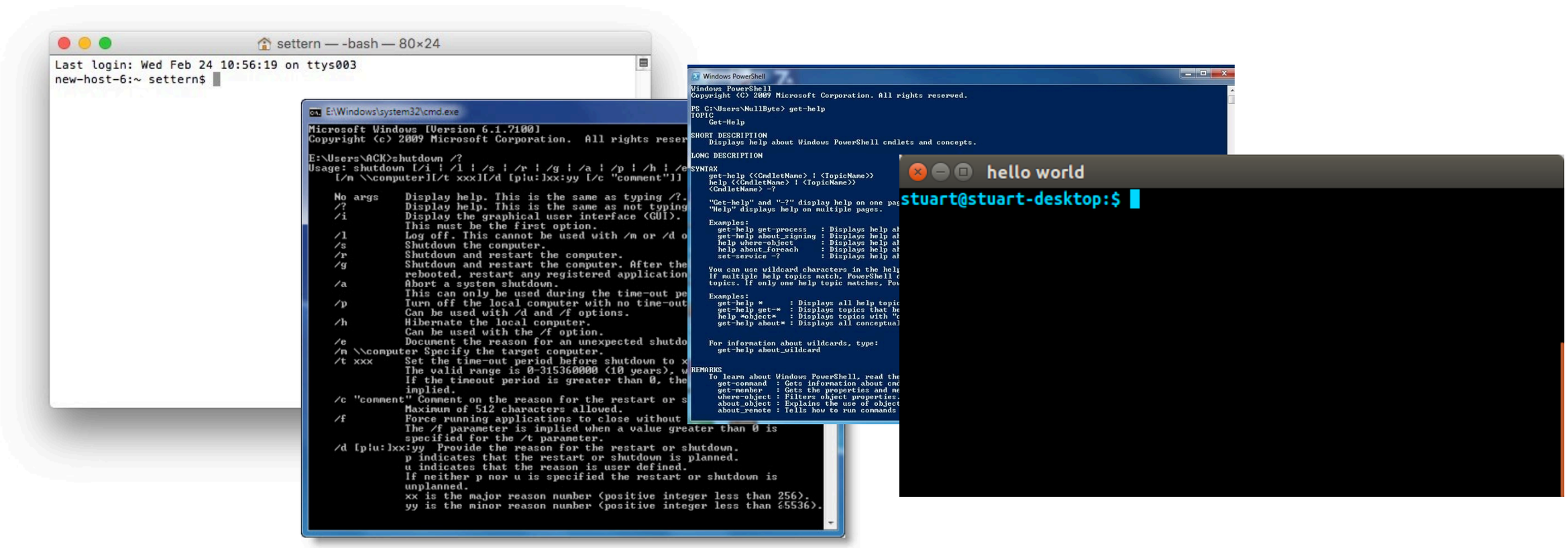
[301] The Terminal

Tyler Caraza-Harter



Today's Topics

Terminal Emulators and Shells

- Terminal history
- Shells
- Running programs from a shell

Navigation

Running Programs and Commands

Demos

History: the Original Terminals

Mainframe
(powerful computer)

https://techcrunch.com/2015/08/16/ibm-teams-with-canonical-on-linux-mainframe/
https://en.wikipedia.org/wiki/Computer_terminal#Dumb_terminals

History: the Original Terminals

Mainframe
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How to share it?

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History: the Original Terminals

Mainframe
(powerful computer)

dumb terminals
(text based)

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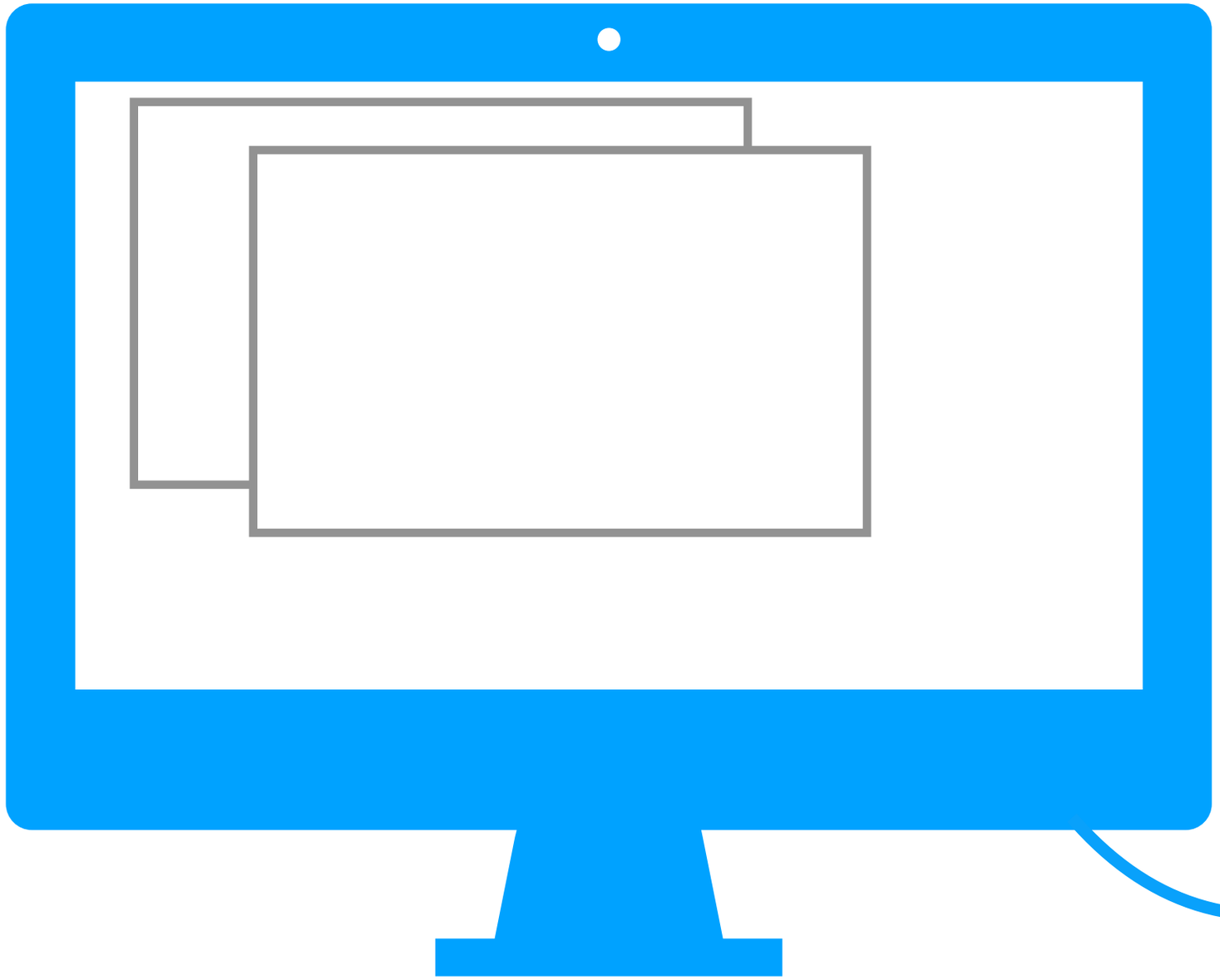
Terminal Emulators



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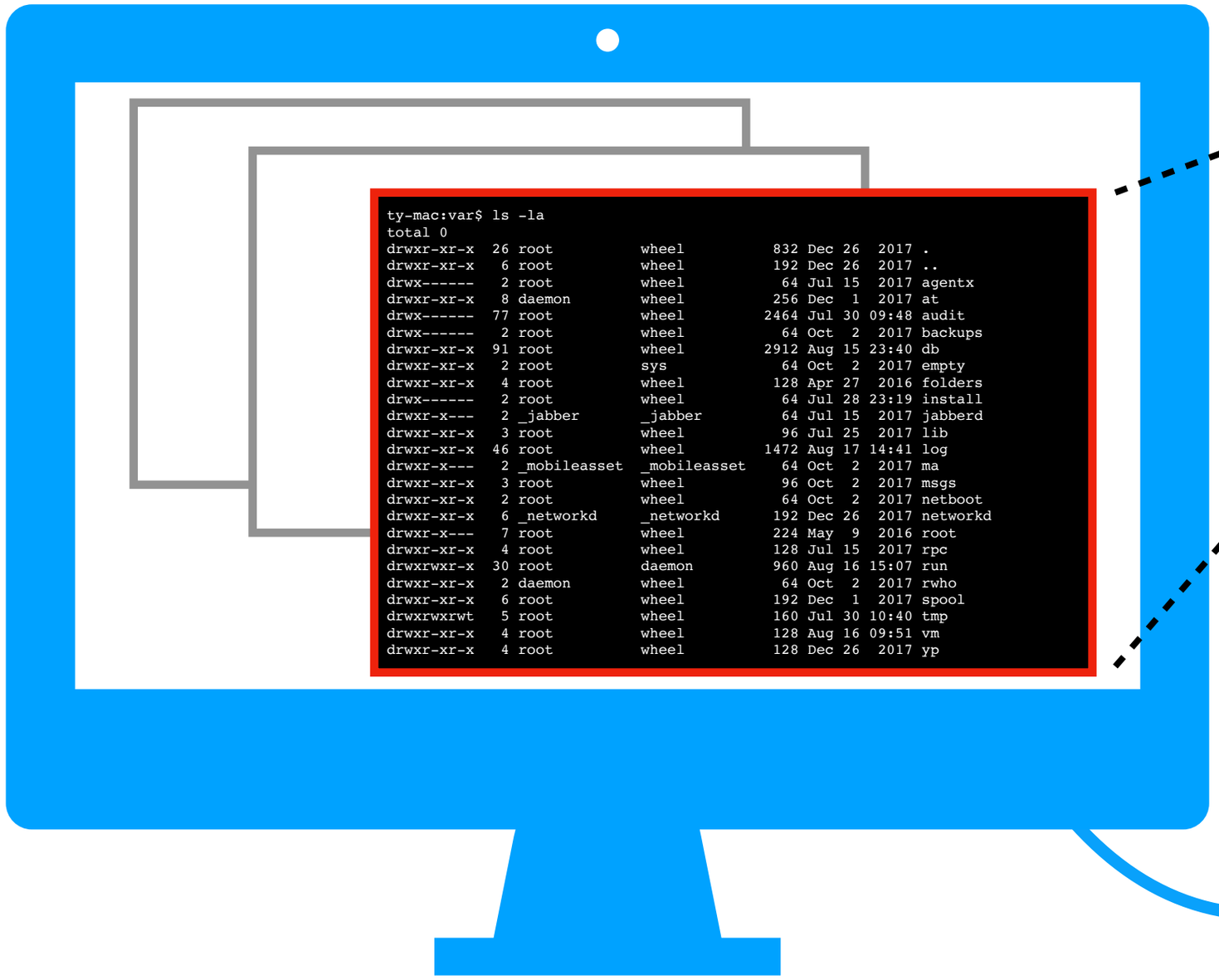
Terminal Emulators



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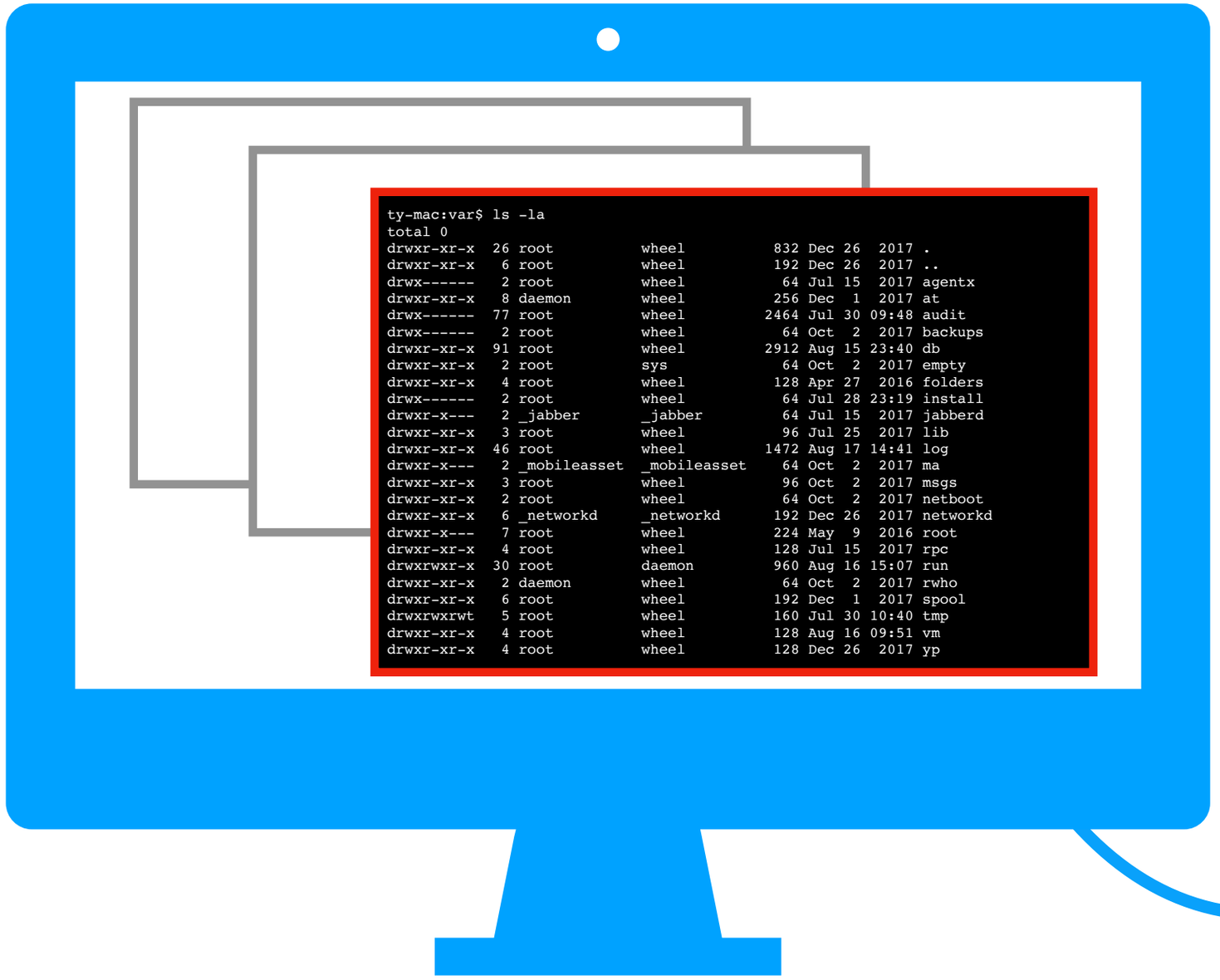
Terminal Emulators



local computer
(e.g., personal)

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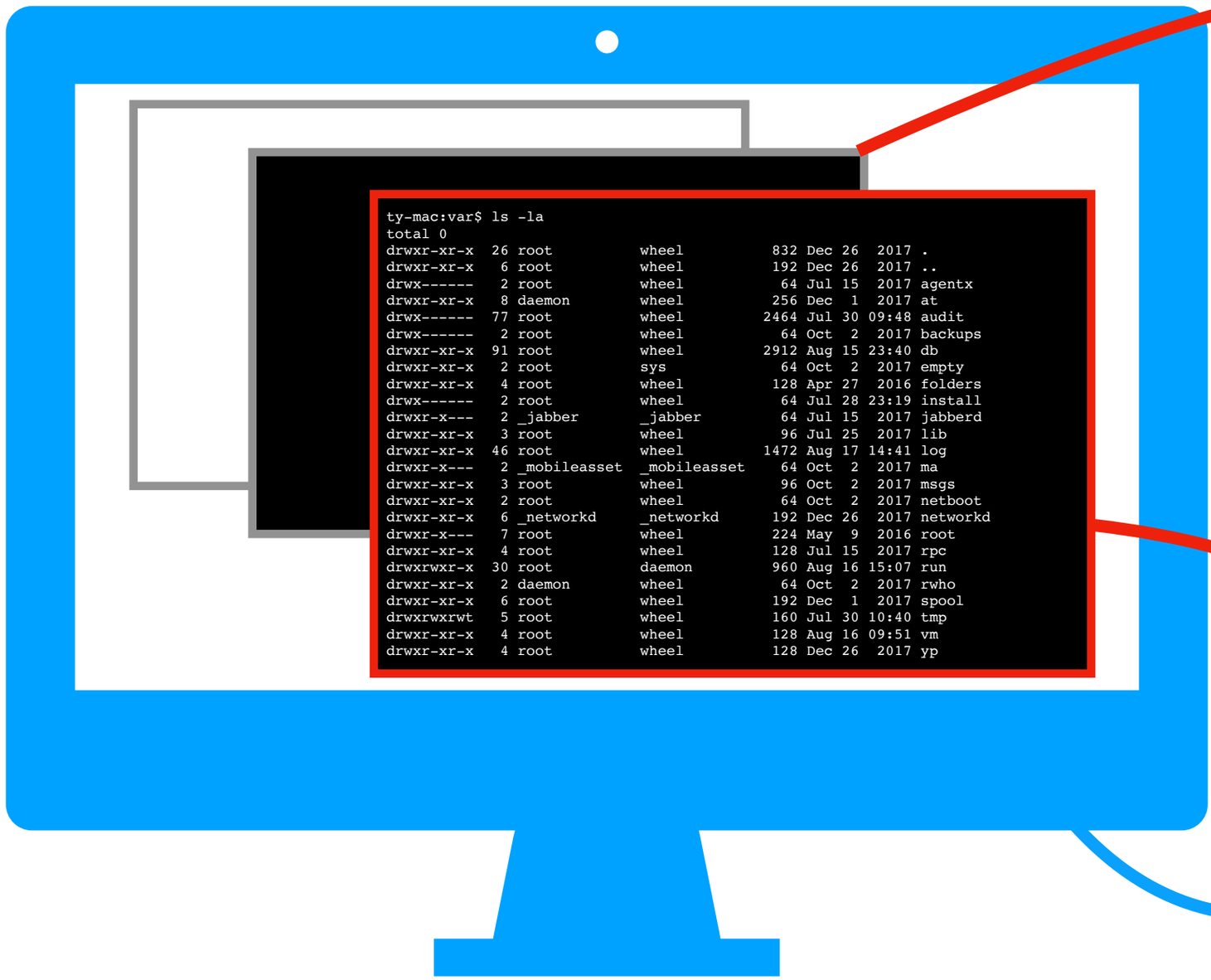
Terminal Emulators



remote computer
(e.g., CS lab)

OR

local computer
(e.g., personal)

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Shells

Inside a terminal, a program called a “shell” runs

- The shell lets users type commands, then carries out the appropriate actions
- Exploring files and running programs are common activities
- You will be running Python programs from a shell in a terminal!

```
Terminal Emulator
what should I do?  COMMAND
... computer does it ...
what should I do?  COMMAND
... computer does it ...
what should I do?
```

the shell is the program running inside the terminal emulator

Shells

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- Different shells have minor (or major) variations

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Windows Shells

- cmd
- PowerShell

type “dir” to view files

type “ls” (for list) to view files

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Windows Shells

- cmd
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UNIX Shells (Mac and Linux)

- bash
- csh
- zsh
- many more

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Running Programs

Running programs is easy, just type name of the program and hit enter:

```
ty-mac:var$
```

Running Programs

Running programs is easy, just type name of the program and hit enter:

```
ty-mac:var$ ls
```

Running Programs

Running programs is easy, just type name of the program and hit enter:

```
ty-mac:var$ ls
agentx     jabberd     root
at         lib         rpc
audit      log         run
backups    ma          rwho

ty-mac:var$
```

Running Programs

Running programs is easy, just type name of the program and hit enter:

program name

prompt

output

prompt

```
ty-mac:var$ ls
agentx      jabberd     root
at          lib         rpc
audit       log         run
backups     ma          rwho

ty-mac:var$
```

a "prompt" is the question, *what should I do?*

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Navigation

- Storage Drives (Windows)
- Files
- Directories (aka Folders)
- Windows vs. Mac

Running Programs and Commands

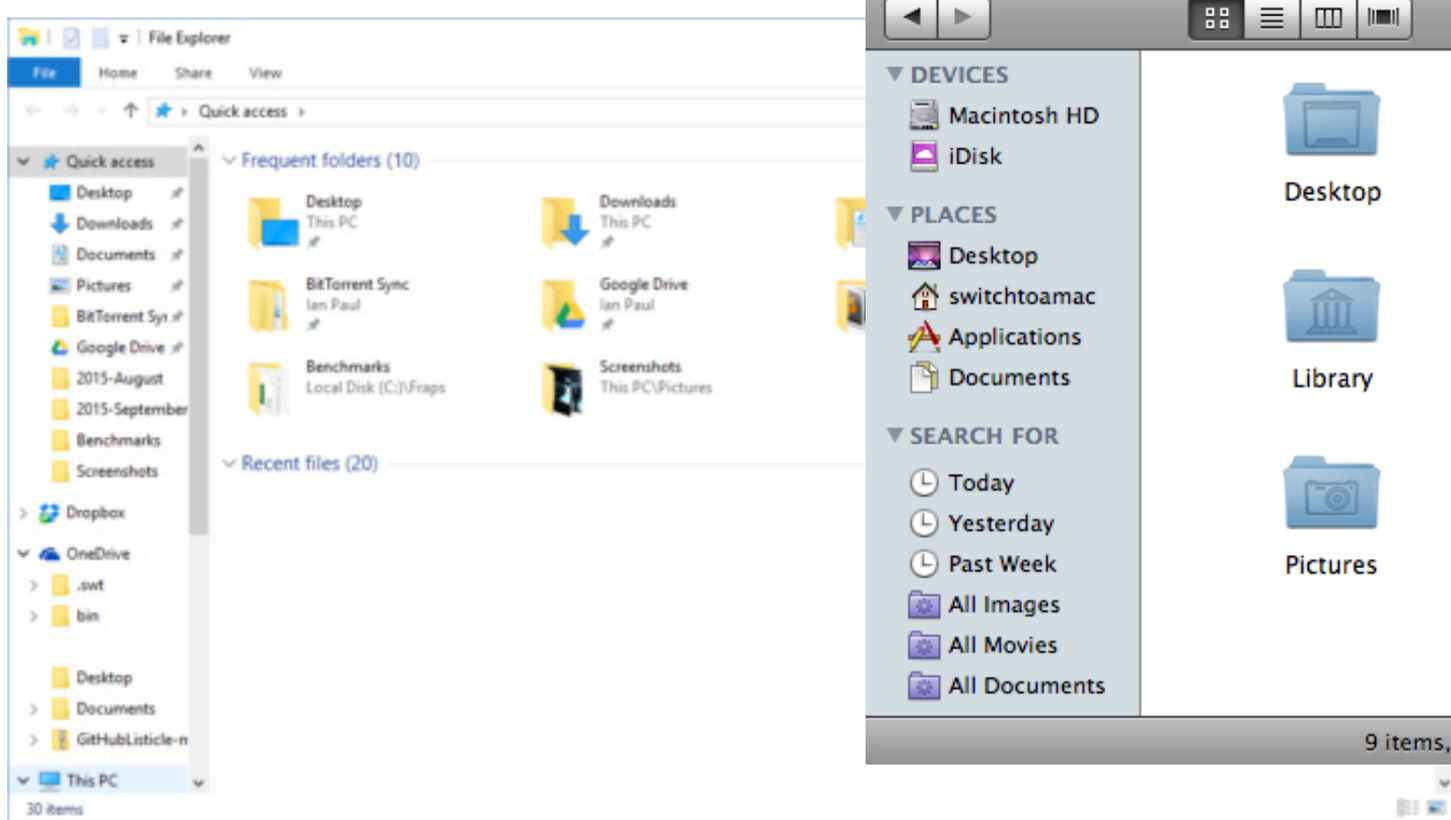
Demos

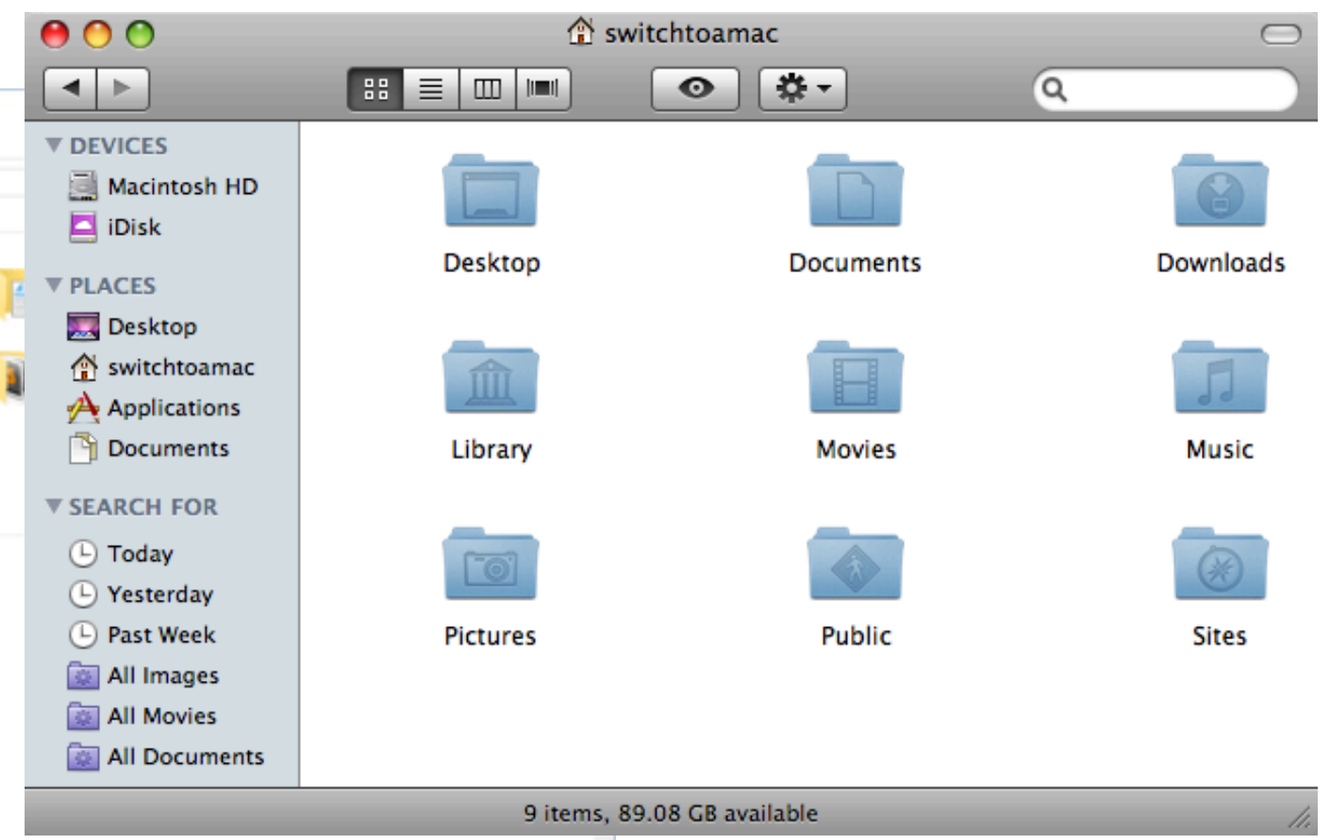
What is navigation?

Navigation is looking around for files/folders you want

Navigation programs

- File Explorer (Windows)
- Finder (Mac)





What is navigation?

Navigation is looking around for files/folders you want

Navigation programs

- File Explorer (Windows)
- Finder (Mac)

With shell, navigate w/ various commands...

`pwd`

`cat`

`...`

`ls`

`cd`

`mkdir`

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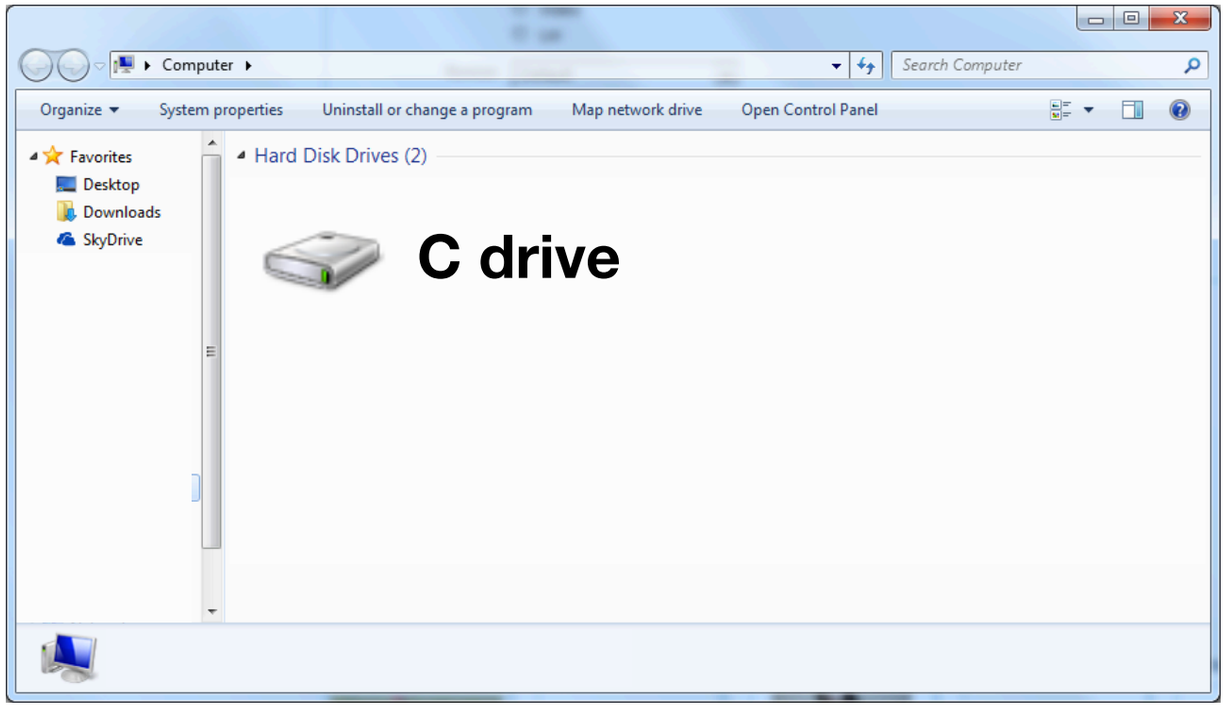
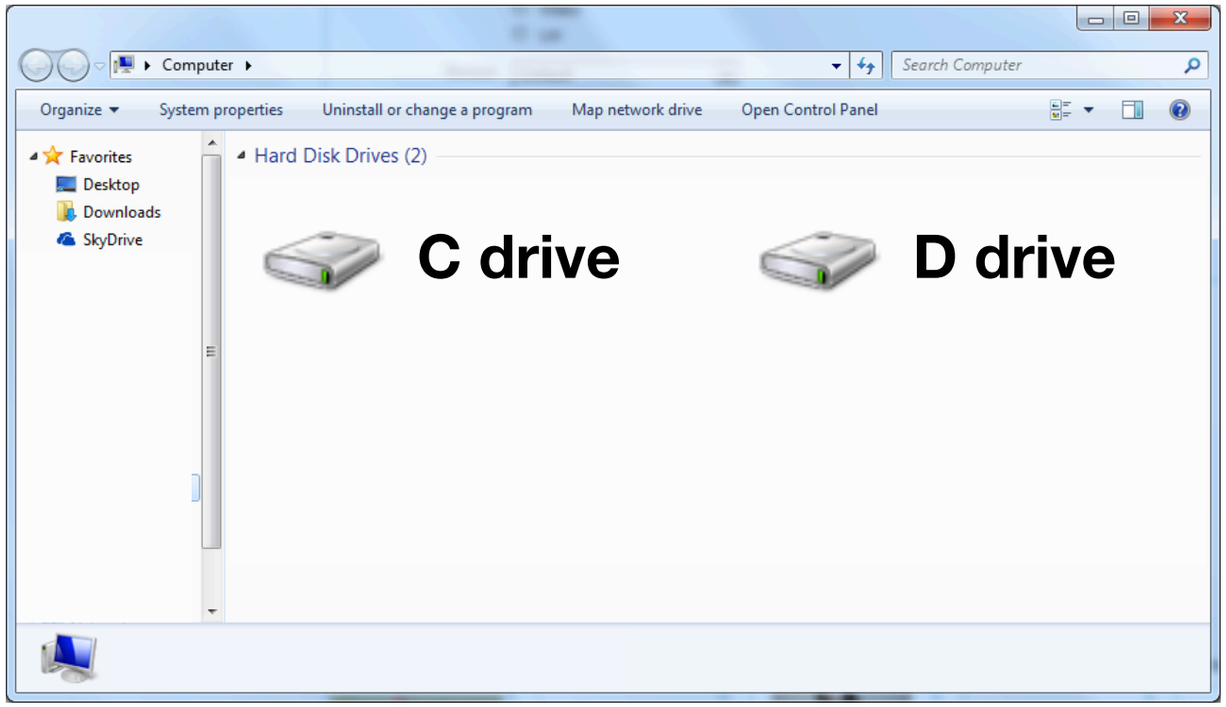
Windows Storage Drives



Each added drive is given its own drive letter

Windows Storage Drives



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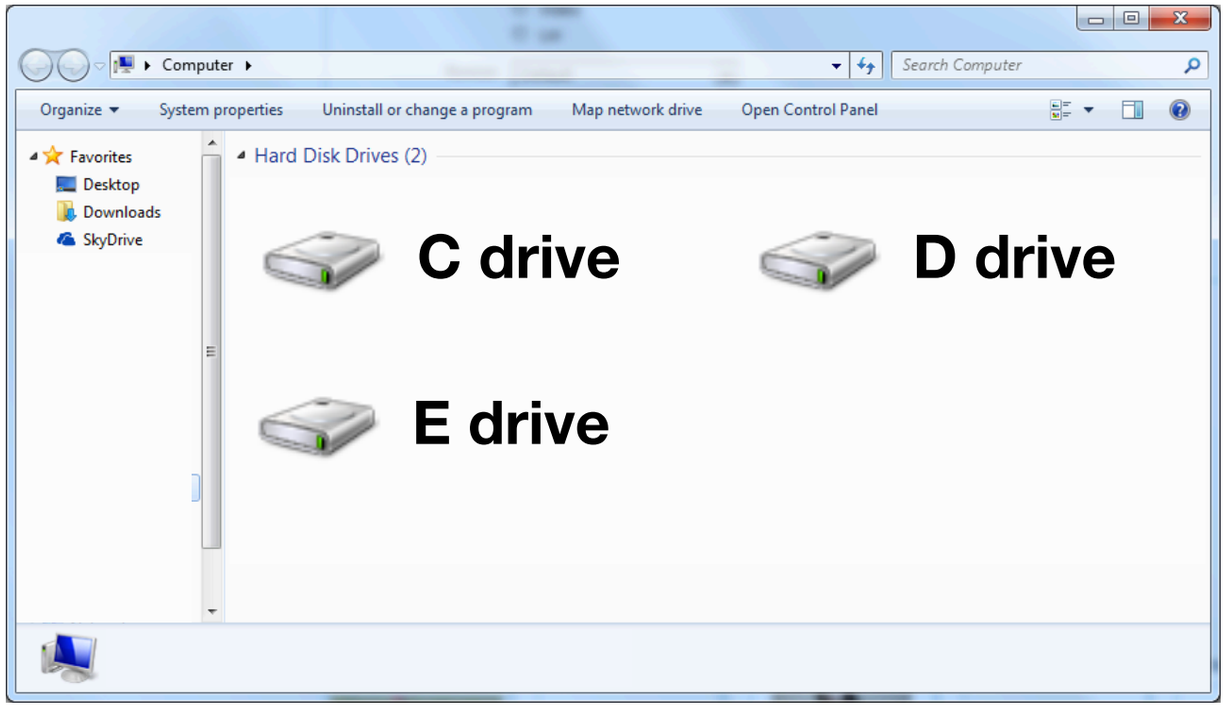

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Files

Each file has a name, called a “path name”

c:\README.txt

c:\hw.docx

d:\page.html

e:\main.py

Files

Each file has a name, called a “path name”

filename

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Each file has a name, called a “path name”

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drive letter **c:\README.txt**

pathname

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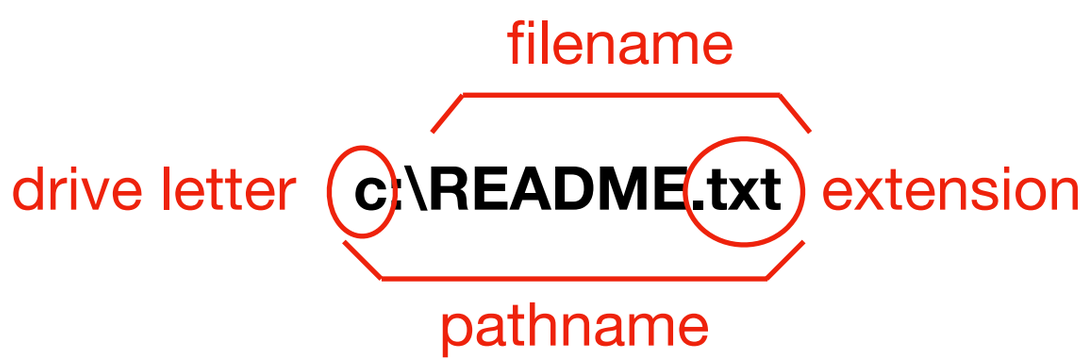

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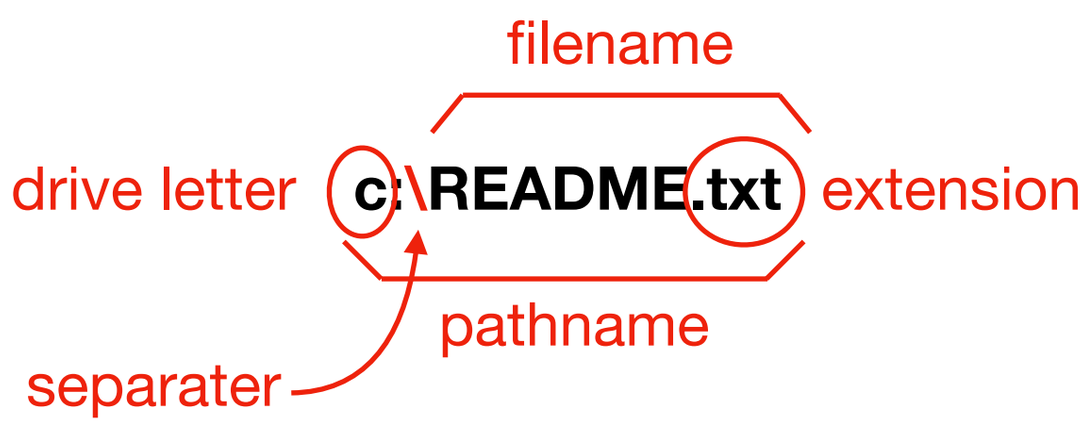


c:\hw.docx

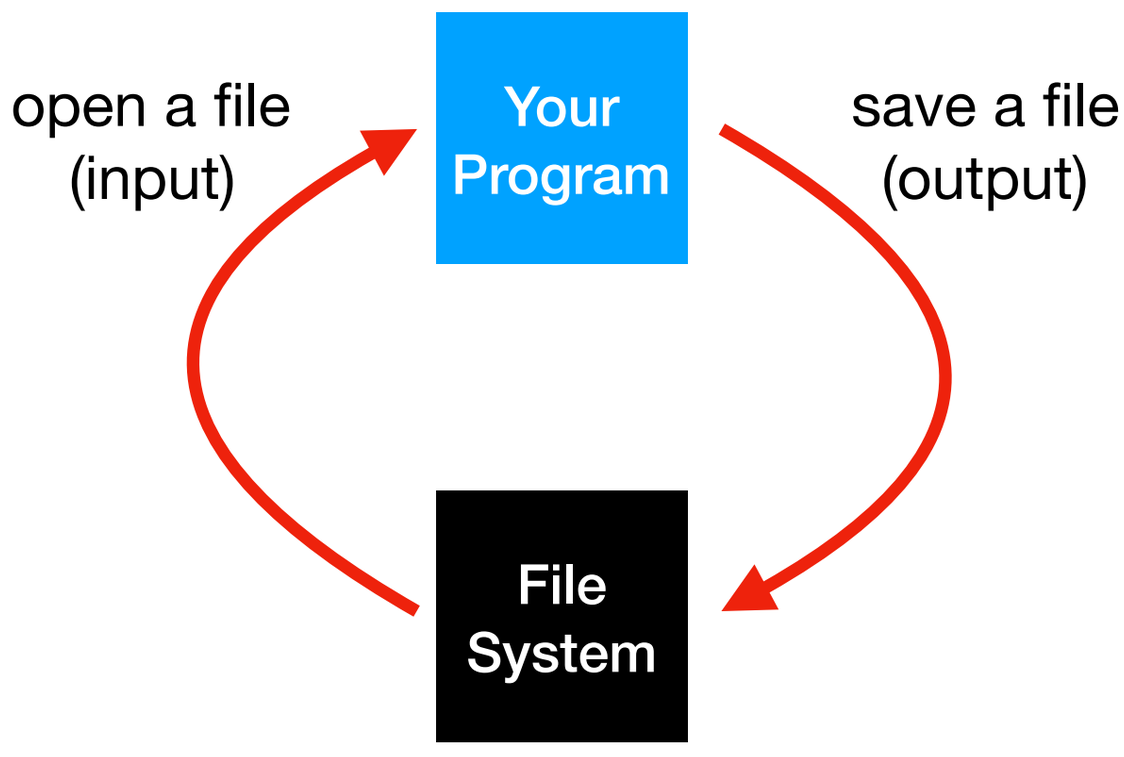
d:\page.html

e:\main.py

Files

Files might be either input or output for your programs

Files are managed by a part of the operating system called the "file system"



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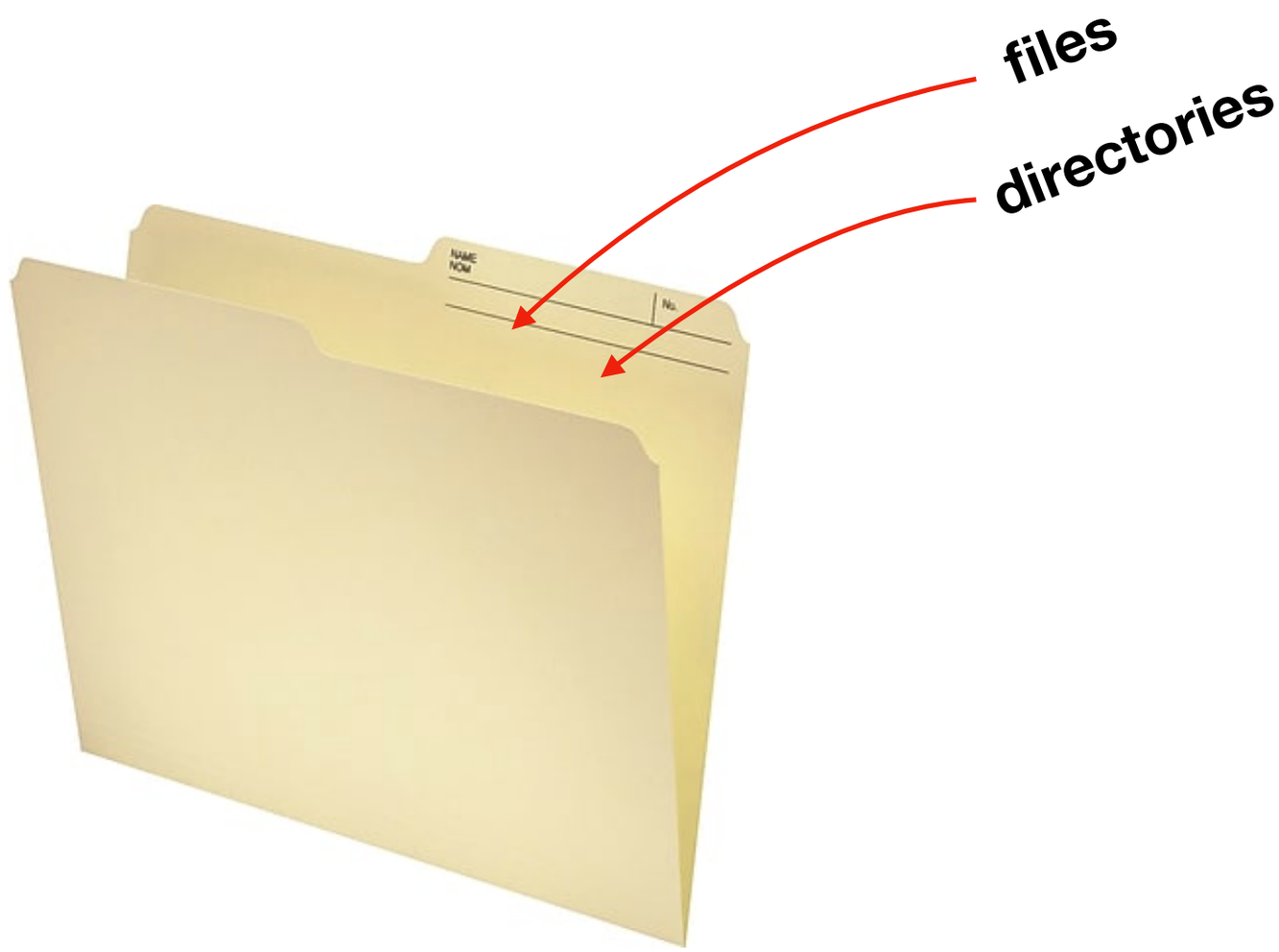
Directories

Directories are used to organize files and sub directories

- Also called “folders”

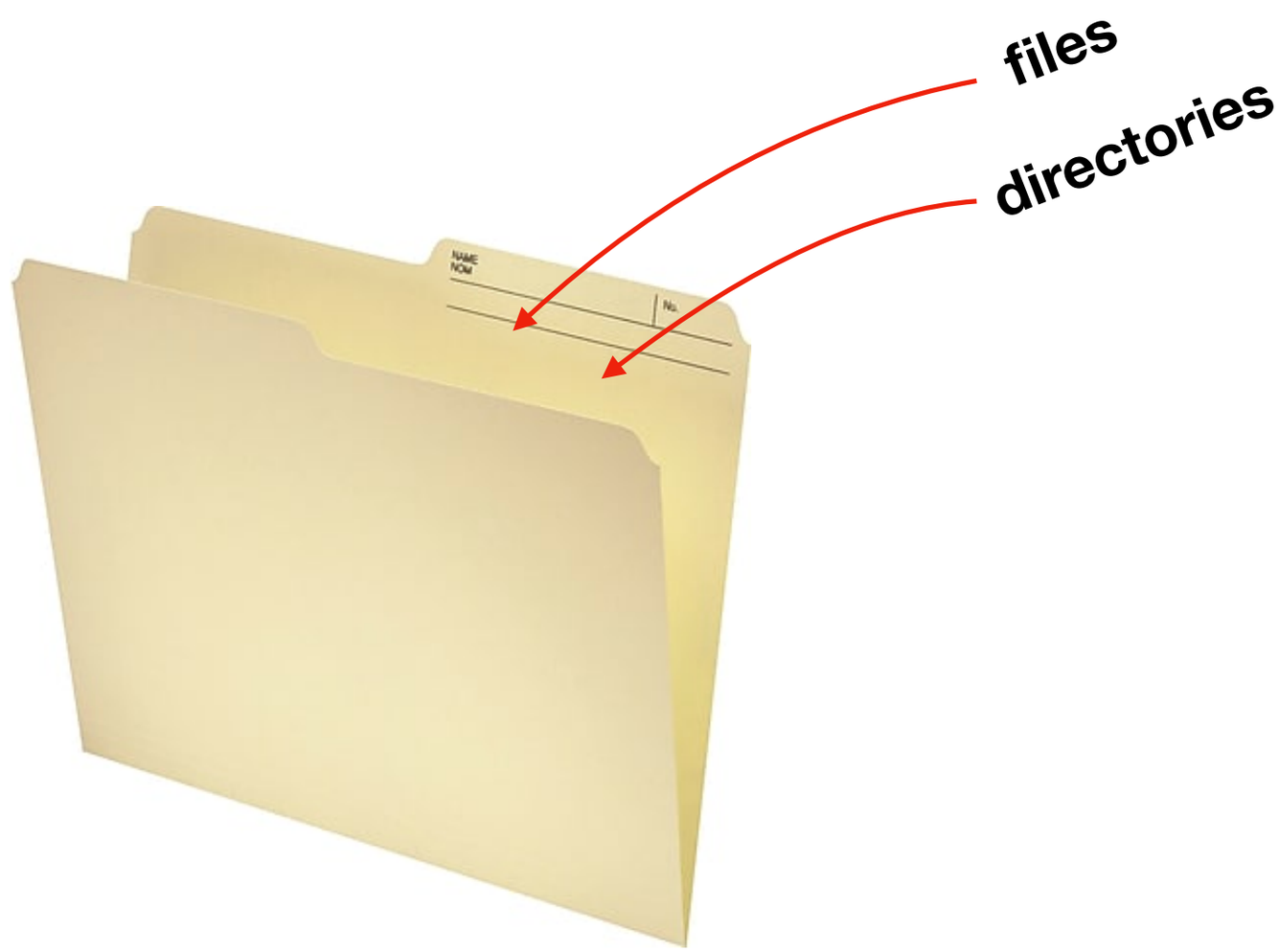


https://www.staples.ca/en/Staples-Recycled-File-Folder-1-2-Cut-Letter-Size-11-pt-Manila-100-Pack/product_13579_1-CA_1_20001

Directories

Directories are used to organize files and sub directories

- Also called “folders”
- A directory also has pathname



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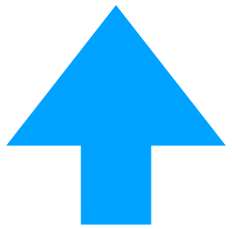
Example paths:

- c:\my-directory\file1.docx
- c:\my-directory\file2.docx
- c:\my-directory\file3.docx



in my-directory

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- c:\my-directory\file1.docx
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- c:\my-directory\file3.docx
- c:\directory1\directory2\file1.docx
- c:\same-dir\same-dir\readme.txt

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- c:\directory1\directory2\file1.docx
- c:\same-dir\same-dir\readme.txt

two types of paths: relative or absolute

Relative Paths

Where is the Computer Science building?

- Answer 1: 1210 W Dayton St, Madison, WI 53706
- Answer 2: on the other side of Johnson street

When is Answer 2 appropriate?

Relative Paths

Where is the Computer Science building?

- Answer 1: 1210 W Dayton St, Madison, WI 53706
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When is Answer 2 appropriate?

- When you're in the psychology building
- It may be more convenient

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Pathnames are absolute (answer 1) or relative (answer 2)

- Absolute paths: always possible
- Relative paths: if current location is known

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Pathnames are absolute (answer 1) or relative (answer 2)

- Absolute paths: always possible
- Relative paths: if current location is known
- **Current Working Directory**

Absolute vs. Relative

Absolute Path	Working Directory	Relative Path
c:\test.txt	c:\	test.txt
c:\x\y\z\my.docx	c:\x\y\z	
c:\x\y\z\my.docx	c:\x\y	
c:\x\y\z	c:\x	

Absolute vs. Relative

Absolute Path	Working Directory	Relative Path
c:\test.txt	c:\	test.txt
c:\x\y\z\my.docx	c:\x\y\z	my.docx
c:\x\y\z\my.docx	c:\x\y	
c:\x\y\z	c:\x	

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c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	

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c:\x\y\z\my.docx	c:\x\y\z	my.docx
c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	y\z

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Absolute Path	Working Directory	Relative Path
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c:\x\y\z\my.docx	c:\x\y\z	my.docx
c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	y\z

Two special directory names

- “..” means up a directory
- “.” means current directory

Absolute vs. Relative

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c:\x\y\z\my.docx	c:\x\y\z	my.docx
c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\x\y\z	c:\x	
c:\x	c:\x\y\z	

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	
c:\x	c:\x\y\z	

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
c:\B\file.txt	c:\A	

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Absolute vs. Relative

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c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
c:\B\file.txt	c:\A	..\B\file.txt

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c:\test.txt	c:\	.\.\test.txt
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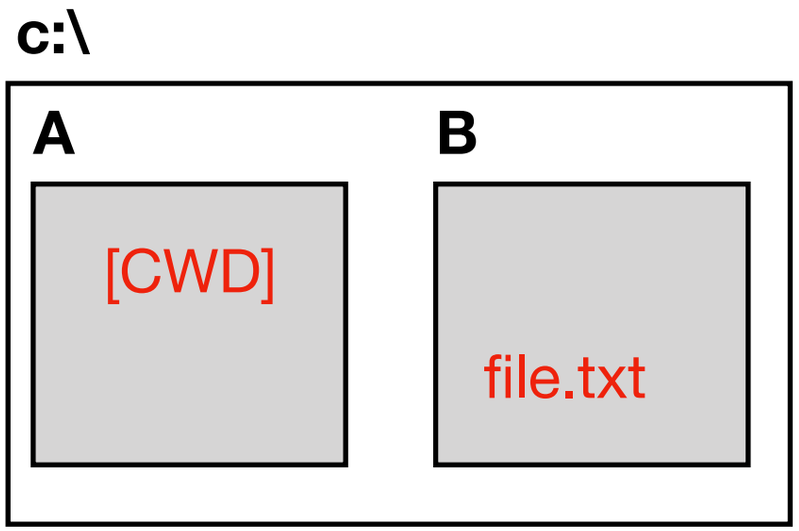

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
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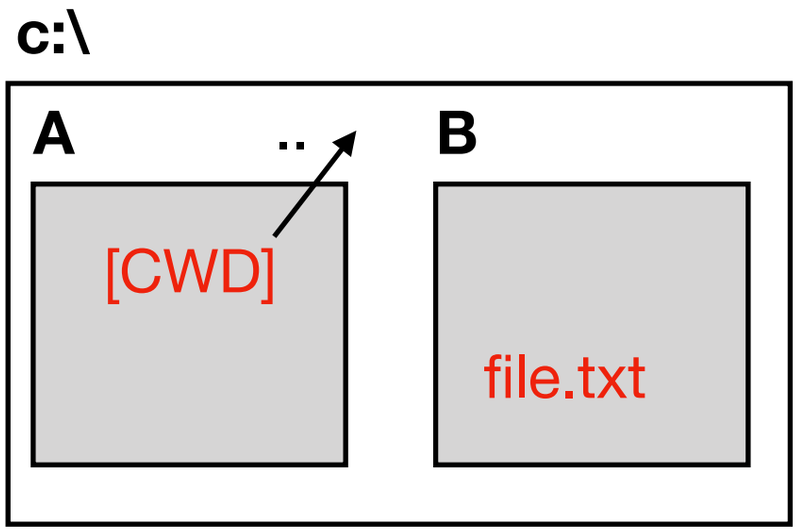

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
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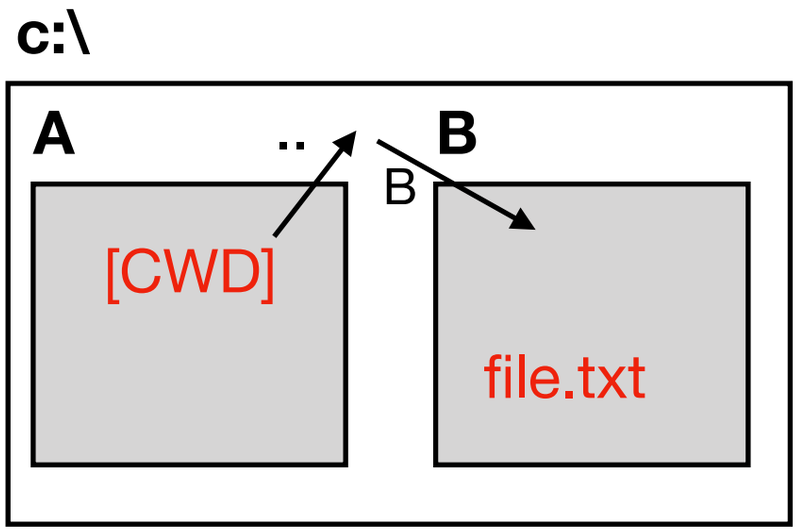

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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
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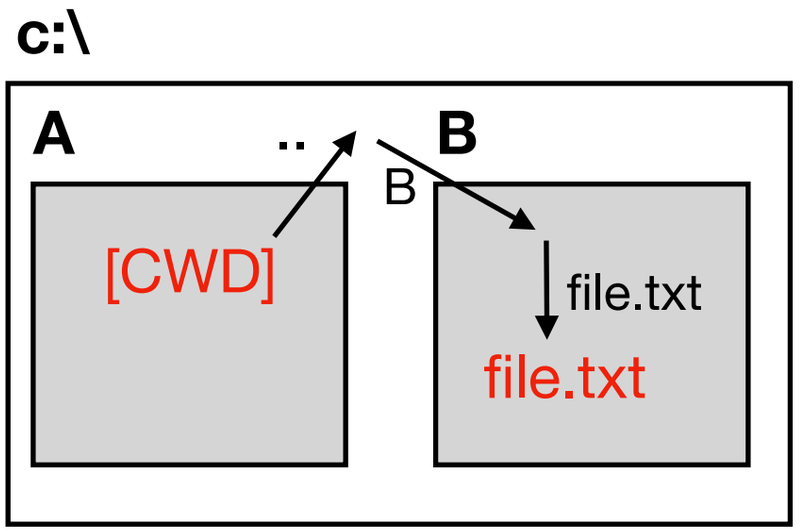

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c:\x\y\z\my.docx	c:\x\y\z	my.docx
c:\x\y\z\my.docx	c:\x\y	z\my.docx
c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	.\.\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
c:\B\file.txt	c:\A	..\B\file.txt

Two special directory names

- “..” means up a directory
- “.” means current directory

more examples in demo later…

Today's Topics

Terminal Emulators and Shells

Navigation

- Storage Drives (Windows)
- Files
- Directories (aka Folders)
- Windows vs. Mac

Running Programs and Commands

Demos

Multiple Drives in Mac

Windows

- Absolute paths start with c:\ or d:\
- Indicates which drive

Mac

- Absolute paths start with /
- Example: /Users/tyler/my-file.docx
- Don't know which drive

How can we use multiple drives if every file paths starts the same???
/.....

Multiple Drives in Mac

Windows

- Absolute paths start with c:\ or d:\
- Indicates which drive

Mac

- Absolute paths start with /
- Example: /Users/tyler/my-file.docx
- Don't know which drive

How can we use multiple drives if every file paths starts the same???
/.....

Answer: different drives feel like different directories

Comparison

Windows	Mac	Drives
c:\Users\tyler\file.txt	/Users/tyler	
c:\Program Files	/usr/local/bin	
c:\Windows\…\Logs	/var/log	
d:\	/Volumes/backup	
d:\A	/Volumes/backup/A	
e:\movies	/Volumes/movies	
e:\movies\demo1.mov	/Volumes/movies/demo1.mov	

Comparison

on a Mac, a path doesn't tell you what drive you're on

Windows	Mac	Drives
c:\Users\tyler\file.txt c:\Program Files c:\Windows\…\Logs	/Users/tyler /usr/local/bin /var/log	
d:\ d:\A	/Volumes/backup /Volumes/backup/A	
e:\movies e:\movies\demo1.mov	/Volumes/movies /Volumes/movies/demo1.mov	

Today's Topics

Terminal Emulators and Shells

Navigation

Running Programs and Commands

- Navigational commands
- Arguments
- Saving output

Demos

We’ll cover a few simple examples for reference in the slides, then go into more detail in the demo…

Most of these examples work in both PowerShell (Windows) and bash (Mac)

Today's Topics

Terminal Emulators and Shells

Navigation

Running Programs and Commands

- Navigational commands
- Arguments
- Saving output

Demos

Where am I? (What directory am I in?)

Command: **`pwd`**

```
PS /Users/trh/scratch>
```

Where am I? (What directory am I in?)

Command: **`pwd`**

"print working directory"

```
PS /Users/trh/scratch> pwd
```

Where am I? (What directory am I in?)

Command: **`pwd`**

```
PS /Users/trh/scratch> pwd

Path
----
/Users/trh/scratch


PS /Users/trh/scratch>
```

this is the current directory

Go up a directory

Command: **`cd ..`**

```
PS /Users/trh/scratch> pwd

Path
----
/Users/trh/scratch


PS /Users/trh/scratch>
```

Go up a directory

Command: **`cd ..`**

```
PS /Users/trh/scratch> pwd

Path
----
/Users/trh/scratch


PS /Users/trh/scratch> cd ..
```

Go up a directory

Command: **`cd ..`**

```
PS /Users/trh/scratch> pwd

Path
----
/Users/trh/scratch


PS /Users/trh/scratch> cd ..
PS /Users/trh>
```

Clear the screen

Command: **`clear`**

```
PS /Users/trh/scratch> pwd

Path
----
/Users/trh/scratch


PS /Users/trh/scratch> cd ..
PS /Users/trh> clear
```

Clear the screen

Command: **`clear`**

```
PS /Users/trh>
```

Go inside a directory

Command: **`cd directory-name`**

```
PS /Users/trh>
```

Go inside a directory

Command: **`cd directory-name`**

name of directory we started in

```
PS /Users/trh> cd scratch
```

Go inside a directory

Command: **`cd directory-name`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch>
```

Go to top directory

is this Windows or Mac?

Command: **`cd /`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
```

Go to top directory

Command: **`cd /`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS />
```

View contents of current directory

Command: **`ls`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS />
```

View contents of current directory

Command: **`ls`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
```

View contents of current directory

Command: **`ls`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS />
```

View contents of a file

Command: **`cat file-name`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS />
```

View contents of a file

Command: **`cat file-name`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS /> cat README.txt
```

View contents of a file

Command: **`cat file-name`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS /> cat README.txt
The file says Hello!

PS />
```

View contents of a file

Command: **`cat file-name`**

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS /> cat README.txt
The file says Hello!

PS />
```

data saved in README.txt

Today's Topics

Terminal Emulators and Shells

Navigation

Running Programs and Commands

- Navigational commands
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Demos

Arguments (program input)

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
Network             installer.failurerequests
System              net
Users               README.txt
PS /> cat README.txt
The file says Hello!

PS />
```

Arguments (program input)

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
                    erequests
Users               README.txt
PS /> cat README.txt
The file says Hello!

PS />
```

program name (cat)

an argument (README.txt)

echo Example

```
PS /Users/trh>
```

echo Example

```
PS /Users/trh> echo hello
```

echo Example

program is “echo”

argument is “hello”

```
PS /Users/trh> echo hello
```

echo Example

```
PS /Users/trh> echo hello
hello
PS /Users/trh>
```

echo Example

```
PS /Users/trh> echo hello
hello
PS /User
```

the echo program prints whatever it's argument is

Today's Topics

Terminal Emulators and Shells

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Running Programs and Commands

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Demos

Saving output

Format: **`program > file-name`**

```
PS /Users/trh>
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh>
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
```

"redirect" operator, sends output to a file

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
PS /Users/trh>
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
PS /Users/trh>
```

without redirect, output was printed to the screen

with redirect, output was saved in the output.txt file

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
PS /Users/trh>
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
PS /Users/trh> cat output.txt
```

Saving output

Format: **`program > file-name`**

```
PS /Users/trh> echo hello
hello
PS /Users/trh> echo hello > output.txt
PS /Users/trh> cat output.txt
hello
PS /Users/trh>
```

Today's Topics

Terminal Emulators and Shells

Navigation

Running Programs and Commands

Demos

Conclusion

Today we covered

- What a terminal and shell is
- What it looks like to have multiple storage drives attached to your computer
- How to navigate between directories/folders
- How to run programs in the terminal