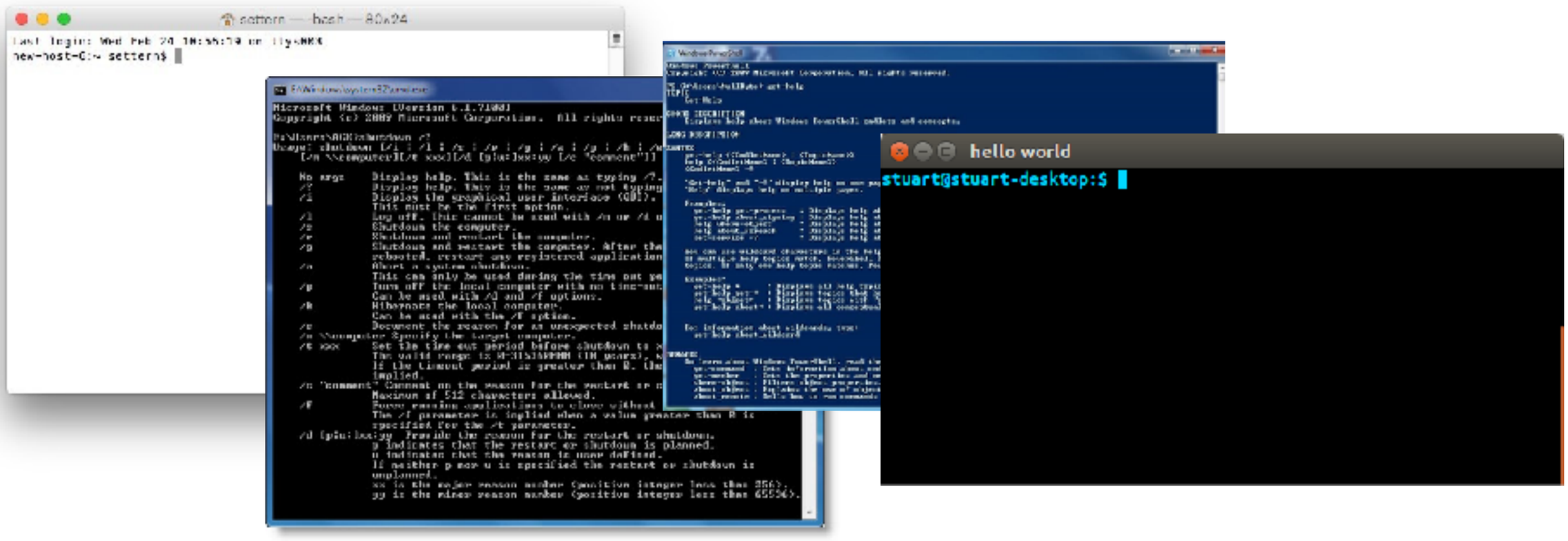
[301] The Terminal

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
(powerful computer)

How to share it?

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History: the Original Terminals

Mainframe
(powerful computer)

dumb terminals
(text based)

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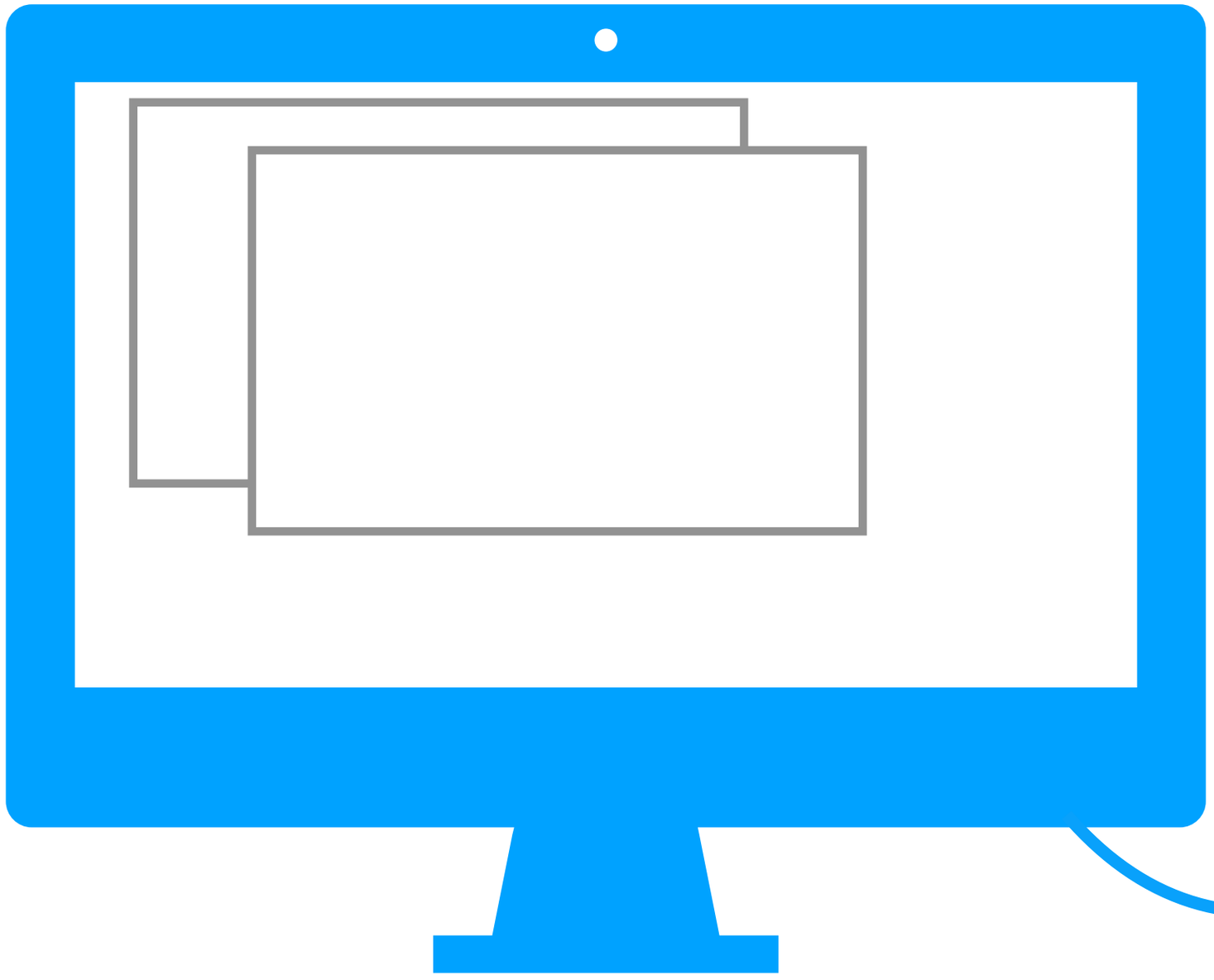
https://en.wikipedia.org/wiki/Computer_terminal#Dumb_terminals

Terminal Emulators



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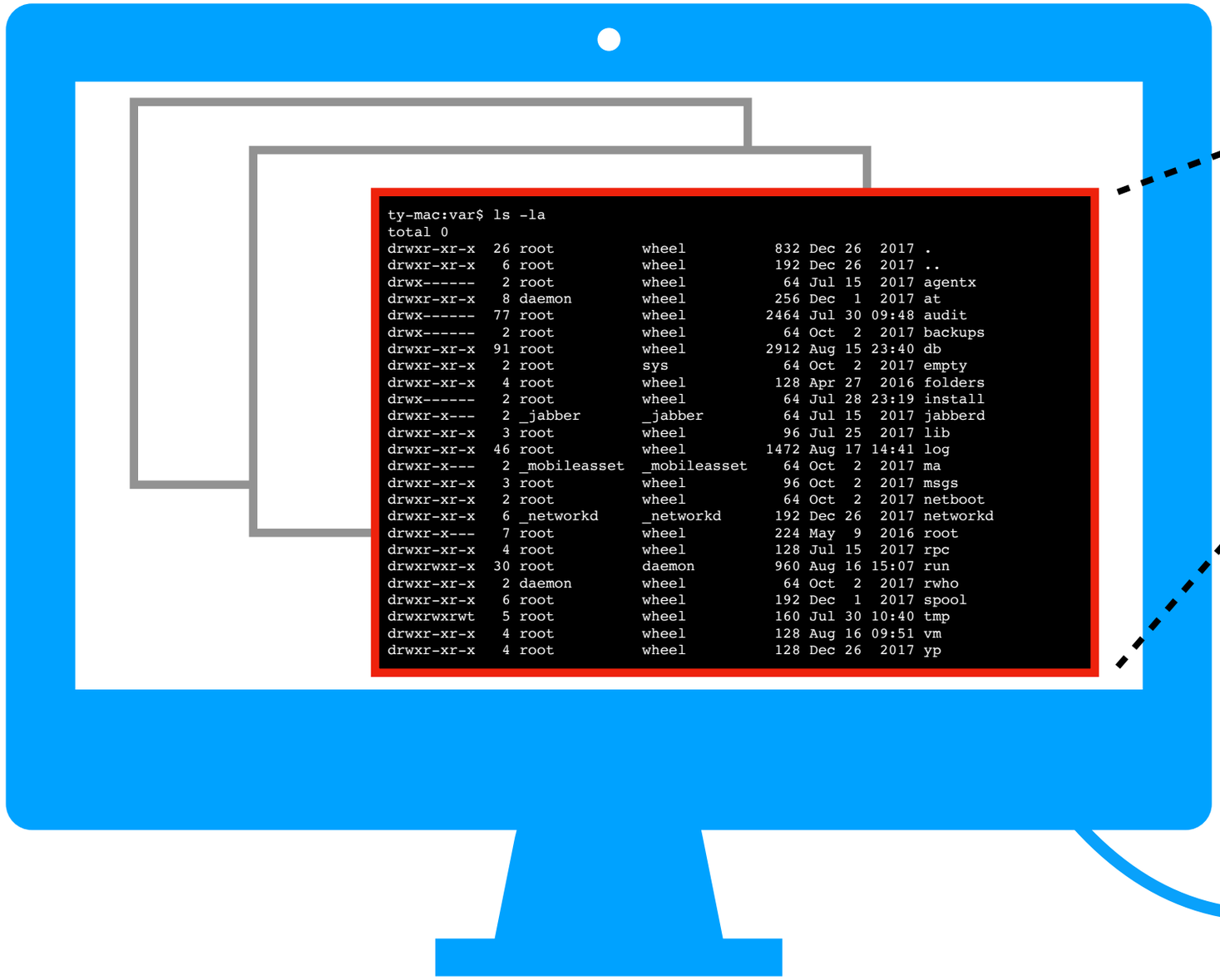
Terminal Emulators



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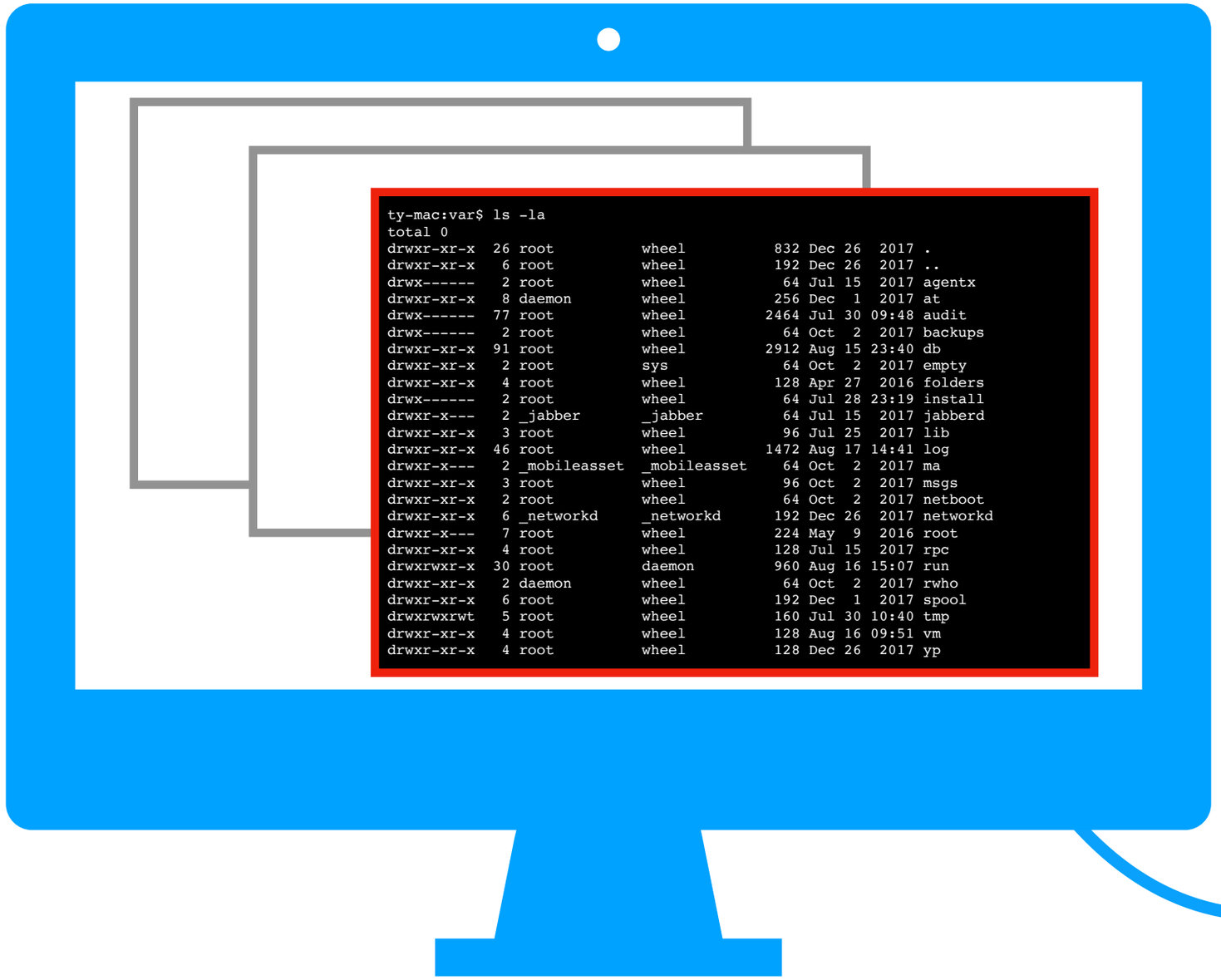
Terminal Emulators



local computer
(e.g., personal)

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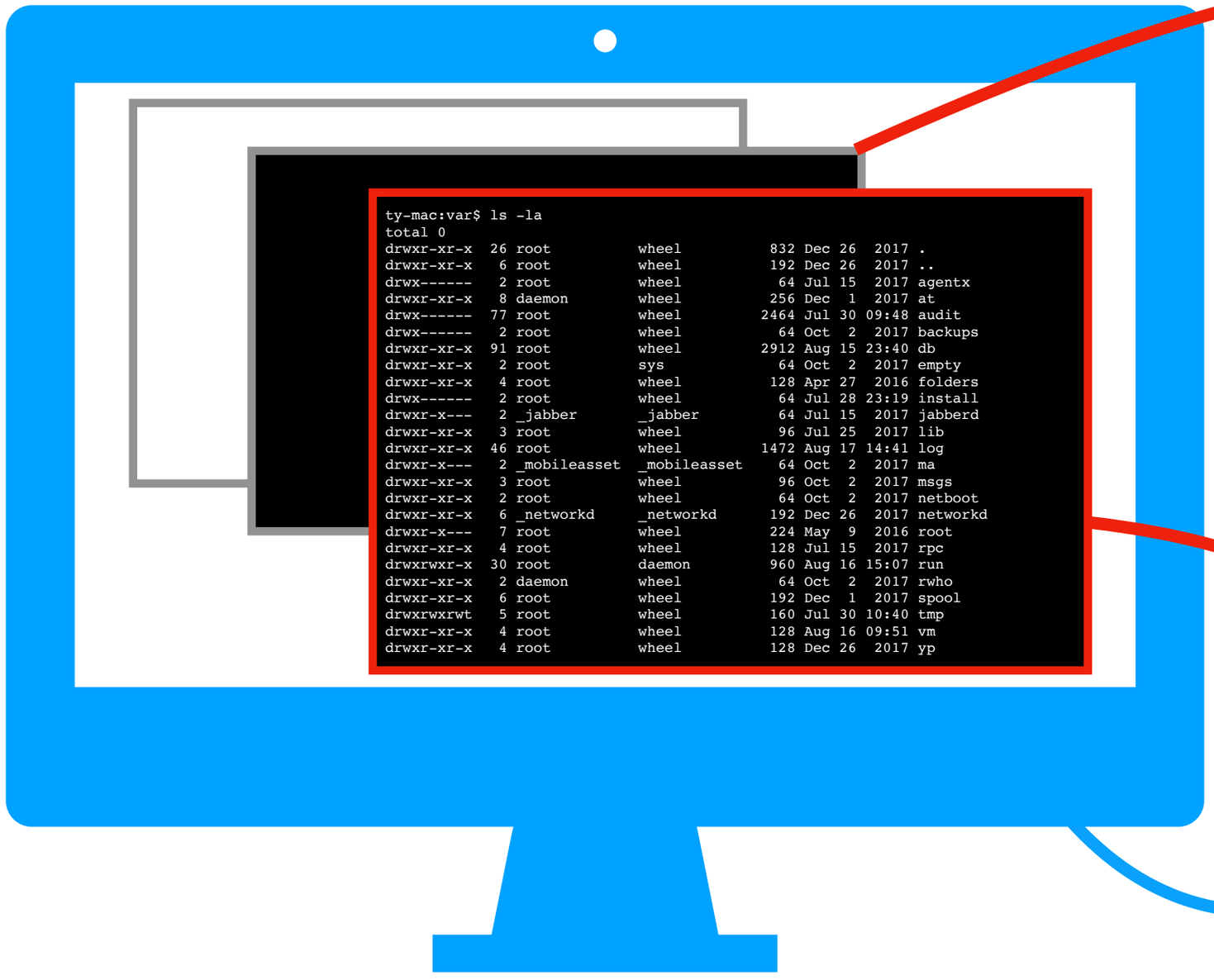
Terminal Emulators



remote computer
(e.g., CS lab)

OR

local computer
(e.g., personal)

https://techcrunch.com/2015/08/16/ibm-teams-with-canonical-on-linux-mainframe/
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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!

Shells

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- Exploring files and running programs are common activities
- You will be running Python programs from a shell in a terminal!
- Different shells have minor (or major) variations

Windows Shells

- cmd
- PowerShell

type “dir” to view files

type “ls” (for list) to view files

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!
- Different shells have minor (or major) variations

Windows Shells

- cmd
- PowerShell

UNIX Shells

- bash
- csh
- zsh
- many more

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Running Programs and Commands

Demos

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

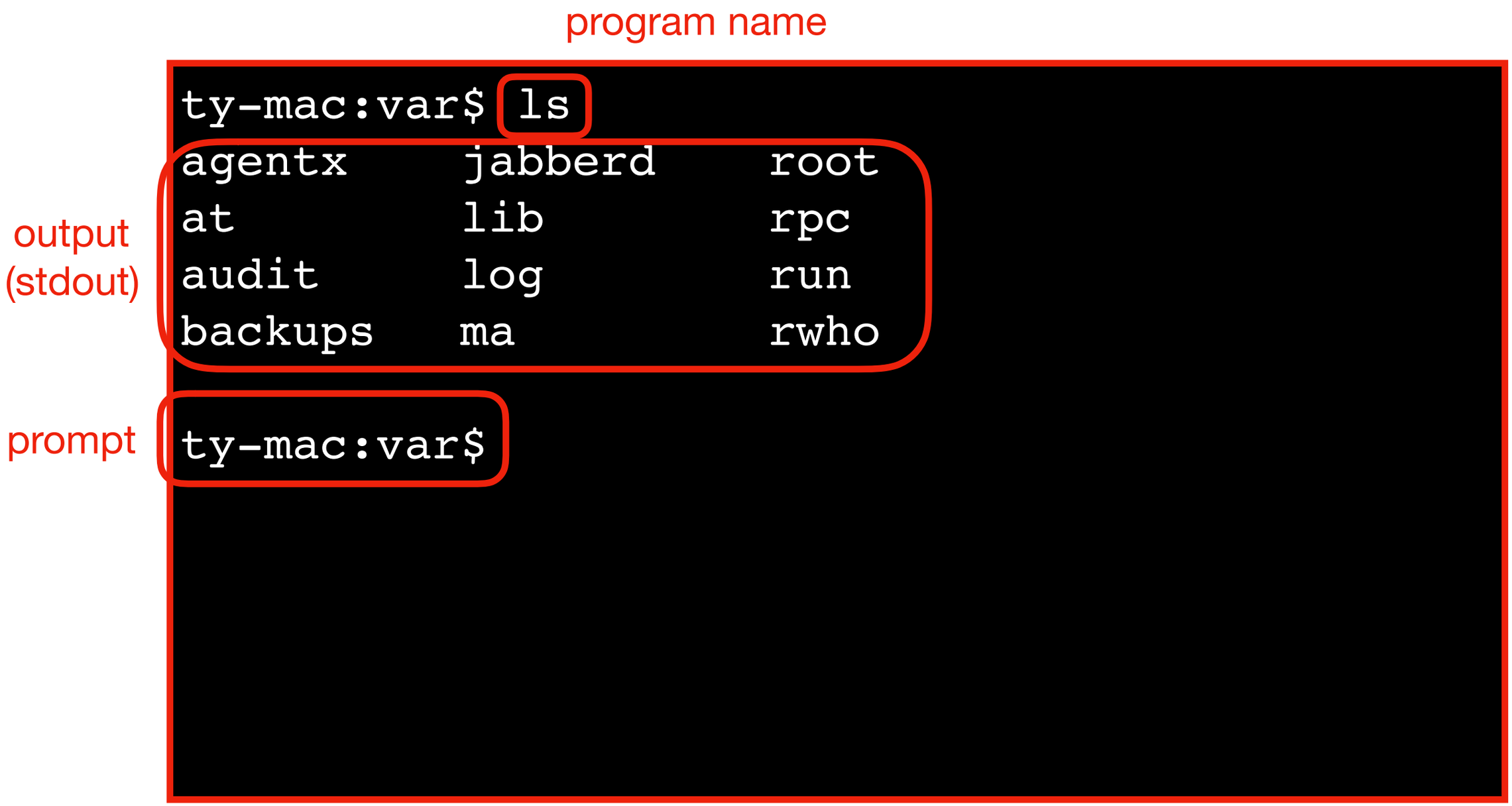
Running programs is easy, just type name of the program and hit enter:

```
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:



Today's Topics

Terminal Emulators and Shells

Navigation

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

Running Programs and Commands

Demos

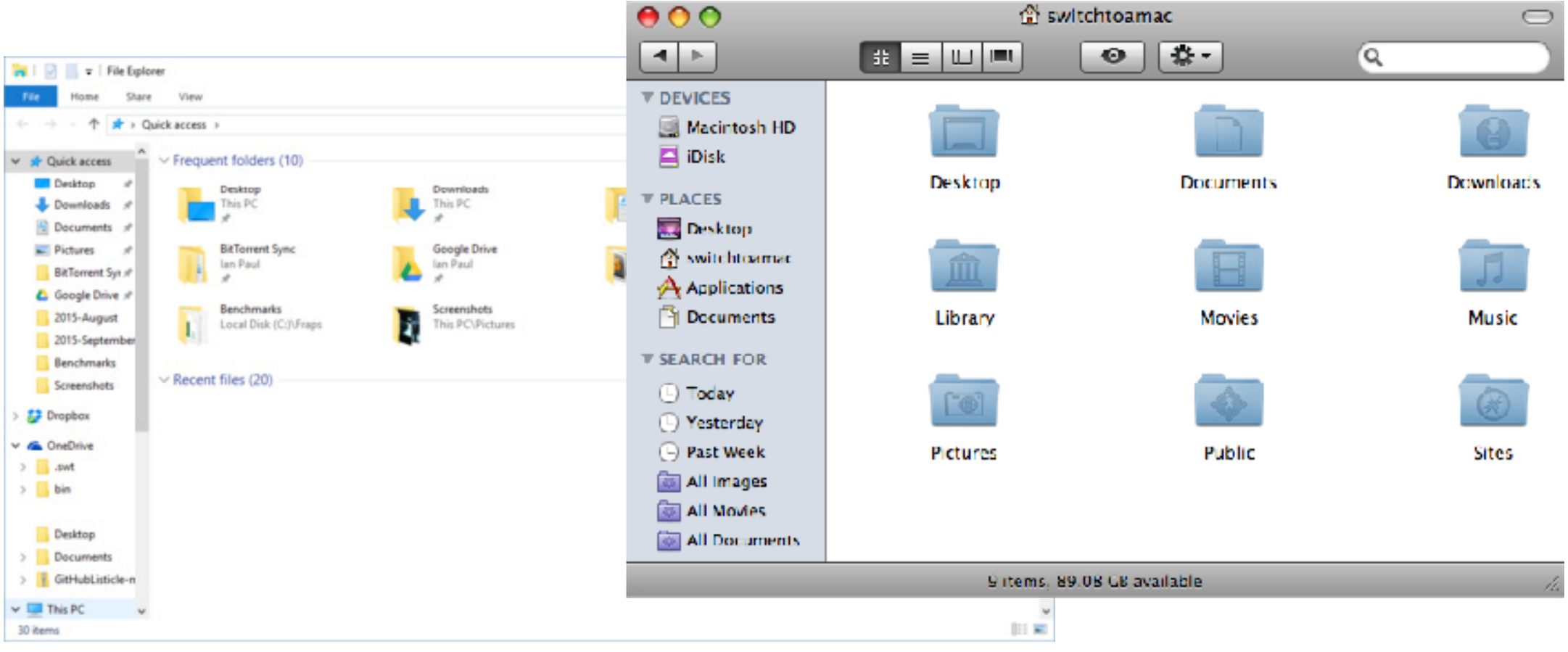
What is navigation?

Navigation is looking around for files/folders you want

- Enter a folder, go up, search, etc

Common navigation programs

- File Explorer (Windows)
- Finder (Mac)



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Navigation is looking around for files/folders you want

- Enter a folder, go up, search, etc

Common navigation programs

- File Explorer (Windows)
- Finder (Mac)

In the shell, you navigate by typing various commands

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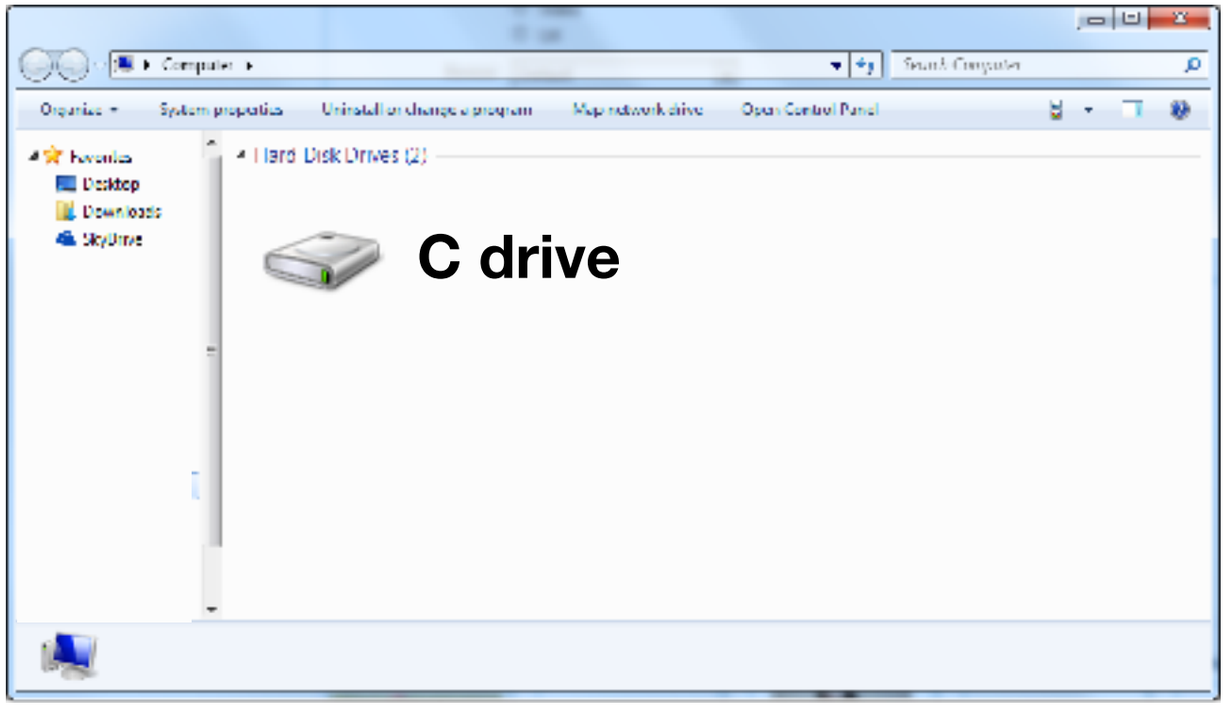
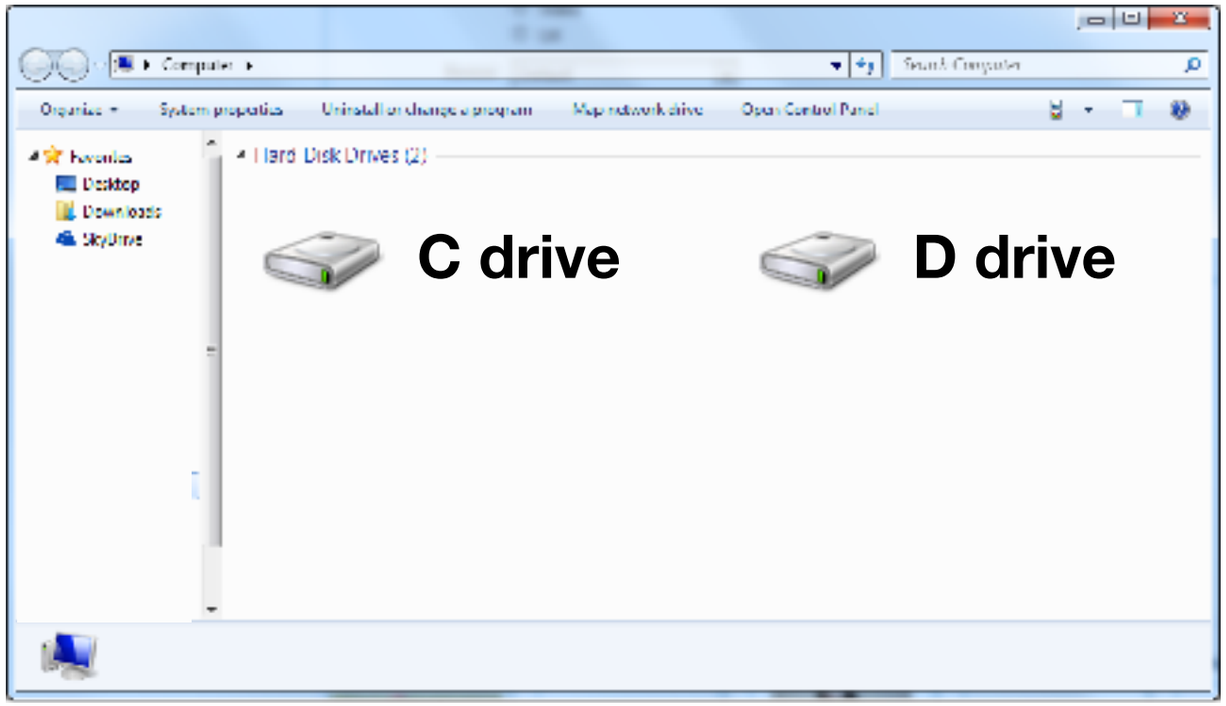
Windows Storage Drives



Each added drive is given its own drive letter

Windows Storage Drives



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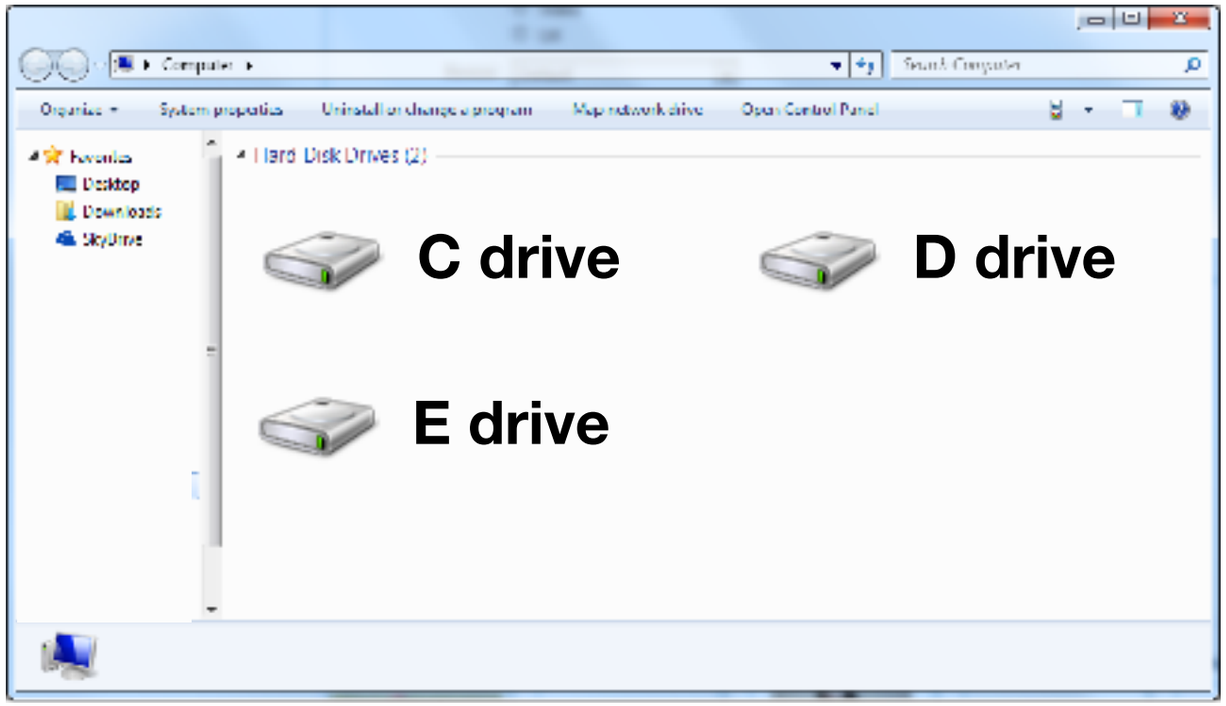

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Files

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

c:\README.txt

c:\hw.docx

d:\page.html

e:\main.py

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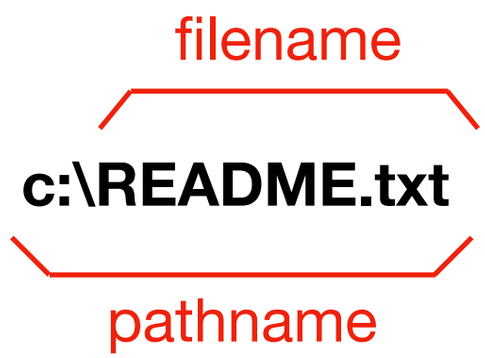

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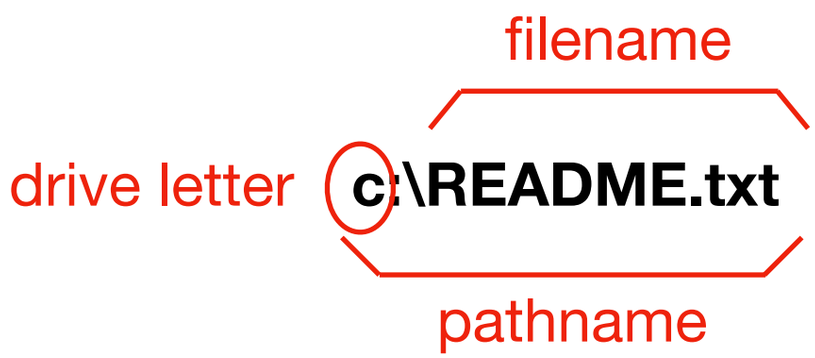

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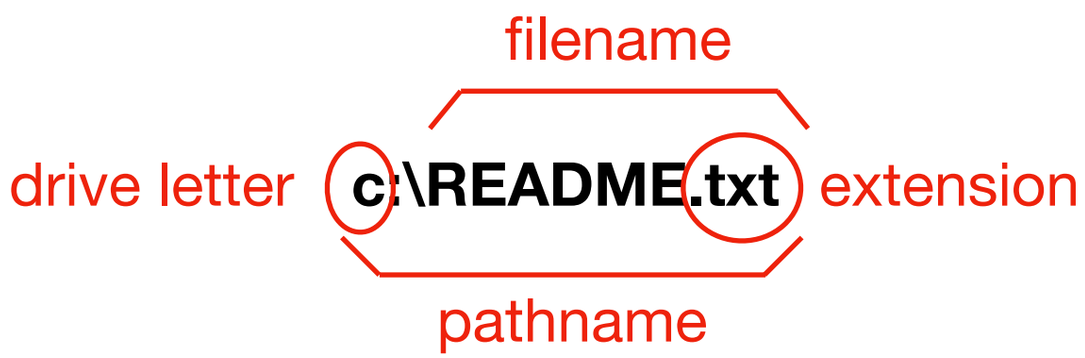

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Files

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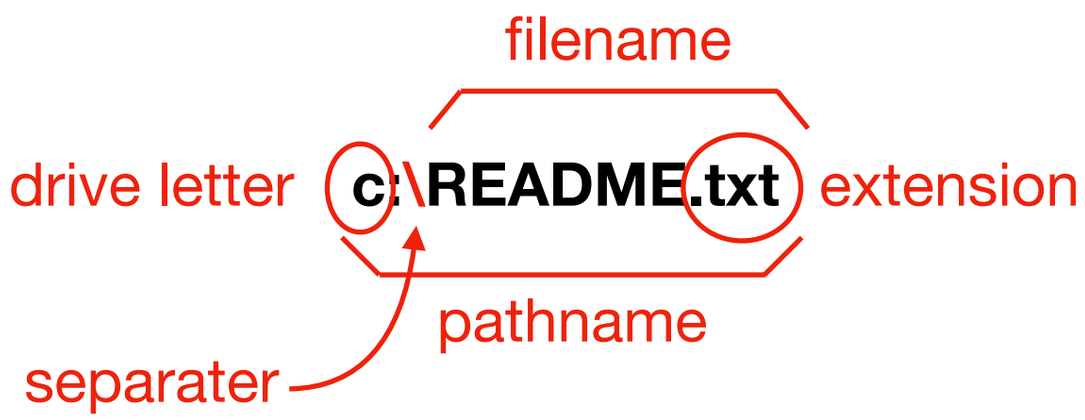

c:\hw.docx

d:\page.html

e:\main.py

Files

Files are sources of input and destinations for output for processes.

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

- Also called “folders”
- A directory also has pathname
- Each directory may contain other directories and files

Example paths:

- c:\my-directory\file1.docx
- c:\my-directory\file2.docx
- c:\my-directory\file3.docx
- c:\directory1\directory2\file1.docx
- c:\same-dir\same-dir\readme.txt

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

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Relative Paths

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When is Answer 2 appropriate?

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

Relative Paths

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- Answer 1: 1210 W Dayton St, Madison, WI 53706
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Pathnames are absolute (answer 1) or relative (answer 2)

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

Relative Paths

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- Answer 1: 1210 W Dayton St, Madison, WI 53706
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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 location/directory is called "working directory" or "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	

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

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	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

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

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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:\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	..\..

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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	

Two special directory names

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

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more examples in tutorial later…

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Demos

Multiple Drives in Linux

Windows

- Generally, every absolute pathname starts with “c:\” or “d:\” or similar
- Name indicates which drive stores the file

Multiple Drives in Linux

Windows

- Generally, every absolute pathname starts with “c:\” or “d:\” or similar
- Name indicates which drive stores the file

UNIX

- Every absolute pathname starts with “/”
- For example, /home/tyler/my-file.docx (note forward slash)
- Name does not indicate on which drive a file lives

Multiple Drives in Linux

Windows

- Generally, every absolute pathname starts with “c:\” or “d:\” or similar
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UNIX

- Every absolute pathname starts with “/”
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How can we use multiple drives if every file paths starts the same, with “/” ???

Multiple Drives in Linux

Windows

- Generally, every absolute pathname starts with “c:\” or “d:\” or similar
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UNIX

- Every absolute pathname starts with “/”
- For example, /home/tyler/my-file.docx (note forward slash)
- Name does not indicate on which drive a file lives

How can we use multiple drives if every file paths starts the same, with “/” ???

Answer: different drives feel like different directories in UNIX systems

Comparison

Windows	Mac	Linux	Drives
c:\Users\tyler\file.txt	/Users/tyler	/home/tyler	
c:\Program Files	/usr/local/bin	/usr/local/bin	
c:\Windows\…\Logs	/var/log	/var/log	
d:\	/Volumes	/mnt/backup	
d:\aug	/Volumes/backup/aug	/mnt/backup/aug	
e:\movies	/Volumes/movies	/home/tyler/movies	

Comparison

Windows	Mac	Linux	Drives
c:\Users\tyler\file.txt	/Users/tyler	/home/tyler	
c:\Program Files	/usr/local/bin	/usr/local/bin	
c:\Windows\…\Logs	/var/log	/var/log	
d:\	/Volumes	/mnt/backup	
d:\aug	/Volumes/backup/aug	/mnt/backup/aug	
e:\movies	/Volumes/movies	/home/tyler/movies	

On Mac, extra drives often appear under /Volumes.
On Linux, extra drives often appear under /mnt (for mount).

Comparison

Windows	Mac	Linux	Drives
c:\Users\tyler\file.txt	/Users/tyler	/home/tyler	
c:\Program Files	/usr/local/bin	/usr/local/bin	
c:			
d:			
d:\aug	/Volumes/backup/aug	/mnt/backup/aug	
e:\movies	/Volumes/movies	/home/tyler/movies	

Unlike in Windows, on UNIX systems, you can’t tell what drive a file is on, just by looking at the path name

On Mac, extra drives often appear under /Volumes.
On Linux, extra drives often appear under /mnt (for mount).

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…

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- Saving output

Demos

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

Command: **`pwd`**

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

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

Command: **`pwd`**

"print working directory"

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

Where am I? (What folder 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

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
- Arguments
- Saving output

Demos

Arguments

```
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

```
PS /Users/trh> cd scratch
PS /Users/trh/scratch> cd /
PS /> ls
Applications        etc
Library             home
                    rerequests
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

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

Navigation

Running Programs and Commands

- Navigational 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
```

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