

[301] The Terminal

Tyler Caraza-Harter

```
settern — -bash — 80x24  
Last login: Wed Feb 24 10:56:19 on ttys003  
new-host-6:~ settern$
```

```
E:\Windows\system32\cmd.exe  
Microsoft Windows [Version 6.1.7100]  
Copyright (c) 2009 Microsoft Corporation. All rights reserved.  
  
E:\Users\ACK>shutdown /?  
Usage: shutdown /l [/i] [/s] [/r] [/g] [/a] [/p] [/h] [/e]  
[/m \\computername] [/t xxx] [/d [pau:xx:yy] [/c "comment"]]  
  
No args      Display help. This is the same as typing /?.  
/?          Display help. This is the same as not typing  
/i          Display the graphical user interface (GUI).  
            This must be the first option.  
/l          Log off. This cannot be used with /m or /d o  
/s          Shutdown the computer.  
/r          Shutdown and restart the computer.  
/g          Shutdown and restart the computer. After the  
            rebooted, restart any registered application  
/a          Abort a system shutdown.  
            This can only be used during the time-out pe  
/p          Turn off the local computer with no time-out  
            Can be used with /d and /f options.  
/h          Hibernate the local computer.  
            Can be used with the /f option.  
/e          Document the reason for an unexpected shutdo  
/m \\computername Specify the target computer.  
/t xxx      Set the time-out period before shutdown to x  
            The valid range is 0-315360000 (10 years).  
            If the timeout period is greater than 0, the  
            implied.  
/c "comment" Comment on the reason for the restart or s  
            Maximum of 512 characters allowed.  
/f          Force running applications to close without  
            The /f parameter is implied when a value greater than 0 is  
            specified for the /t parameter.  
/d [pau:xx:yy Provide the reason for the restart or shutdown.  
            p indicates that the restart or shutdown is planned.  
            u indicates that the reason is user defined.  
            If neither p nor u is specified the restart or shutdown is  
            unplanned.  
            xx is the major reason number (positive integer less than 256).  
            yy is the minor reason number (positive integer less than 65536).
```

```
Windows PowerShell  
Copyright (c) 2009 Microsoft Corporation. All rights reserved.  
  
PS C:\Users\NullByte> get-help  
Get-Help  
  
TOPIC  
Get-Help  
  
SHORT DESCRIPTION  
Displays help about Windows PowerShell cmdlets and concepts.  
  
LONG DESCRIPTION  
SYNTAX  
get-help <CmdletName> [-<TopicName>]  
help <CmdletName> [-<TopicName>]  
<CmdletName> -?  
  
"Get-help" and "-?" display help on one page.  
"Help" displays help on multiple pages.  
  
Examples:  
get-help get-process : Displays help about the get-process cmdlet.  
get-help about_signing : Displays help about digital signatures.  
help where-object : Displays help about the where-object cmdlet.  
help about_foreach : Displays help about the about_foreach topic.  
set-service -? : Displays help about the set-service cmdlet.  
  
You can use wildcard characters in the help topic.  
If multiple help topics match, PowerShell displays the first match.  
If only one help topic matches, PowerShell displays the help for that topic.  
  
Examples:  
get-help * : Displays all help topics.  
get-help get-* : Displays topics that begin with "get-".  
help where-object* : Displays topics with "where-object" in the name.  
get-help about* : Displays all conceptual topics.  
  
For information about wildcards, type:  
get-help about_wildcard  
  
REMARKS  
To learn about Windows PowerShell, read the  
get-command : Gets information about cmdlets.  
get-member : Gets the properties and methods of an object.  
where-object : Filters object properties.  
about_object : Explains the use of object.  
about_remote : Tells how to run commands on a remote computer.
```

```
hello world  
stuart@stuart-desktop:~$
```

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)

History: the Original Terminals



**Mainframe
(powerful computer)**

How to share it?

History: the Original Terminals



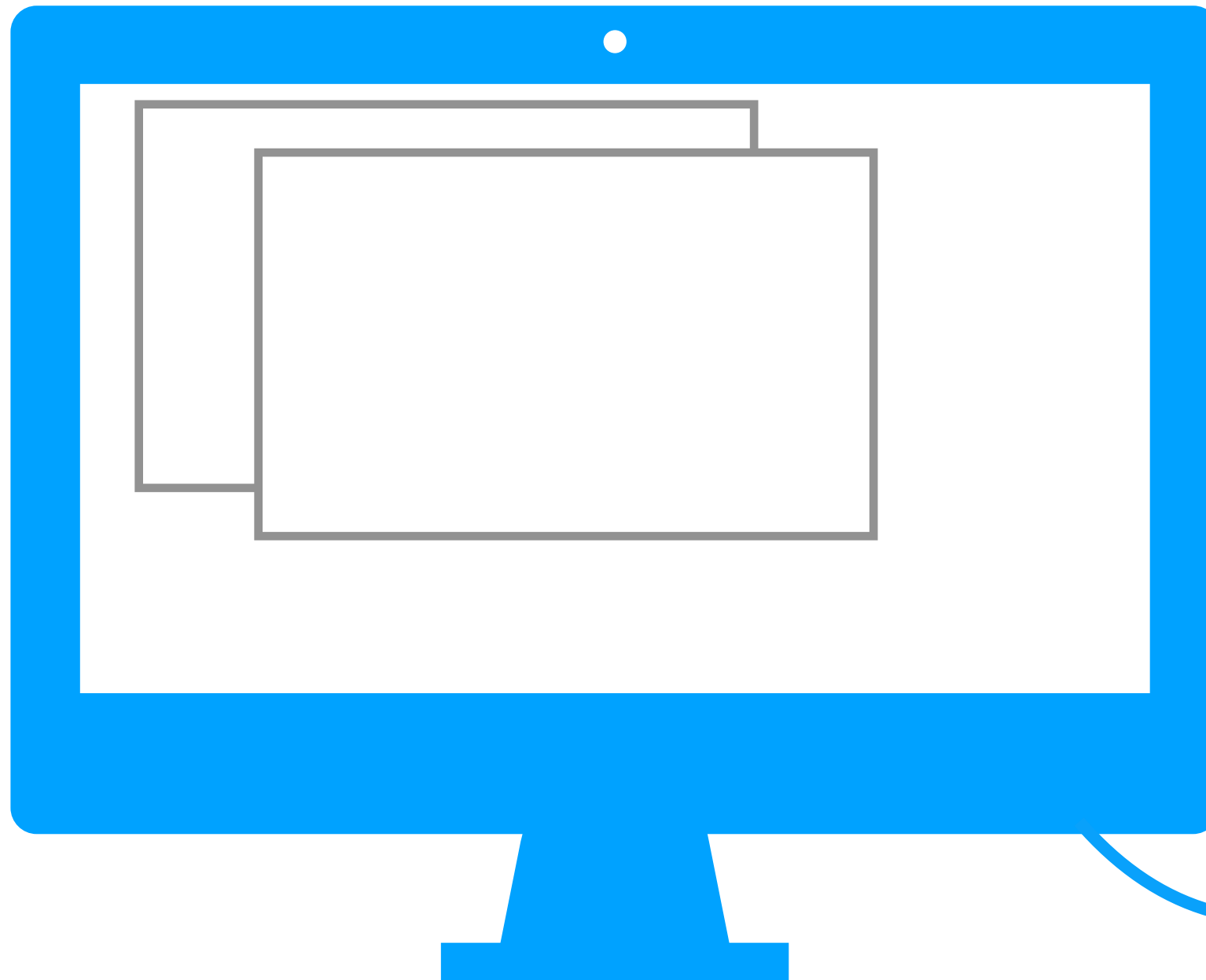
**Mainframe
(powerful computer)**



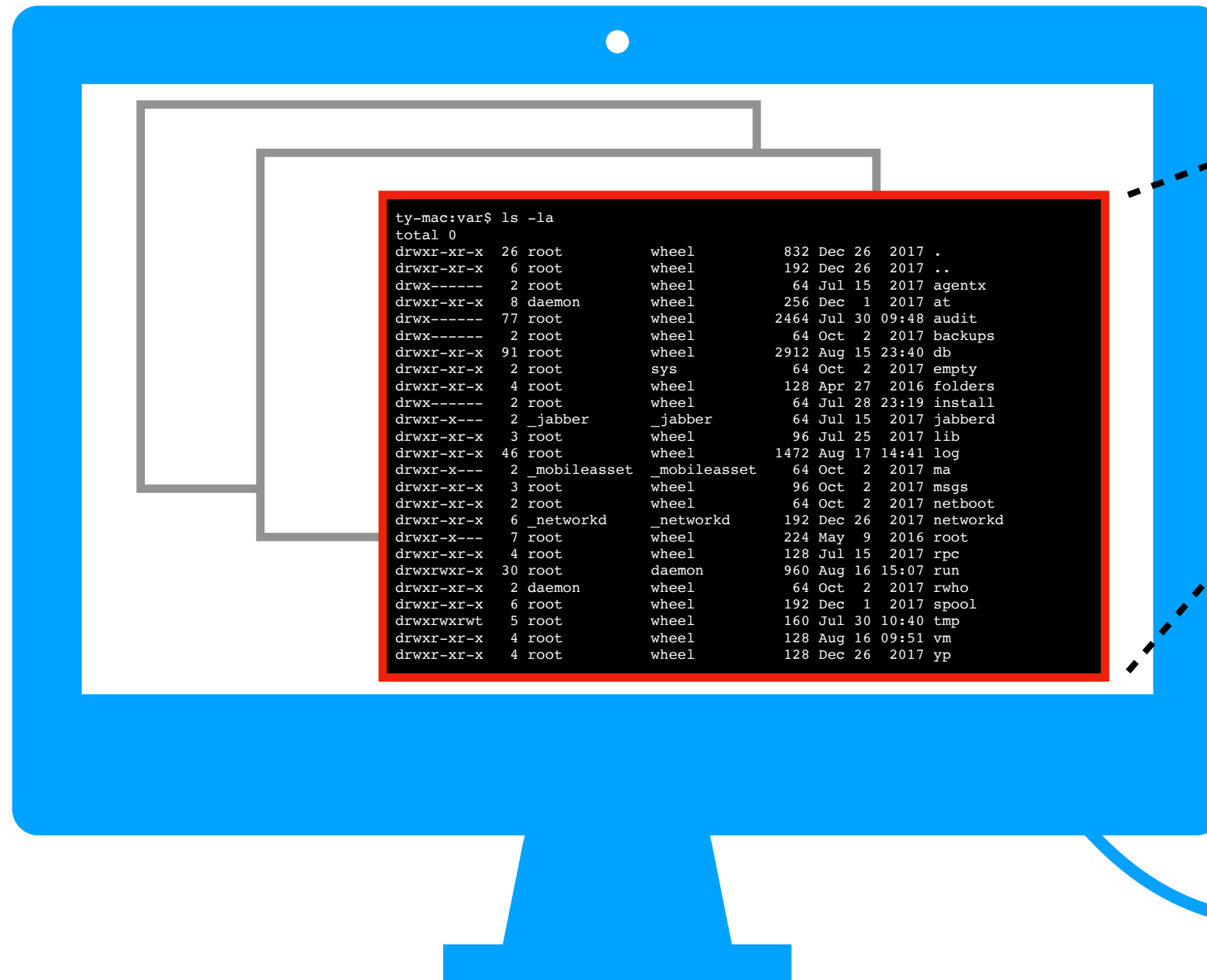
**dumb terminals
(text based)**



Terminal Emulators



Terminal Emulators



Terminal Emulators

```
ty-mac:var$ ls -la
total 0
drwxr-xr-x 26 root    wheel    832 Dec 26  2017 .
drwxr-xr-x  6 root    wheel    192 Dec 26  2017 ..
drwx----- 2 root    wheel     64 Jul 15  2017 agentx
drwxr-xr-x  8 daemon  wheel    256 Dec  1  2017 at
drwx----- 77 root    wheel   2464 Jul 30 09:48 audit
drwx----- 2 root    wheel     64 Oct  2  2017 backups
drwxr-xr-x 91 root    wheel   2912 Aug 15 23:40 db
drwxr-xr-x  2 root    sys       64 Oct  2  2017 empty
drwxr-xr-x  4 root    wheel    128 Apr 27  2016 folders
drwx----- 2 root    wheel     64 Jul 28 23:19 install
drwxr-x---  2 _jabber  _jabber   64 Jul 15  2017 jabberd
drwxr-xr-x  3 root    wheel     96 Jul 25  2017 lib
drwxr-xr-x 46 root    wheel   1472 Aug 17 14:41 log
drwxr-x---  2 _mobileasset _mobileasset 64 Oct  2  2017 ma
drwxr-xr-x  3 root    wheel     96 Oct  2  2017 msgs
drwxr-xr-x  2 root    wheel     64 Oct  2  2017 netboot
drwxr-xr-x  6 _networkd _networkd 192 Dec 26  2017 networkd
drwxr-x---  7 root    wheel    224 May  9  2016 root
drwxr-xr-x  4 root    wheel    128 Jul 15  2017 rpc
drwxrwxr-x 30 root    daemon   960 Aug 16 15:07 run
drwxr-xr-x  2 daemon  wheel     64 Oct  2  2017 rwho
drwxr-xr-x  6 root    wheel    192 Dec  1  2017 spool
drwxrwxrwt  5 root    wheel    160 Jul 30 10:40 tmp
drwxr-xr-x  4 root    wheel    128 Aug 16 09:51 vm
drwxr-xr-x  4 root    wheel    128 Dec 26  2017 yp
```



local computer
(e.g., personal)

Terminal Emulators



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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!

what should I do?

does it

what should I do?

does it

what should I do?


...

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  type “dir” to view files
- PowerShell  type “ls” (for list) to view files

Shells

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- Different shells have minor (or major) variations

Windows Shells

- cmd
- PowerShell

UNIX Shells (Mac and Linux)

- bash
- csh
- zsh
- many more

Shells


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- The shell lets users type commands, then carries out the appropriate actions
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- PowerShell 

UNIX Shells (Mac and Linux)

- bash 
- csh
- zsh
- many more

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- Running programs from a shell

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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:

```
program name
prompt (ty-mac:var$ ls)
output (agentx      jabberd      root
at      lib      rpc
audit    log      run
backups  ma      rwho)
prompt (ty-mac:var$)
```

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

Today's Topics

Terminal Emulators and Shells

Navigation

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

Running Programs and Commands

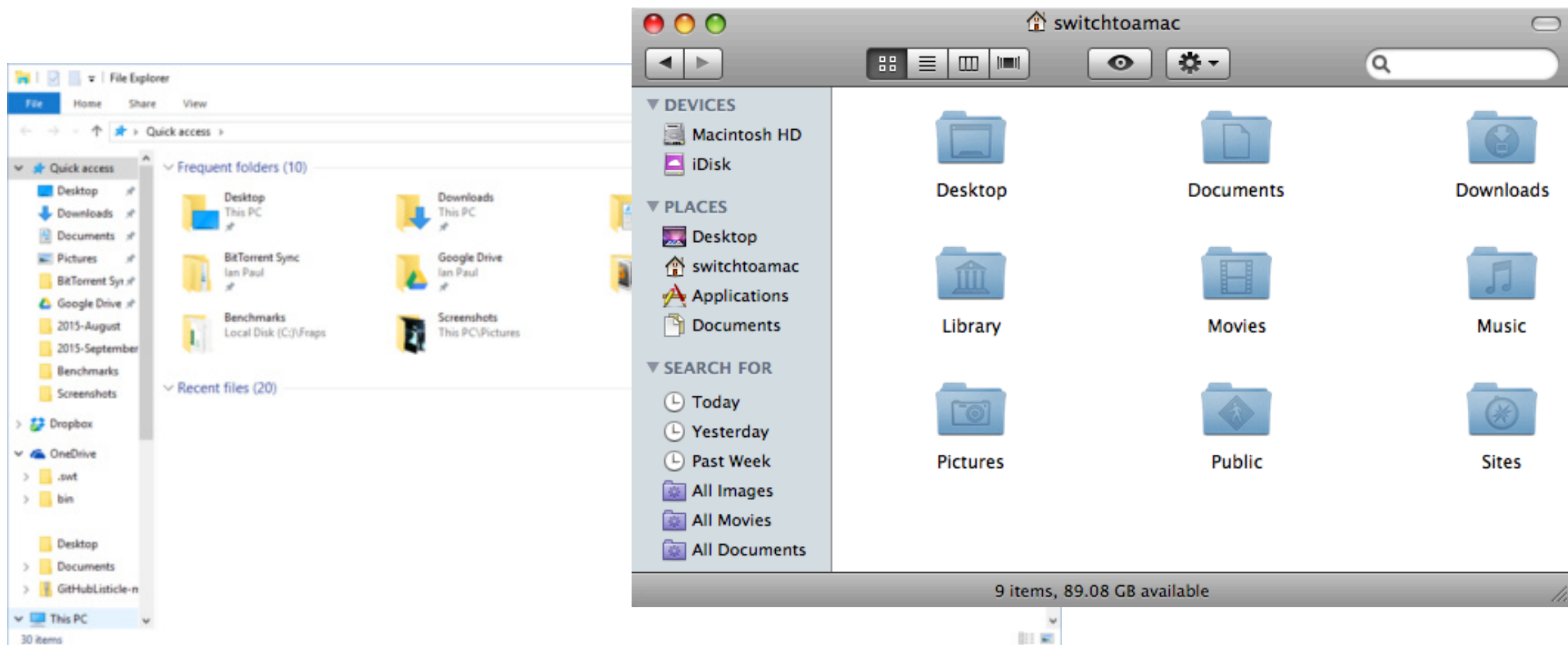
Demos

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...

`ls`

`pwd`

`cat`

...

`cd`

`mkdir`

Today's Topics

Terminal Emulators and Shells

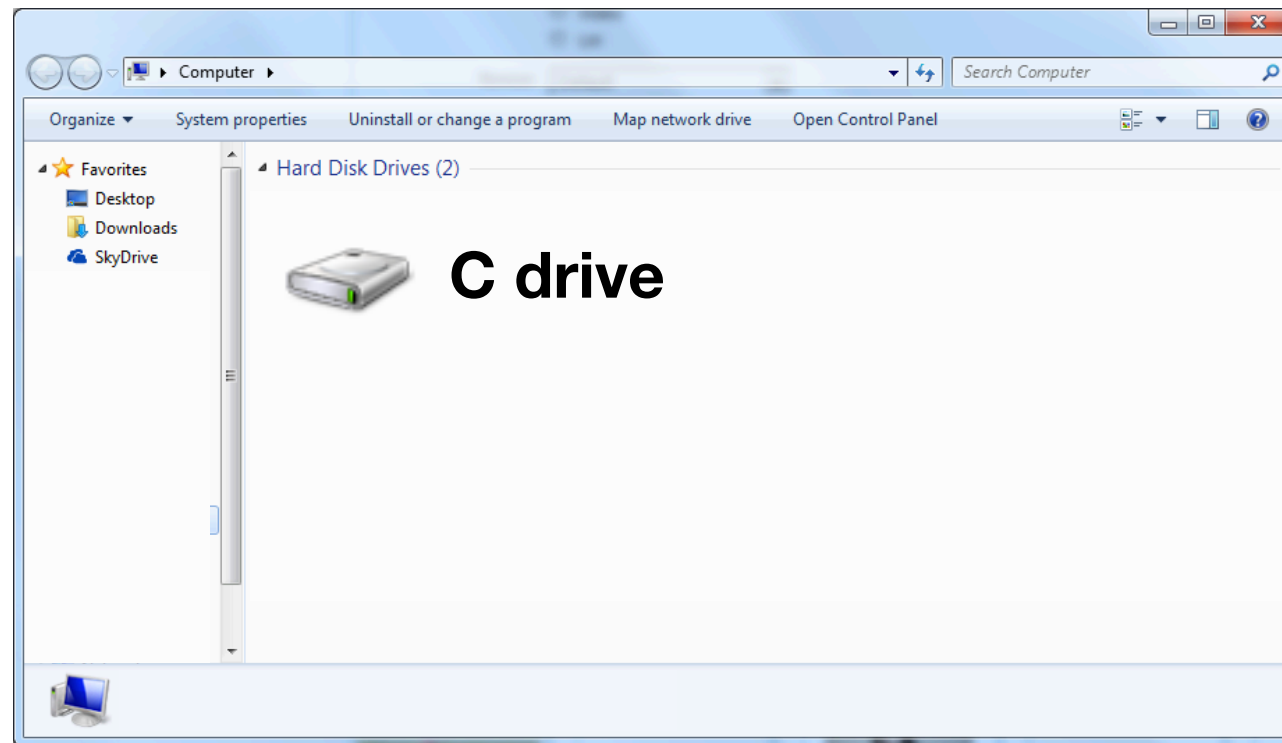
Navigation

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

Running Programs and Commands

Demos

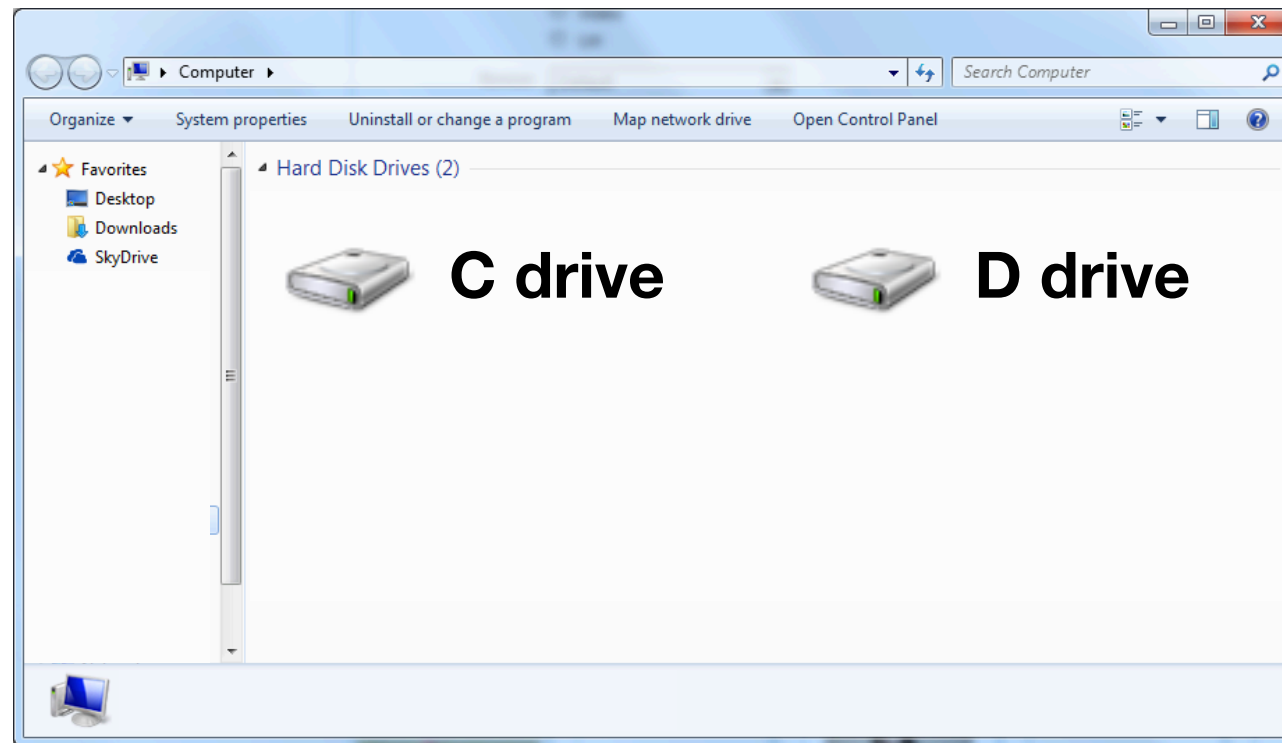
Windows Storage Drives



**Each added drive is given
its own drive letter**



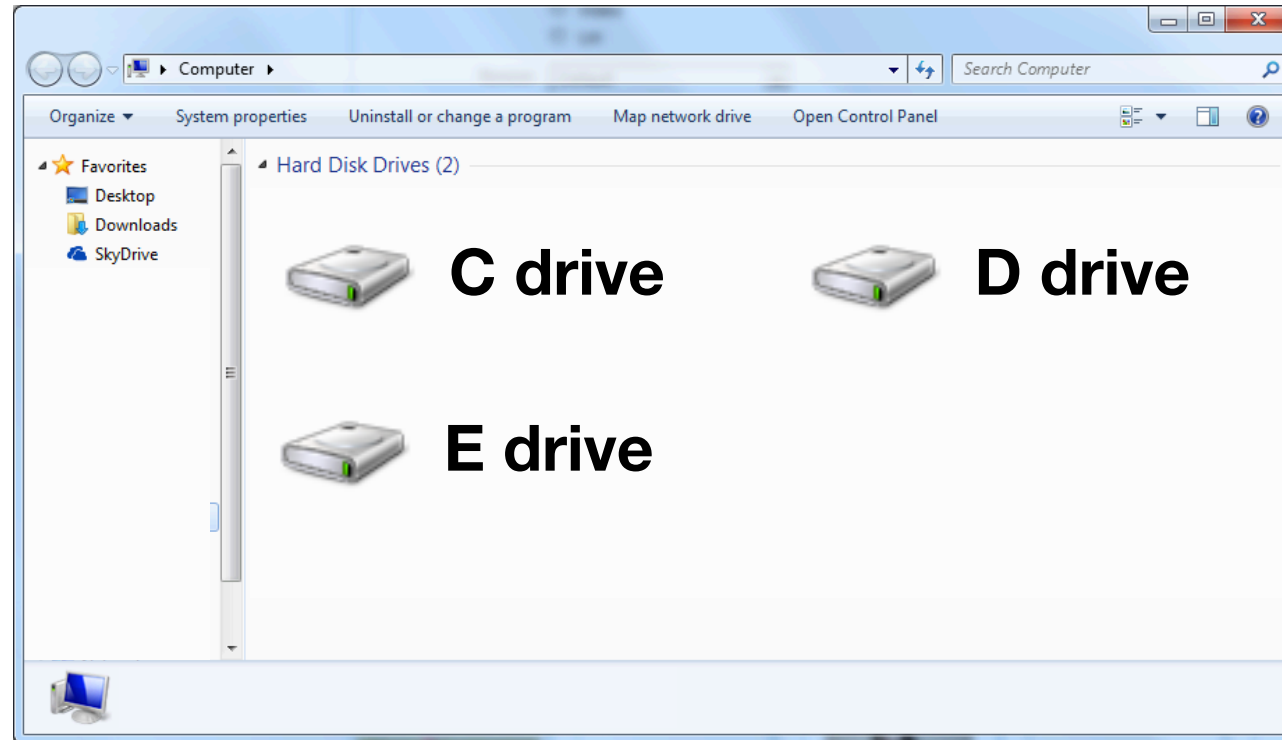
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- Storage Drives (Windows)
- **Files**
- Directories (aka Folders)
- Windows vs. Mac

Running Programs and Commands

Demos

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

c:\README.txt

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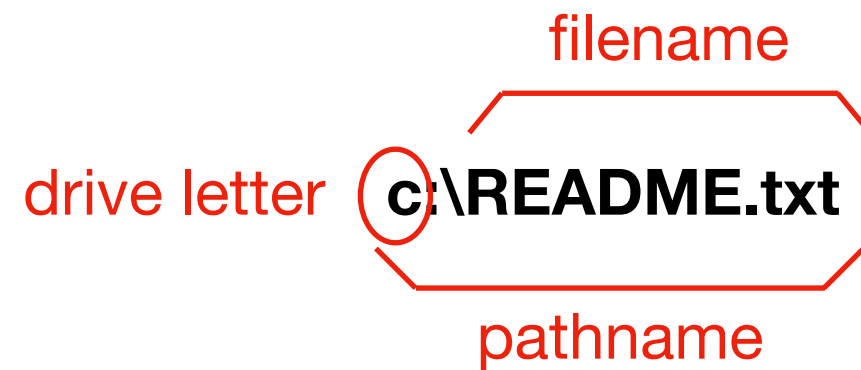
Files

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

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

filename

pathname



c:\hw.docx

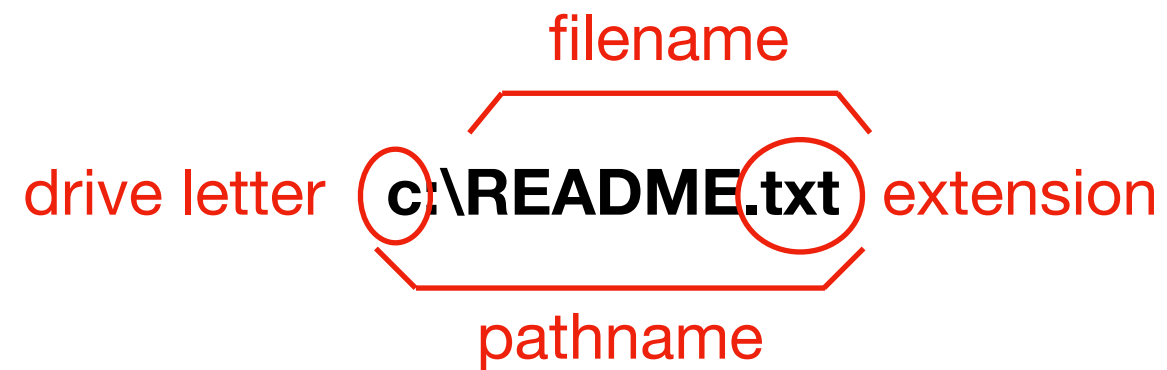
d:\page.html

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Files

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

filename
drive letter **c:\README.txt** extension
pathname



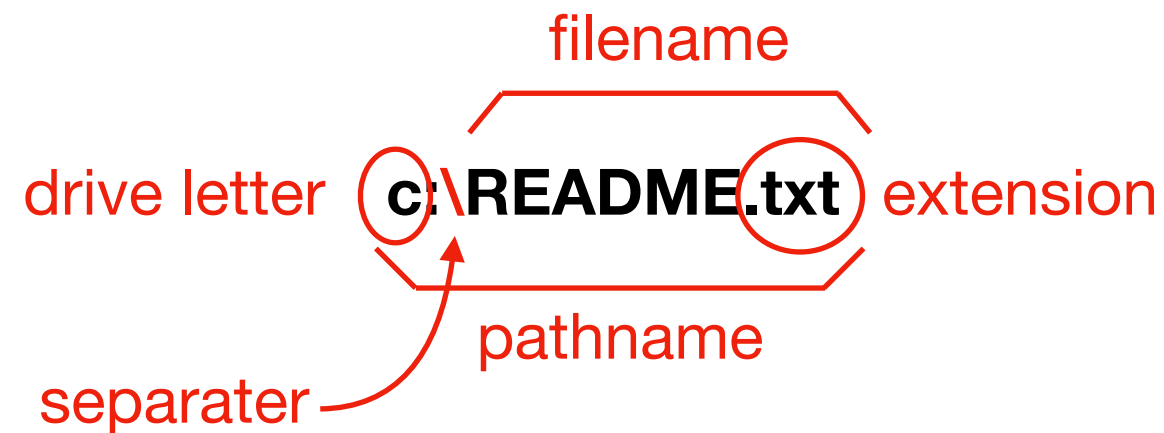
c:\hw.docx

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Files

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



`c:\hw.docx`

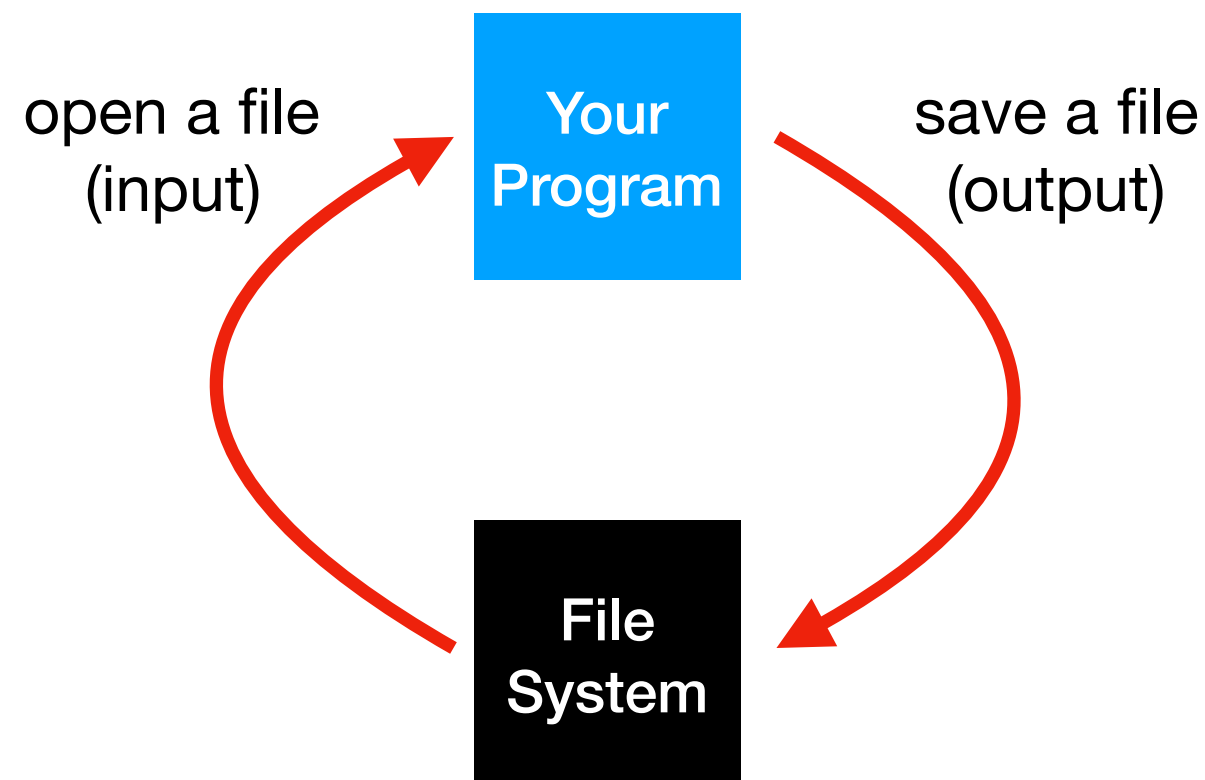
`d:\page.html`

`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”**



Today's Topics

Terminal Emulators and Shells

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

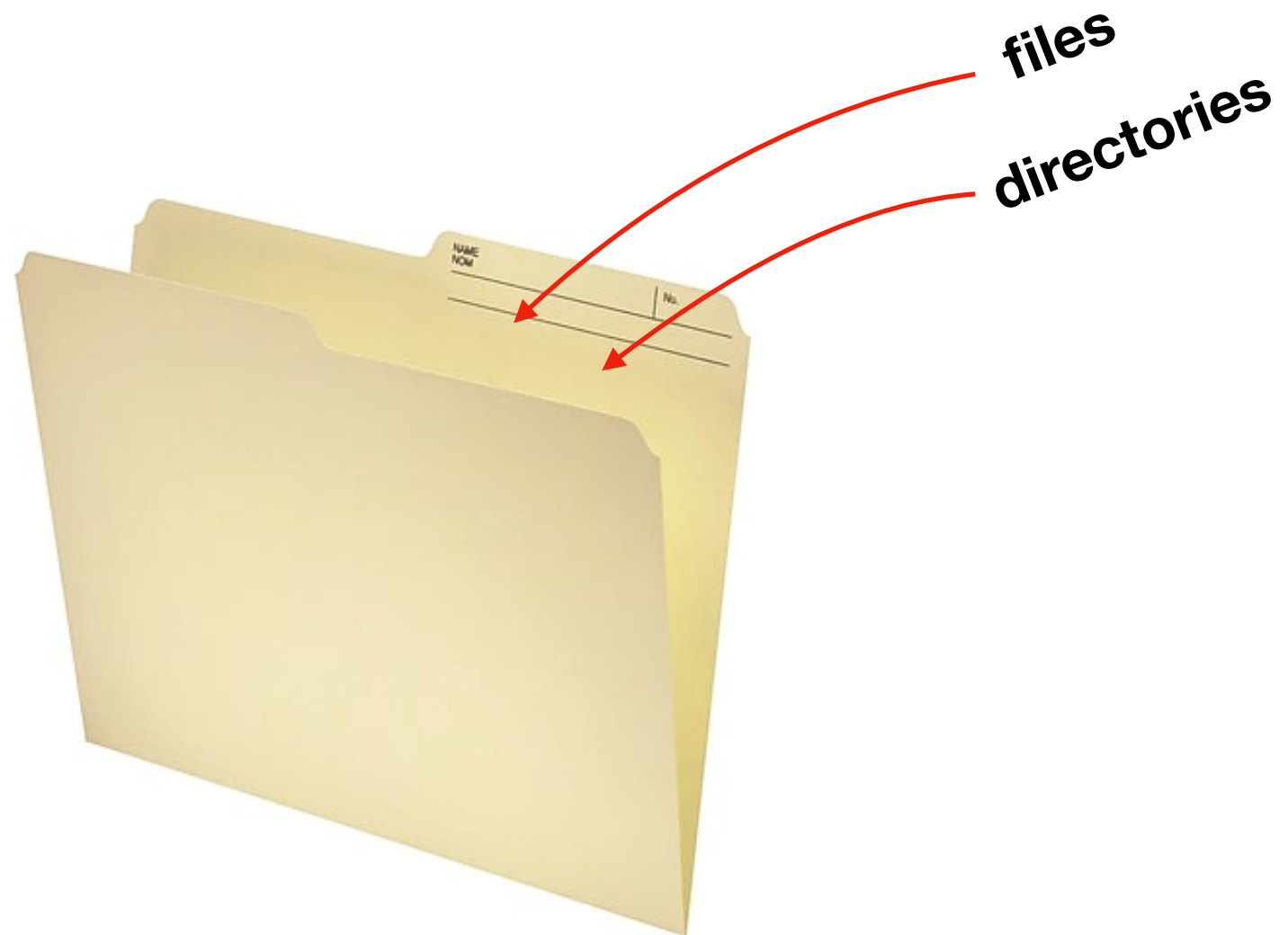
Running Programs and Commands

Demos

Directories

Directories are used to organize files and sub directories

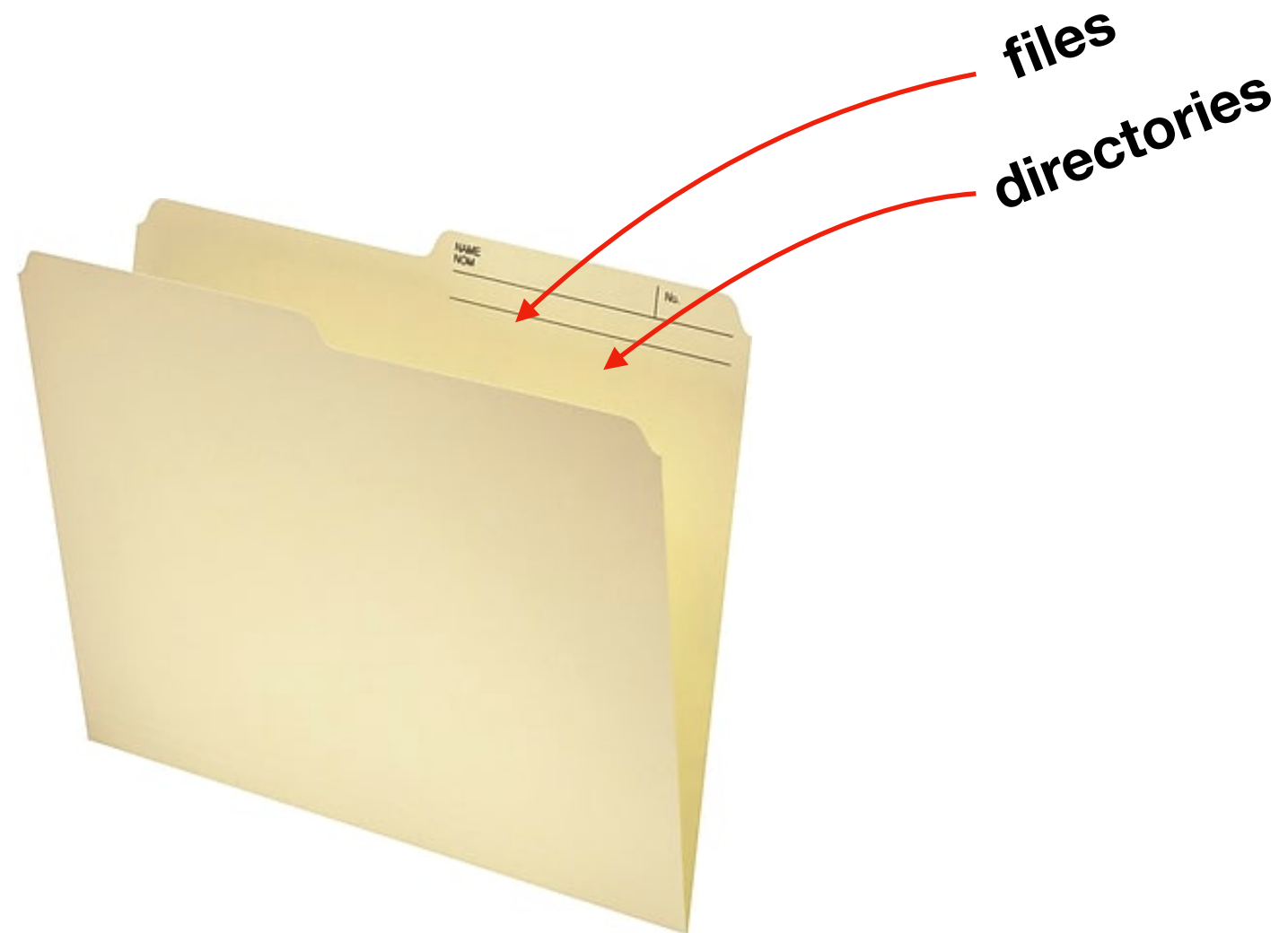
- Also called “folders”



Directories

Directories are used to organize files and sub directories

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



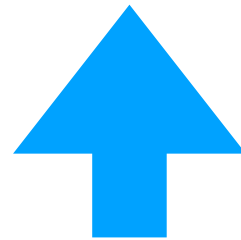
Directories

Directories are used to organize files and sub directories

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

Example paths:

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



in my-directory

Directories

Directories are used to organize files and sub directories

- Also called “folders”
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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

Directories

Directories are used to organize files and sub directories

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

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

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
- **Answer 2:** on the other side of Johnson street



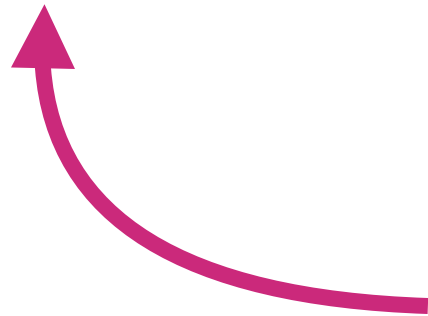
When is Answer 2 appropriate?

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

Relative Paths

Where is the Computer Science building?

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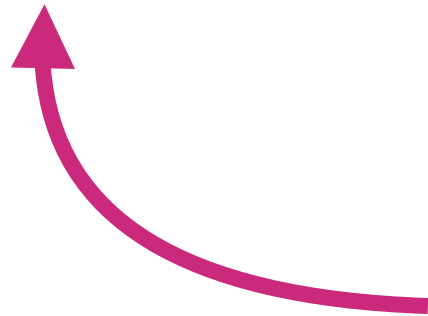
Pathnames are absolute (answer 1) or relative (answer 2)

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

Relative Paths

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- When you're in the psychology building
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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	

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	

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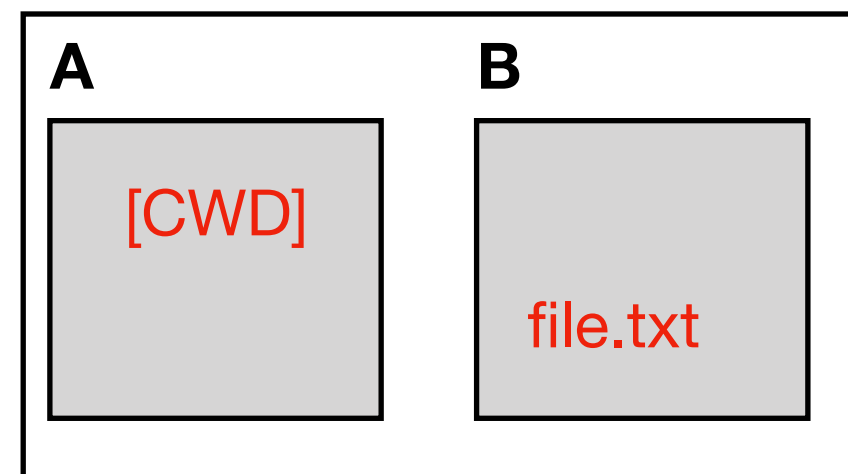
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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	..\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
c:\B\file.txt	c:\A	..\B\file.txt

Two special directory names

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c:

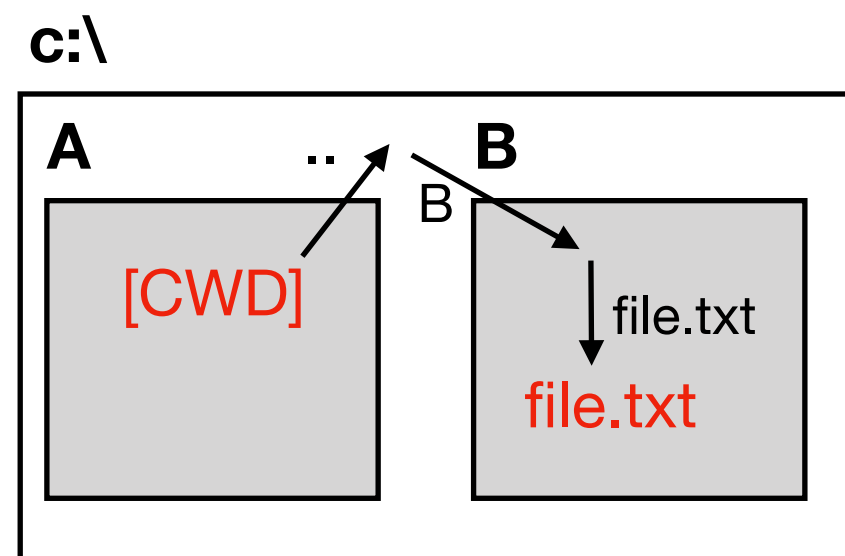


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c:\test.txt	c:\	..\test.txt
c:\x\y\z	c:\x	.\y\z
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c:\x\y\z	c:\x	y\z
c:\test.txt	c:\	.\test.txt
c:\test.txt	c:\	..\test.txt
c:\x\y\z	c:\x	.\y\z
c:\x	c:\x\y\z	..\..
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more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

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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
```



this is the current directory

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

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!
```

data saved in README.txt

Today's Topics

Terminal Emulators and Shells

Navigation

Running Programs and Commands

- Navigational commands
- **Arguments**
- Saving output

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
Network               internet
Requests              prerequests
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

Navigation

Running Programs and Commands

- Navigational commands
- Arguments
- Saving output

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