SWEN-123
Software Development & Problem Solving

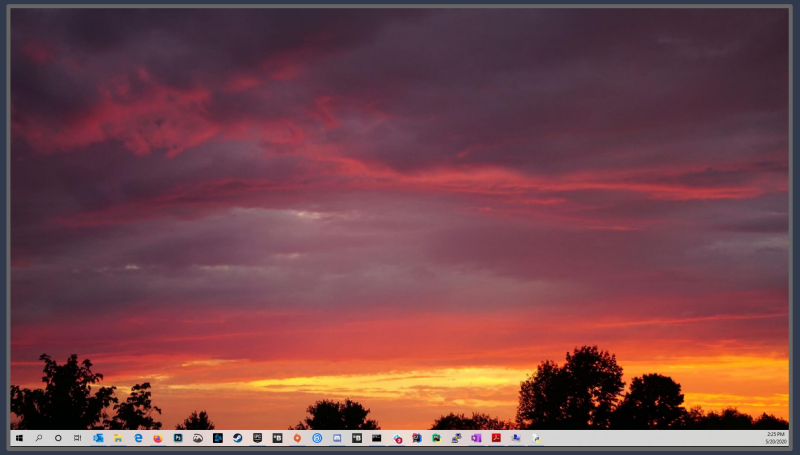
File System Basics

This Week

SUN	MON	TUE	WED	THU	FRI	SAT
	- Course Overview - Academic Honesty - File System Basics		- Git Basics - Environment Variables Assignment 01 Due (start of class)		- More Git - Batch Files - The System Path Assignment 02 Due (start of class)	

Please note: You will be given an assignment at the end of each class that is due ***before*** the start of the next class!

Windows 10 Computer Literacy



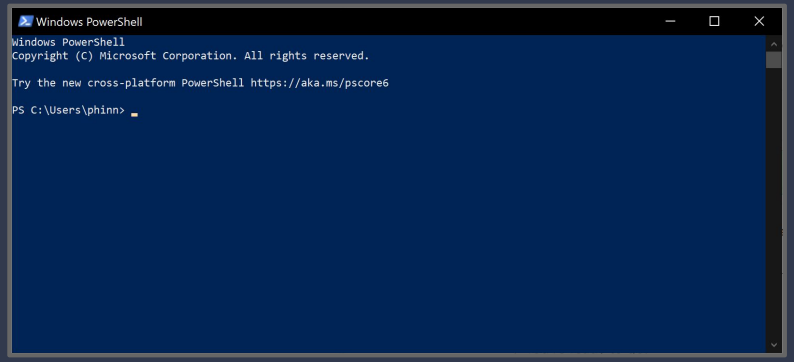
If you'd like to use a non-Windows computer for your out of class work, you will need to do some extra learning on your own.

Many of the commands you will use work much the same in Linux or OSX. Others you may easily Google.

- The goal of this week's lectures is to establish a common, minimum level of computer literacy amongst the students in the class.
- We will explore:
  - The Command Line
  - The File System
  - Version Control (with Git)
  - Environment Variables
  - Batch Files
- You will learn to perform many tasks using only the command line.
  - After a short time, you will find using the command line to be much faster and more efficient than trying to use a graphical user interface like Explorer.
- Please note that throughout this series of lectures (and the entire course) we will be using the Windows 10 operating system.
  - If your personal computer has a different operating system, many of the examples will not work.
  - It is therefore recommended that you use one of the lab computers to follow along.

The Command Prompt

- Every major operating system includes support for a ***command prompt***.
  - The command prompt is often called a “terminal” or “command line interface” (CLI).
  - Some operating systems *only* include a command prompt!
- Many features of the operating system can be quickly and efficiently executed via the command prompt, including:
  - Running programs.
  - Opening files.
  - Creating or editing text files.
  - Copying, moving, or deleting files.
  - Creating or deleting directories.
  - etc.
- Starting the command prompt is easy:
  - Press the **Windows key** on your keyboard to open the **Start Menu**.
  - Type “**`powershell`**” into the search field.
  - If necessary, use the up and down arrow keys to select **Windows PowerShell** in the search results.
  - Press the enter key.

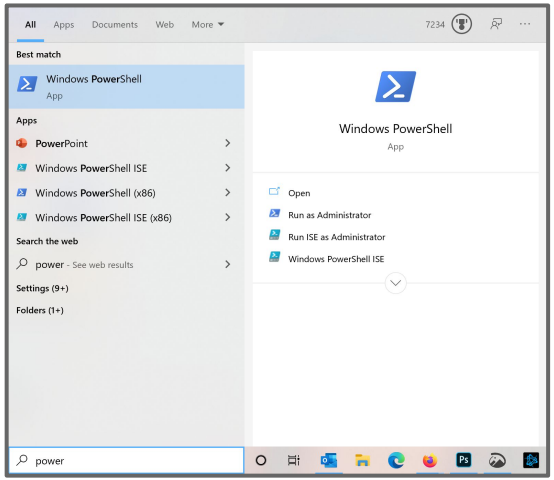


The default terminal is small and ugly. Let’s fix that by customizing it!

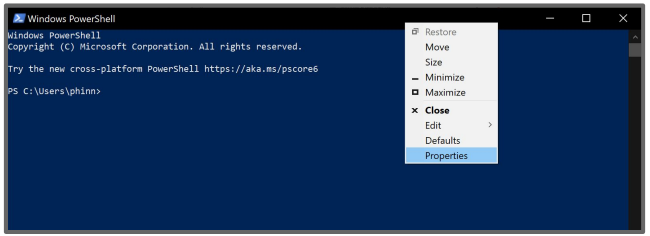
1.1

Activity: Customizing the Command Prompt

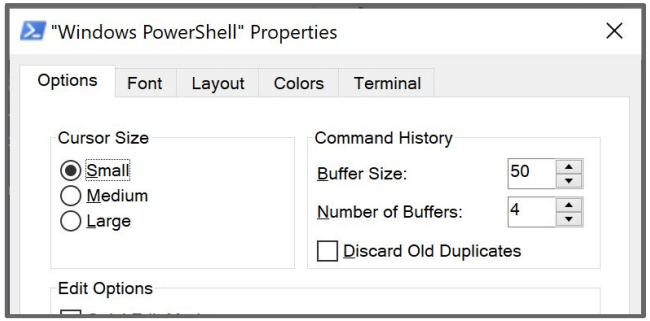
(**individual**) Customize the look and feel of your Windows command prompt.

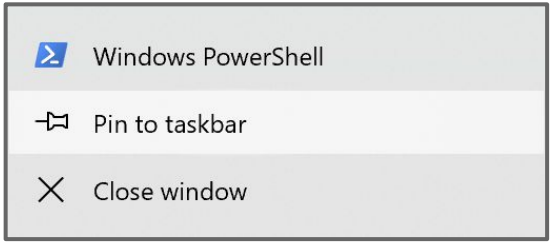


If you haven't already done so, use the Windows key to open the start menu and run the command prompt.



Right-click the window's title bar and select the ***Properties*** menu option. Play around with customizing font color & size, layout, and so on.



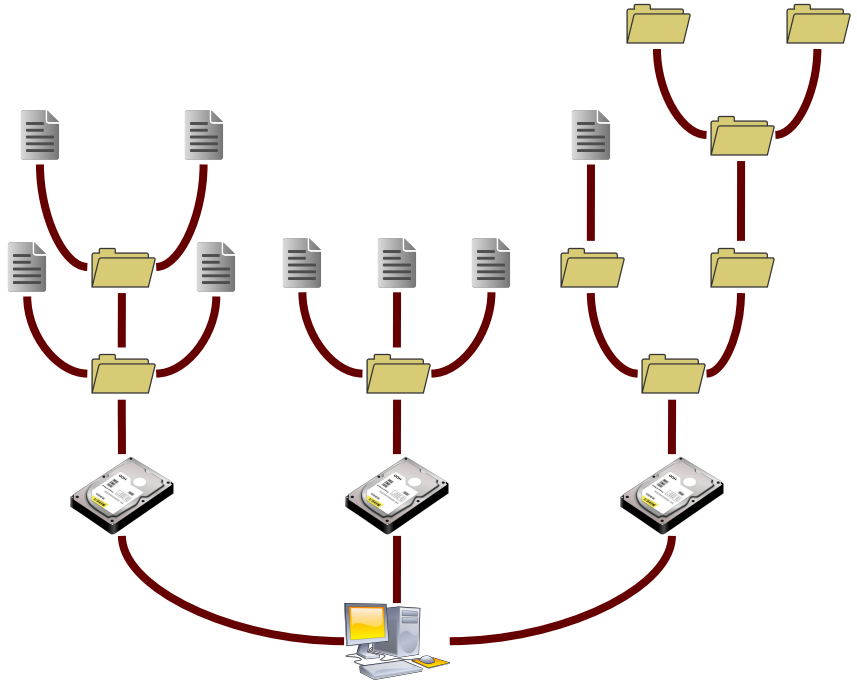


You'll be using the command prompt *a lot*, so go ahead and pin it to your taskbar (right click the icon and select ***Pin to taskbar***).

Close and re-open the command prompt using the button on the taskbar to make sure that your settings were saved.

The File System

- The **File System** on your computer is organized into a **tree structure**. Your PC is at the **root** of the tree.
- Your PC contains one or more **drives**.
  - Most contemporary computers use some combination of **solid state drives** (SSDs) and **removable drives** (e.g. USB or SATA).
- Each drive has a root **directory**.
  - Directories are often also called **folders**.
- While a directory may be empty, most contain some combination of **subdirectories** and **files**.
- Each subdirectory is itself a directory, and so may also contain its own files and subdirectories.
- In fact, directories may be nested to an arbitrary depth.



The `gdr` command, which is short for “Get Drive” can be used to list the drives on your computer.

1.2

Activity: Listing Drives

(**individual**) Launch a PowerShell command prompt and use the `gdr` command to list the available drives on your current computer.

After running the command, you should see a table of results similar to this.

The **drive letters** will be listed on the left (along with some other *stuff*)...

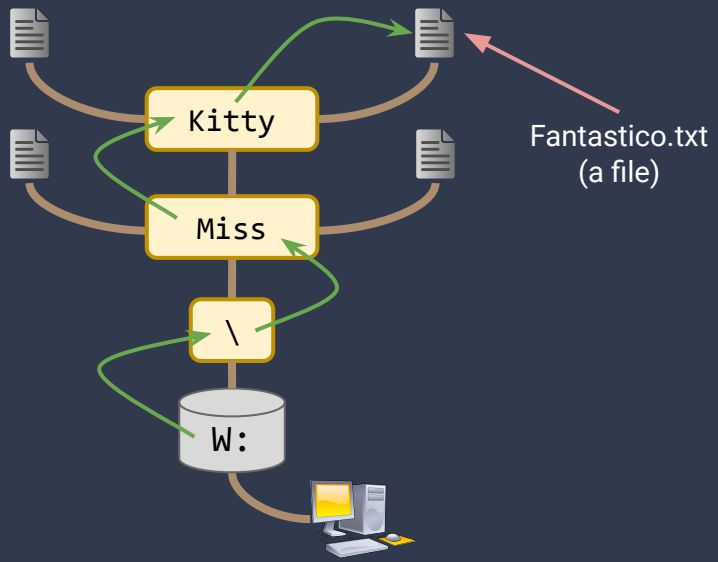
```
PS C:\Users\charlie> gdr
Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
Alias                                  Alias
C              312.36        640.88    FileSystem    C:\
D              2746.24       48.28     FileSystem    D:\
E              0.28          0.06      FileSystem    E:\
F              464.75        11.40     FileSystem    F:\
Z              784.97        168.90    FileSystem    Z:\

PS C:\Users\charlie> _
```

And the **root directory** on each drive is shown on the right.

The used and available storage on each drive is shown (in gigabytes).

File Paths

Consider the file named “`Fantastico.txt`” depicted below. It is in a directory named “`Kitty`”, which is in a directory named “`Miss`” in the root directory on drive “`W`”.



The absolute path to the file begins with the drive letter and includes each of the directories along the way to the file...

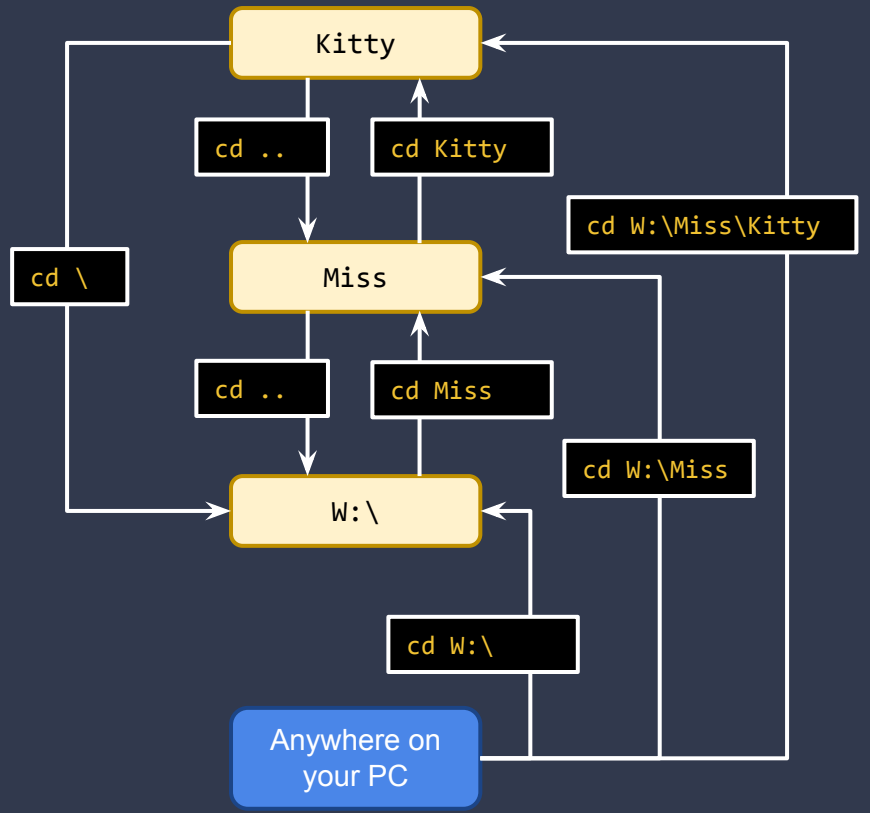
```
W:\Miss\Kitty\Fantastico.txt
```

- Every drive in your PC is identified by a **drive letter**, e.g. `C`, `D`, or `Z`.
  - A removable drive (e.g. a USB flash drive) will be automatically assigned an unused letter.
- You may switch between drives on your computer from the command prompt by typing the drive letter followed by a colon (`:`) into the prompt and pressing enter, e.g. `C:`
  - Case does not matter.
- Every file or directory in your file system is uniquely identified by its **absolute path**.
  - The path begins with the letter of the drive on which the file resides.
  - It includes the name of each directory and subdirectory.
  - It ends with the name of the file.
  - The names of directories and files are separated by a file separator, e.g. ‘\’.

Navigating the File System

- A file or directory may always be accessed by its absolute path, e.g. the path `W:\Miss\Kitty` can be used from anywhere in the file system to access the specified directory or its contents.
- You may also move from one drive to another by typing the drive letter followed by a colon, e.g. `C:`, `W:`, etc.
  - This will move your command prompt into the last directory you used on the drive, or the root directory if you have not used the drive yet.
- Once on a drive, you may change from one directory to another using the `cd` command.
  - When used with the name of a subdirectory, cd will move into that directory, e.g. `cd Kitty`
  - `cd \` will move to the root directory on the current drive.
  - `..` is a shortcut for the parent directory, so `cd ..` will move *up* one directory (e.g. from a subdirectory into its parent directory).

Consider the directory structure from the previous example: `W:\Miss\Kitty\`



Listing Files

- Once you are in a directory, you can use the `ls` command to list the files in the directory.
  - "`ls`" is short for "list."
- The listing provides a lot of detailed information about the contents of the directory.
  - The **mode** indicates details about the attributes of each file.
    - `d` indicates that it is a directory.
    - `a` indicates that the file has been archived (backed up) since the last update.
    - `r` indicates that the file is read only.
  - The **last write time** is the last time that the file was updated.
  - The **length** is the number of bytes of data in the file.
  - The **name** is, well, the name.

```
PS C:\users\charlie\Downloads> ls
  Directory: C:\users\charlie\Downloads
Mode          LastWriteTime     Length  Name
----          -------------     ------  ----
d-----   4/2/2020   8:33 PM             nightmare_hero
d-----  5/12/2020   8:36 AM             hello-world
--r---  5/22/2020  10:57 AM     352609  The File System.pdf
-a----  5/22/2020   9:20 AM     241580  More Git.pdf
-ar---  5/16/2020   9:26 AM    1353127  batman-logo.png
-a----  5/12/2020   1:57 PM  198109216  AtomSetup-x64.exe
-a----  5/22/2020   1:08 PM   46891904  Git-2.26.2-64-bit.exe
-a----  5/12/2020   1:54 PM         24  hello.py
-a----  5/12/2020   2:34 PM        204  hw02.py
-a----  5/20/2020  12:25 PM       2138  set.txt


PS C:\users\charlie\Downloads> _
```

1.3

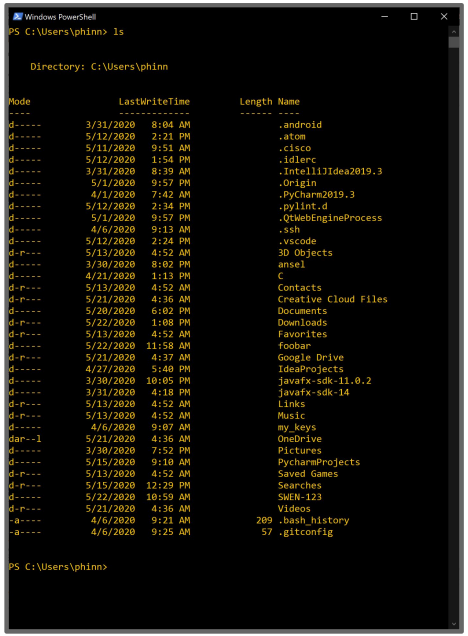
Activity: Changing Directories

(**individual**) If necessary, run the command prompt and then use the `cd` command to navigate between the directories listed below.

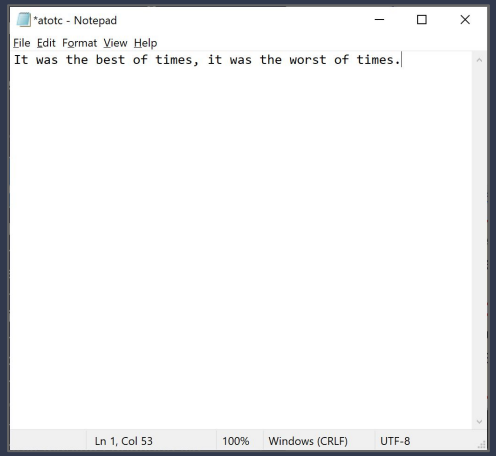
Use the `ls` command to list the files in each directory. Close the command prompt when you are finished.

Hint: you can type the first few letters in the name of the directory and press the TAB key to autocomplete, e.g. `cd Doc` → `cd .\Documents\`

- Your user directory, e.g. `C:\Users\Bobby`
- `Documents` (in your user directory)
- `Downloads` (in your user directory)
- `Pictures` (in your user directory)
- `C:\Program Files`
- `C:\Program Files (x86)`



File Types



Notepad is the default text editor for the Windows operating system and it can be used to create and edit text files.

You can run Notepad from the command prompt followed by the name of the file that you want to create or edit.

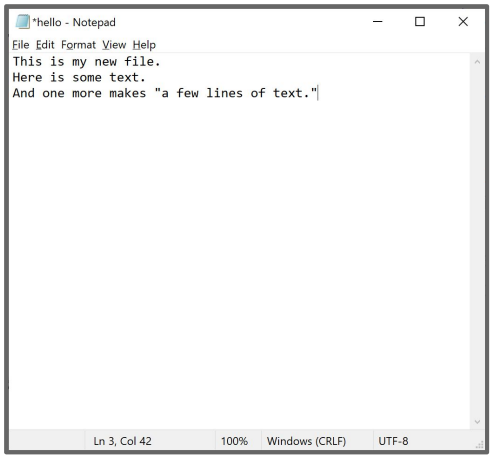
```
C:\users\charlie> notepad atotc.txt
```

- Files are used to store data such as text, images, video, or executable applications.
- The file type is usually indicated using a file extension - the last part of the filename after a dot (`.`).
  - For legacy purposes, most file extensions are three characters.
- Some examples of file extensions include:

Extension	File Type
`txt`	A text file, containing only characters
`pdf`	Portable Document Format
`png, gif, jpg`	Image files
`zip`	A ZIP compressed archive
`py`	A Python program (or script)
`html`	A Hypertext Markup Language file

1.4

Activity: Creating Text Files



(**individual**) Create a new text file in the `Documents` directory.

- Launch a new command prompt.
- Navigate to the `Documents` directory.
- Use `notepad` to create a file named "`hello.txt`".
  - When prompted, choose to create the file.
- Add a few lines of text to your file, save it (shortcut: ***CTRL-S***), and exit (shortcut ***ALT-F*** to open the File menu and ***X*** to exit) Notepad.
- Use `dir` to verify that your file has been created.
- Use `notepad` again to open your file and see the text.
- Close the command prompt.

Copying Files

- A **copy** of a file is a new file with a different path that contains exactly the same data as the original file.
- The `cp` command can be used to create a copy of a file. It requires at least one argument: the name (or path) of the file to copy.
  - For example, `cp C:\story.txt` will create a copy of the file with the specified path in the current directory; the copy will be named `story.txt`.
- An optional second argument can be used to specify the name (or path) of the copy.
  - For example `cp story.txt tale.txt` will create a copy of the file `story.txt` in the current directory; the copy will be named `tale.txt`.
- A directory cannot contain two files with exactly the same name; trying to create a copy a file into a directory that already has a file with that name will cause an error.

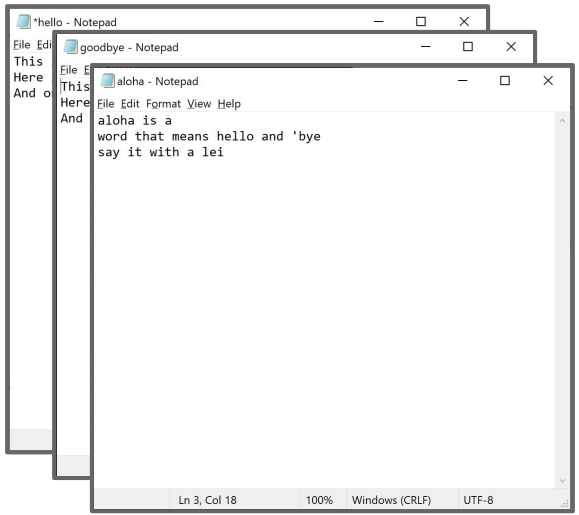
The `cp` command can be used with any combination of file names and paths for both the original file and the copy.

```
PS C:\Users\charlie> cp atotc.txt dickens.txt
PS C:\Users\charlie> ls

       Directory: C:\users\charlie

Mode          LastWriteTime  Length  Name
----          -------------  ------  ----
-a----  5/23/2020  10:54 AM      52  atotc.txt
-a----  5/23/2020  10:54 AM      52  dickens.txt

C:\Users\charlie> cp atotc.txt
cp : Cannot overwrite the item
C:\users\charlie\atotc.txt with itself.

PS C:\Users\charlie> cp C:\afile.txt here.txt
PS C:\Users\charlie> cp here.txt Documents\there.txt
```

If everything goes well, the `cp` command is silent (it will not produce any output). Use `ls` to see your copy.

1.5

Activity: Copying Files



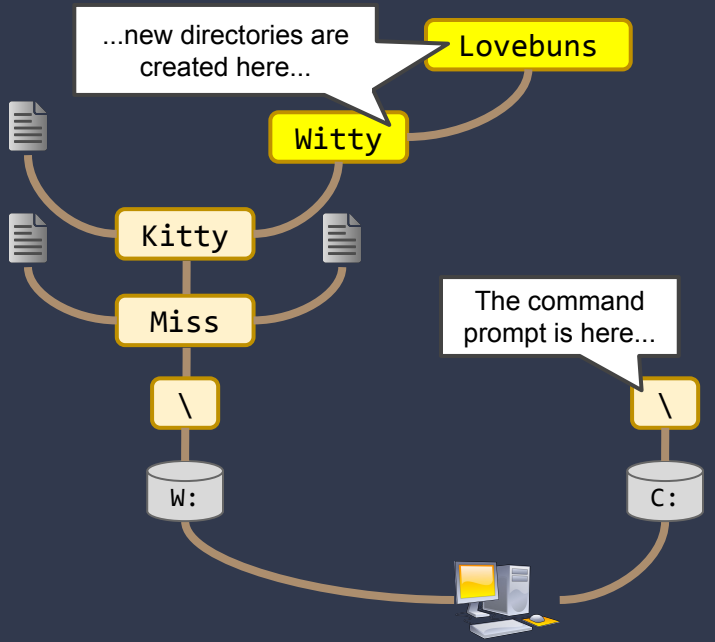
(**individual**) Make two copies of a file.

- Launch a new command prompt.
- Navigate to the `Documents` directory.
- Use `cp` to create two copies of your "`hello.txt`" file.
  - Name them whatever you'd like.
- Use Notepad to edit and change the contents of the files.
  - Don't forget to save (***CTRL-S***)!
- When you are finished, close the command prompt.

Making Directories

The `mkdir` command allows you to create new directories anywhere in the file system.

```
C:\> mkdir W:\Miss\Kitty\Witty\Lovebuns
```



- You will often want to create your own directories in the file system to better organize your files.
  - For example, when we start coding in the coming weeks you will want to create two different directories for your **source** and **test** code so that you can keep the code separate.
- The `mkdir` command can be used to make a new directory with a specified name in the current directory.
  - For example, assuming that you are in the directory with the path `C:\Users\charlie`, then `mkdir Garfield` will make a subdirectory named Garfield.
  - The full path to the new directory would be `C:\Users\charlie\Garfield`.
- You may also create the same directory from anywhere in the file system using an absolute path.
  - `mkdir C:\Users\charlie\Garfield`
  - Any directories in the path that do not already exist will be created.

Moving Files

- The `cp` command will create a copy of an existing file, but what if you want to **move** the file rather than duplicate it?
- The `mv` command will let you do exactly that.
- Like `cp`, `mv` can be used with at least one argument: the path to the file to move.
  - For example, `mv C:\story.txt` will move the file named `story.txt` from `C:\` to the current directory.
- An optional second argument can be used to specify the name (or path) of the destination.
  - For example `mv C:\story.txt W:\tale.txt` will move the file `story.txt` from `C:\` to `W:\` and rename it to `tale.txt` at the same time.
  - The `mv` command can also be used to rename files in place, e.g. `mv old.txt new.txt` will change the name of the file "`old.txt`" to "`new.txt`" in the current directory.

A file that is moved is not necessarily ***physically*** moved from one location to another on the storage media.

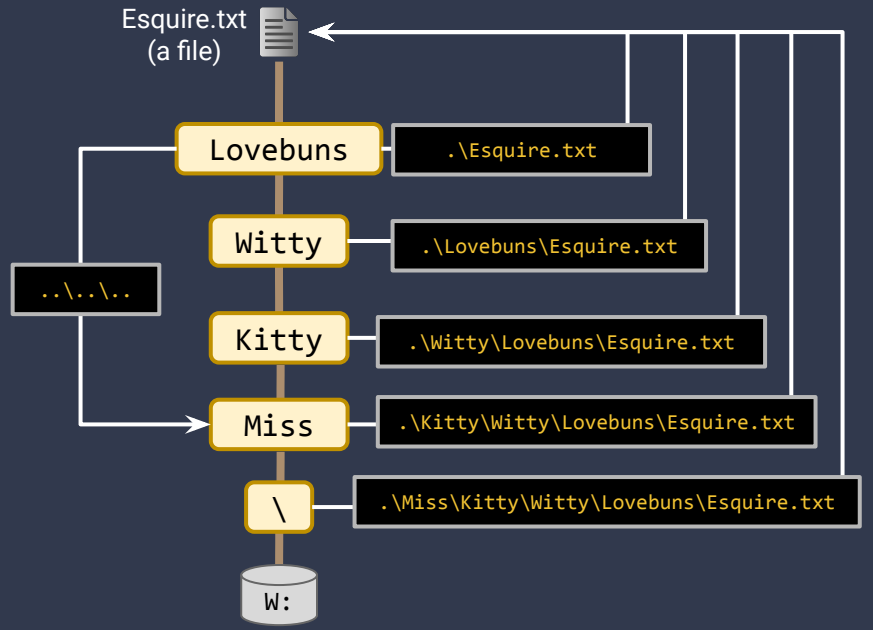
It is more often the case that the alias used to refer to the file's location is changed from one name to another.

Conversely, your operating system may physically move a file from one place to another ***without*** changing its name.

Relative Paths

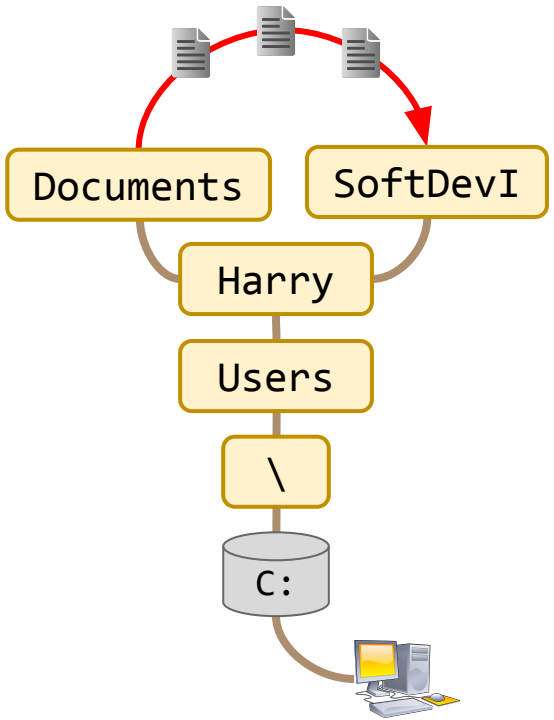
- So far we have referred to files either by name (in the current directory) or by using the absolute path to the file.
- Files may also be referenced using a **relative path**, that is a path ***relative*** to the current directory; it specifies how to get ***there*** from ***here***.
- For example, consider the file named `Esquire.txt` that is depicted to the right.
  - The **relative path** to the file from the `Kitty` directory is: `.\Witty\Lovebuns\Esquire.txt`.
  - Note that the dot (.) is a shortcut to refer to the current directory.
- A relative path may include both `.` and `..` (to refer to a parent directory), e.g. the path to `Miss` from `Witty` would be `..\..` (the parent of its parent).

Consider the file depicted below with the absolute path `W:\Miss\Kitty\Witty\Lovebuns\Esquire.txt`
What is the **relative path** from each directory?



Remember: `..` can be used to create paths that move in the opposite direction.

1.6



Activity: Making Directories and Moving Files

(**individual**) Make a new directory and move a file into it.

- Launch a new command prompt.
- Create a new directory in your user directory named `SoftDev1`, e.g. `C:\Users\Harry\SoftDevI`
- Move all 3 of the text files that you created previously into the new directory.
    - e.g. `mv .\Documents\hello.txt .\SoftDevI\`

Wildcards & Deleting Files

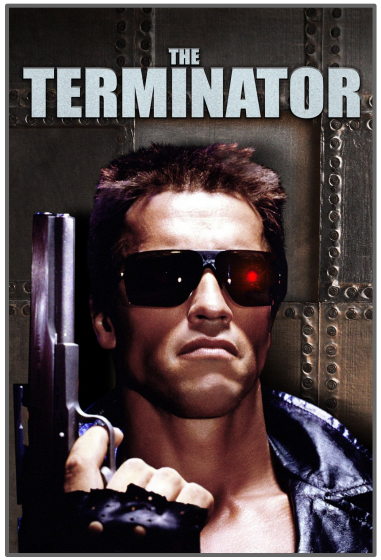
- A **wildcard** (*) can be used to find multiple files with names that match a certain pattern, e.g.:
  - `*.txt` matches all files with a `.txt` extension.
  - `hel*` matches all files with names that begin with "`hel`" such as "`hello.txt`" or "`help.png`".
  - `*if*` matches all files with "`if`" anywhere in the name such as "`if_only.txt`", "`riff.jpg`", or "`tears.gif`".
  - etc.
- Wildcards can be used in combination with commands such as `ls`.
  - e.g. `ls *.txt` will list all of the text files in the current directory.
- Sometimes it is necessary to **delete** files to free up storage space or to reduce clutter in your file system. The `rm` command can be used to delete a file by name, e.g. `rm hello.txt`
- Wildcards can be used with `rm`, and so `rm *.txt` will delete *all* of the files with a `.txt` extension in the current directory.

You may be used to being able to recover deleted files, but files deleted from the command line line ***are not*** moved to the Recycle Bin!

That means that you should use caution when using the `del` command to delete anything, especially when using a wildcard (`*`)!

1.7

Activity: Deleting Files



(**individual**) Delete two of your text files.

- Launch a new command prompt.
  - If necessary, navigate to your user directory.
- Delete two of the text files in your `SoftDevI` folder.
  - Challenge: can you use a *relative path* and a *wildcard* (*) to delete both files from your user directory without deleting the third?
- List the files in the directory to verify that your files have been deleted.

Remember! Deleting files from the command prompt deletes them permanently! Be careful!

Deleting Directories

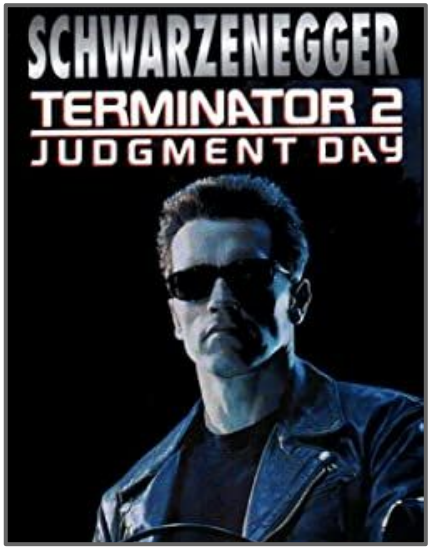
- The `rm` command can also be used to **delete directories** and their contents.
- If the directory is empty, the command will run silently.
- If the directory is not empty, you will be prompted to confirm whether or not you want to delete any files or subdirectories.
  - `Y` - yes, but you will be prompted again if one or more of the subdirectories is not empty.
  - `A` - yes to all, delete everything without prompting again.
  - `N` - no, do not delete this file or directory, but otherwise continue deleting.
  - `L` - No to all, do not delete any non-empty directories and don't prompt again.
  - `S` - suspend (stop) deleting.
  - `?` - Help!
- Alternatively, you can use the `-Recurse` option to avoid being prompted.
  - `rm -Recurse .\SomeDirectory\`
  - Be ***extremely*** when using this option!

```
PS C:\Users\charlie> rm .\SoftDev\

Confirm
The item at C:\users\phinn\SoftDevI\ has children and
the Recurse parameter was not specified. If you
continue, all children will be removed with the item.
Are you sure you want to continue?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S]
Suspend  [?] Help
(default is "Y"): A
PS C:\Users\charlie> _
```

As with files, directories deleted using rm are not moved to the Recycle Bin. Use with extreme caution, especially when using the `-Recurse` option.

1.8

Activity: Deleting Directories



(**individual**) Use `rm` to delete a directory.

- Launch a new command prompt.
- If necessary, navigate to your user folder.
- Delete the `SoftDevI` directory.
  - For now, do not use the `-Recurse` option.

Using rm with directories is even more dangerous than rm by itself. **Be careful!**

Homework Assignment

Homework Assignment 01

- Software Development & Problem Solving is a fast paced course that can be challenging, especially for students new to computing.
- The homework assignments are designed to give you an opportunity to practice between lectures.
- Each is designed to take about 60-90 minutes.
- The assignments will also help you to identify topics with which you need more help. Ask questions!

You can find the full instructions for this and any other assignment on MyCourses under Content.

- If you are using a personal computer for this class, make sure that you have Git installed.
  - https://www.git-scm.com
- Sign up for a GitHub account if you do not already have one.
  - https://www.github.com
- Your instructor will provide you with a link to a GitHub Classroom assignment. Open the link in a browser.
  - Sign in with your GitHub account.
  - When prompted, find your name in the class roster to link it to your account.
  - Accept the assignment.
- Once your Git repository has been created for you, you will be provided with a link to the repository. Open it in your browser.
- You will find further instructions in the repository in the file as a PDF.
  - You can also find a copy of the assignment instructions under Content on MyCourses.

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