

Part 1.1:

Introduction to directory structures and command line



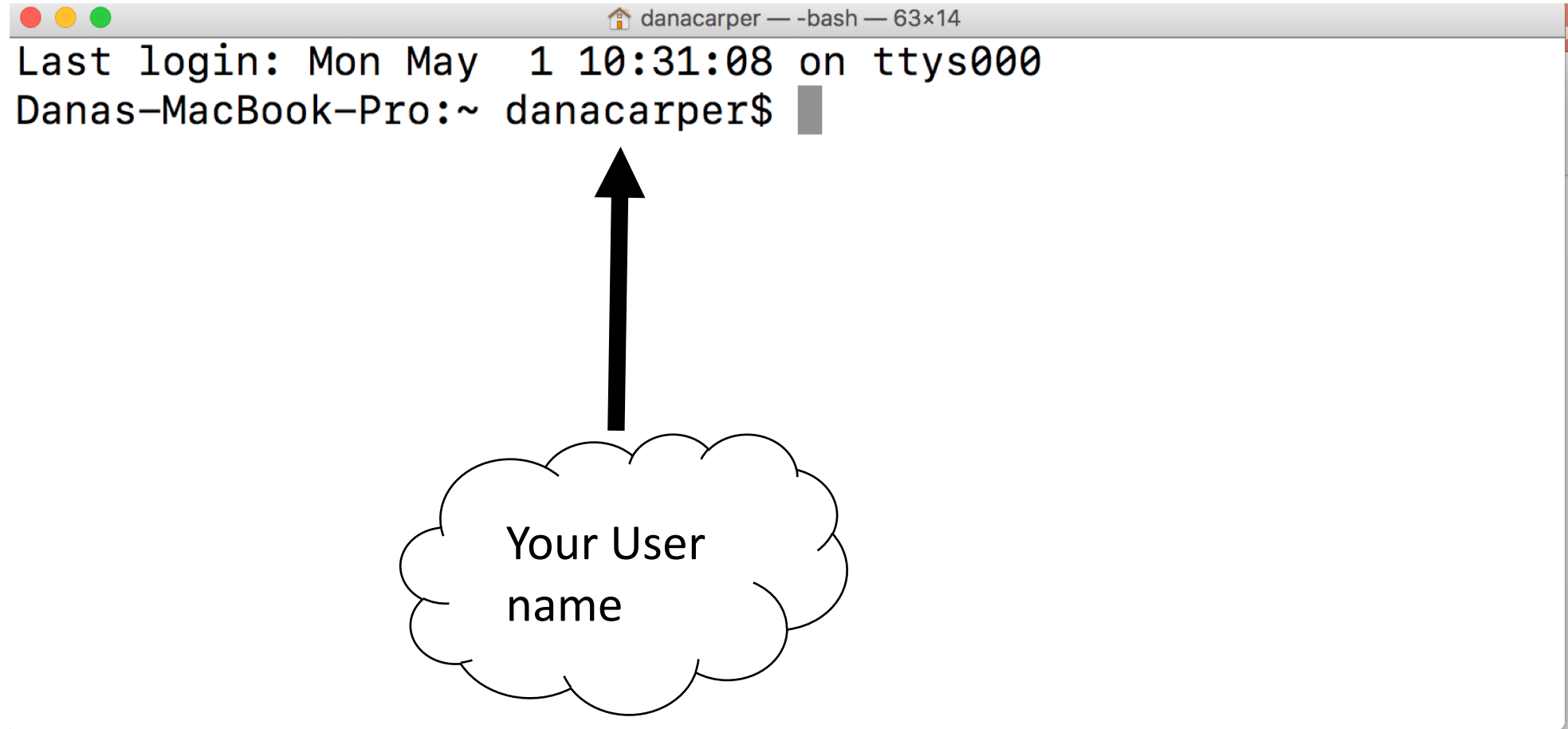
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Quantitative and Systems Biology
University of California, Merced

Where to find a terminal?

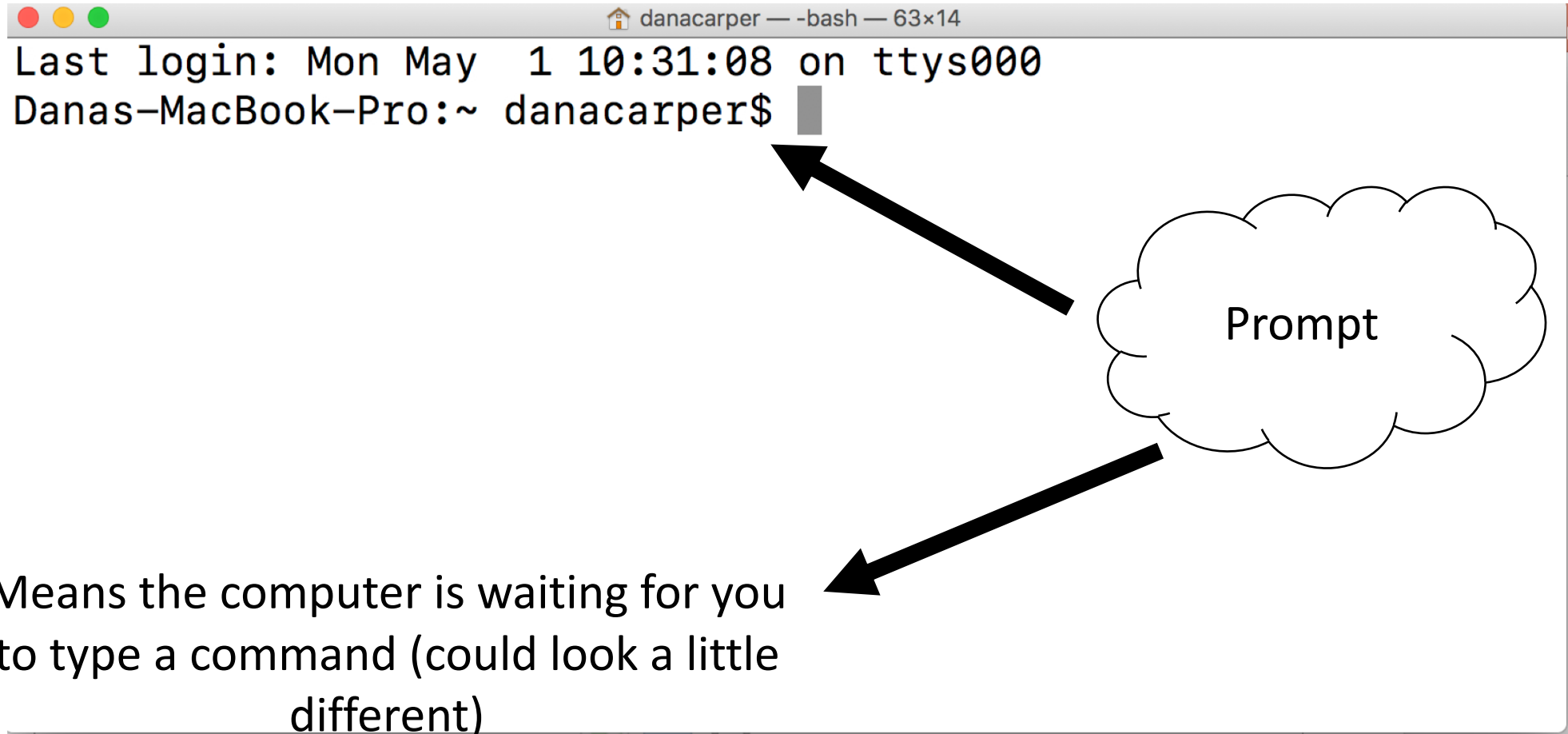
- A Terminal is a device that allows you to talk to the computer
- It can usually be found within the utilities folder in mac
- In ubuntu, under applications or search for terminal



Opening Terminal



Opening Terminal



Computer Terminology

Directory



Folder

How do we determine which directory we are in?

```
danacarper — -bash — 63x14
Last login: Mon May  1 10:31:08 on ttys000
Danas-MacBook-Pro:~ danacarper$ pwd
```

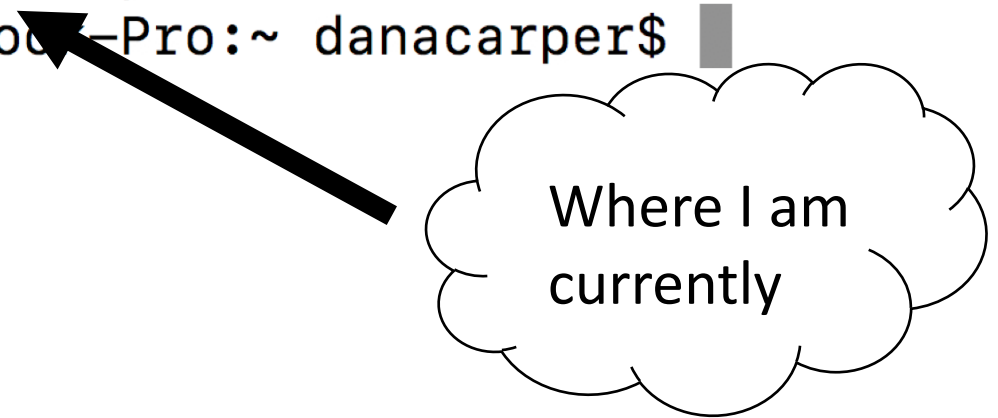


Print
working
directory

Print out which directory (folder) I am in
currently

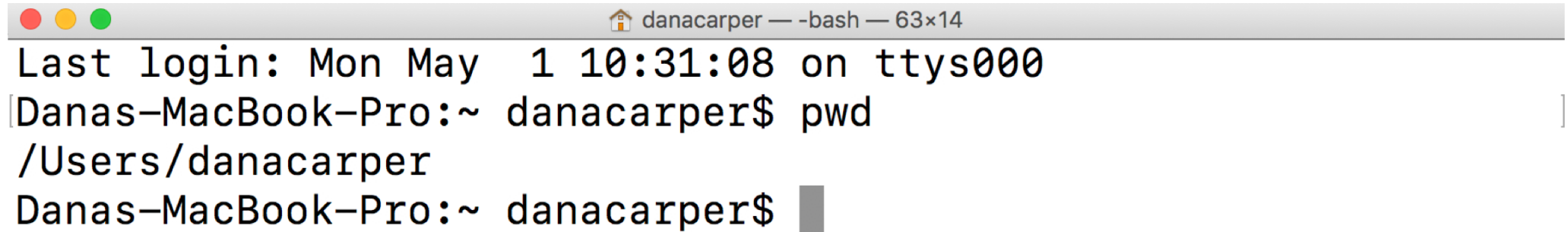
How do we determine which directory we are in?

```
danacarper — -bash — 63x14
Last login: Mon May  1 10:31:08 on ttys000
Danas-MacBook-Pro:~ danacarper$ pwd
/Users/danacarper
Danas-MacBook-Pro:~ danacarper$
```

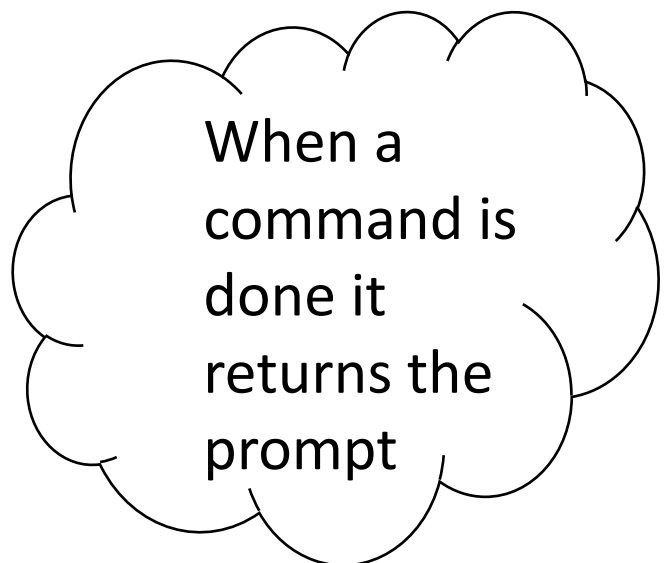


Where I am
currently

How do we determine which directory we are in?

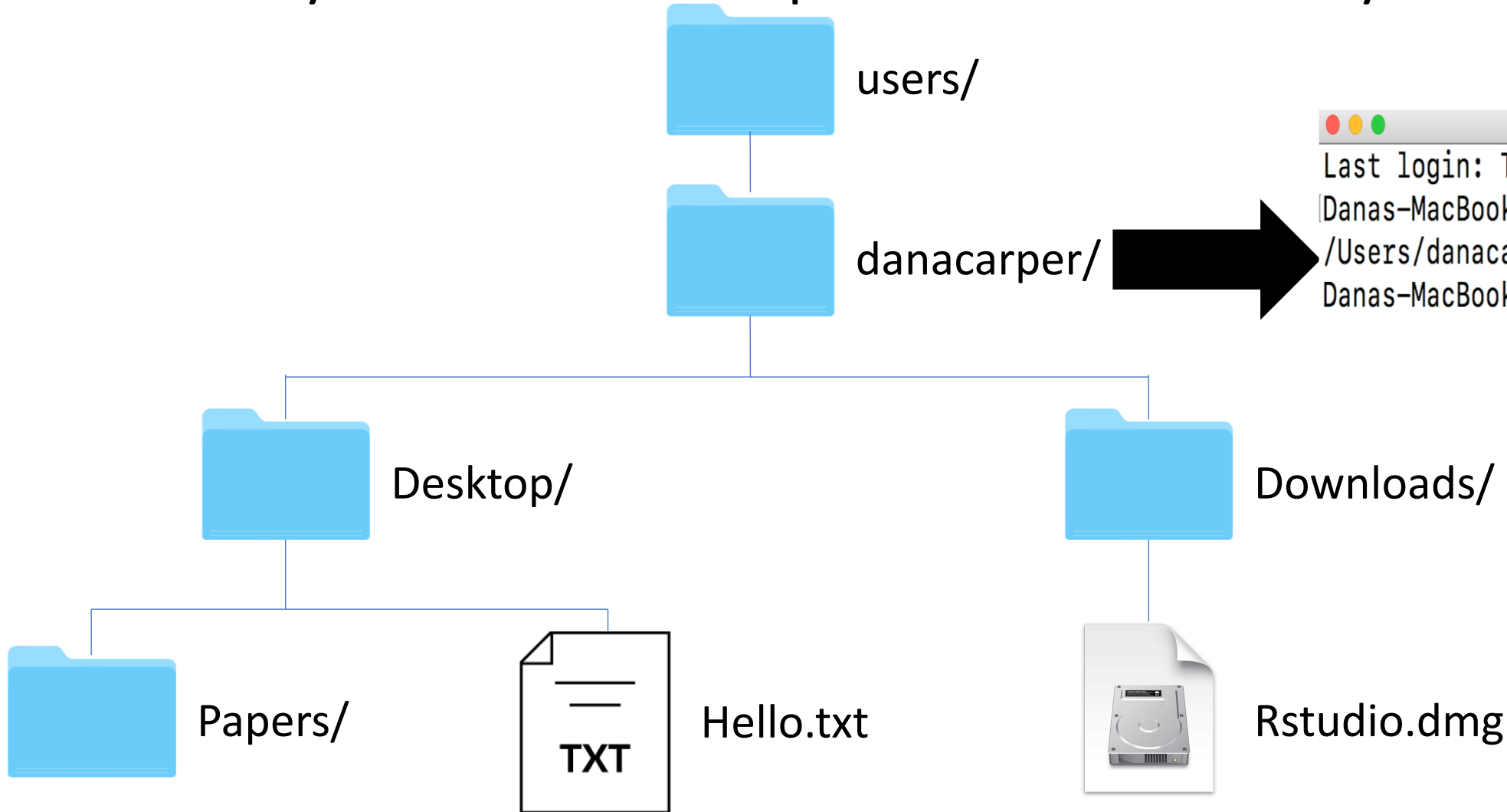


```
danacarper — -bash — 63x14
Last login: Mon May  1 10:31:08 on ttys000
Danas-MacBook-Pro:~ danacarper$ pwd
/Users/danacarper
Danas-MacBook-Pro:~ danacarper$
```



When a
command is
done it
returns the
prompt

A file system is set up like a hierarchy

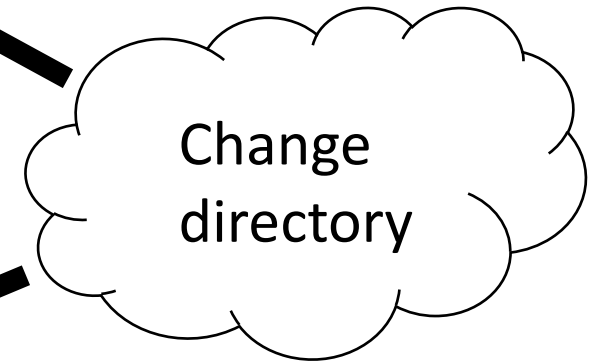


```
danacarper$ pwd
/Users/danacarper
danacarper$
```

A terminal window showing the output of the `pwd` command. The prompt is `Danas-MacBook-Pro:~ danacarper$`. The output is `/Users/danacarper`.

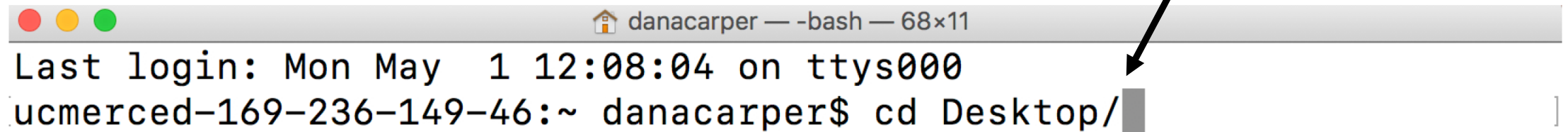
Moving to a different directory

```
danacarper — -bash — 68x11
Last login: Mon May  1 12:08:04 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
```



This is the same as double clicking on a folder

Moving to a different directory



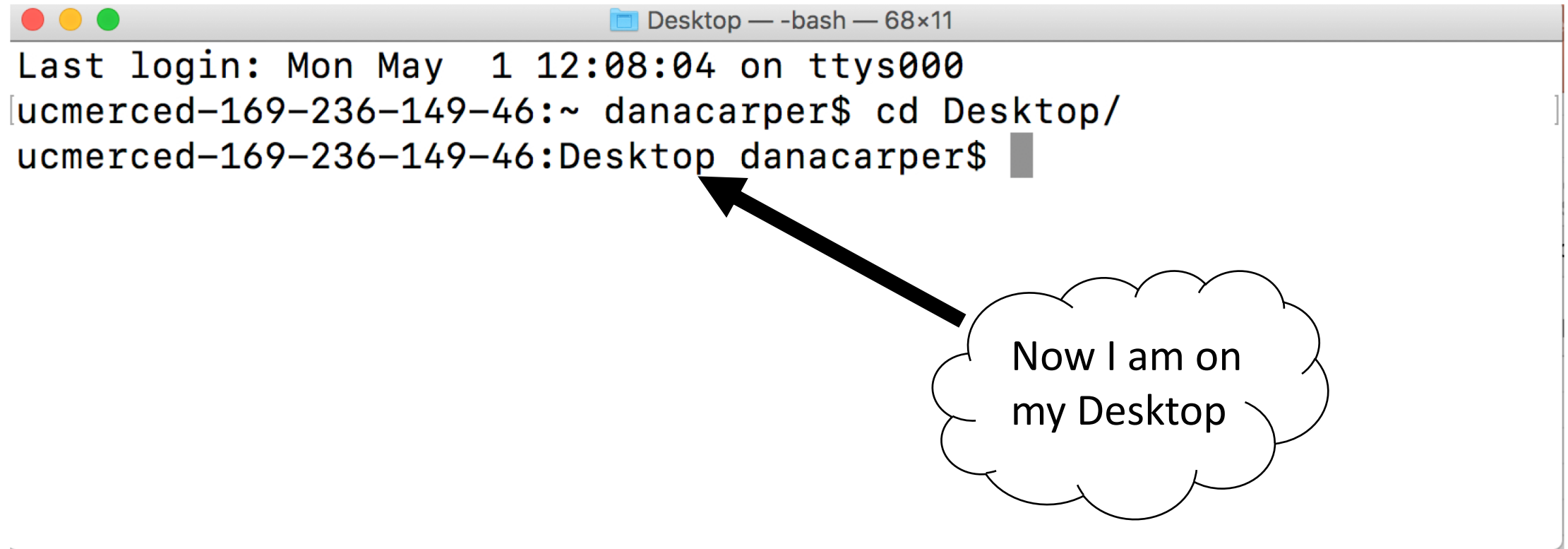
A terminal window with a title bar showing 'danacarper — -bash — 68x11'. The window contains the following text: 'Last login: Mon May 1 12:08:04 on ttys000', 'ucmerced-169-236-149-46:~ danacarper\$', and 'cd Desktop/'. A cursor is positioned at the end of the command. A cloud callout points to the slash in 'Desktop/' with the text 'A slash indicates it is a folder'. Another cloud callout points to the word 'Desktop' with the text 'Which folder I want to go to'.

```
Last login: Mon May 1 12:08:04 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
```

A slash
indicates it
is a folder

Which folder
I want to go
to

Moving to a different directory

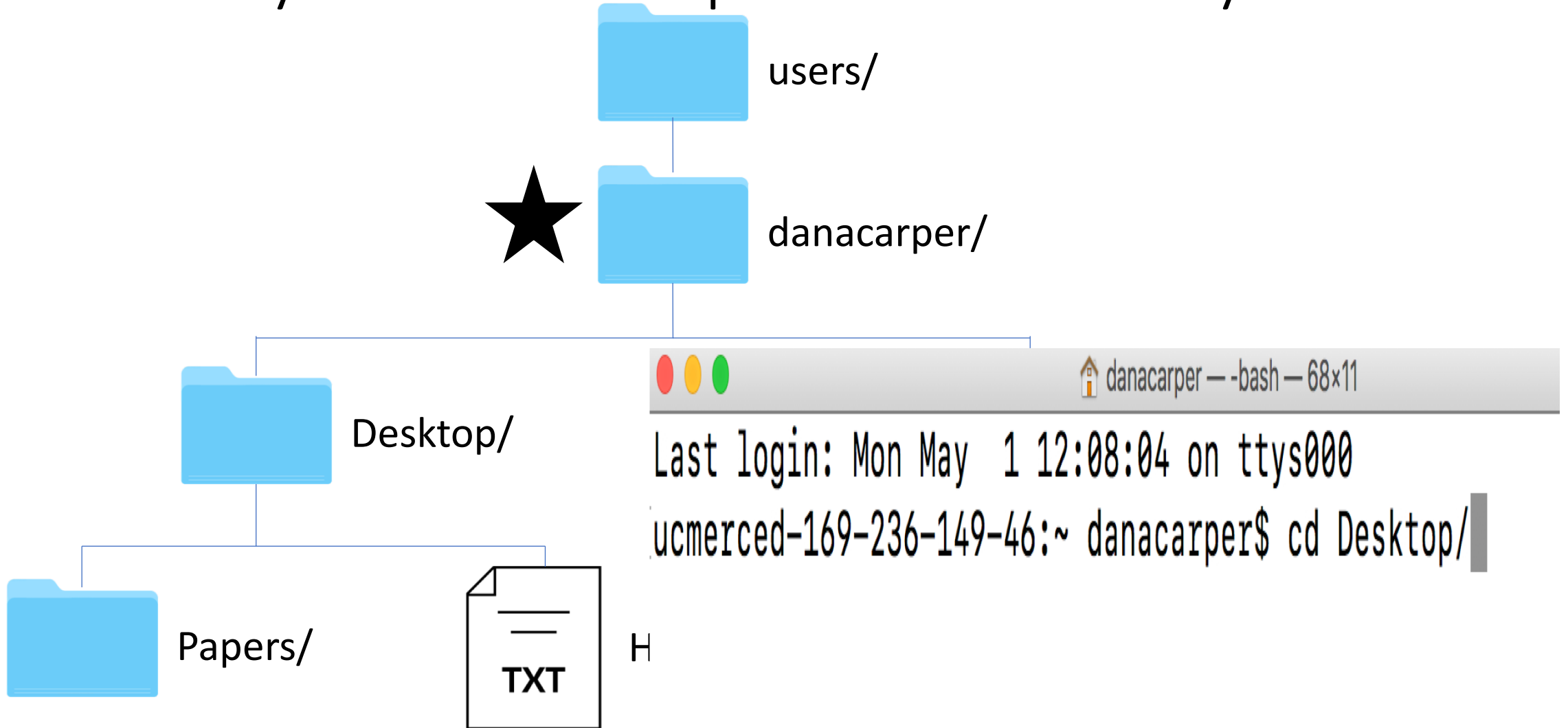


A terminal window titled "Desktop — -bash — 68x11" with standard macOS window controls (red, yellow, green buttons). The terminal output shows a login message and a directory change command. A black arrow points from a cloud-shaped callout bubble to the word "Desktop" in the prompt.

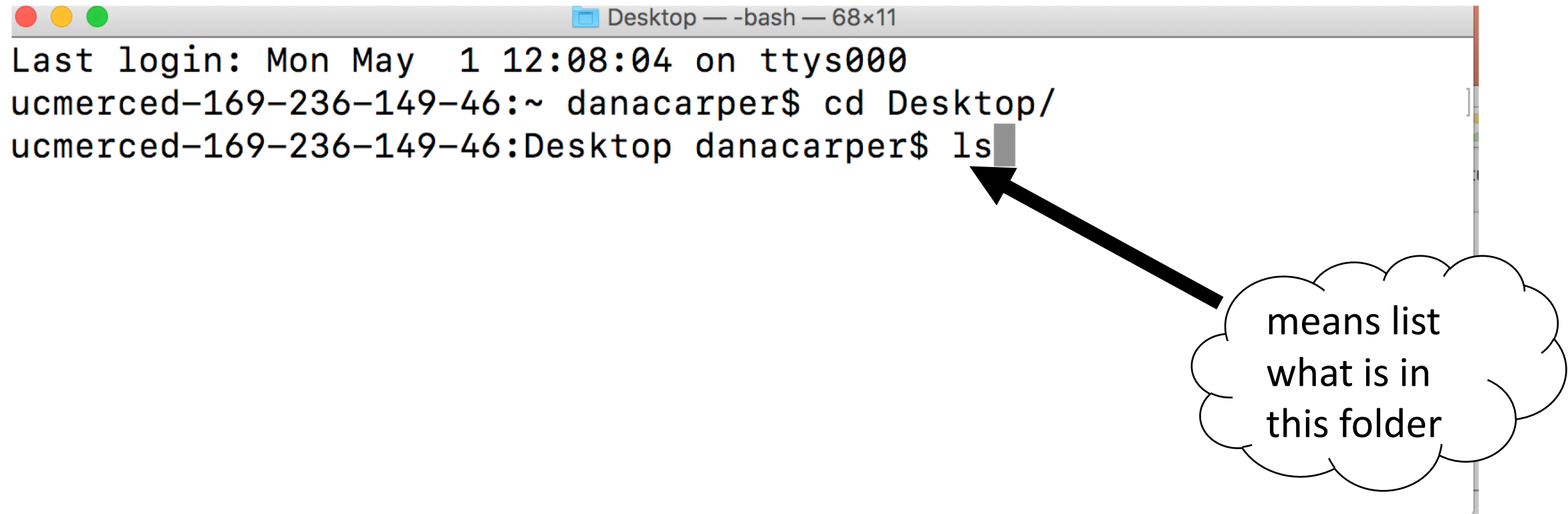
```
Last login: Mon May  1 12:08:04 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$
```

Now I am on my Desktop

A file system is set up like a hierarchy



How do I know what is in a directory?



A terminal window titled "Desktop — -bash — 68x11" with three colored window control buttons (red, yellow, green) on the left. The terminal text shows a login session for user "danacarper" on May 1 at 12:08:04. The user navigates to the "Desktop" directory using "cd Desktop/" and then enters the "ls" command. A black arrow points from a thought bubble to the "ls" command. The thought bubble contains the text "means list what is in this folder".

```
Last login: Mon May  1 12:08:04 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$ ls
```

means list
what is in
this folder

How do I know what is in a directory?

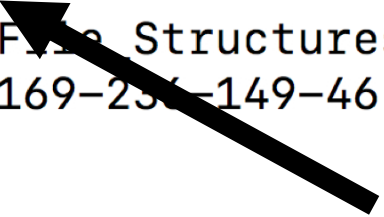
```
Desktop — -bash — 80x24
Last login: Mon May  1 12:22:30 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ ls
Carper_manuscript_2017      Order_List.xlsx
Genetics_S17               Overall_Semester_Goals_S17.docx
Hello.txt                  Papers
Intro_to_File_Structures.pptx Seedling_adult
ucmerced-169-236-149-46:Desktop danacarper$ █
```



Everything
in this folder

How do I look at a file?

```
Desktop — -bash — 80x24
Last login: Mon May  1 12:22:30 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ ls
Carper_manuscript_2017      Order_List.xlsx
Genetics_S17                Overall_Semester_Goals_S17.docx
Hello.txt                  Papers
Intro_to_Fish_Structures.pptx  Seedling_adult
ucmerced-169-236-149-46:Desktop danacarper$
```



I want to
look at this
file

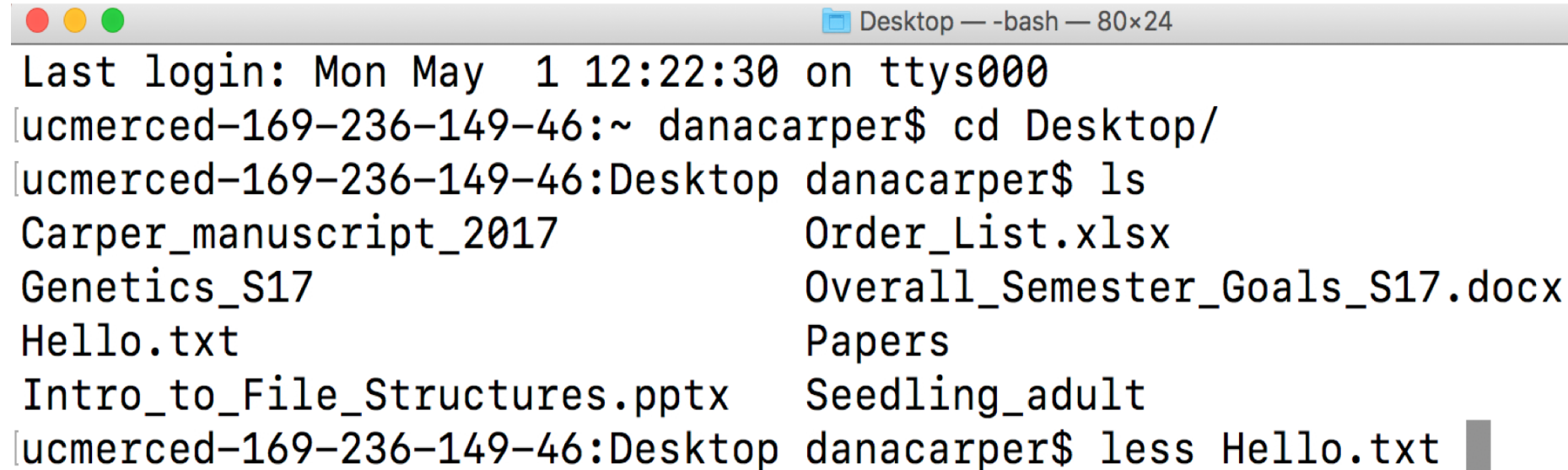
How do I look at a file?

```
Desktop — -bash — 80x24
Last login: Mon May  1 12:22:30 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ ls
Carper_manuscript_2017      Order_List.xlsx
Genetics_S17               Overall_Semester_Goals_S17.docx
Hello.txt                  Papers
Intro_to_File_Structures.pptx Seedling_adult
[ucmerced-169-236-149-46:Desktop danacarper$ less Hello.txt █
```

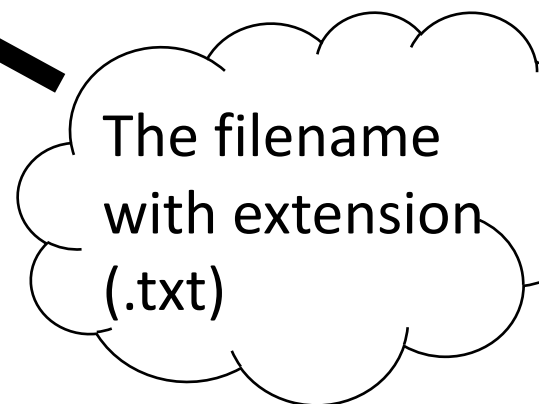


Means view

How do I look at a file?

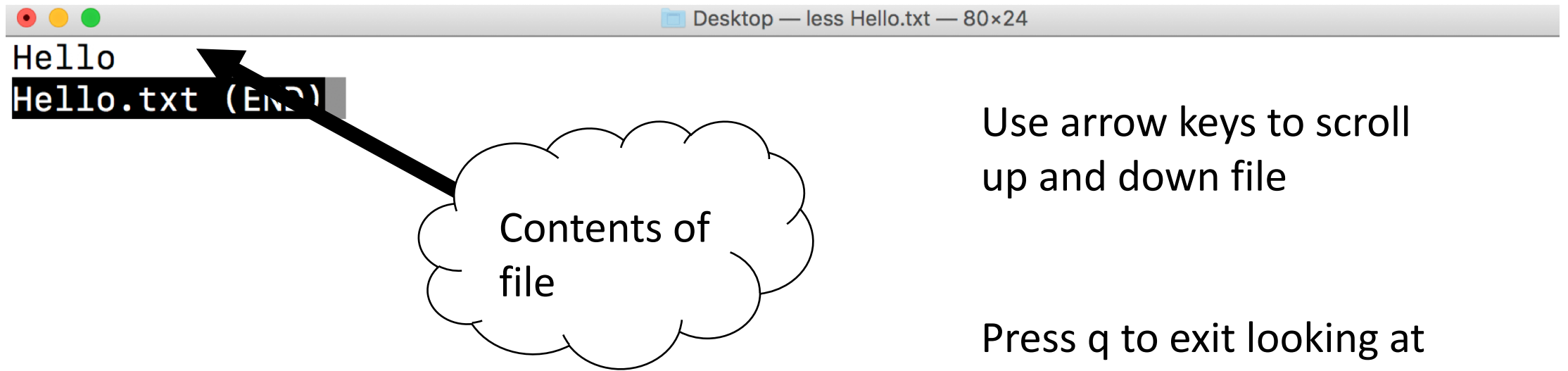
A screenshot of a terminal window titled "Desktop — -bash — 80x24". The window shows a series of commands and their outputs. The first line shows the last login time. The second line shows the user navigating to the Desktop directory. The third line shows the user listing files in the Desktop directory. The fourth line shows the user using the 'less' command to view the contents of 'Hello.txt'.

```
Last login: Mon May  1 12:22:30 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ ls
Carper_manuscript_2017      Order_List.xlsx
Genetics_S17                Overall_Semester_Goals_S17.docx
Hello.txt                  Papers
Intro_to_File_Structures.pptx Seedling_adult
[ucmerced-169-236-149-46:Desktop danacarper$ less Hello.txt
```

A callout bubble with a black arrow pointing to the filename 'Hello.txt' in the terminal output. The bubble contains the text 'The filename with extension (.txt)'.

The filename
with extension
(.txt)

How do I look at a file?



Use arrow keys to scroll
up and down file

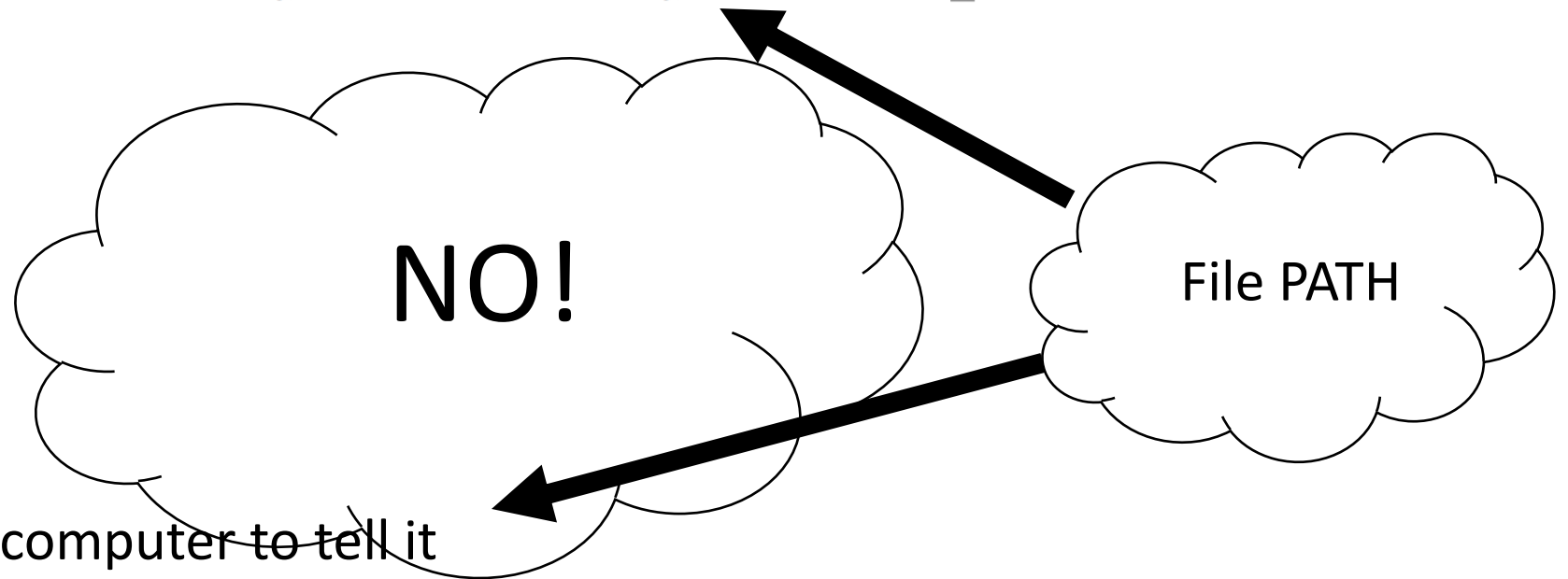
Press q to exit looking at
the file (q =quit)

Do I have to be in the same folder as the file to look at it?

danacarper — -bash — 93x23

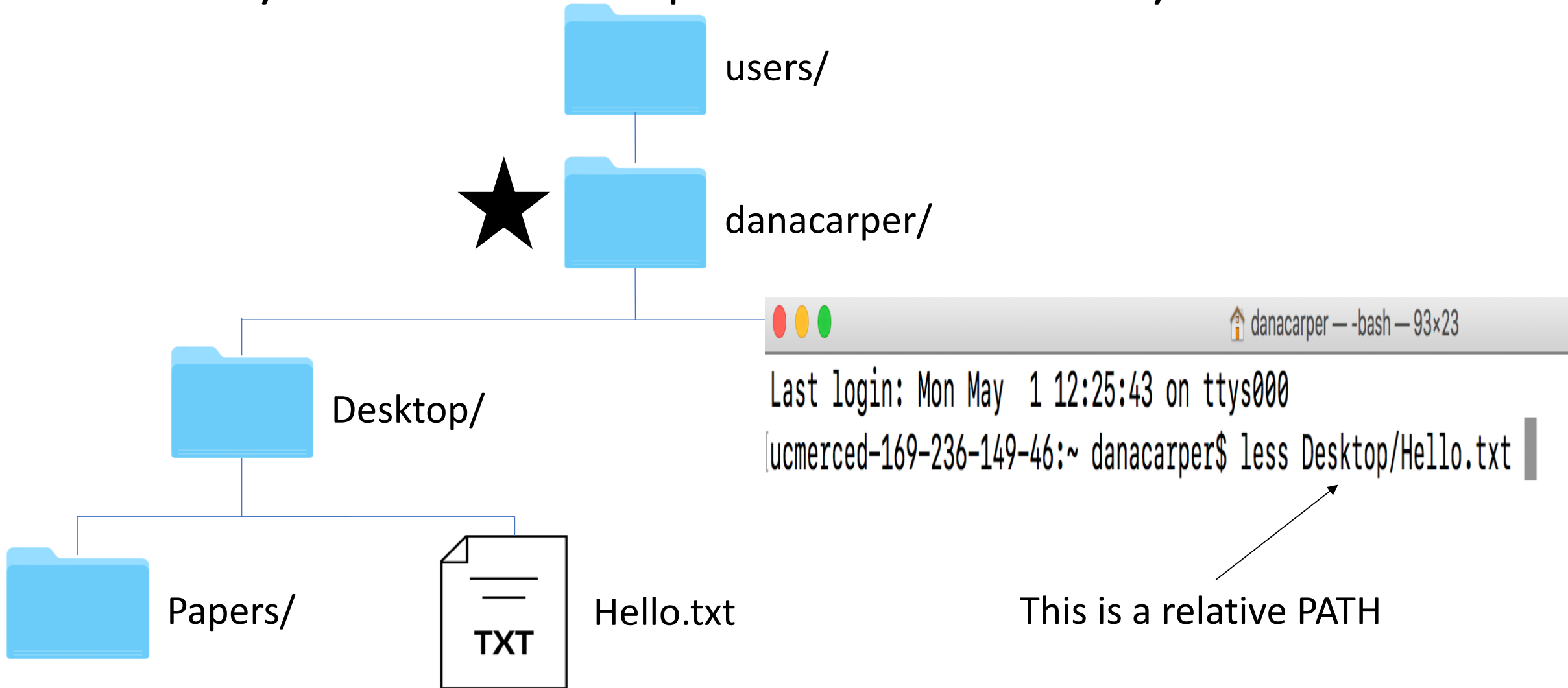
Last login: Mon May 1 12:25:43 on ttys000

[ucmerced-169-236-149-46:~ danacarper\$ less Desktop/Hello.txt

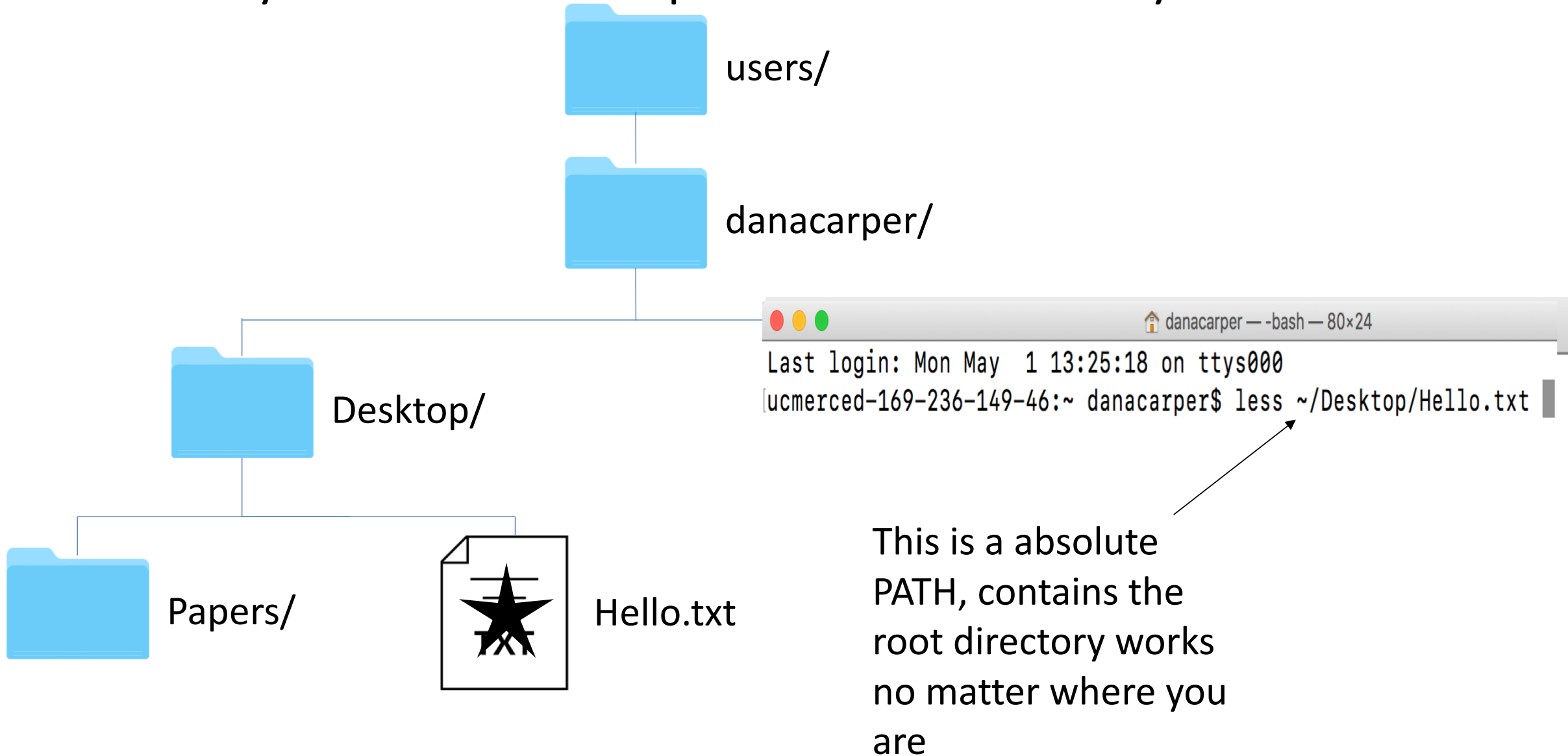


Directions for the computer to tell it
where the file is

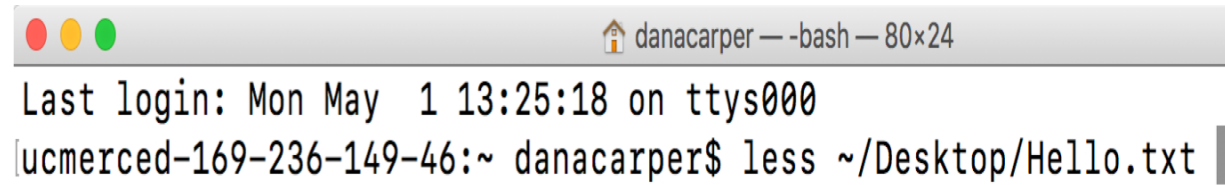
A file system is set up like a hierarchy



A file system is set up like a hierarchy



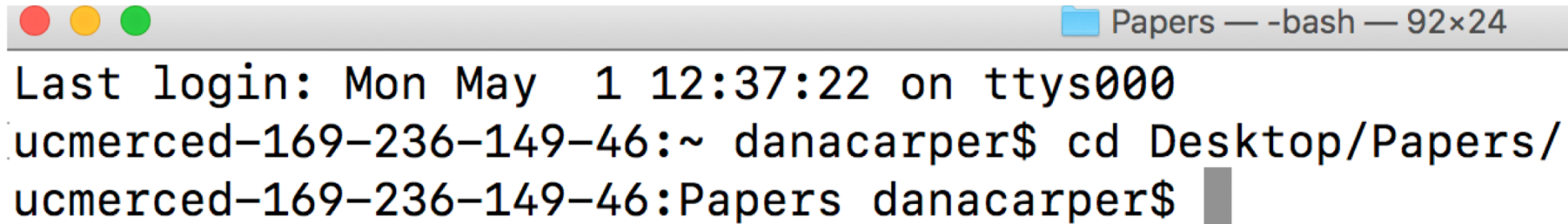
Absolute PATH



A terminal window with a title bar that says "danacarper — -bash — 80x24". The window contains the text "Last login: Mon May 1 13:25:18 on ttys000" and a command prompt "[ucmerced-169-236-149-46:~ danacarper\$ less ~/Desktop/Hello.txt" with a cursor at the end of the line. A large black arrow points from the tilde symbol in the command to the tilde symbol in the definition below.

~ = HOME
(/users/danacarper/)

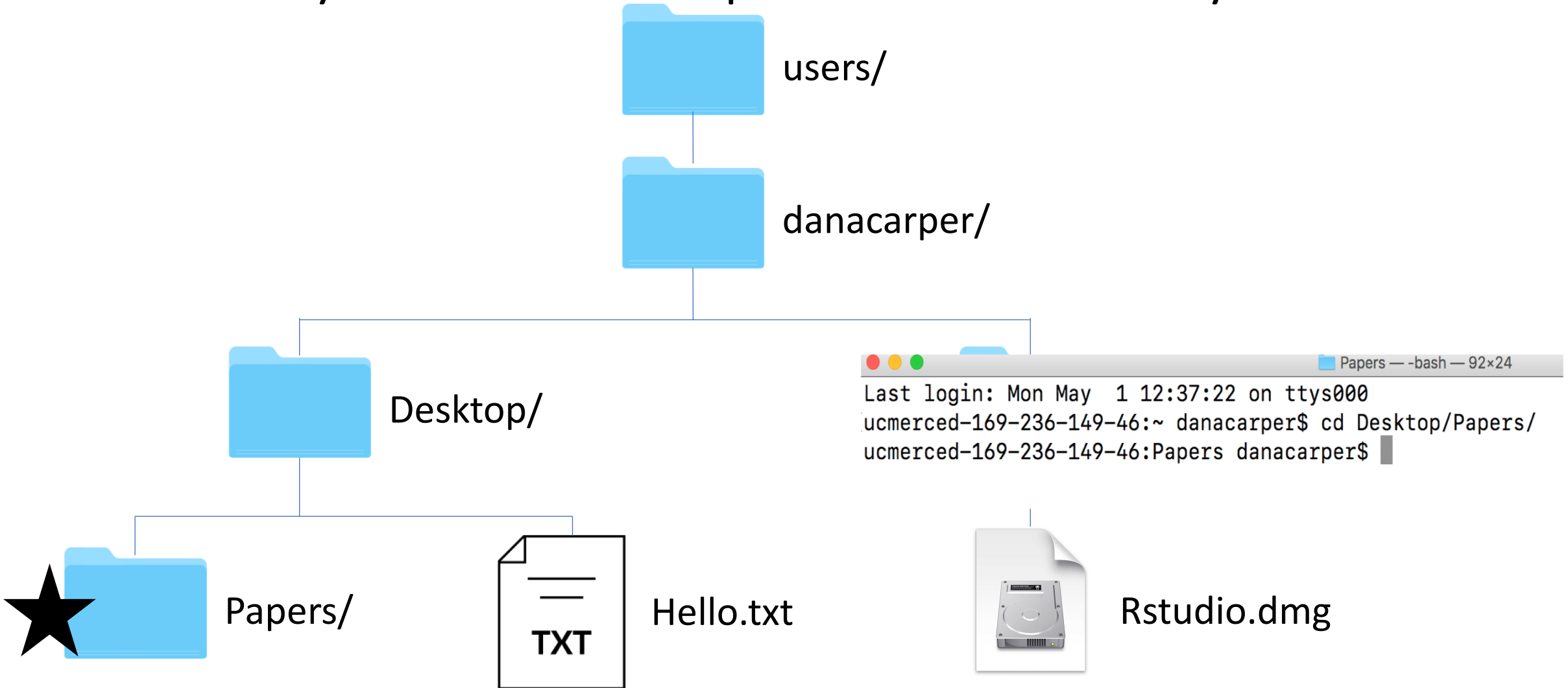
Giving the PATH works for other commands too!



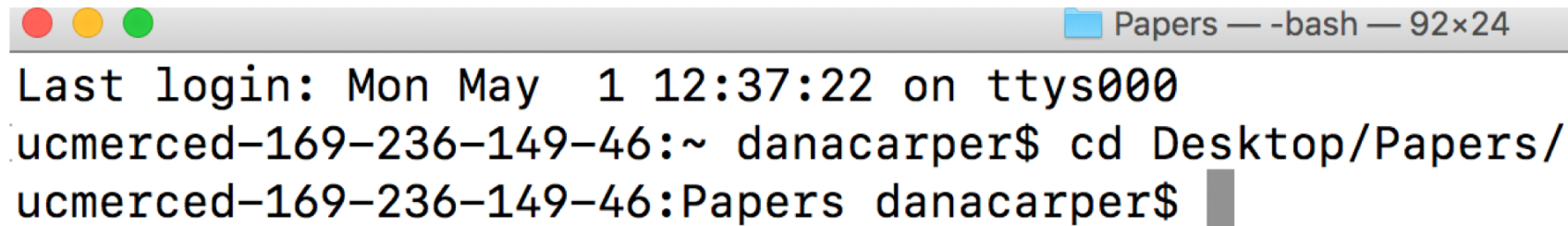
A terminal window titled "Papers — -bash — 92x24" with standard macOS window controls (red, yellow, green buttons). The terminal output shows a login message and a directory change command. A black arrow points to the word "Papers" in the second line of the output.

```
Last login: Mon May  1 12:37:22 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/Papers/
ucmerced-169-236-149-46:Papers danacarper$
```

A file system is set up like a hierarchy

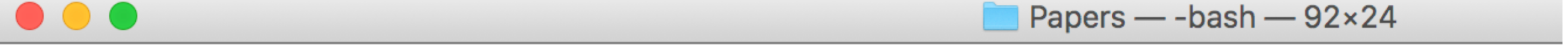


Oops I went too far I meant to be on the desktop, How do I go back?

A screenshot of a macOS terminal window. The title bar at the top shows three colored window control buttons (red, yellow, green) on the left and a title bar with a blue folder icon, the text 'Papers — -bash — 92x24', and a close button on the right. The terminal content shows a login message, a directory change command, and the resulting prompt.

```
Last login: Mon May  1 12:37:22 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/Papers/
ucmerced-169-236-149-46:Papers danacarper$
```

Multiple ways to go back



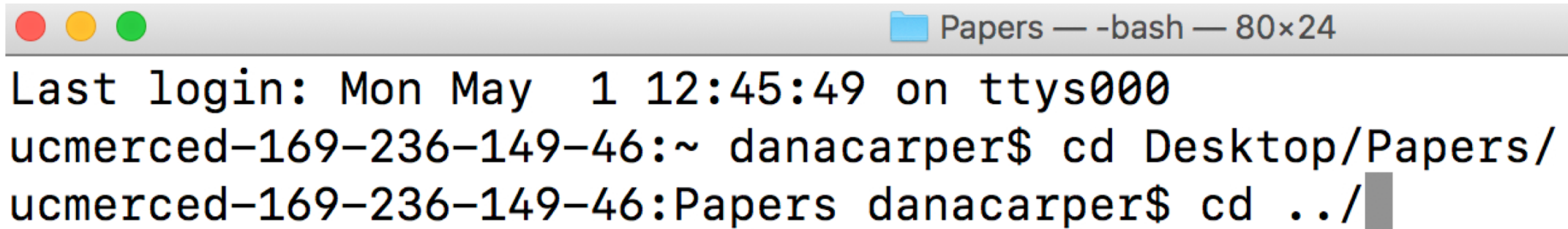
A terminal window with a title bar containing three colored circles (red, yellow, green) on the left and a folder icon followed by the text 'Papers — -bash — 92x24' on the right. The terminal content shows a login message and two directory change commands.

```
Last login: Mon May  1 12:37:22 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/Papers/
[ucmerced-169-236-149-46:Papers danacarper$ cd ~/Desktop/
```



Means Home
(/users/danacarper/)

Multiple ways to go back

A screenshot of a macOS terminal window. The title bar at the top shows three colored window control buttons (red, yellow, green) on the left and a title 'Papers — -bash — 80x24' on the right. The terminal text shows a login message, a directory change to 'Desktop/Papers/', and another directory change to '../'.

```
Last login: Mon May  1 12:45:49 on ttys000
ucmerced-169-236-149-46:~ danacarper$ cd Desktop/Papers/
ucmerced-169-236-149-46:Papers danacarper$ cd ../
```



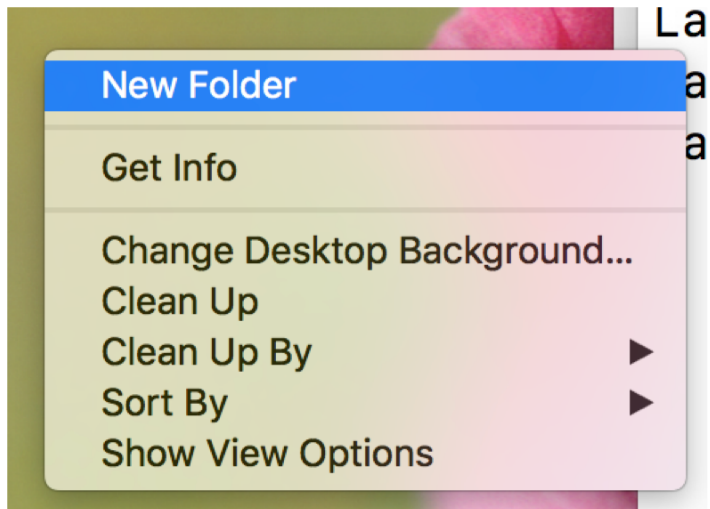
Means go back
one folder

Now that we have navigated
directories

How do we create a new directory?

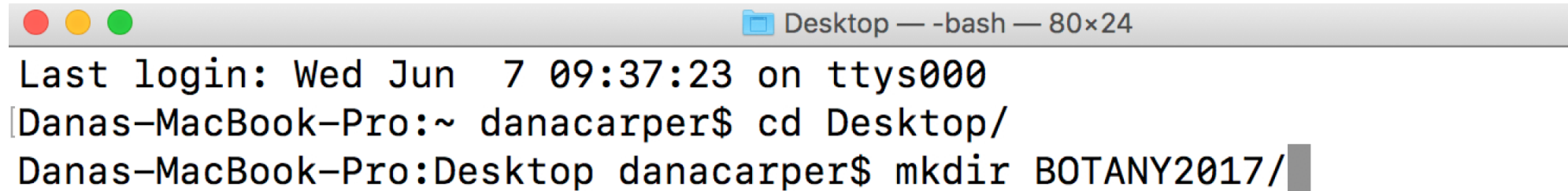
```
Desktop — -bash — 80x24
Last login: Wed Jun  7 09:37:23 on ttys000
Danas-MacBook-Pro:~ danacarper$ cd Desktop/
Danas-MacBook-Pro:Desktop danacarper$ mkdir BOTANY2017/
```

The same a
right clicking
to make a
new folder

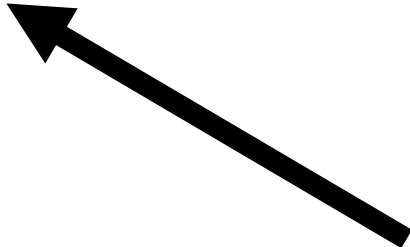


Make new
folder

How do we create a new directory?

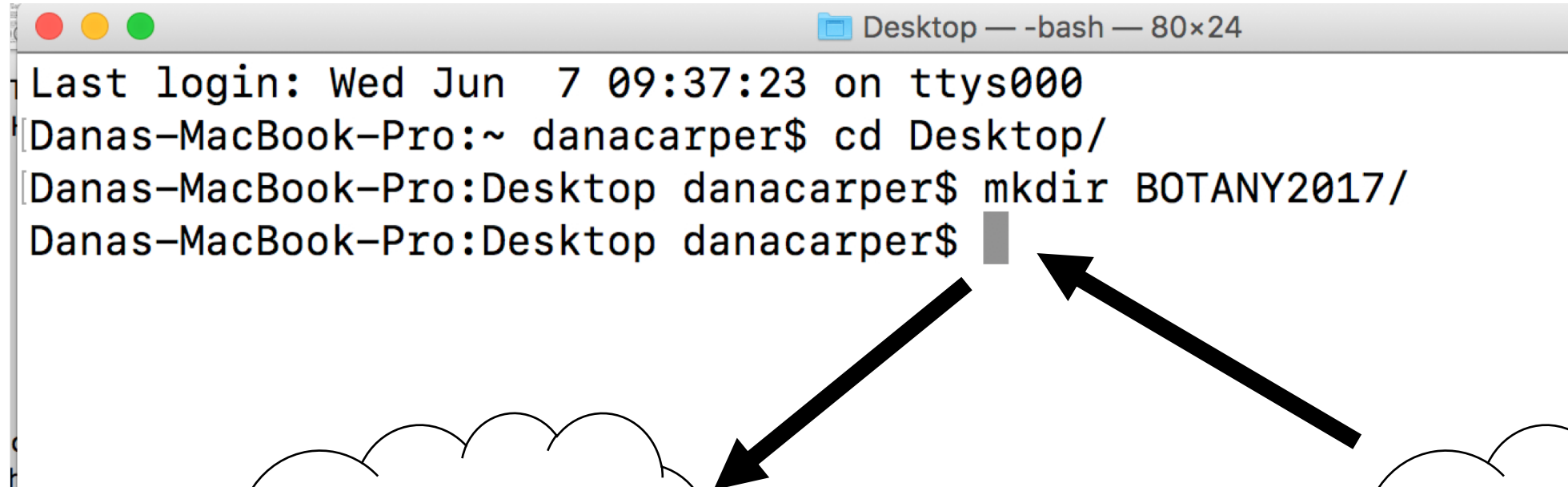
A screenshot of a macOS terminal window. The title bar shows three colored window control buttons (red, yellow, green) on the left and a folder icon followed by the text 'Desktop — -bash — 80x24' on the right. The terminal content shows a login message, a directory change command, and a directory creation command.

```
Last login: Wed Jun  7 09:37:23 on ttys000
Danas-MacBook-Pro:~ danacarper$ cd Desktop/
Danas-MacBook-Pro:Desktop danacarper$ mkdir BOTANY2017/
```

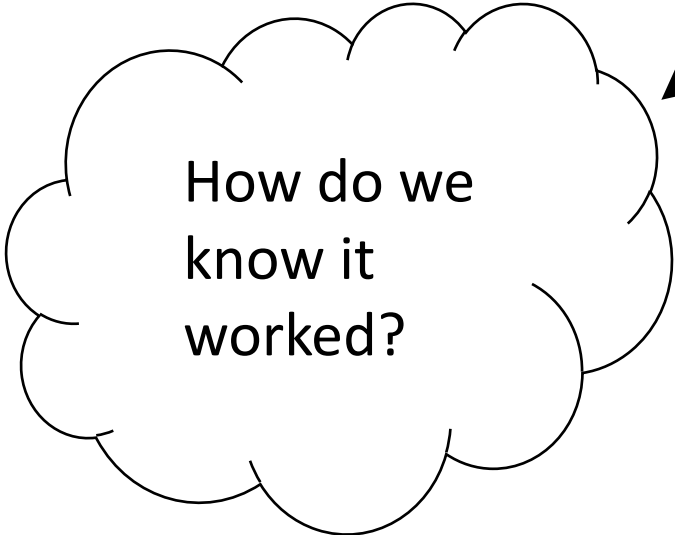
A thick black arrow originates from a cloud-shaped callout box and points towards the text 'BOTANY2017/' in the terminal command line above.

Name of
folder

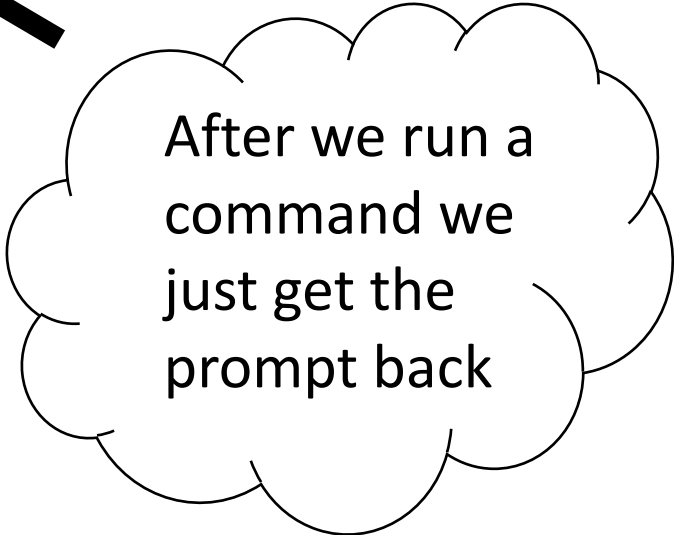
How do we create a new directory?

A terminal window titled "Desktop — -bash — 80x24" with three colored window control buttons (red, yellow, green) in the top-left corner. The terminal text shows a user logging in, changing to the Desktop directory, and running the 'mkdir' command to create a directory named 'BOTANY2017'. The prompt returns after the command is executed.

```
Last login: Wed Jun  7 09:37:23 on ttys000
Danas-MacBook-Pro:~ danacarper$ cd Desktop/
Danas-MacBook-Pro:Desktop danacarper$ mkdir BOTANY2017/
Danas-MacBook-Pro:Desktop danacarper$
```

A cloud-shaped thought bubble with a black outline, containing the text "How do we know it worked?".

How do we know it worked?

A cloud-shaped thought bubble with a black outline, containing the text "After we run a command we just get the prompt back".

After we run a command we just get the prompt back

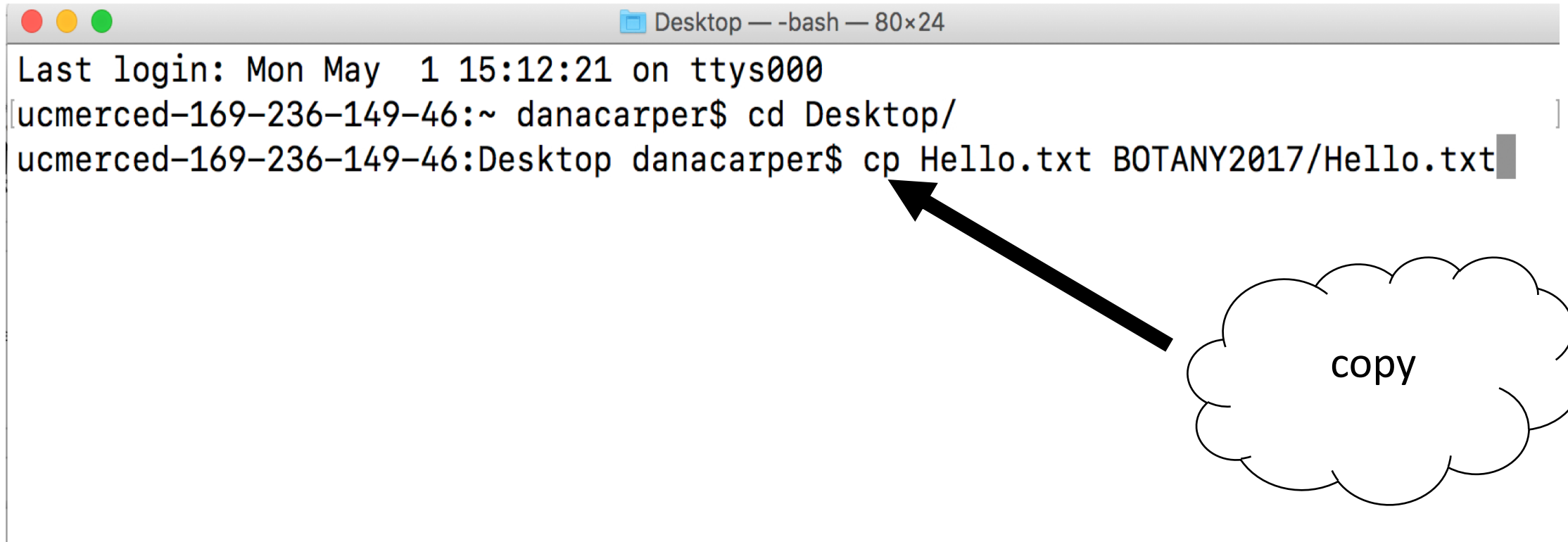
How do we create a new directory?

```
Desktop — -bash — 80x24
Last login: Wed Jun  7 09:37:23 on ttys000
Danas-MacBook-Pro:~ danacarper$ cd Desktop/
Danas-MacBook-Pro:Desktop danacarper$ mkdir BOTANY2017/
Danas-MacBook-Pro:Desktop danacarper$ ls
Arabidopsis_thaliana.TAIR10.35.gff3
BOTANY2017
BOTANY_2017_carper.pptx
Carper_manuscript_2017
Hello.txt
Order_List.xlsx
Overall_Semester_Goals_S17.doc
Papers
Plantae.csv
Screen Shot 2017-06-07 at 9
Screen Shot 2017-06-07 at 9
Screen Shot 2017-06-07 at 9
Seedling_adult
hisat2
Danas-MacBook-Pro:Desktop danacarper$
```

There is our
new folder

Check using ls
command

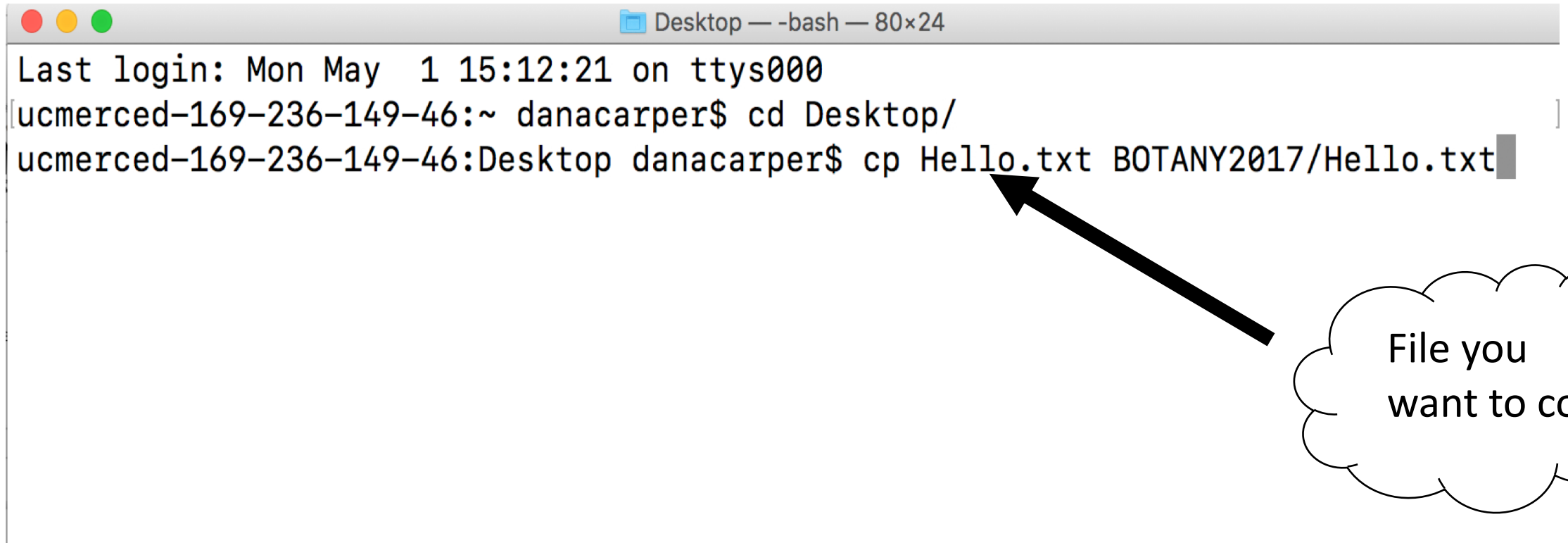
How do we copy a file to that new folder?



```
Desktop — -bash — 80x24
Last login: Mon May  1 15:12:21 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$ cp Hello.txt BOTANY2017/Hello.txt
```

A diagram consisting of a cloud shape with the word "copy" inside. A thick black arrow points from the cloud towards the terminal command `cp Hello.txt BOTANY2017/Hello.txt` in the terminal window.

How do we copy a file to that new folder?

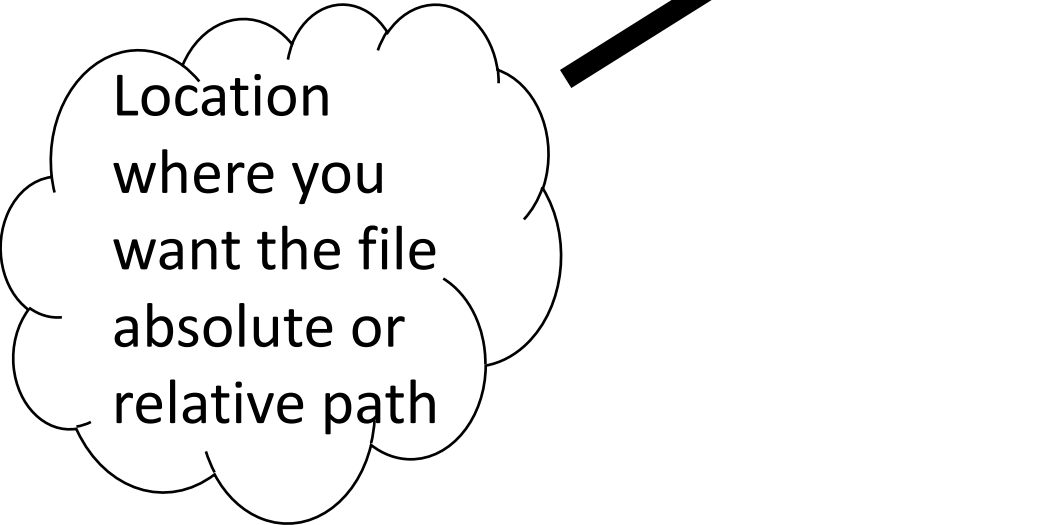


```
Desktop — -bash — 80x24
Last login: Mon May  1 15:12:21 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$ cp Hello.txt BOTANY2017/Hello.txt
```

A terminal window titled "Desktop — -bash — 80x24" shows a sequence of commands. The first command is `cd Desktop/`. The second command is `cp Hello.txt BOTANY2017/Hello.txt`. A black arrow points from a cloud-shaped callout bubble containing the text "File you want to copy" to the `Hello.txt` file in the `cp` command.

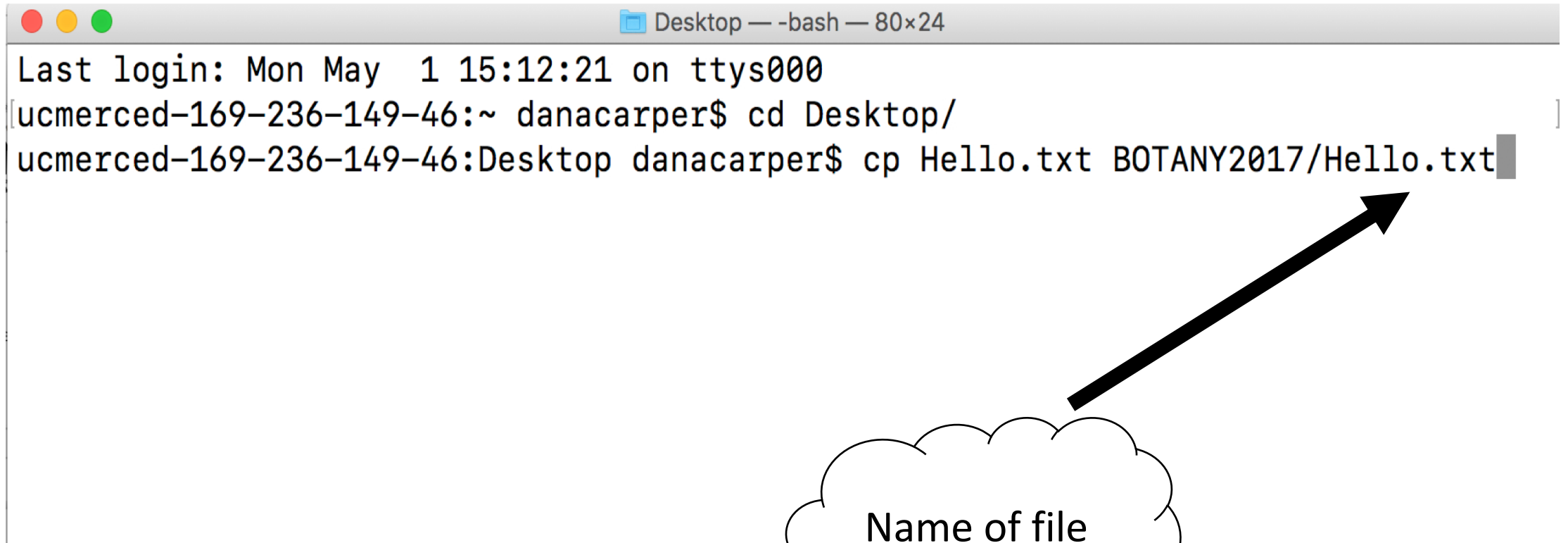
How do we copy a file to that new folder?

```
Desktop — -bash — 80x24
Last login: Mon May  1 15:12:21 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$ cp Hello.txt BOTANY2017/Hello.txt
```



Location
where you
want the file
absolute or
relative path

How do we copy a file to that new folder?



A terminal window titled "Desktop — -bash — 80x24" shows the following commands and output:

```
Last login: Mon May  1 15:12:21 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
ucmerced-169-236-149-46:Desktop danacarper$ cp Hello.txt BOTANY2017/Hello.txt
```

Below the terminal, a cloud-shaped callout contains the text "Name of file". A thick black arrow points from this cloud to the file name "Hello.txt" in the command line of the terminal.

What if we want to delete a file?

```
Desktop — -bash — 80x24
Last login: Mon May  1 15:13:12 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ rm BOTANY2017/Hello.txt
```

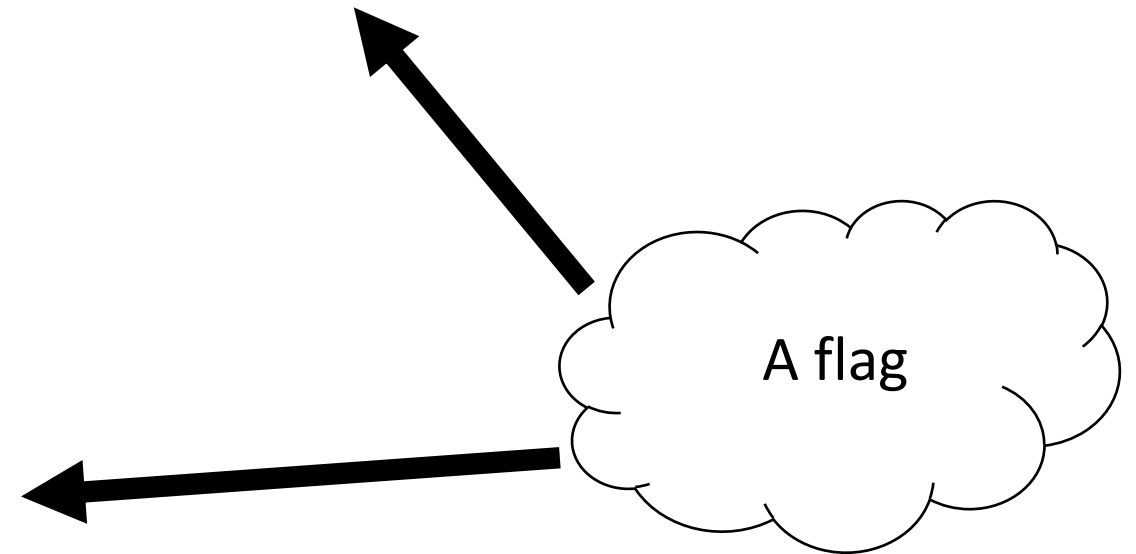
THIS CAN NOT BE UNDONE!!!!

Remove or
delete

What if we want to delete a file and a folder?

```
Desktop — -bash — 80x24  
Last login: Mon May  1 15:22:15 on ttys000  
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/  
[ucmerced-169-236-149-46:Desktop danacarper$ rm -R BOTANY2017/
```

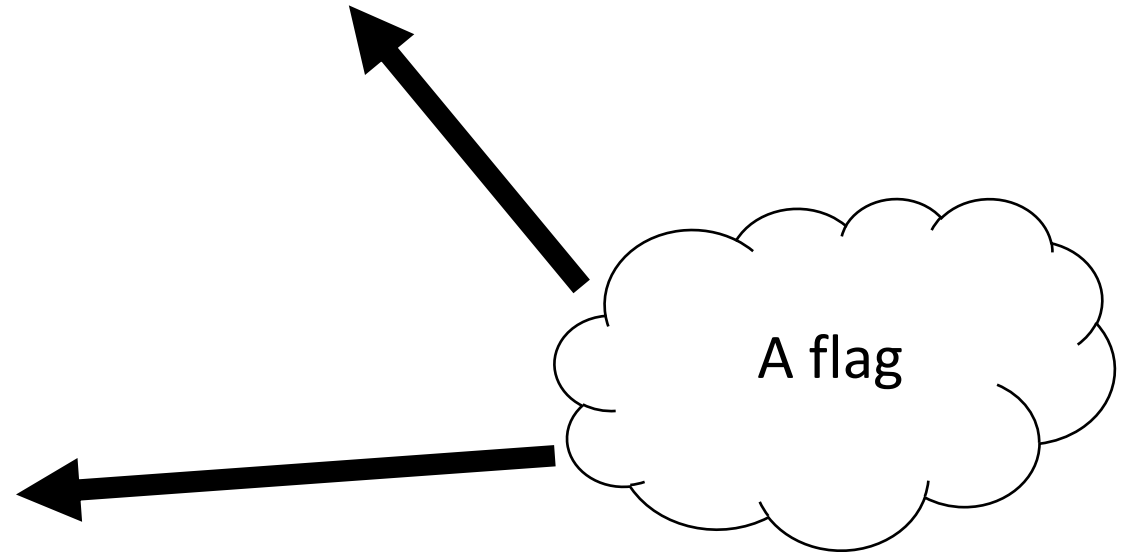
This is an option for a command



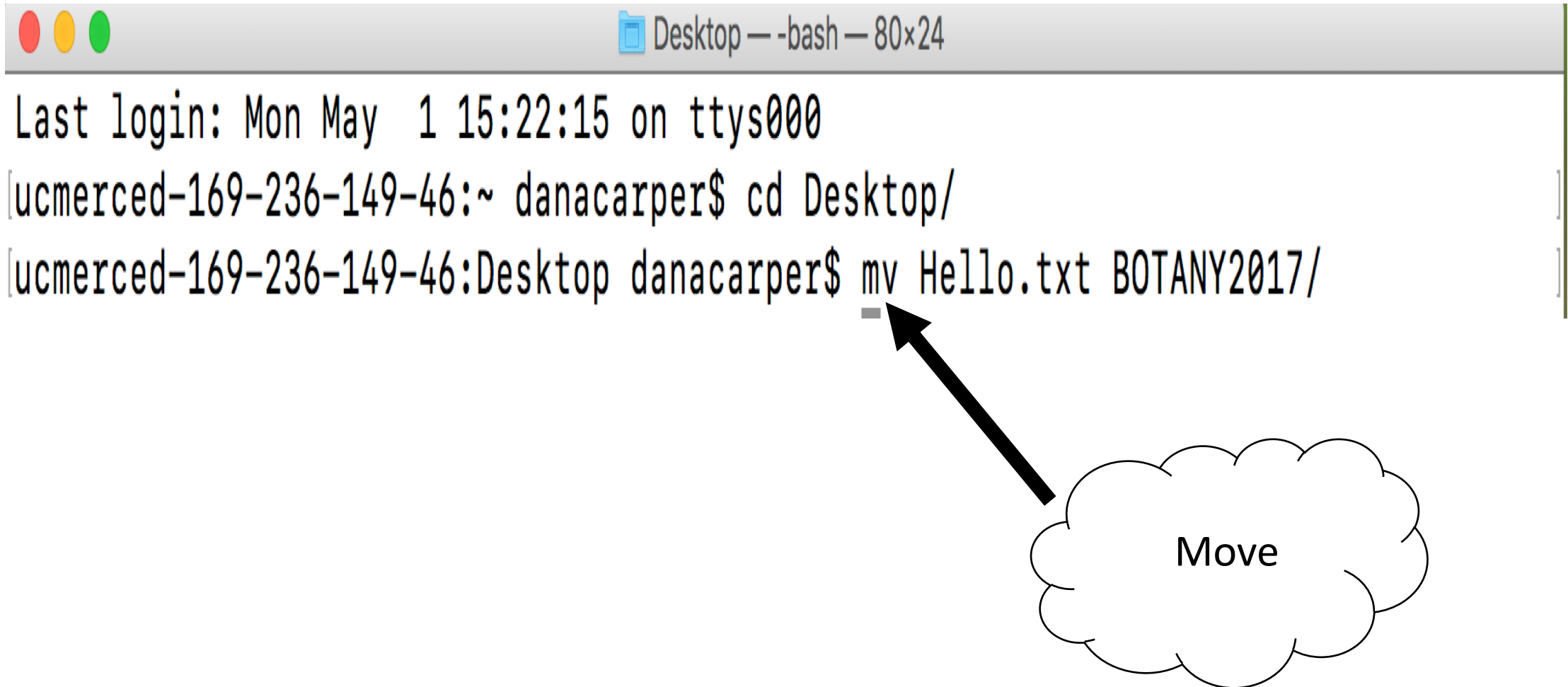
What if we want to delete a file and a folder?

```
Desktop — -bash — 80x24  
Last login: Mon May  1 15:22:15 on ttys000  
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/  
[ucmerced-169-236-149-46:Desktop danacarper$ rm -R BOTANY2017/
```

means remove all files and folder



What if we want to move a file instead of copying it?



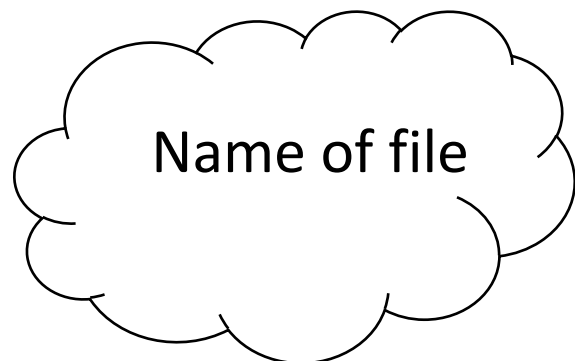
A terminal window with a title bar that says "Desktop — -bash — 80x24". The window contains the following text:

```
Last login: Mon May  1 15:22:15 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/
[ucmerced-169-236-149-46:Desktop danacarper$ mv Hello.txt BOTANY2017/
```

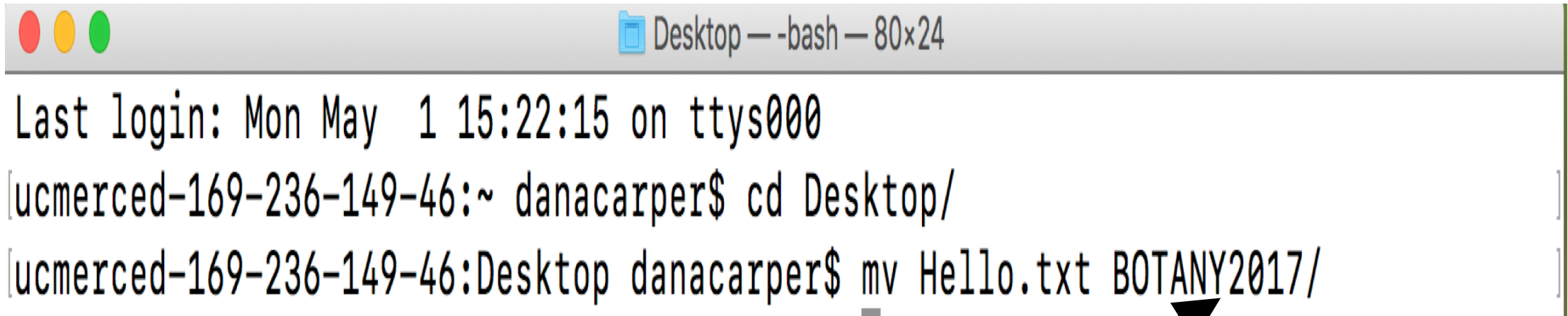
An arrow points from a cloud labeled "Move" to the `mv` command in the terminal.

What if we want to move a file instead of copying it?

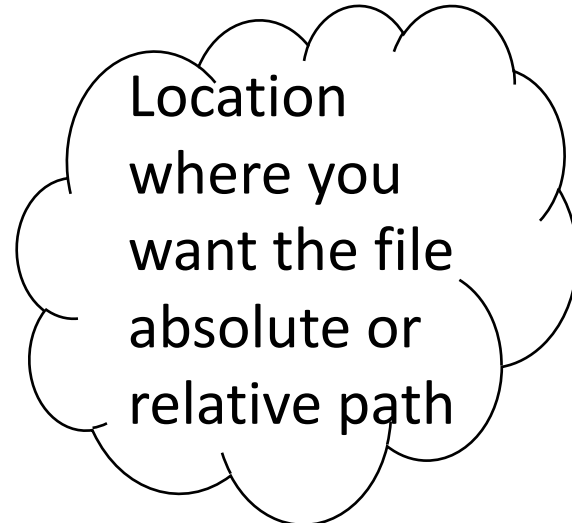
```
Desktop — -bash — 80x24  
Last login: Mon May  1 15:22:15 on ttys000  
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/  
[ucmerced-169-236-149-46:Desktop danacarper$ mv Hello.txt BOTANY2017/
```



What if we want to move a file instead of copying it?



```
Desktop — -bash — 80x24  
Last login: Mon May  1 15:22:15 on ttys000  
[ucmerced-169-236-149-46:~ danacarper$ cd Desktop/  
[ucmerced-169-236-149-46:Desktop danacarper$ mv Hello.txt BOTANY2017/
```



Why do these things on command line?

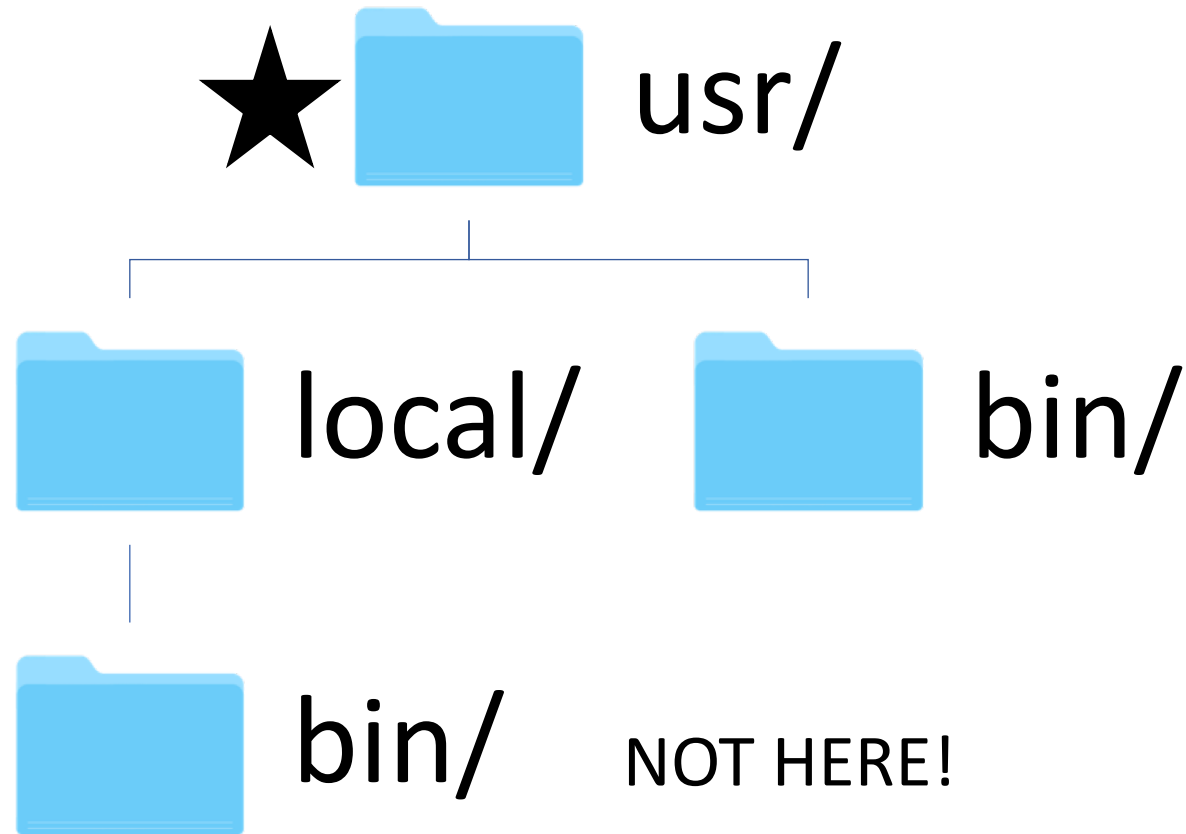
- Don't always have a interface that has a mouse
 - such as a cluster or server
- Working with a bunch of files
 - will show you how to move many files coming up in the next sections

UNIX Ideas: PATH

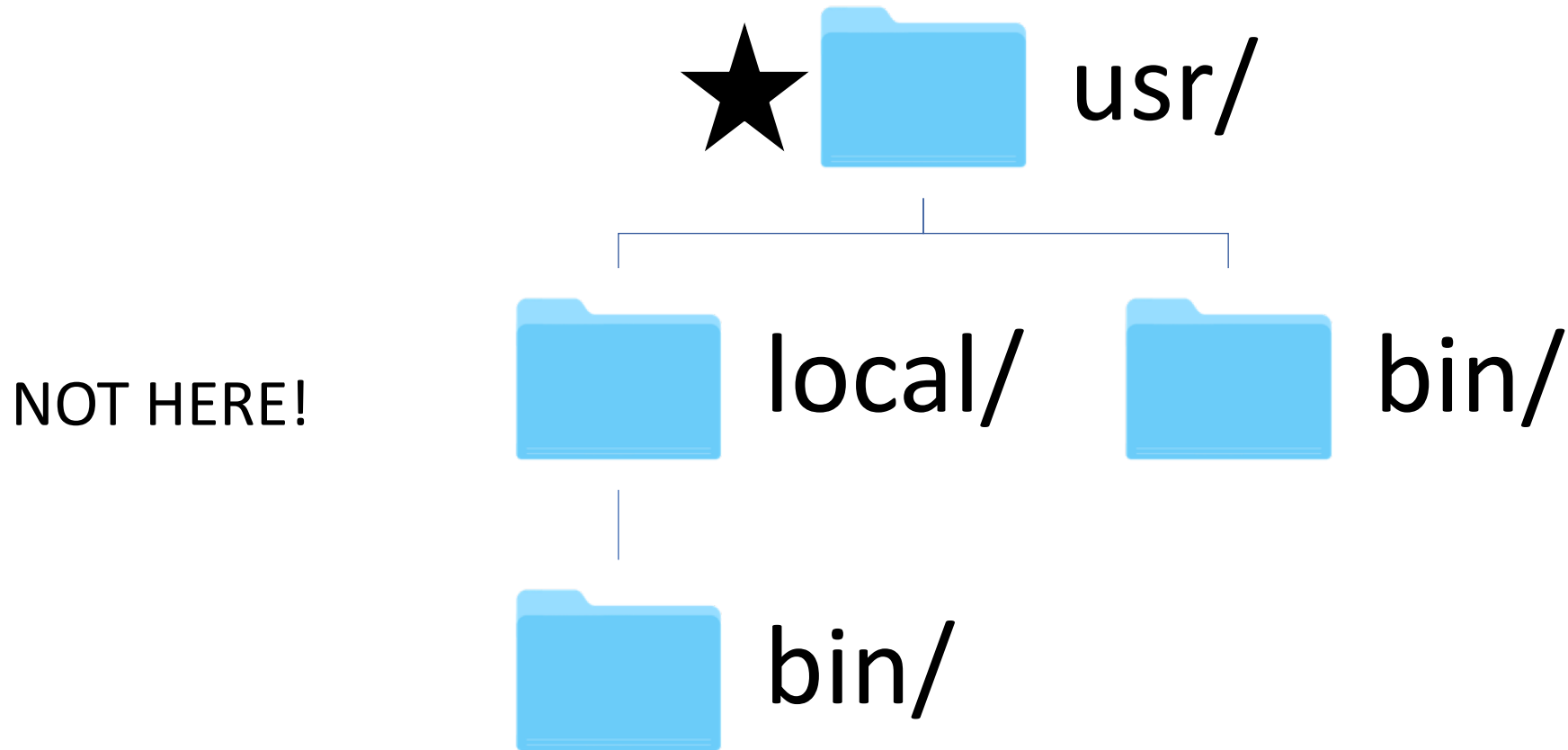
How does the computer know commands?

- Computers need to know where to look for commands or new functions
- If you add a new function or command:
 - To be able to use it no matter what folder you are in it has to be in your \$PATH
 - A \$PATH is a list of folders the computer checks for a command or function
- Example \$PATH:
 - /usr/local/bin:/usr/local:/usr/bin
 - What does this mean?

Example \$PATH:
/usr/local/bin:/usr/local:/usr/bin

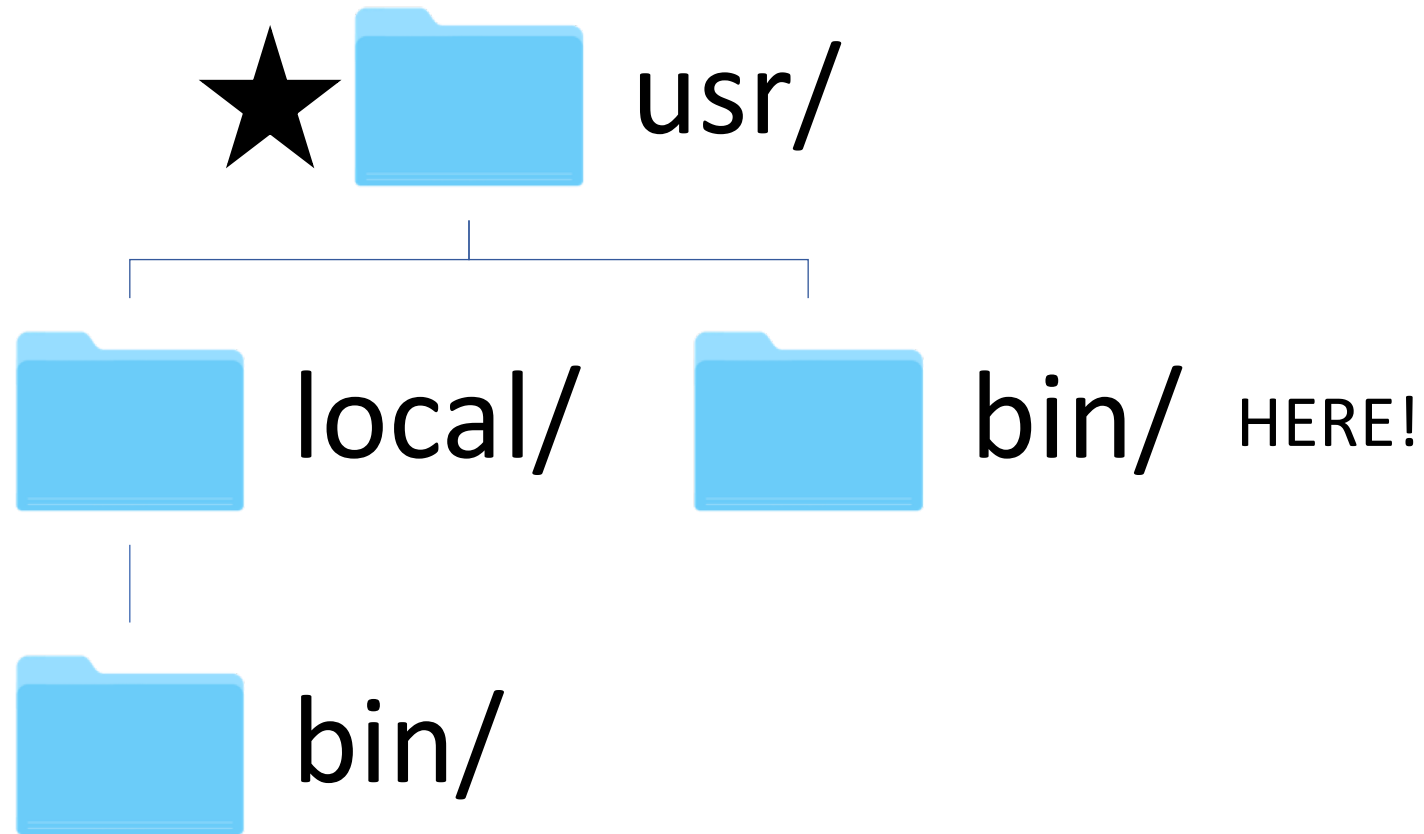


Example \$PATH:
/usr/local/bin:/usr/local:/usr/bin



Example \$PATH:

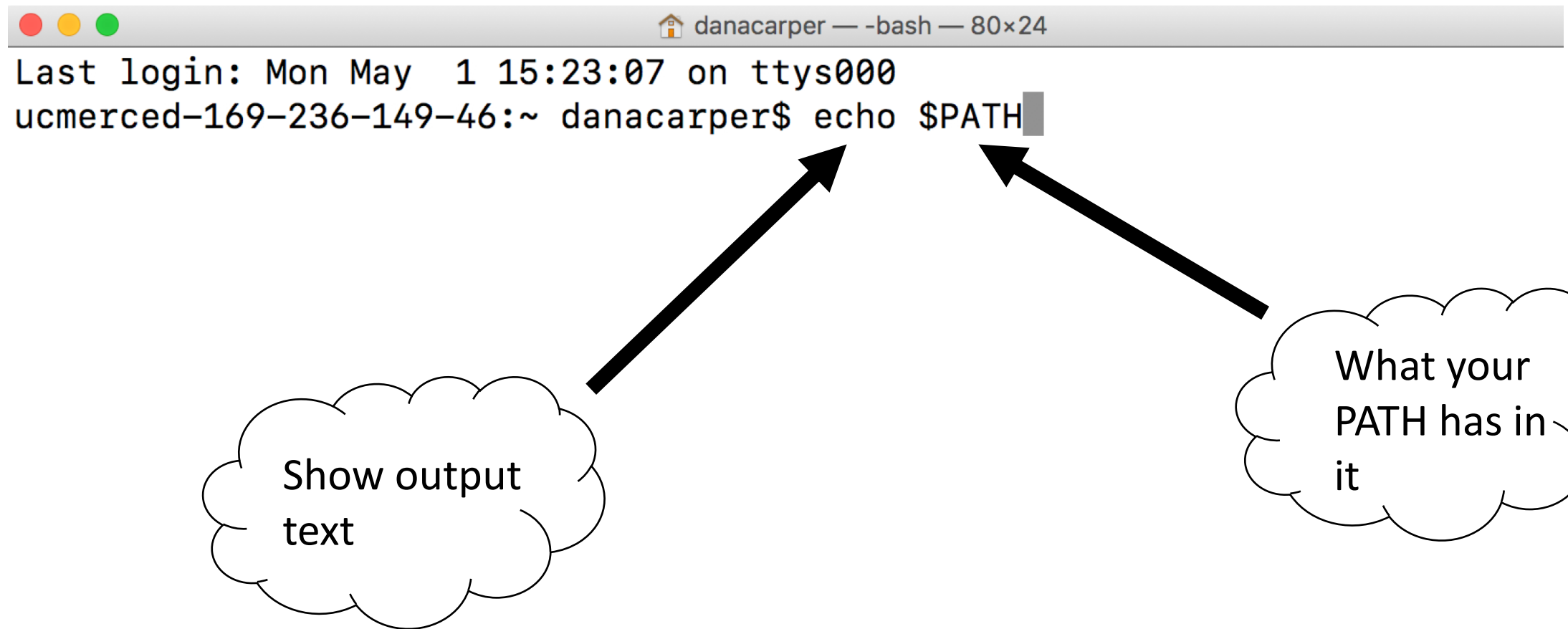
/usr/local/bin:/usr/local:/usr/bin



Why do we need to know about our \$PATH?

- When we install new programs they need to be in our path for them to work
 - so it is important to know what folders are in our path so we can put new programs in them
 - or so we can add new folders to our path

Displaying your PATH




Displaying your PATH

```
Last login: Mon May  1 15:23:07 on ttys000
[ucmerced-169-236-149-46:~ danacarper$ echo $PATH
/Users/danacarper/perl5/perlbrew/bin:/Users/danacarper/perl5/perlbrew/perls/perl
-5.22.0/bin:/usr/local/bin:/usr/bin:/bin:/usr/sbin:/sbin:/opt/X11/bin:/Users/dan
acarper/Bin
ucmerced-169-236-149-46:~ danacarper$
```

Output is a list of folders that it will search for commands, separated by :

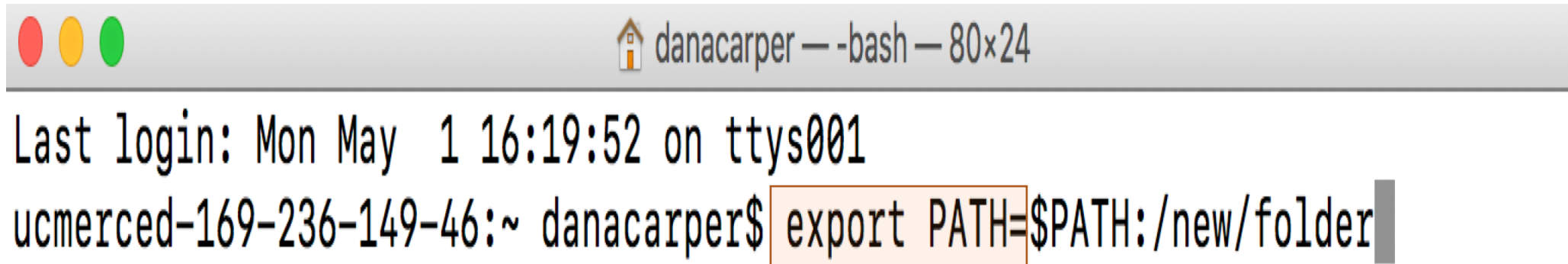
Displaying your PATH

```
danacarper — -bash — 80x24
Last login: Mon May  1 15:23:07 on ttys000
ucmerced-169-236-149-46:~ danacarper$ echo $PATH
/Users/danacarper/perl5/perlbrew/bin:/Users/danacarper/perl5/perlbrew/perl5.22.0/bin:/usr/local/bin:/usr/bin:/usr/sbin:/sbin:/opt/X11/bin:/Users/danacarper/Bin
ucmerced-169-236-149-46:~ danacarper$
```



A folder it is
searching

I have a new folder I want in my path

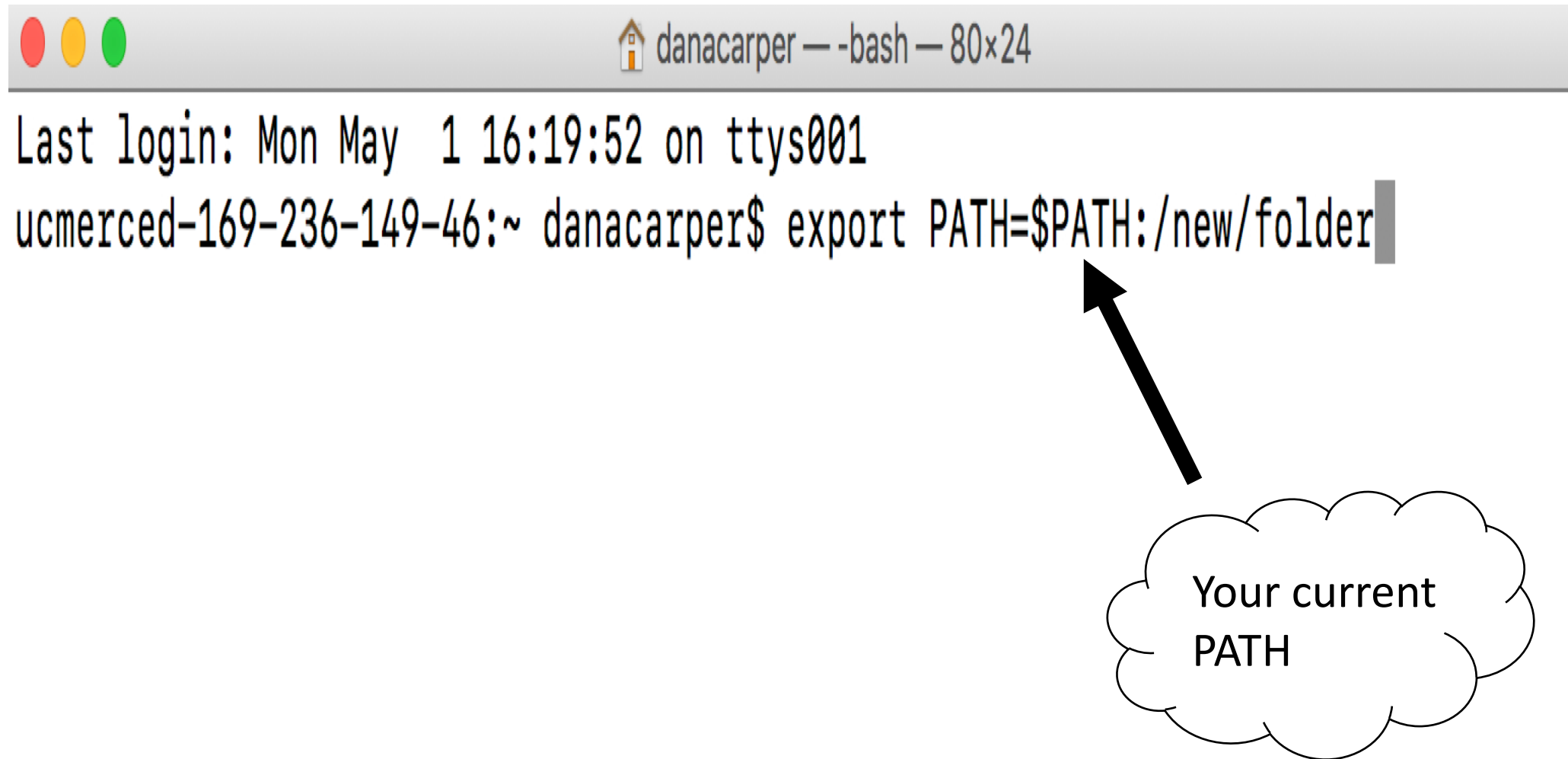


```
danacarper — -bash — 80x24  
Last login: Mon May  1 16:19:52 on ttys001  
ucmerced-169-236-149-46:~ danacarper$ export PATH=$PATH:/new/folder
```

The terminal window shows a command being entered: `export PATH=$PATH:/new/folder`. The text `export PATH=$PATH:/new/folder` is highlighted with an orange box. An arrow points from a cloud-shaped callout below to this highlighted text.

Add to your current PATH

I have a new folder I want in my path

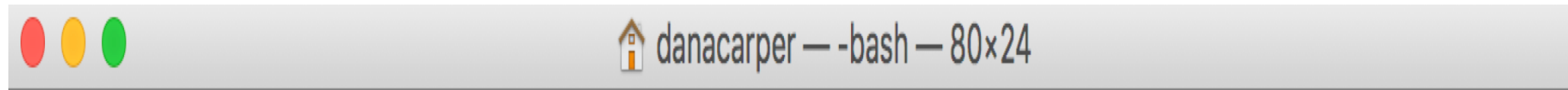


A terminal window with a title bar showing three colored window control buttons (red, yellow, green) on the left and a title "danacarper — -bash — 80x24" on the right. The terminal content shows a login message and a command being entered. A black arrow points from a cloud-shaped callout box to the end of the command line.

```
Last login: Mon May  1 16:19:52 on ttys001
ucmerced-169-236-149-46:~ danacarper$ export PATH=$PATH:/new/folder
```

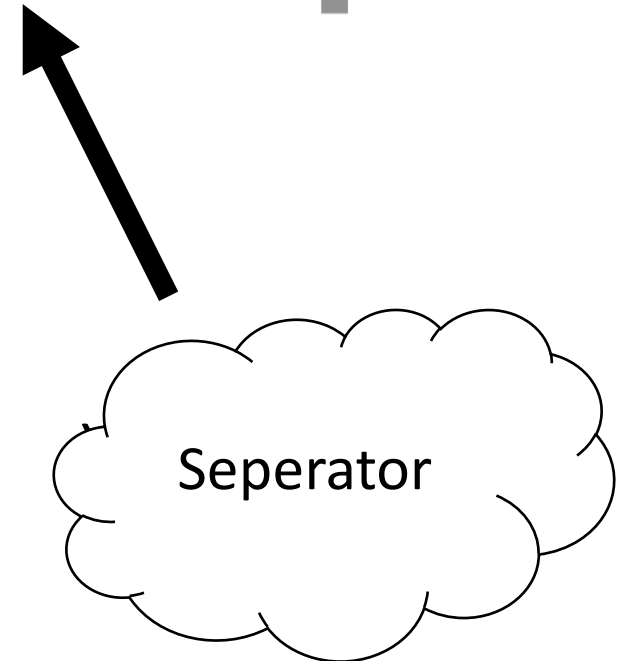
Your current
PATH

I have a new folder I want in my path

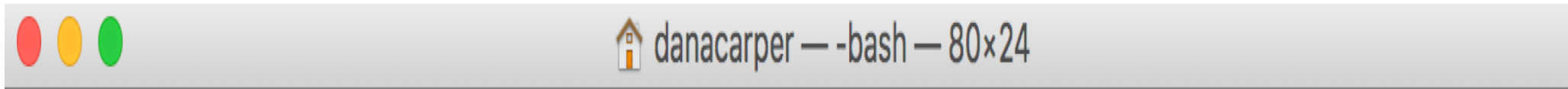


Last login: Mon May 1 16:19:52 on ttys001

ucmerced-169-236-149-46:~ danacarper\$ export PATH=\$PATH:/new/folder

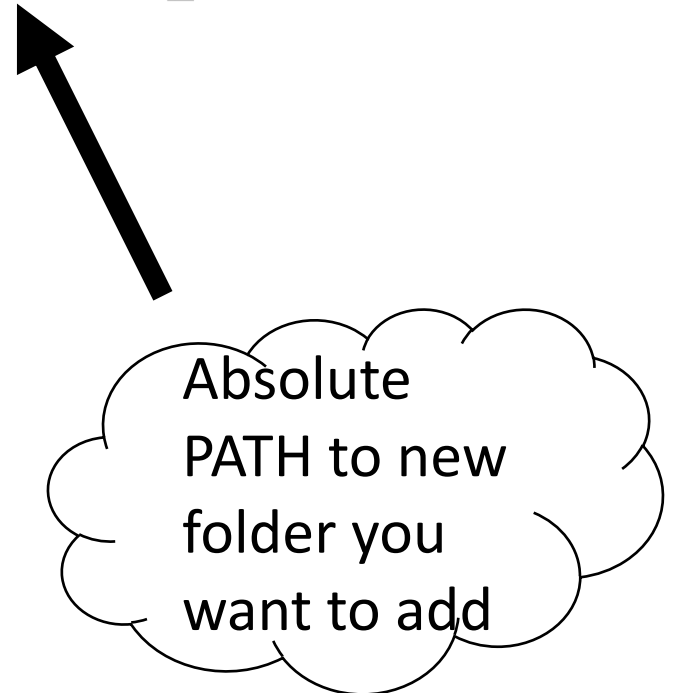


I have a new folder I want in my path

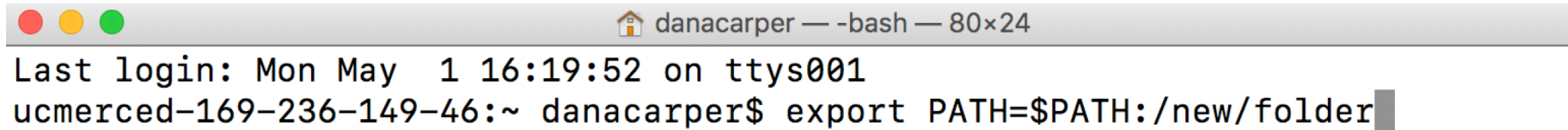


Last login: Mon May 1 16:19:52 on ttys001

```
ucmerced-169-236-149-46:~ danacarper$ export PATH=$PATH:/new/folder
```



Export \$PATH is not permanent

A screenshot of a macOS terminal window. The title bar at the top shows three colored window control buttons (red, yellow, green) on the left, and a home icon followed by the text 'danacarper — -bash — 80x24' on the right. The terminal content shows the last login information: 'Last login: Mon May 1 16:19:52 on ttys001'. Below that, the prompt 'ucmerced-169-236-149-46:~ danacarper\$' is followed by the command 'export PATH=\$PATH:/new/folder' which has been entered and is followed by a black cursor block.

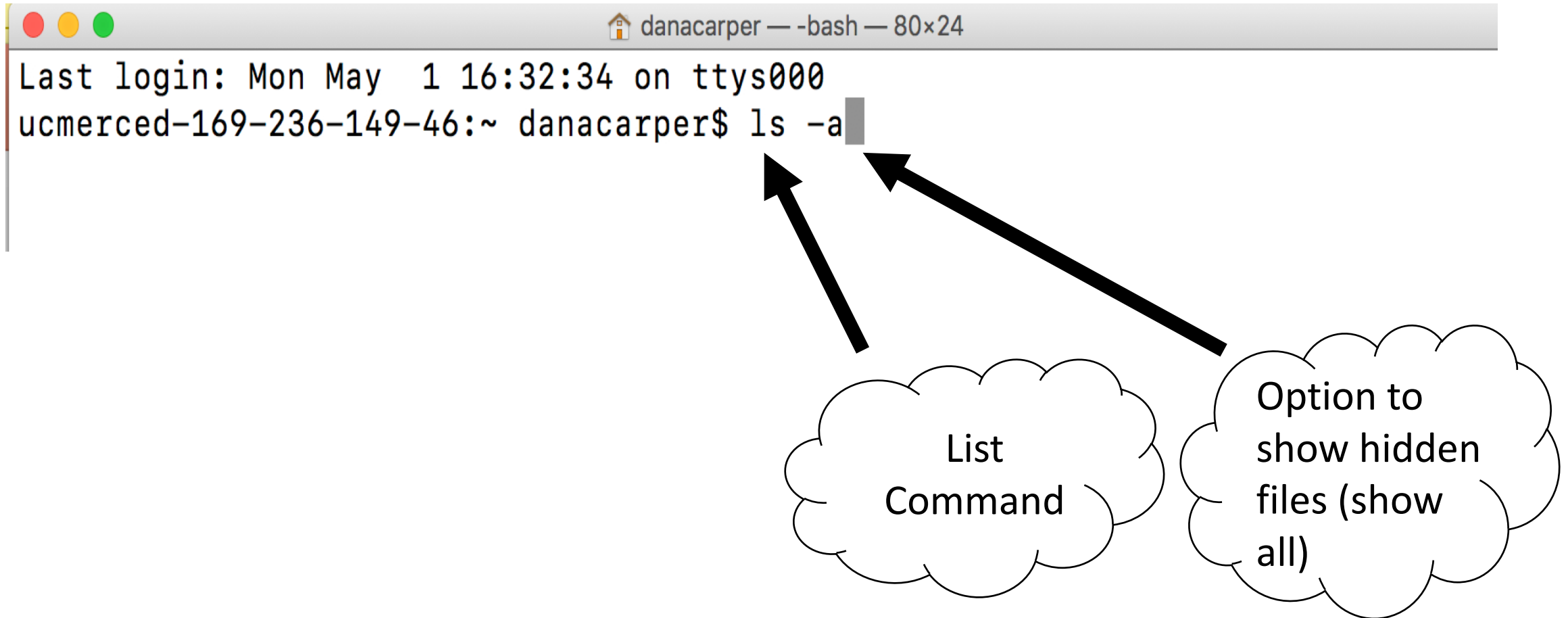
```
Last login: Mon May 1 16:19:52 on ttys001
ucmerced-169-236-149-46:~ danacarper$ export PATH=$PATH:/new/folder
```

This is only saved until you exit the terminal, when you re-open the terminal the new folder wont be a part of your PATH

How to permanently change your PATH

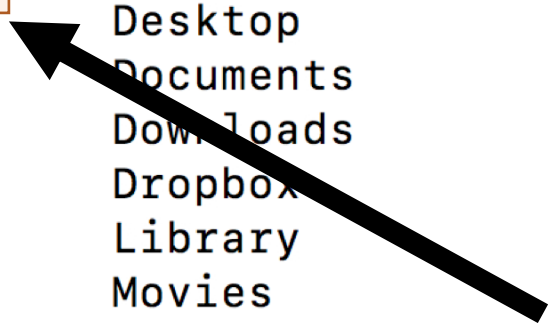
- Need to change `.bash_profile`
- A file containing your PATH
- Where is it? I have never seen a file named this!

Showing hidden files



Showing hidden files

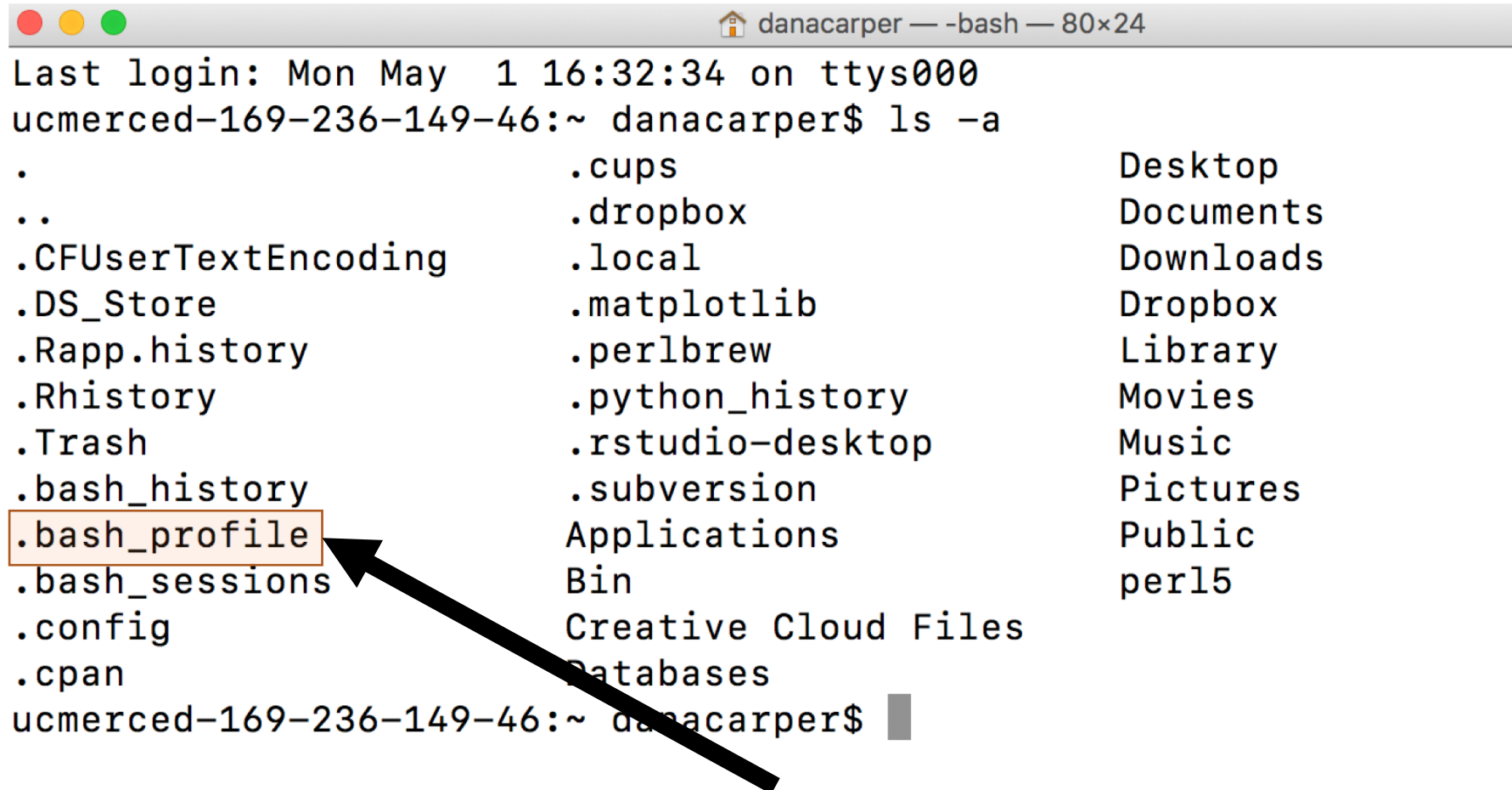
```
danacarper — -bash — 80x24
Last login: Mon May  1 16:32:34 on ttys000
ucmerced-169-236-149-46:~ danacarper$ ls -a
.          .cups
..         .dropbox
.CFUserTextEncoding .local
.DS_Store  .matplotlib
.Rapp.history .perlbrew
.Rhistory  .python_history
.Trash     .rstudio-desktop
.bash_history .subversion
.bash_profile Applications
.bash_sessions Bin
.config     Creative Cloud Files
.cpan       Databases
ucmerced-169-236-149-46:~ danacarper$
```



Desktop
Documents
Downloads
Dropbox
Library
Movies
Music
Pictures
Public
perl5

Showing hidden files

```
danacarper — -bash — 80x24
Last login: Mon May  1 16:32:34 on ttys000
ucmerced-169-236-149-46:~ danacarper$ ls -a
.          .cups          Desktop
..         .dropbox       Documents
.CFUserTextEncoding .local         Downloads
.DS_Store  .matplotlib    Dropbox
.Rapp.history .perlbrew      Library
.Rhistory  .python_history Movies
.Trash     .rstudio-desktop Music
.bash_history .subversion    Pictures
.bash_profile Applications    Public
.bash_sessions Bin             perl5
.config     Creative Cloud Files
.cpan       Databases
ucmerced-169-236-149-46:~ danacarper$
```



Modifying .bash_profile

- Open in a text editor
 - Nano
 - Vim
 - Add `export PATH=$PATH:/new/folder`
- Or enter this in the terminal:
 - `echo 'export PATH=$PATH:/usr/local/bin' >> ~/.bash_profile`

