Lesson Module Checklist
- Slides
- Converted WB

- Flash cards
- Page numbers
- 1st minute quiz
- Web Calendar summary
- Web book pages
- Commands

- Lock turnin directory at midnight
- Lab 7 tested
- Lab X1 tested

- 9V backup battery for microphone
- Backup slides, CCC info, handouts on flash drive

Student checklist

1) Browse to the CIS 90 website Calendar page
   - http://simms-teach.com
   - Click <u>CIS 90 </u>link on left panel
   - Click <u>Calendar</u> link near top of content area
   - Locate today's lesson on the Calendar

2) Download the presentation slides for today's lesson for easier viewing

3) Click <u>Enter virtual classroom</u> to join CCC Confer session

4) Connect to Opus using Putty or ssh command

Introductions and Credits

Jim Griffin
• Created this Linux course
• Created Opus and the CIS VLab
• Jim's site: http://cabrillo.edu/~jgriffin/

Rich Simms
• HP Alumnus
• Started teaching this course in 2008 when Jim went on sabbatical
• Rich's site: http://simms-teach.com

And thanks to:
• John Govsky for many teaching best practices: e.g. the First Minute quizzes, the online forum, and the point grading system (http://teacherjohn.com/)

CIS 90 - Lesson 8

Instructor: **Rich Simms**
Dial-in: **888-886-3951**
Passcode: **136690**

Francisco · Leila · Justin · Jesus · Shenghong · Paul · Roberto · Sam · Navin · Jimmy
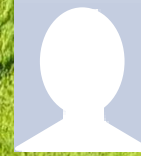
Luis · Tommy · Adrian · Ann · Cameron · Cody · Alejandrino · Deane · Nadia · Richard Z.

Gabriel · Ryan · Takashi · Jeff · Nick · Jonathan · Shea · Dylan · Joshua · Richard I.
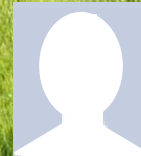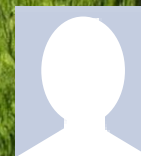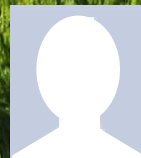
Aaron · Nicole · James · Matthew · Abraham · Chris · Ronald · Scott
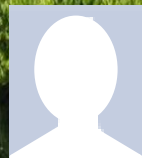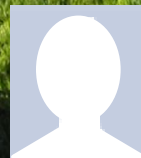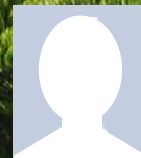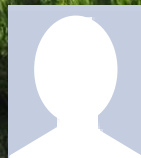
Email me (risimms@cabrillo.edu) a relatively current photo of your face for 3 points extra credit

Instructor CCC Confer checklist

[ ] Preload White Board
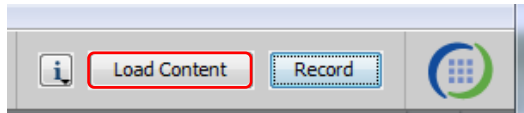
[ ] Connect session to Teleconference

Session now connected to teleconference
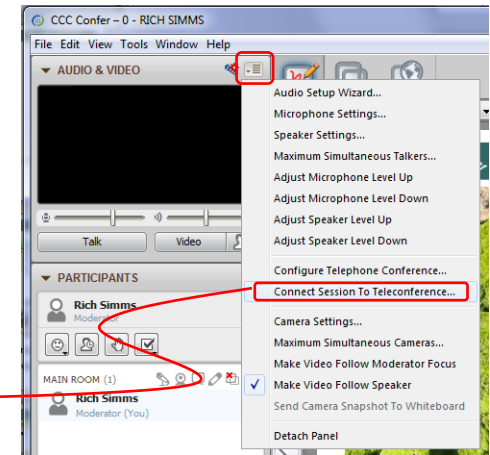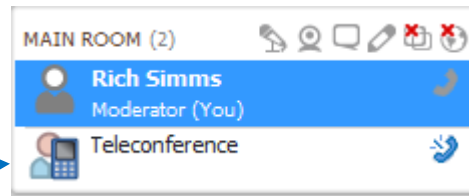
[ ] Is recording on?

Red dot means recording

[ ] Use teleconferencing, not mic

Should be greyed out
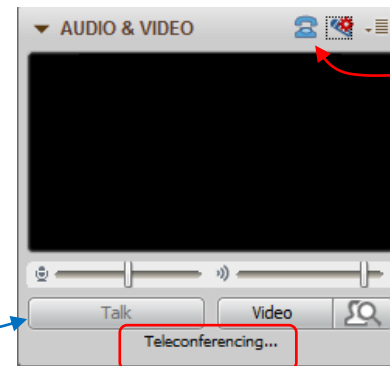
Should show as this live "off hook" telephone handset icon and the Teleconferencing … message displayed

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Instructor CCC Confer checklist

[ ] layout and share apps

Instructor CCC Confer checklist
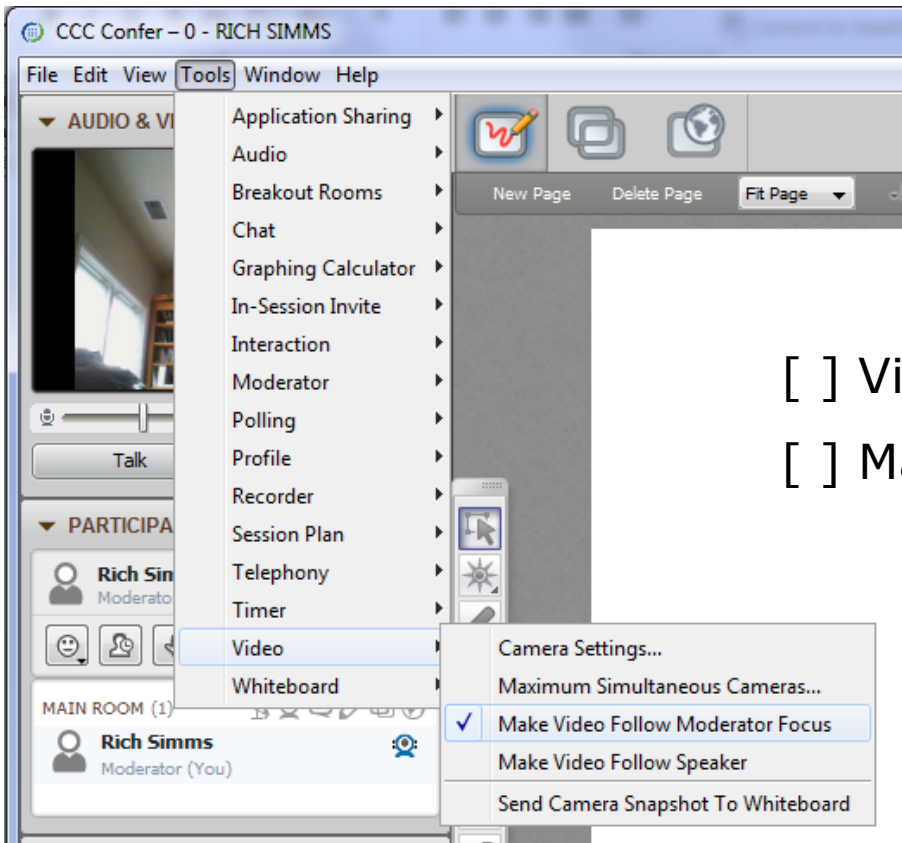
[ ] Video (webcam)

[ ] Make Video Follow Moderator Focus

Using Elmo with CCC Confer

The "rotate image" button is necessary if you use both the side table and the white board.

Quite interesting that they consider you to be an "expert" in order to use this button!

Elmo rotated down to view side table

Rotate image button

Elmo rotated up to view white board

Rotate image button

Run and share the Image Mate program just as you would any other app with CCC Confer

8
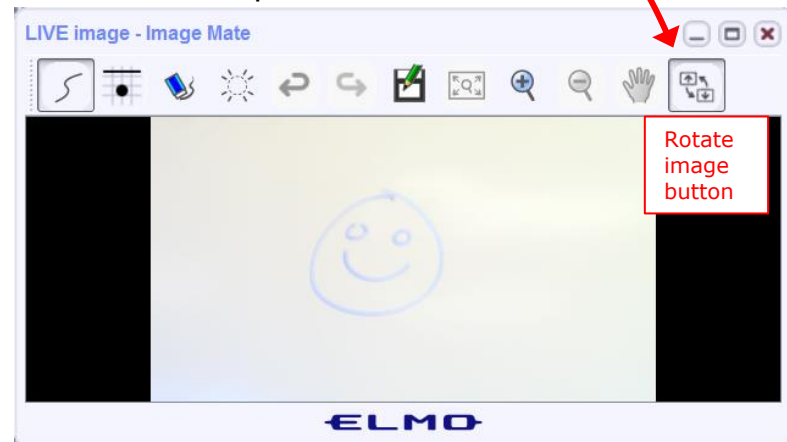
Instructor CCC Confer checklist

Universal Fix for CCC Confer:
1) Shrink (500 MB) and delete Java cache
2) Uninstall and reinstall latest Java runtime

Control Panel (small icons)   General Tab > Settings…   500MB cache size   Delete these
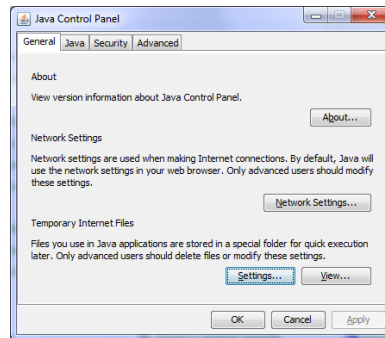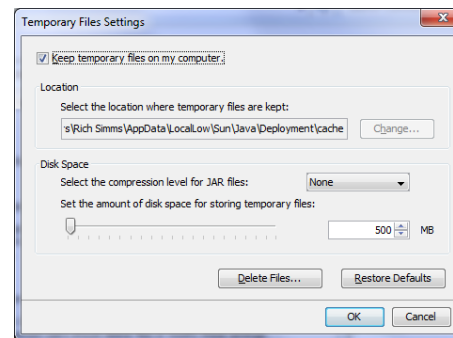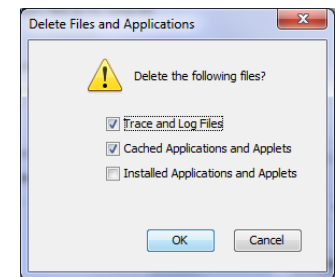
Google Java download

9
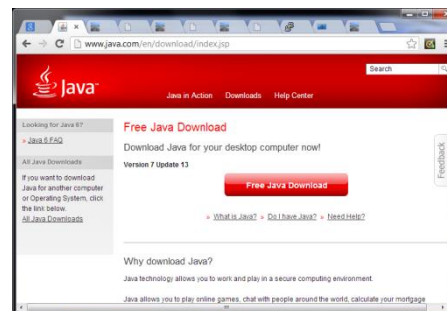
Quiz

Please answer these questions **in the order** shown:

See electronic white board

email answers to: risimms@cabrillo.edu

(answers must be emailed within the first few minutes of class for credit) 10

Input/Output Processing

Objectives	Agenda

• Identify the three open file descriptors an executing program is given when started.
• Be able to redirect input from files and output to files
• Define the terms pipe, filter, and tee
• Use pipes and tees to combine multiple commands
• Know how to use the following useful UNIX commands:
      o find
      o grep
      o wc
      o sort
      o spell
	• Quiz
	• Questions
	• Warmup
	• Housekeeping
	• Review
	• File descriptors
	• Pipelines
	• New commands
	• Tasks using pipelines

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Questions

Questions?

Lesson material?

Labs?   Tests?

How this course works?

· Graded work in home directories

· Answers in /home/cis90/answers

Who questions much, shall learn much, and retain much.
- Francis Bacon

If you don't ask, you don't get.
- Mahatma Gandhi

Chinese Proverb	他問一個問題，五分鐘是個傻子，他不問一個問題仍然是一個傻瓜永遠。
	He who asks a question is a fool for five minutes; he who does not ask a question remains a fool forever.

Lab 5
Post Mortem

Lab 5 – Results

Making Directories
Step 2 - docs/ should be in home dir not in edits/ (x)

Moving Files
Steps 1, 2, 3, and 5 - missing MarkTwain or policy (xx)
Step 4 - no datecal in bin/ (x)
Step 6 - no ant, nursury, twister in Anon/ (x)
Step 9, 10 - letter not restored (x)
Step 11 - incorrect edits/ directory contents (xxxxx)

Copying Files
Step 2 - hosts not found in etc/ (x)
Step 4 - sonnet6 not copied (xxx)

Removing Files and Directories
Step 3 - letter.bak not removed (xx)
Steps 4, 5, 6 - Lab2.0 not removed (xx)
Step 7 - Lab2.1 not removed (x)
Step 8 - Sonnets not removed (x)

Linking Files
Step 2 - no greeting hard link to motd (xxx)

31 labs submitted

5 labs not submitted

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CIS Lab Schedule
http://webhawks.org/~cislab/
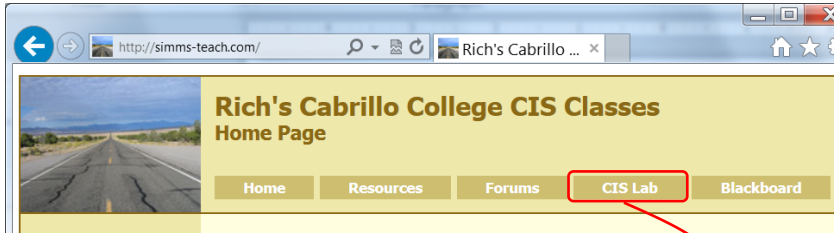
Not submitting tests or lab work?

If you would like some additional help come over to the CIS Lab.

Leandro and Geoff are both CIS 90 Alumni.

Michael is the other Linux instructor.
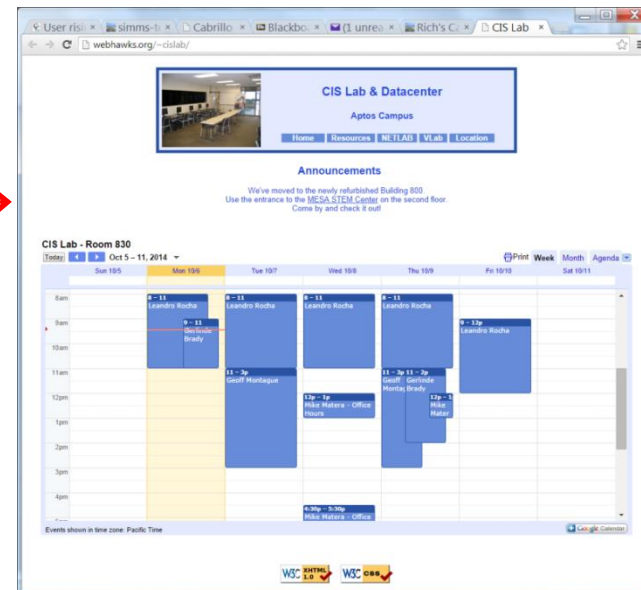
Or hang around after class. Rich has his office hours right after each class in Room 828.

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CIS 90 Tutoring Available

http://www.cabrillo.edu/services/tutorials/

Matt Smithey

All students interested in tutoring in CIS 90, 172, and 81 classes need to come directly to the Tutorials Center to schedule, register and fill out some paperwork. This is just a one-time visit.

The tutoring will take place at the STEM center.

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More CIS 90 Tutoring Available

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Warmup

File Tree Pathname Practice
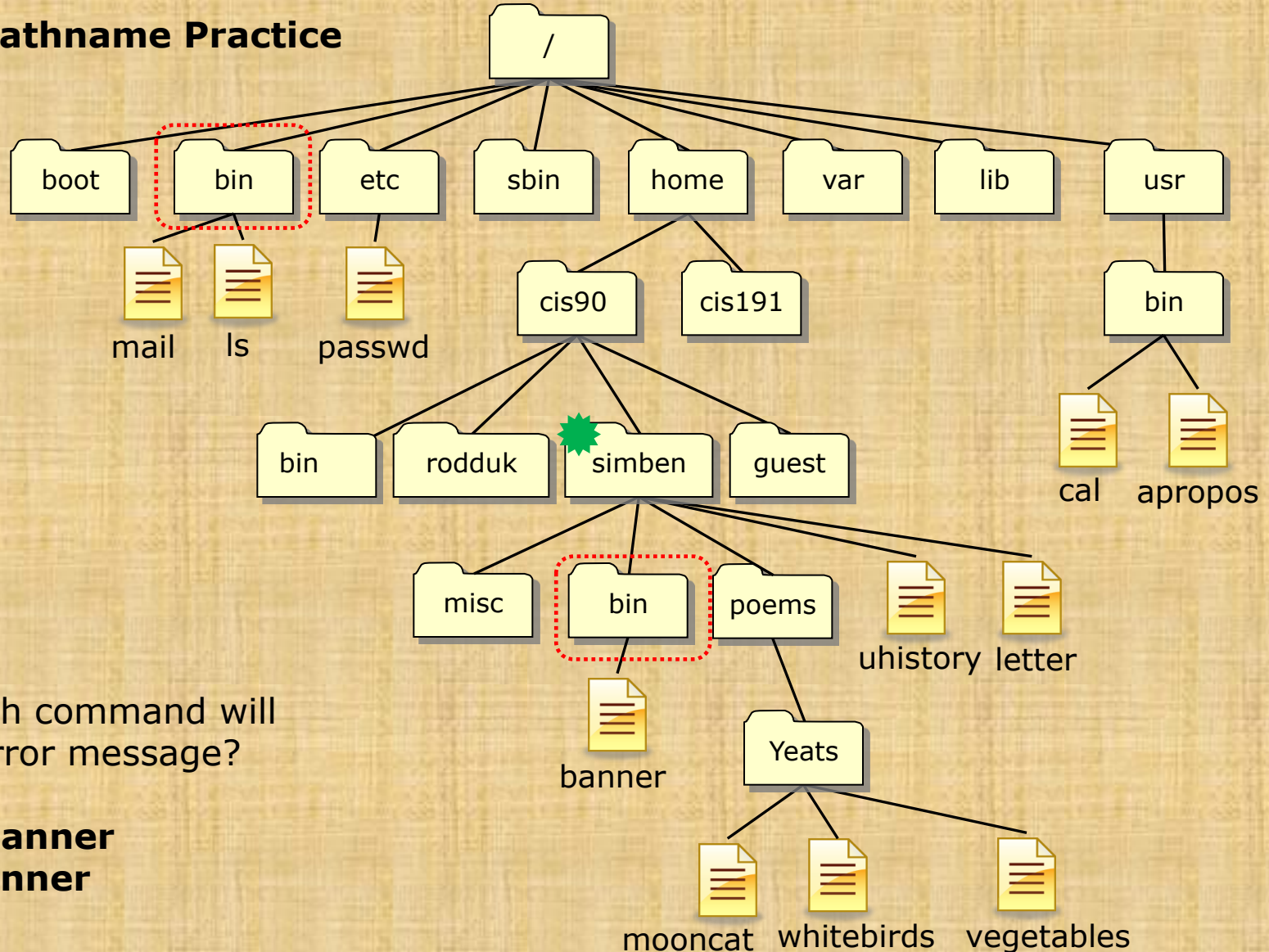
From ✹ which command will generate an error message?

touch /bin/banner
touch bin/banner

File Tree Pathname Practice
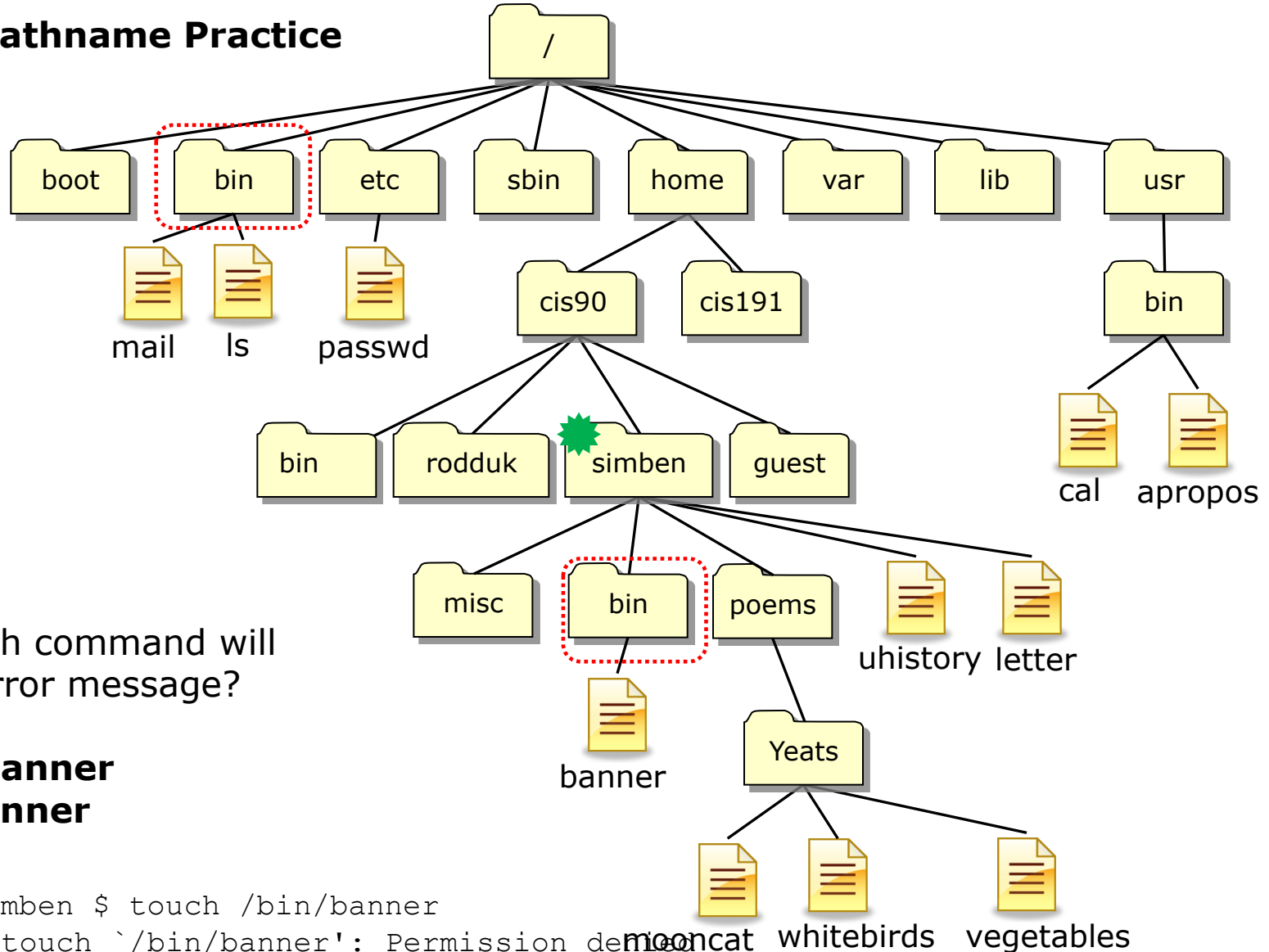
From ✳ which command will generate an error message?

touch /bin/banner
touch bin/banner

```
/home/cis90/simben $ touch /bin/banner
touch: cannot touch `/bin/banner': Permission denied
```

banner is in your local bin directory

File Tree Pathname Practice
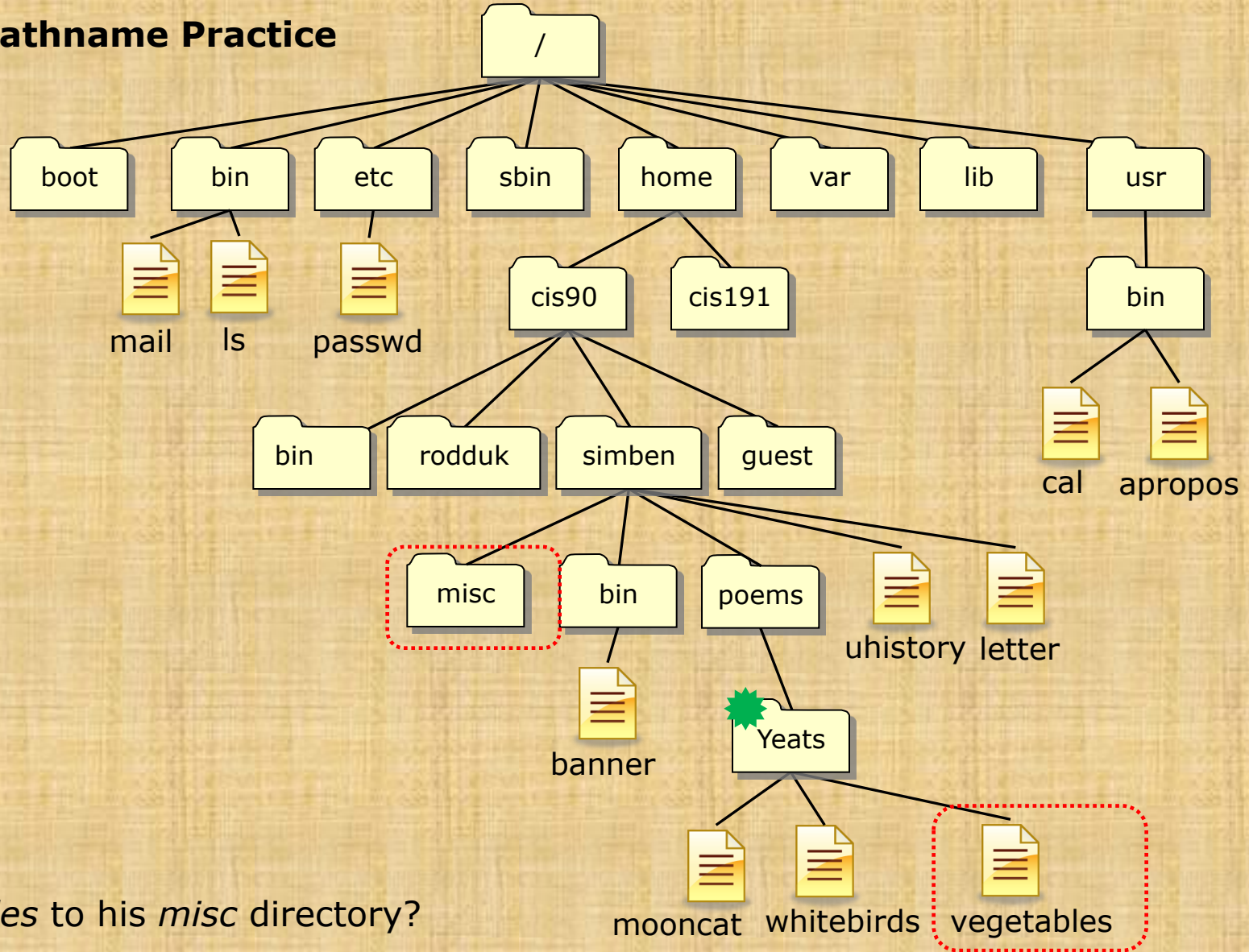
From ✴ how
does Benji:

Move *vegetables* to his *misc* directory?

File Tree Pathname Practice
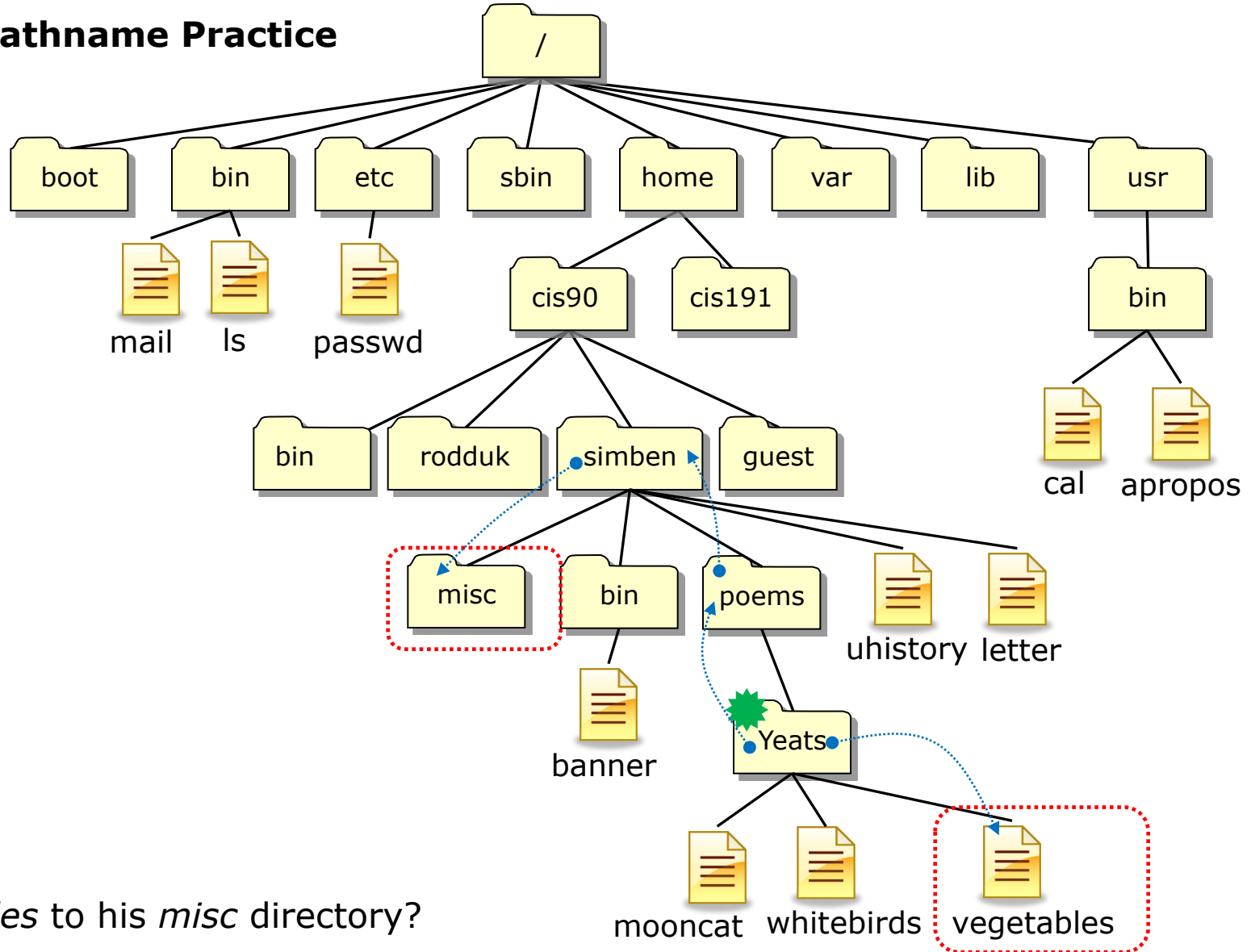
From 🟢 how
does Benji:

Move *vegetables* to his *misc* directory?

`/home/cis90/simben/poems/Yeats` $ **mv vegetables ../../misc/**

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Other answers are also acceptable

From ✴ how does Benji:

Move *vegetables* to his *misc* directory?

mv *<path-to-file> <path-to-directory>*

mv vegetables ../../misc/

mv vegetables /home/cis90/simben/misc/

mv /home/cis90/simben/poems/Yeats/vegetables ../../misc/

mv /home/cis90/simben/poems/Yeats/vegetables /home/cis90/simben/misc/

mv vegetables ~/misc/

All these answers are correct

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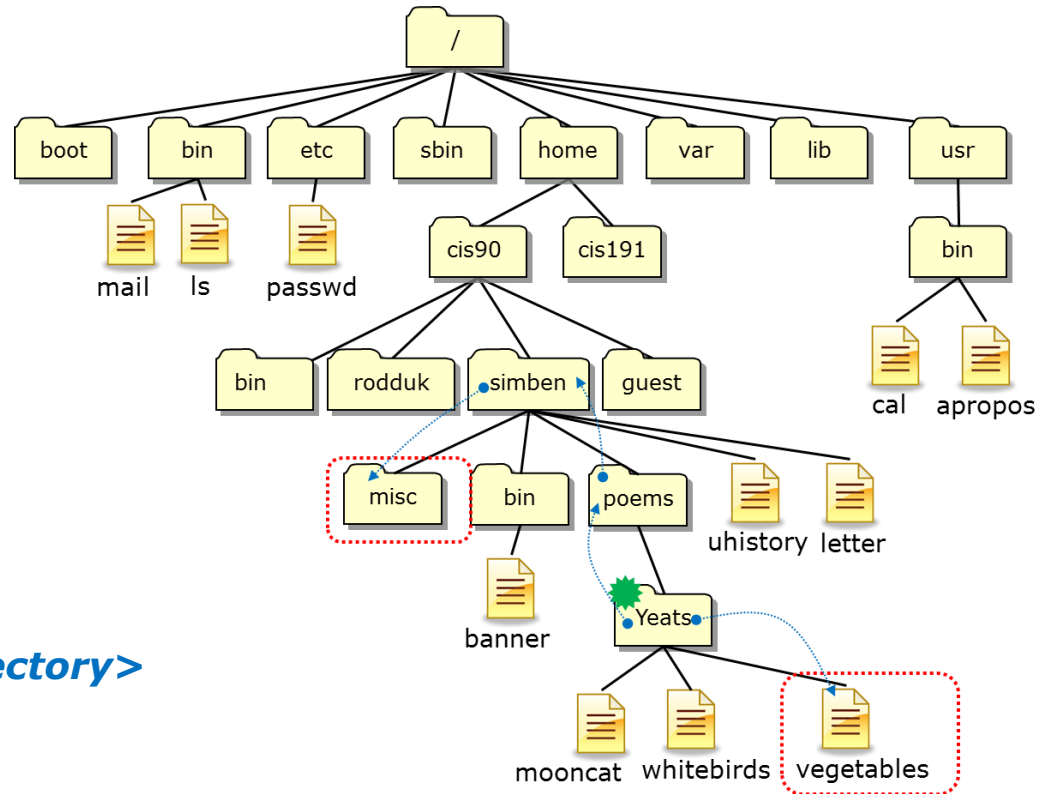
File Tree Pathname Practice
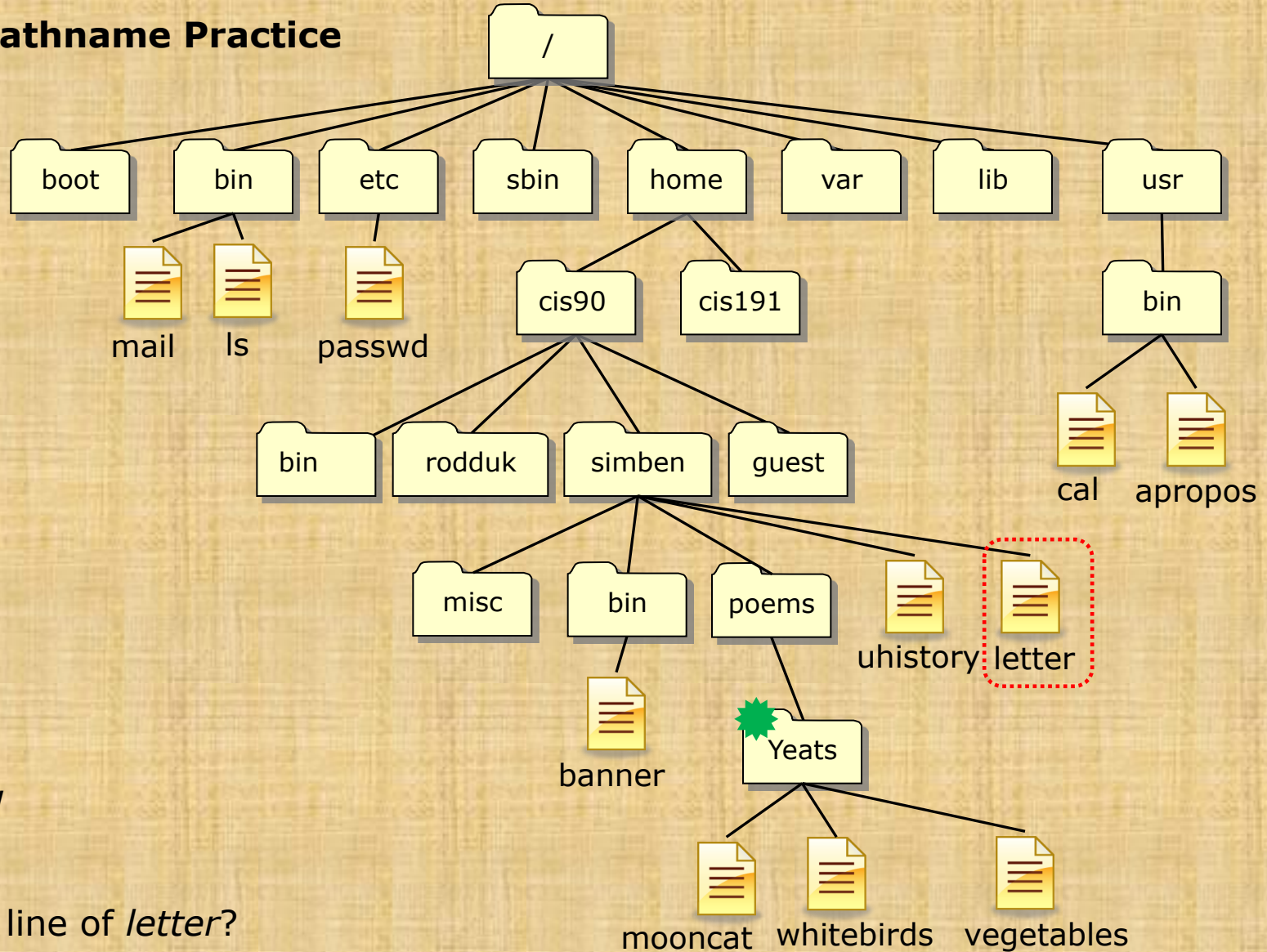
From ✳ how
does Benji:

Print the last line of *letter*?

File Tree Pathname Practice
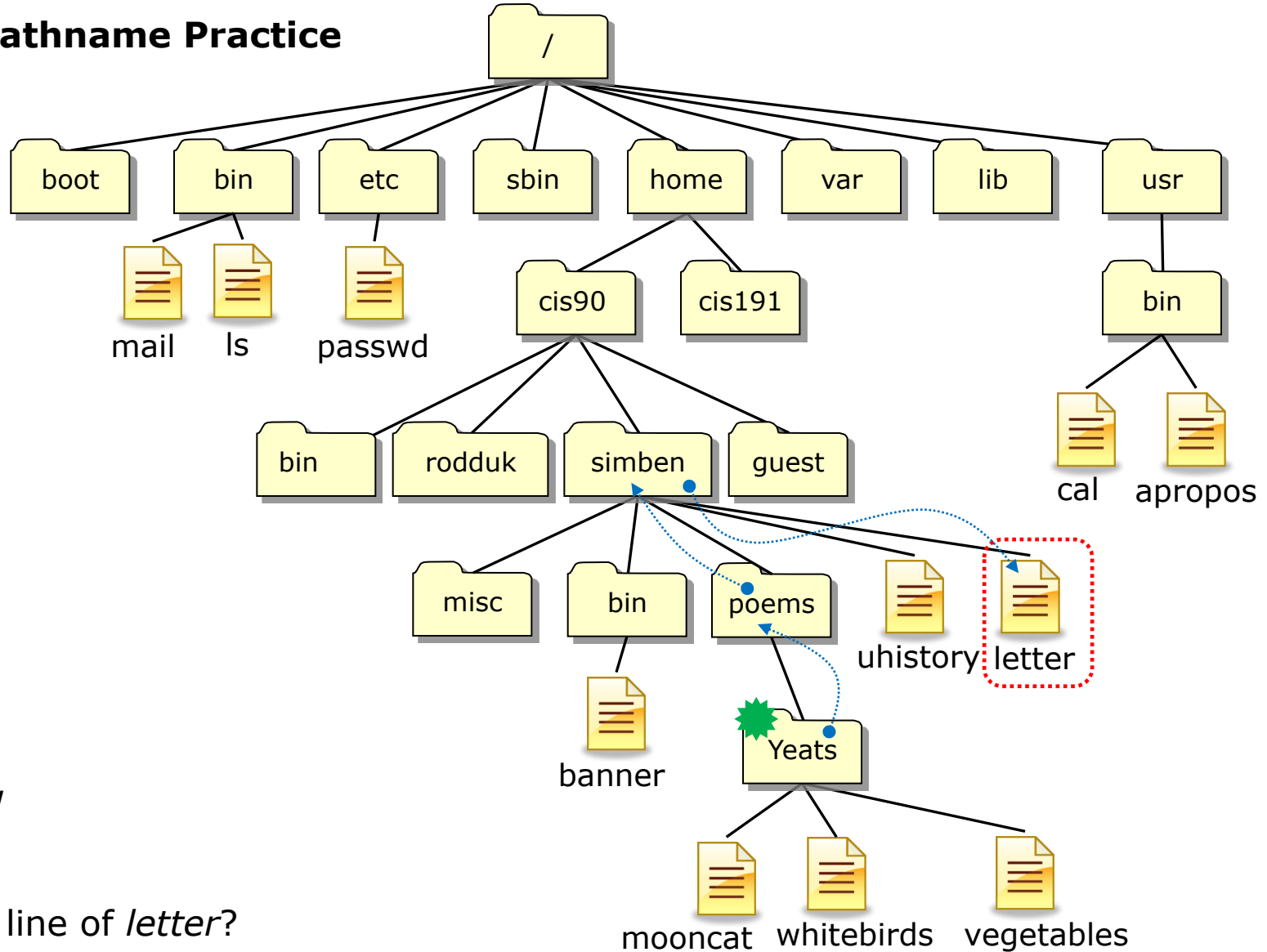
From ✹ how
does Benji:

Print the last line of *letter*?

`/home/cis90/simben/poems/Yeats $` **tail -n1 ../../letter**

Other answers are also acceptable
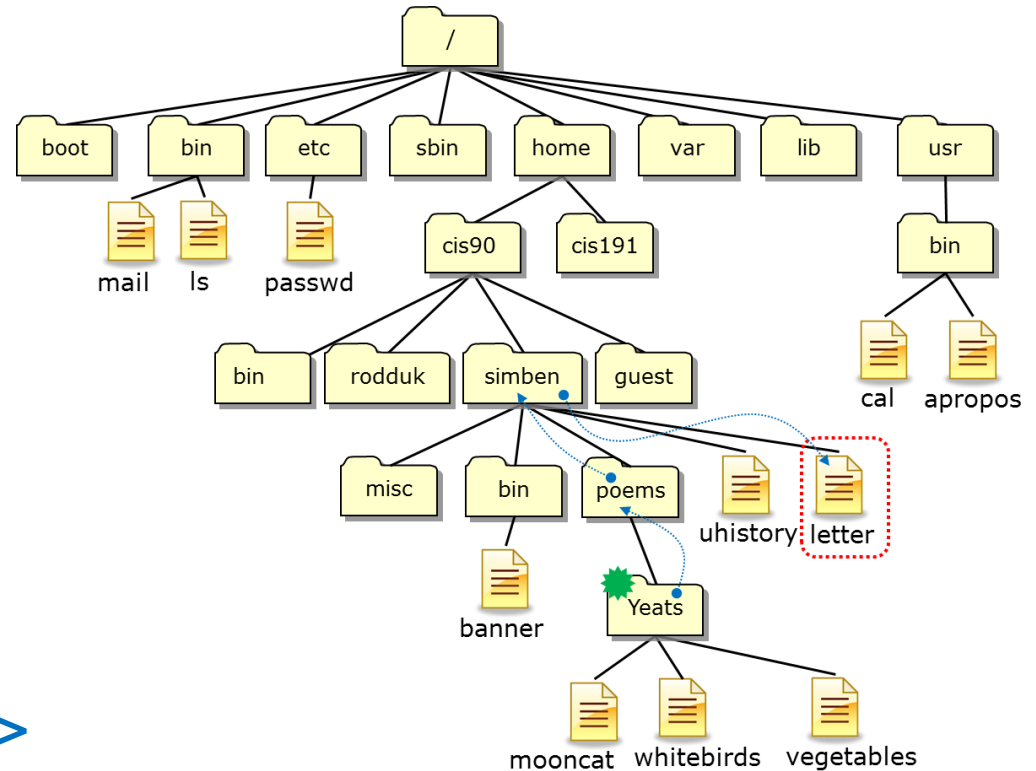
From ✳ how does Benji:

Print the last line of *letter*?

tail -n<number> <path-to-file>

tail -n1 ../../letter

tail -n1 /home/cis90/simben/letter

tail -n1 ~/letter

All these answers are correct

File Tree Pathname Practice
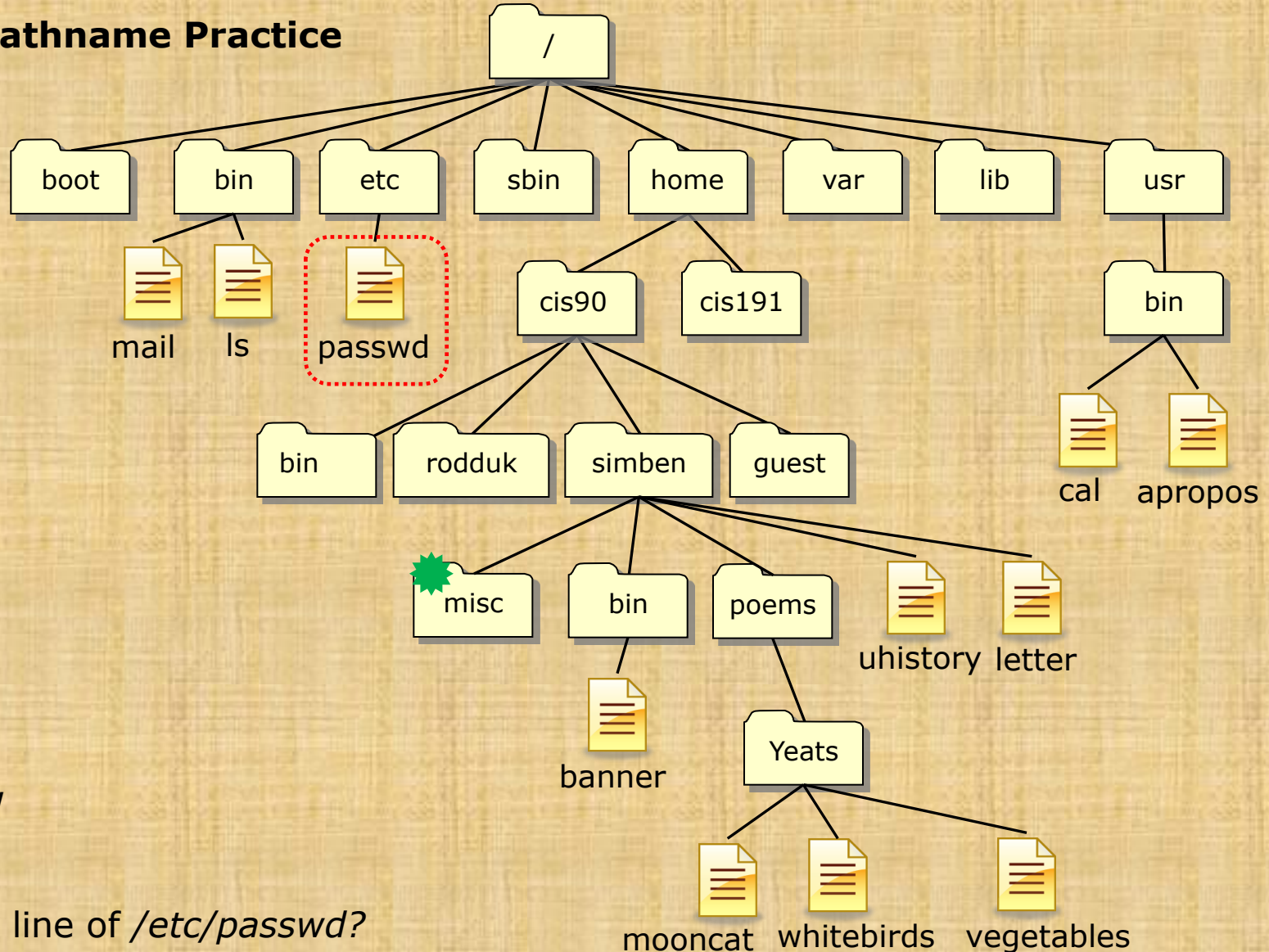
From ✳ how
does Benji:

Print the first line of *'/etc/passwd?*

File Tree Pathname Practice
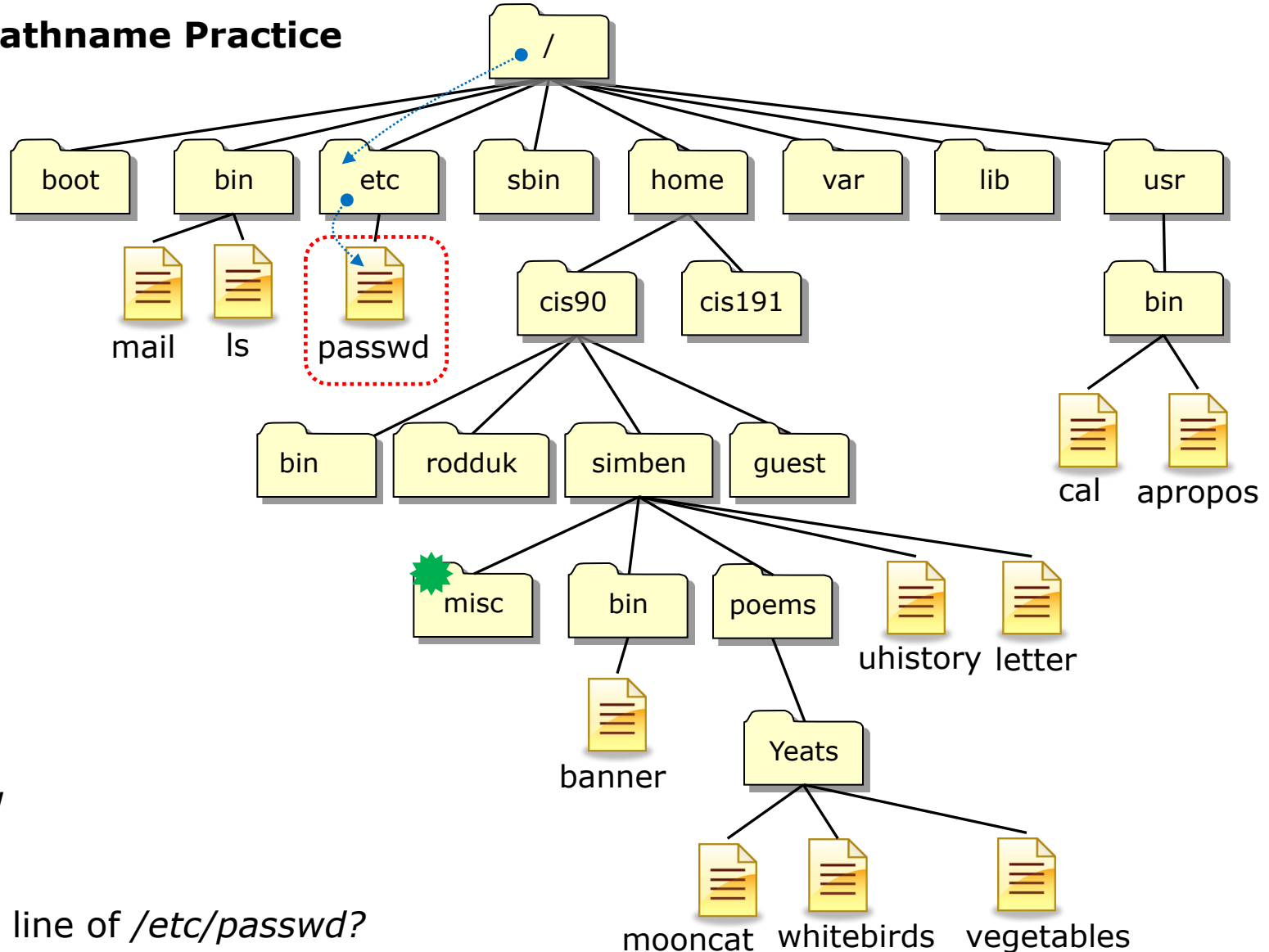
From ✳ how
does Benji:

Print the first line of *etc/passwd?*

```
/home/cis90/simben/misc $ head -n1 /etc/passwd
```

Other answers are also acceptable
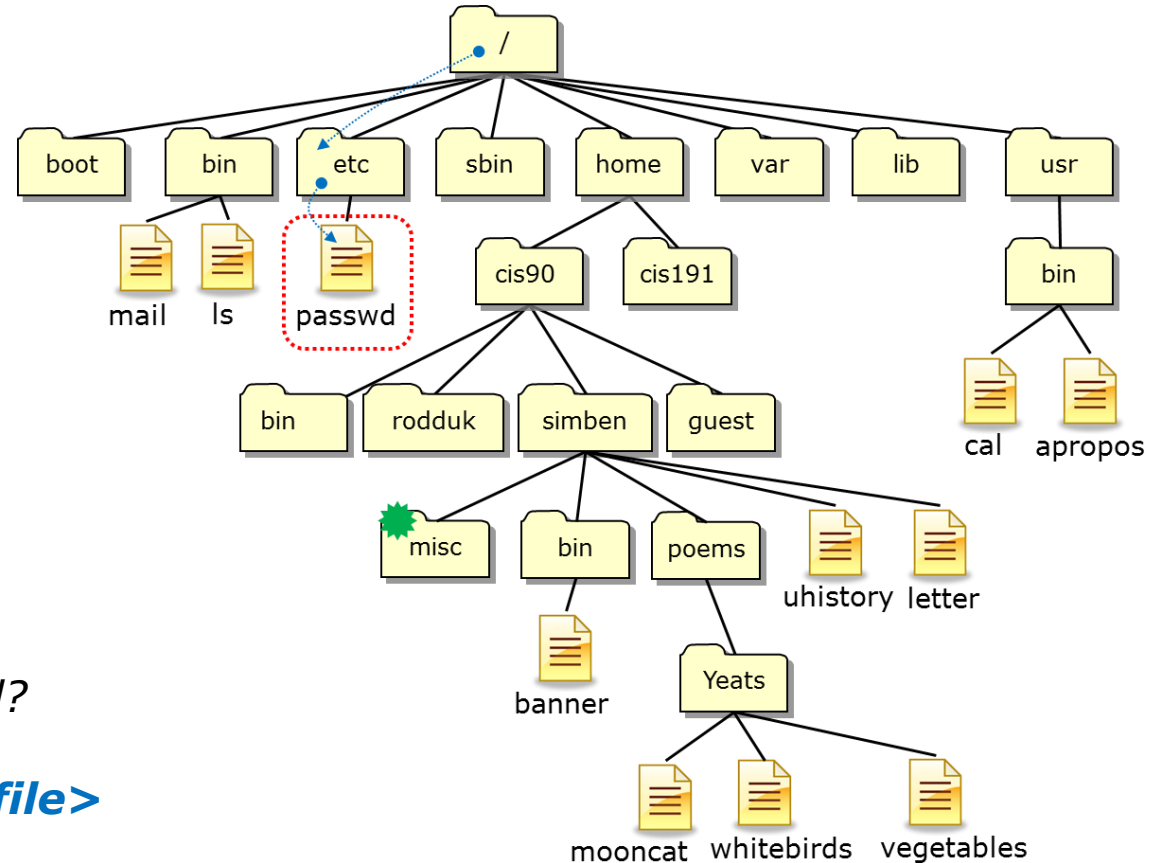
From ✳ how does Benji:

Print the first line of */etc/passwd?*

head -n<number> <path-to-file>

head -n1 /etc/passwd

head -n1 ../../../../etc/passwd

Both these answers are correct

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File Tree Pathname Practice
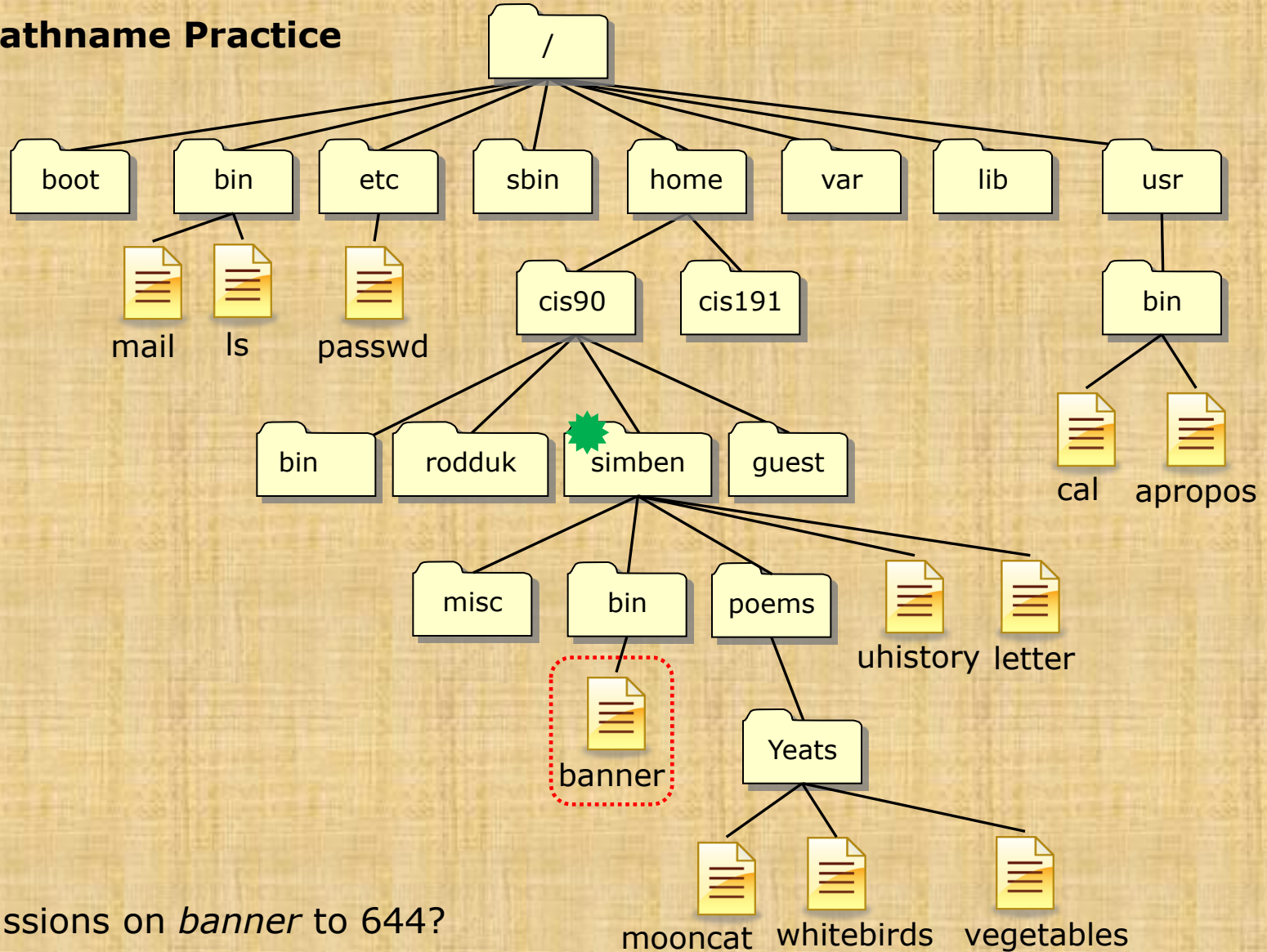
From 🟢 how
does Benji:

Change permissions on *banner* to 644?

File Tree Pathname Practice
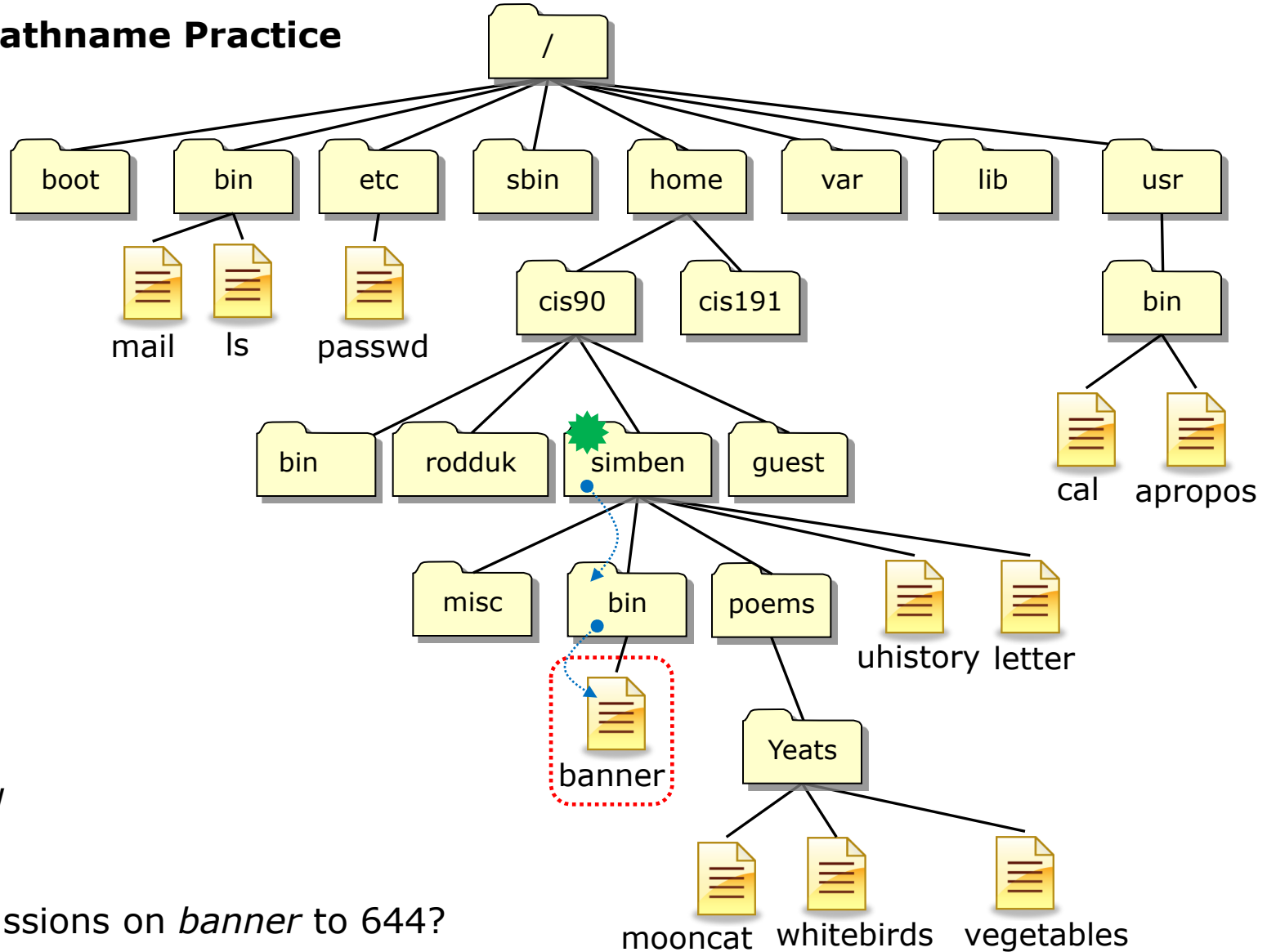
From ✳ how
does Benji:

Change permissions on *banner* to 644?

`/home/cis90/simben $` **chmod 644 bin/banner**

Other answers are also acceptable
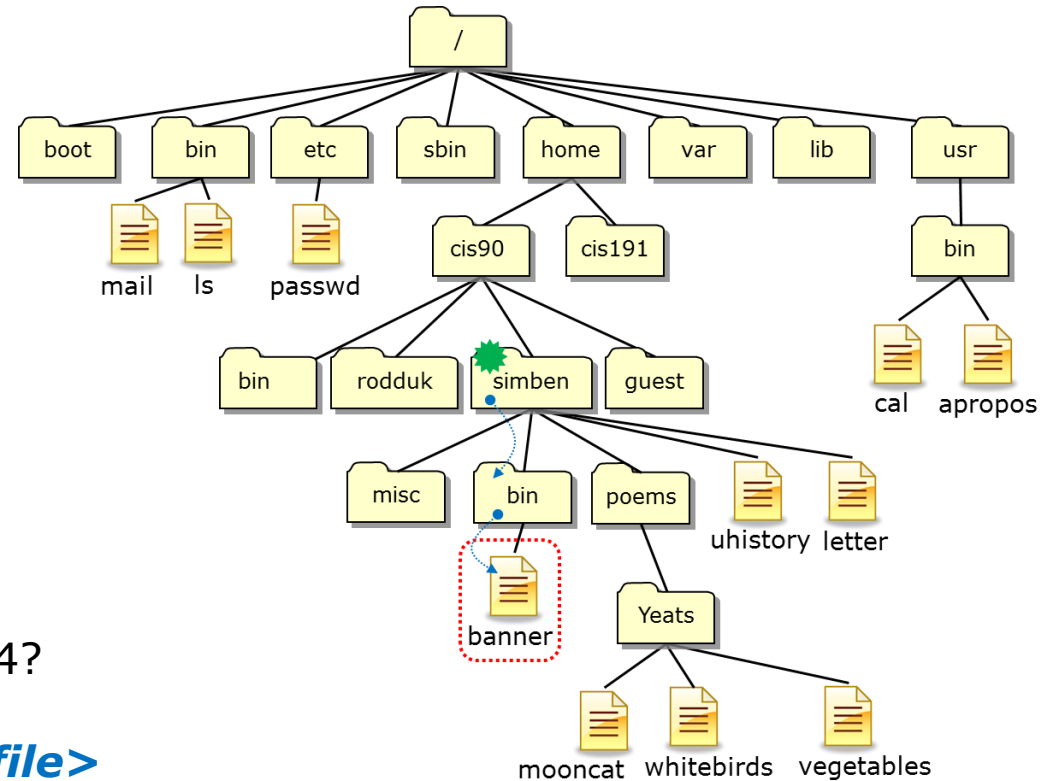
From 🌟 how does Benji:

Change permissions on *banner* to 644?

chmod <permissions> <path-to-file>

chmod 644 bin/banner

chmod 644 /home/cis90/simben/bin/banner

Both these answers are correct

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File Tree Pathname Practice

From ✳ how
does Benji:

Create new files *a1, a2, a3,* and *a4* in *misc*?

File Tree Pathname Practice
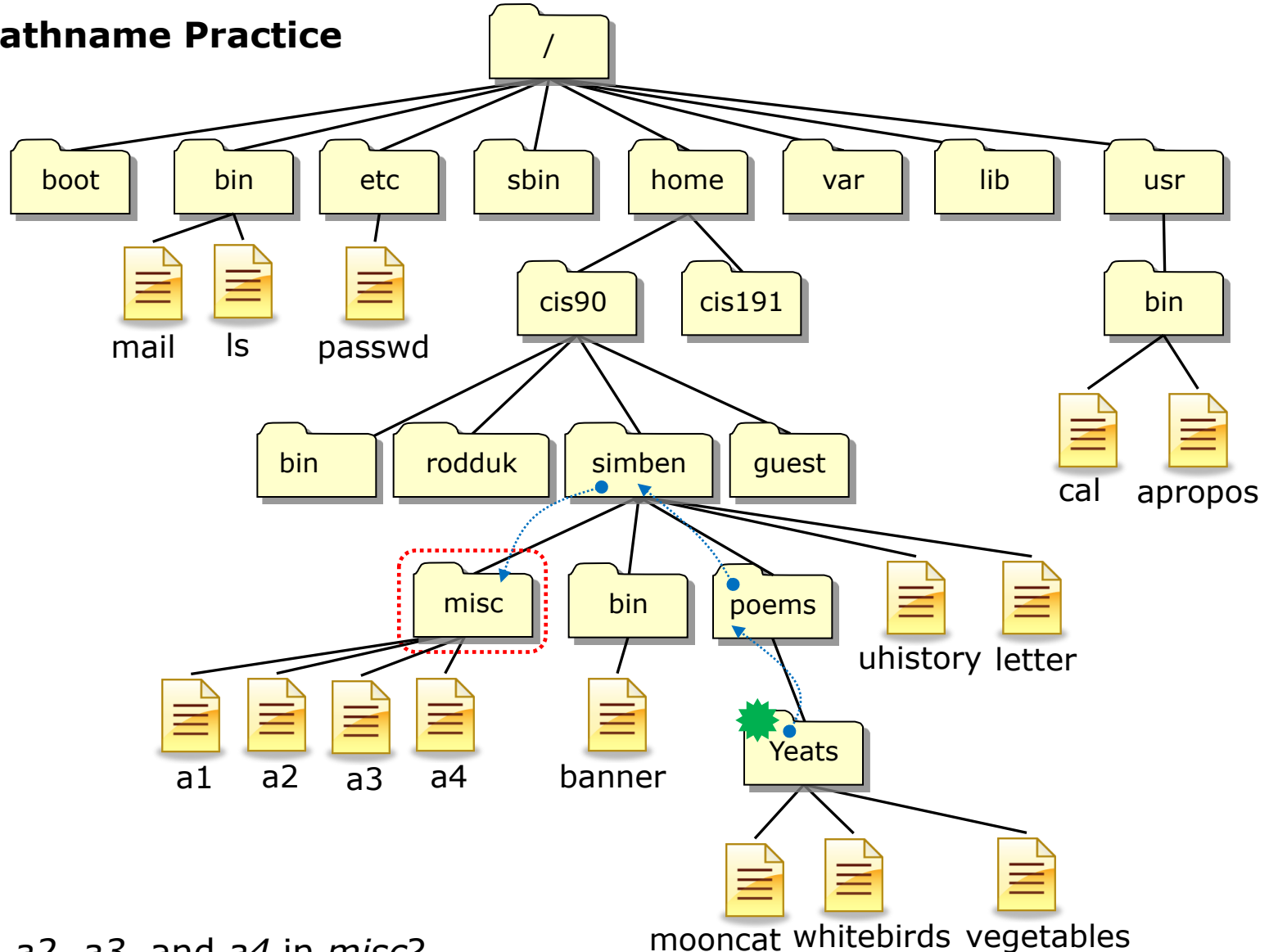
```
/
├── boot
├── bin
│   ├── mail
│   └── ls
├── etc
│   └── passwd
├── sbin
├── home
│   ├── cis90
│   │   ├── bin
│   │   ├── rodduk
│   │   ├── simben
│   │   │   ├── misc
│   │   │   │   ├── a1
│   │   │   │   ├── a2
│   │   │   │   ├── a3
│   │   │   │   └── a4
│   │   │   ├── bin
│   │   │   │   └── banner
│   │   │   ├── poems
│   │   │   │   └── Yeats
│   │   │   │       ├── mooncat
│   │   │   │       ├── whitebirds
│   │   │   │       └── vegetables
│   │   │   ├── uhistory
│   │   │   └── letter
│   │   └── guest
│   └── cis191
├── var
├── lib
└── usr
    └── bin
        ├── cal
        └── apropos
```

From ✹ how does Benji:

Create files *a1, a2, a3,* and *a4* in *misc*?

/home/cis90/simben/poems/Yeats $ **touch ../../misc/a1 ../../misc/a2 ../../misc/a3 ../../misc/a4**

Other answers are also acceptable
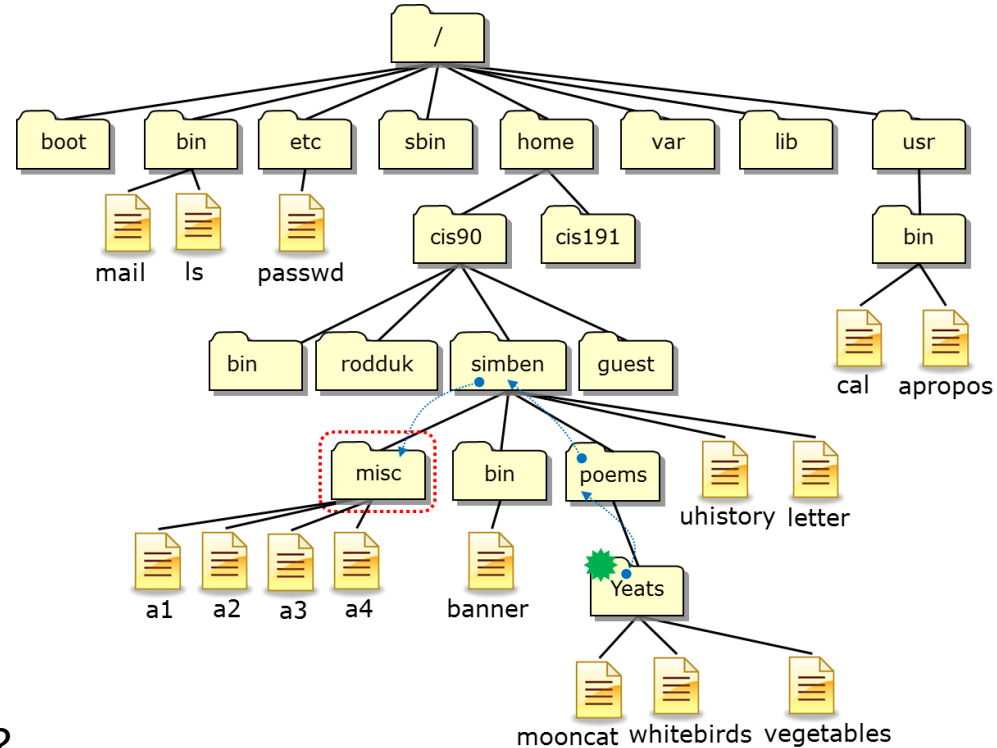
From 🟢 how does Benji:

Create files *a1, a2, a3,* and *a4* in *misc*?

touch *<path-to-file> <path-to-file> <path-to-file> <path-to-file>*

touch ../../misc/a1   ../../misc/a2   ../../misc/a3   ../../misc/a4

touch ~/misc/a1   ~/misc/a2   ~/misc/a3   ~/misc/a4

touch /home/cis90/simben/misc/a1   /home/cis90/simben/misc/a2   /home/cis90/simben/misc/a3   /home/cis90/simben/misc/a4 *(all on one line)*

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All these answers are correct

FYI
only

For the aspiring gurus there is an even better way to do the last operation!

File Tree Pathname Practice
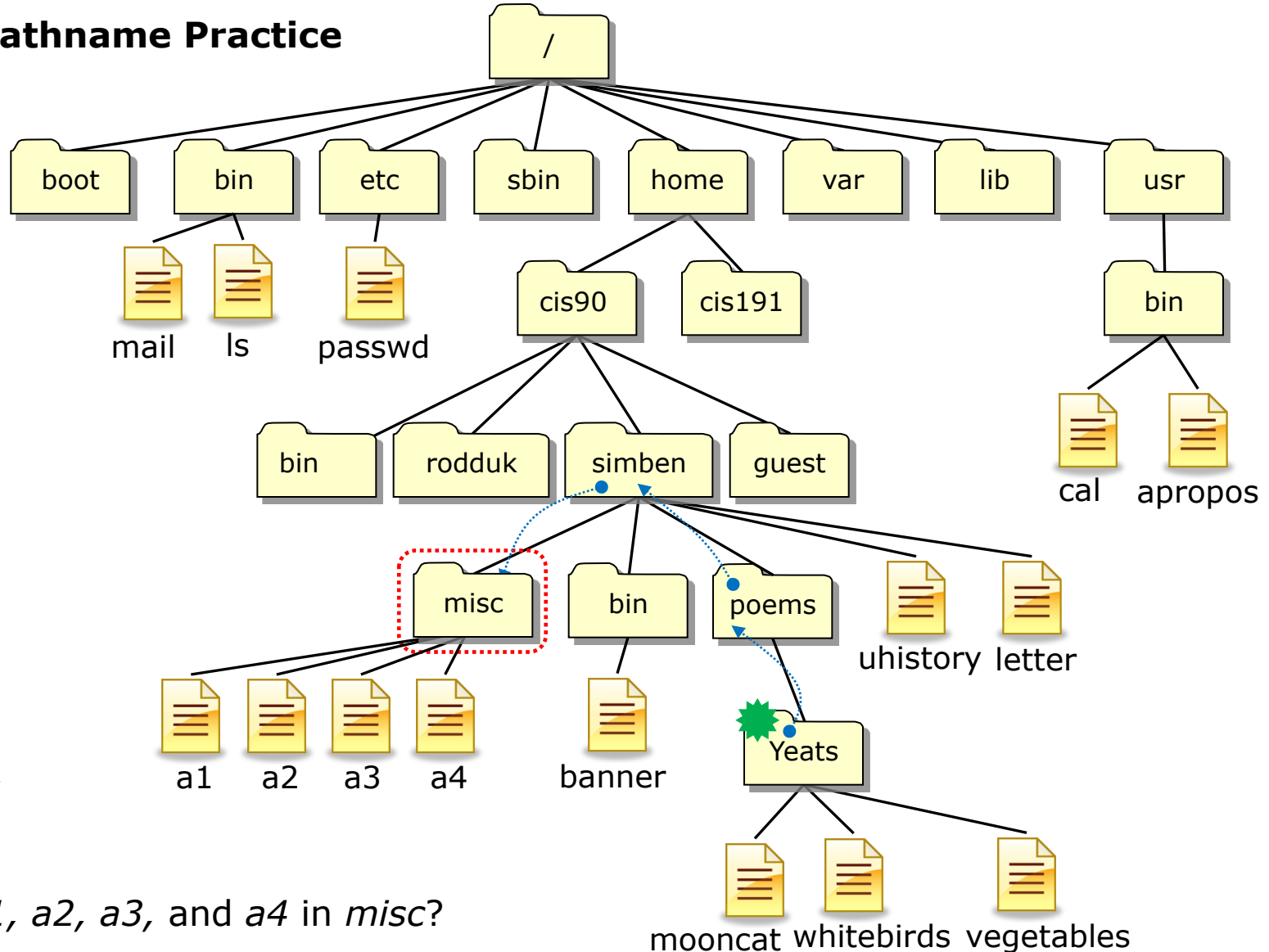
From 🟢 how does Benji:

Create files *a1, a2, a3,* and *a4* in *misc*?

/home/cis90/simben/poems/Yeats $ **touch ~/misc/a{1,2,3,4}**

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umask continued

Why umask?

Allows users and system administrators to disable specific permissions on new files and directories when they are created.

*Unlike **chmod**, it does **NOT** change the permissions on existing files or directories.*

umask summary

To determine permissions on a new file or directory apply the umask to the initial starting permissions:

- For new files, start with **666**

- For new directories, start with **777**

- For file copies, start with **the permission on the source file**

Case 1 – a new directory

With a umask of 033 what permissions would a newly created DIRECTORY have?

Write your answer in the chat window

Case 1 – a new directory

With a umask of 033 what permissions would a newly created DIRECTORY have?

r w x r w x r w x
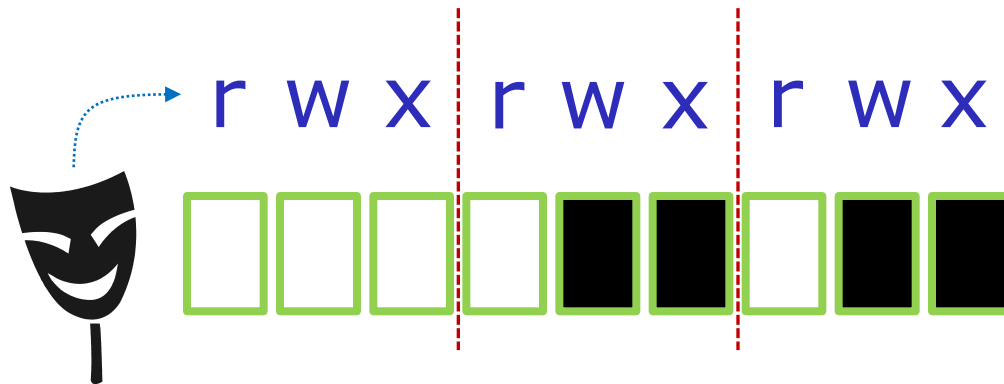
starting point = 777 (new directory)

umask setting of 033 strips these bits: --- -wx -wx

Now slide the mask up and over the starting point permissions

Case 1 – a new directory

With a umask of 033 what permissions would a newly created DIRECTORY have?

| r | w | x | r | ■ | ■ | r | ■ | ■ |
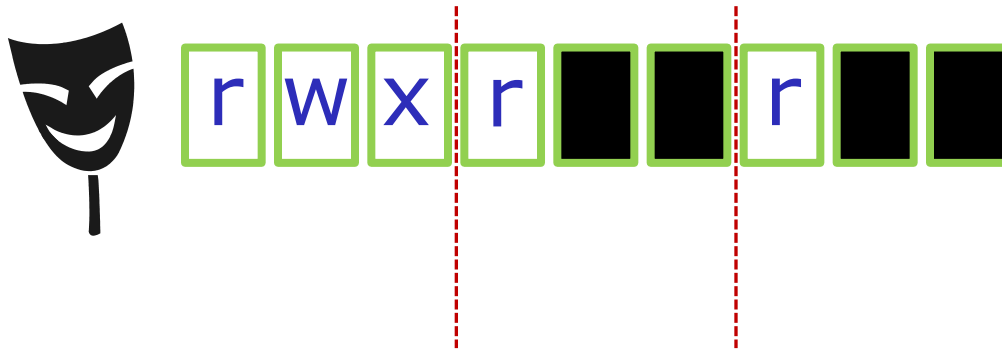
starting point = 777 (new directory)

umask setting of 033 strips these bits: --- -wx -wx

Answer: 744

Prove it to yourself on Opus as shown here

```
/home/cis90ol/simmsben $ umask 033
/home/cis90ol/simmsben $ mkdir brandnewdir
/home/cis90ol/simmsben $ ls -ld brandnewdir/
drwxr--r-- 2 simmsben cis90ol 4096 Apr 21 12:46 brandnewdir/
  7  4  4
```

Case 2 – new file

With a umask of 077 what permissions would a newly created FILE have?

Write your answer in the chat window

Case 2 – new file

With a umask of 077 what permissions would a newly created FILE have?

r w - r w - r w -

**starting point = 666
(new file)**

umask setting of 077 strips these bits: --- rwx rwx
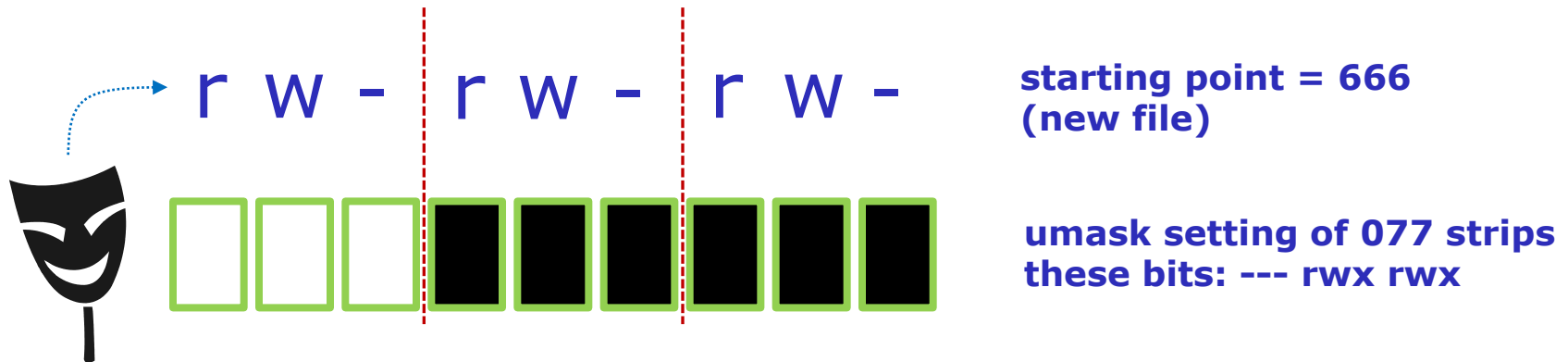
Now slide the mask up and over the starting point permissions

Case 2 – new file

With a umask of 077 what permissions would a newly created FILE have?

| r | w | - | ■ | ■ | ■ | ■ | ■ | ■ |
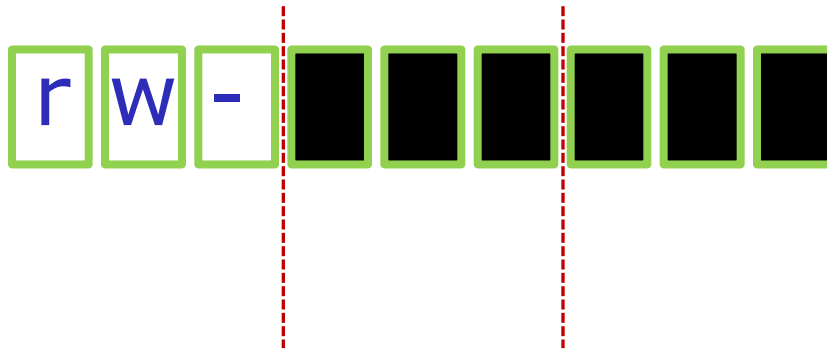
starting point = 666 (new file)

umask setting of 077 strips these bits: --- rwx rwx

Answer: 600

Prove it to yourself on Opus as shown here

```
/home/cis90ol/simmsben $ umask 077
/home/cis90ol/simmsben $ touch brandnewfile
/home/cis90ol/simmsben $ ls -l brandnewfile
-rw------- 1 simmsben cis90ol 0 Apr 21 12:50 brandnewfile
   6  0  0
```

Case 3 – file copy

**If umask=066 and the *cinderella* file permissions are 440
What would the permissions be on *cinderella.bak* after:**
```
cp cinderella cinderella.bak
```

Write your answer in the chat window

Case 3 – file copy

**If umask=066 and the *cinderella* file permissions are 440
What would the permissions be on *cinderella.bak* after:**
`cp cinderella cinderella.bak`

r - - r - - - - -
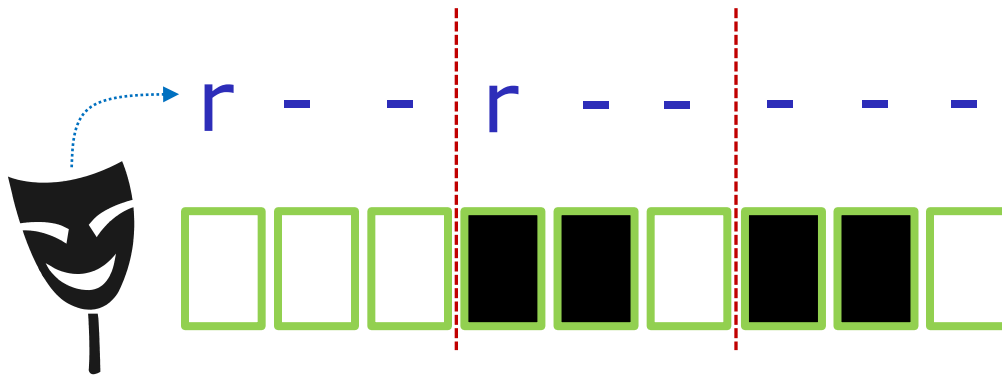
**starting point = 440
(source file permissions)**

**umask setting of 066 strips
these bits: --- rw- rw-**

Now slide the mask up and over the starting point permissions

Case 3 – file copy

**If umask=066 and the *cinderella* file permissions are 440
What would the permissions be on *cinderella.bak* after:**
`cp cinderella cinderella.bak`

r - - ■ ■ - ■ ■ -
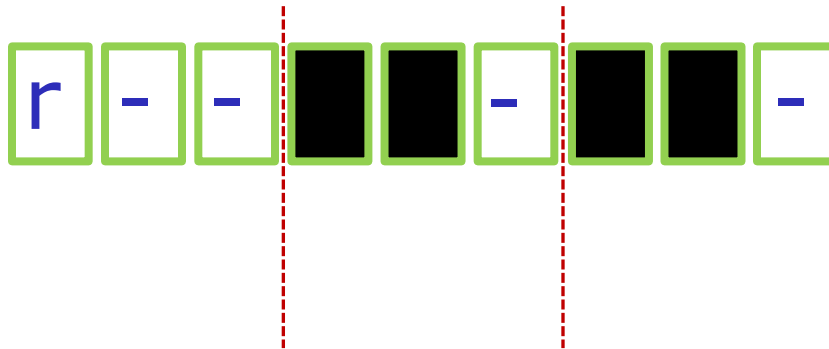
**starting point = 440
(source file permissions)**

**umask setting of 066 strips
these bits: --- rw- rw-**

Answer: 400

Prove it to yourself on Opus as shown here

```
/home/cis90/simben $ touch cinderella
/home/cis90/simben $ chmod 440 cinderella
/home/cis90/simben $ umask 066
/home/cis90/simben $ cp cinderella cinderella.bak
/home/cis90/simben $ ls -l cinderella.bak
-r--------. 1 simben90 cis90 0 Oct 22 09:17 cinderella.bak
  4  0  0
```

Housekeeping

Previous material and assignment

1. Lab 6 due 11:59PM

2. A **check6** script is available (modified last night to check you copied the uhistory file)

**Don't forget to submit
Lab 6 with the submit script!**

3. Five more posts due 11:59PM

4. Early preview of Lab X2 is now available. This is recommended for anyone wanting more practice with pathnames.

http://simms-teach.com/cis90grades.php

GRADES

- Check your progress on the Grades page

- If you haven't already, send me a student survey to get your LOR secret code name

- Graded labs & tests are placed in your home directories on Opus

- Answers to labs, tests and quizzes are in the */home/cis90/answers* directory on Opus
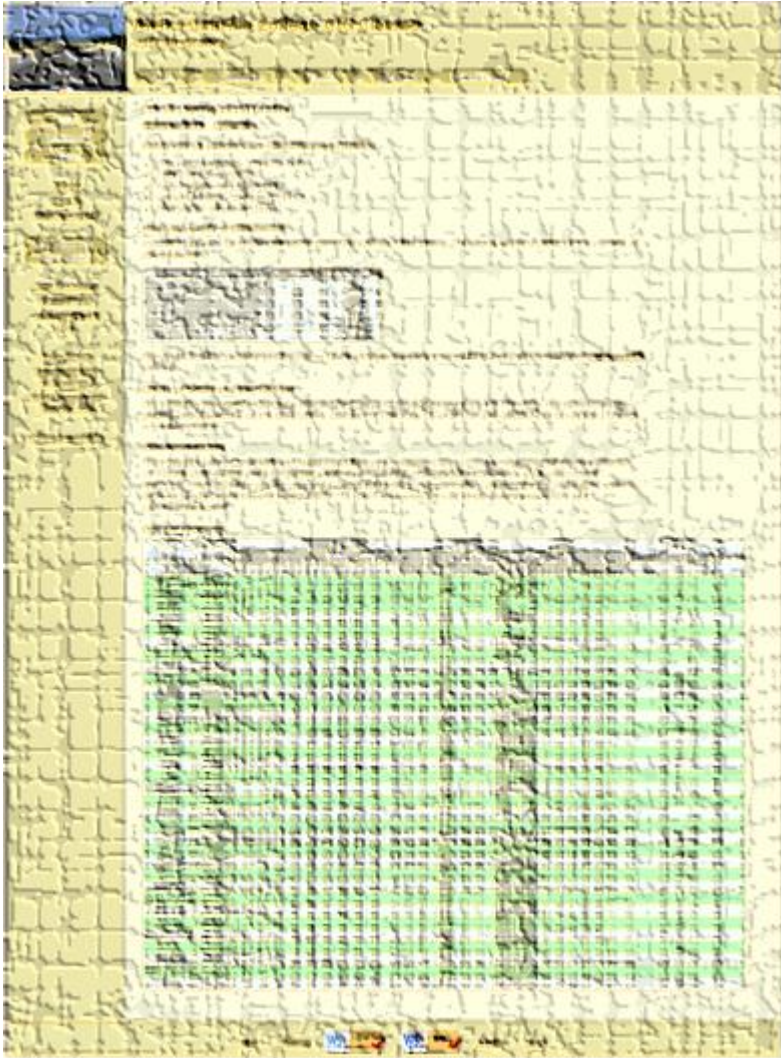
Current Point Tally
As of 10/16/2014

Points that could have been earned:

5 quizzes:	15 points
5 labs:	150 points
1 test:	30 points
1 forum quarter:	20 points
Total:	**215 points**

Percentage	Total Points	Letter Grade	Pass/No Pass
90% or higher	504 or higher	A	Pass
80% to 89.9%	448 to 503	B	Pass
70% to 79.9%	392 to 447	C	Pass
60% to 69.9%	336 to 391	D	No pass
0% to 59.9%	0 to 335	F	No pass

If you are not happy with your current standing contact the instructor ASAP

Jesse's checkgrades python script

http://oslab.cabrillo.edu/forum/viewtopic.php?f=31&t=773&p=2966

```
/home/cis90/simben $ checkgrades smeagol

Remember, your points may be zero simply because the
assignment has not been graded yet.

Quiz 1: You earned 3 points out of a possible 3.
Quiz 2: You earned 3 points out of a possible 3.
Quiz 3: You earned 3 points out of a possible 3.
Quiz 4: You earned 3 points out of a possible 3.


Forum Post 1: You earned 20 points out of a possible 20.

Lab 1: You earned 30 points out of a possible 30.
Lab 2: You earned 30 points out of a possible 30.
Lab 3: You earned 30 points out of a possible 30.
Lab 4: You earned 29 points out of a possible 30.


You've earned 15 points of extra credit.

You currently have a 109% grade in this class. (166 out of
152 possible points.)
```

Use your LOR code name as an argument on the checkgrades command

Jesse is a CIS 90 Alumnus. He wrote this python script when taking the course. It mines data from the website to check how many of the available points have been earned so far.

55

sort command

Tools for your toolbox

NEW **sort** - sorts the lines in a file

sort command

Basic syntax
(see man page for the rest of the story)

sort *<options>* *<filepath>*

The **sort** command can read lines from a file or *stdin* and sort them.

The **-r** option will do a reverse sort

sort command

Get the *names* file to use in the next module

return to home directory

`/home/cis90/simben $` **cd**

relative path to the names file in the depot directory

`/home/cis90/simben $` **cp ../depot/names .**

Think of the single dot file as "here" (it is hard linked to the current directory)

`/home/cis90/simben $` **cat names**
```
duke
benji
star
homer
```

/

59

sort command

sort command with a filename argument

```
/home/cis90/simben $ cat names
duke
benji
star
homer

/home/cis90/simben $ sort names
benji
duke
homer
star
```

The sort command will sort the lines in a file and output the sorted lines

sort command

sort command with no arguments

```
/home/cis90/simben $ sort
kayla
sky
bella
benji
charlie
bella
benji
charlie
kayla
sky
```

*If no filename was specified, **sort** will read input from the keyboard*

ctrl D

Ctrl-D specifies the EOF (End Of File).

After sort receives the EOF it sorts the lines and outputs them

61

sort command

sort command with bad argument

```
/home/cis90/simben $ sort bogus
sort: open failed: bogus: No such file or directory
/home/cis90/simben $
```

The sort program will try and open any file it receives as an argument and print an error message if the file does not exist

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

Lets visualize being the sort program and being loaded into memory and executing
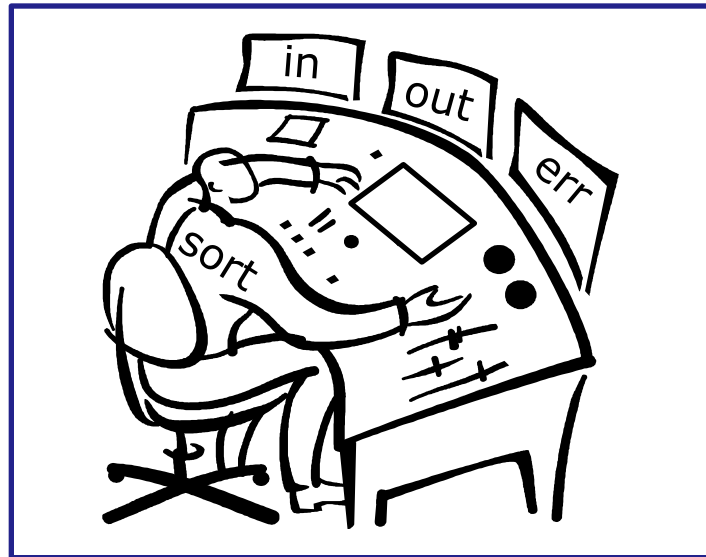
A day in the life of a process

Looking around you notice there is one in tray and two out trays
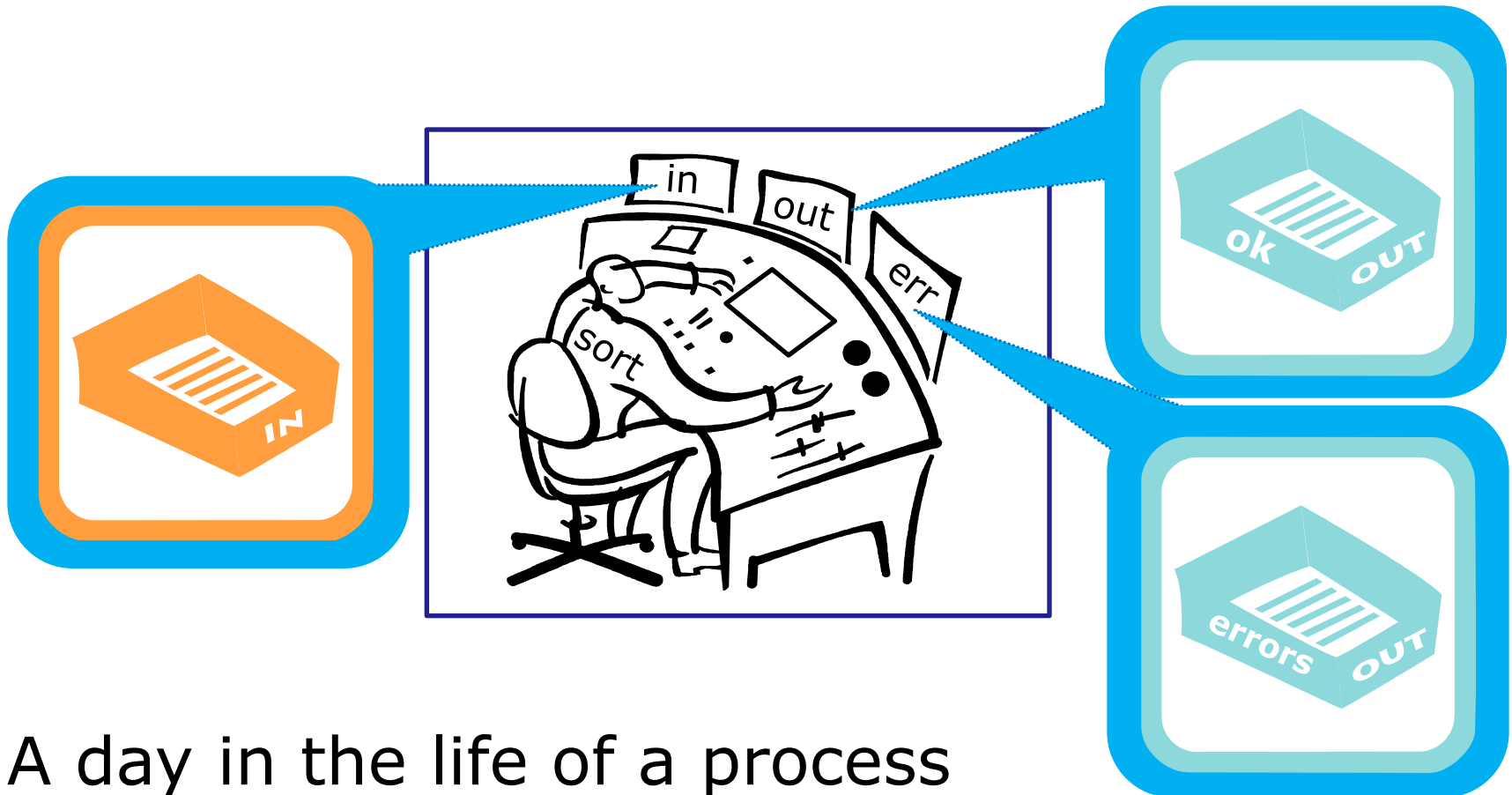
A day in the life of a process

You also notice an instruction window on your desk. This is where you find out about any options or arguments the shell passes on to you.
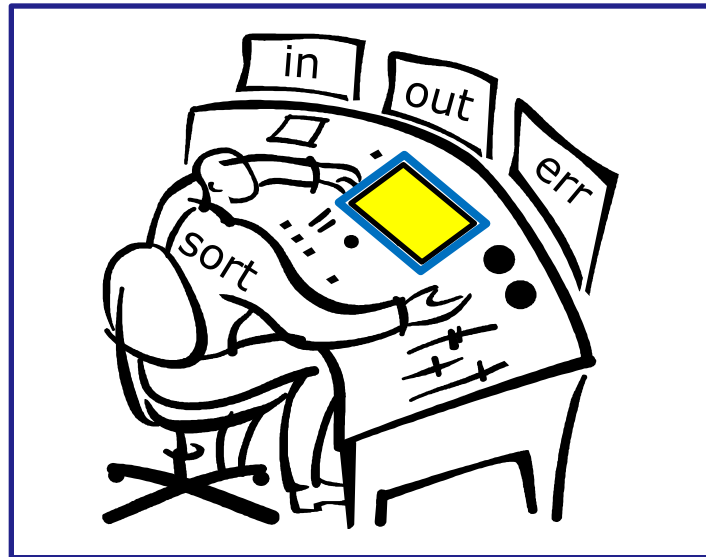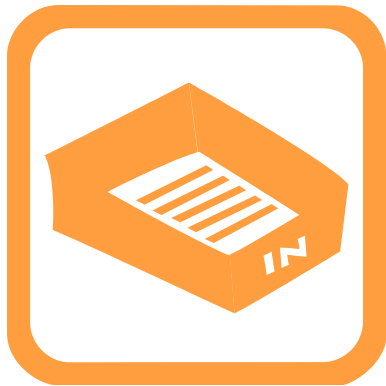
A day in the life of a process

sort process with filename argument (deep dive)

```
/home/cis90/simben $ sort names
benji
duke
homer
star
/home/cis90/simben $
```

66

`/home/cis90/simben $ ` **`sort names`**

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

1. Prompt string is: "`/home/cis90/simben $ `"

2. Parsing results:
    - command = `sort`
    - no options
    - 1 argument = "`names`"
    - no redirection

3. Search user's path and locate the sort program in */bin*

4. Sort loaded into memory and execution begins

67

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

/home/cis90/simben $ **sort names**

You (the sort process) check your instruction window and see the shell passed one argument "names" to you. You know (given your internal DNA code) that you must contact the kernel and request this file be opened.

68

/home/cis90/simben $ **sort names**
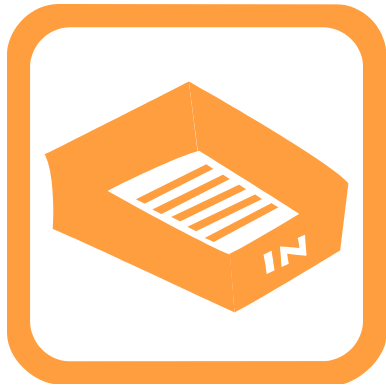
Note: After the names file is opened you read in each line one at a time until you reach the EOF (End of File).

/home/cis90/simben $ **sort names**

benji duke homer star

in

out

err

sort

ok OUT

errors OUT

IN
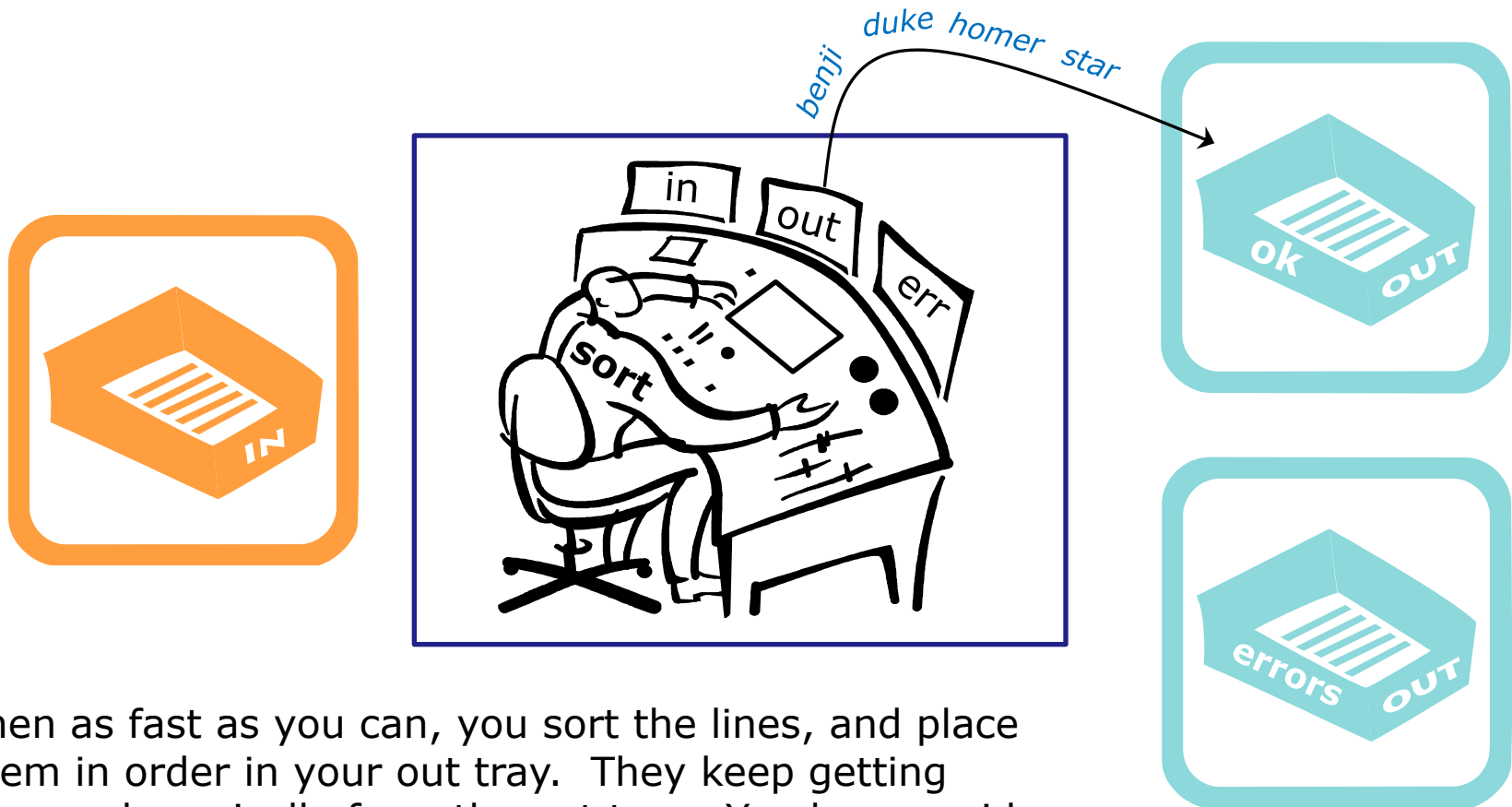
Then as fast as you can, you sort the lines, and place them in order in your out tray. They keep getting removed magically from the out tray. You have no idea where they go after that. You are done.

70

sort process
no arguments
(deep dive)

```
/home/cis90/simben $ sort
kayla
sky
bella
benji
charlie
bella
benji
charlie
kayla
sky
/home/cis90/simben $
```

EOF

`/home/cis90/simben $ ` **sort**

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

1. Prompt string is: "`/home/cis90/simben $ `"

2. Parsing results:
    *   command = `sort`
    *   no options
    *   no arguments
    *   no redirection

3. Search user's path and locate the sort program in */bin*

4. Sort loaded into memory and execution begins

72

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

/home/cis90/simben $ **sort**
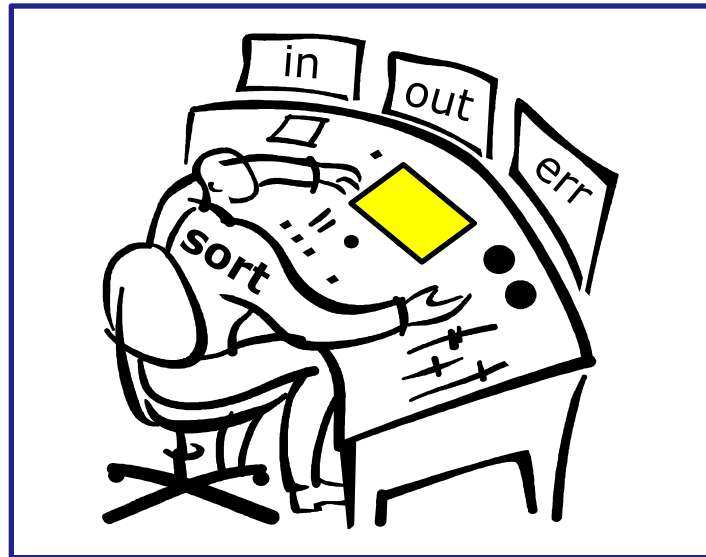
You (the sort process) check your instruction window and see that no options or arguments were passed to you from the shell to handle. You know (given your internal DNA code) that with no arguments you must look for lines to sort in your in tray, so you reach in to grab the first line to sort.

73

/home/cis90/simben $ **sort**
kayla
sky
bella
benji
charlie

charlie benji bella sky kayla

in

out

err

sort

OK OUT

errors OUT

IN
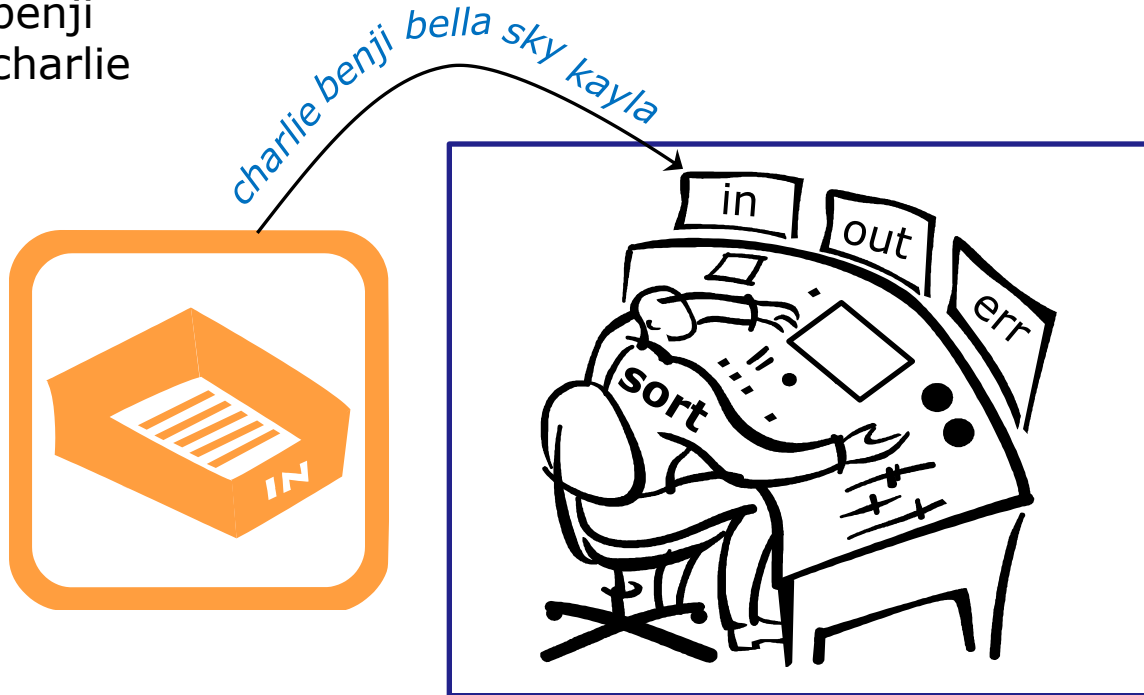
You work hard and fast. Each time you reach into the in tray there is another line! They just magically keep appearing into your in tray. You have no idea where they are coming from.

74

/home/cis90/simben $ **sort**
kayla
sky
bella
benji
charlie

EOF

ctrl D
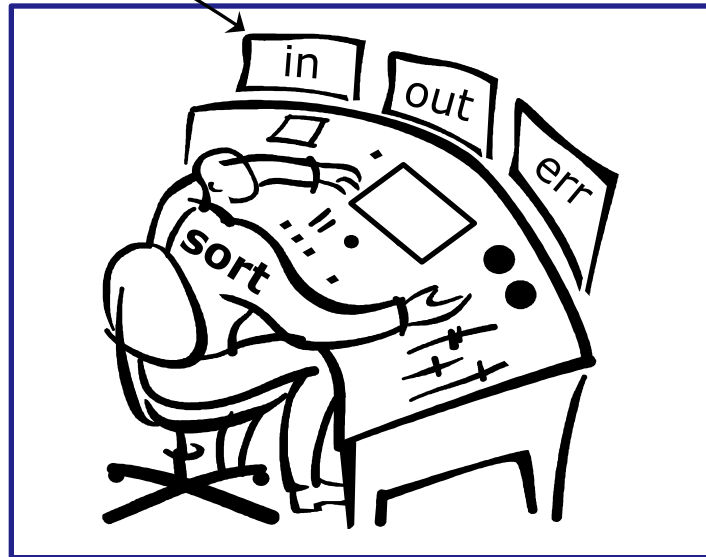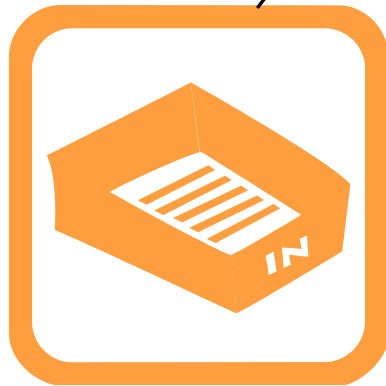
Then suddenly, when you reach for the next line, you find an EOF. You know (your internal DNA code) that this EOF means no more lines coming. You must sort what you have collected so far and place them, in order, into your out tray.

75

bella
benji
charlie
kayla
sky
/home/cis90/simben $

sky kayla charlie benji bella
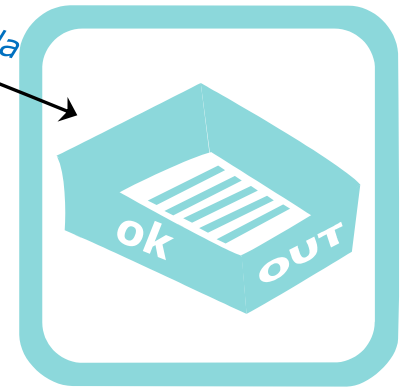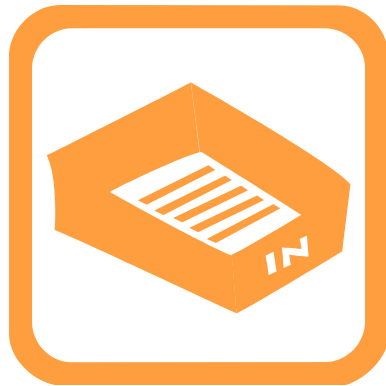
As fast as you can, you sort them, and place then in order in your out tray. They keep getting removed magically from the out tray. You have no idea where they go after that. You are done.

76

sort process bad argument (deep dive)

```
/home/cis90/simben $ sort bogus
sort: open failed: bogus: No such file or directory
/home/cis90/simben $
```

/home/cis90/simben $ **sort bogus**

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

1. Prompt string is: "/home/cis90/simben $ "

2. Parsing results:
   - command = sort
   - no options
   - 1 argument = bogus
   - no redirection

3. Search user's path and locate the sort program in */bin*

4. Sort command loaded into memory and execution begins

/home/cis90/simben $ **sort bogus**

Shell Steps
1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat
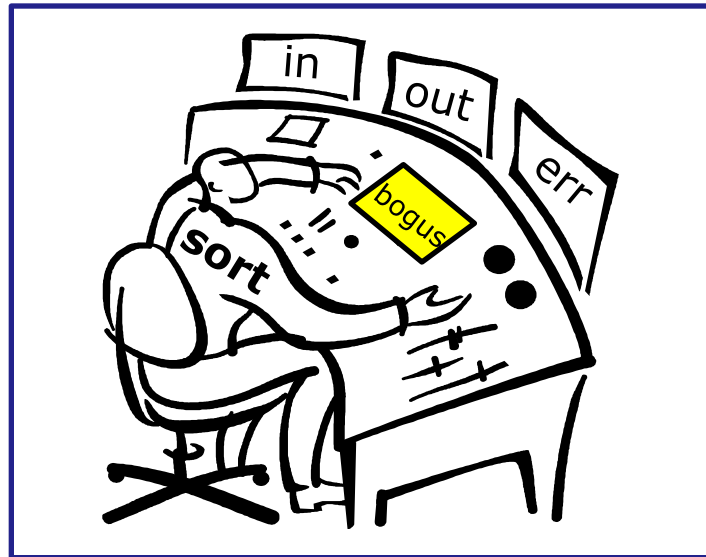
You check the instruction window and notice the shell passed you one argument: "bogus". You know (given your internal DNA code) that you must contact the kernel and request this file be opened.

79

/home/cis90/simben $ **sort bogus**
sort: open failed: bogus: No such file or directory
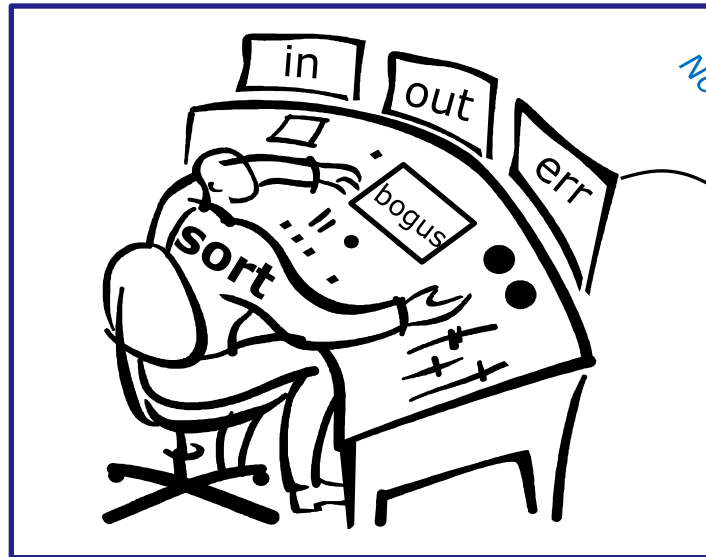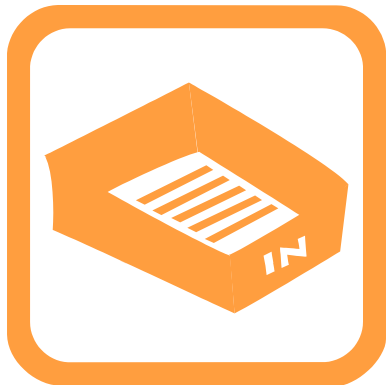
sort: open failed: bogus:
No such file or directory
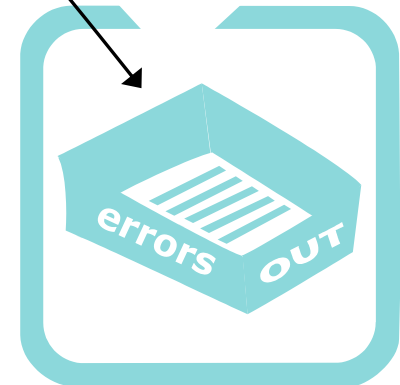
However the kernel tells you the file does not exist.
You place an error message in the out tray for errors.
You are done.

80

File Descriptors

Input and Output
File Descriptors

Every process is given three open files upon its execution. These open files are inherited from the shell.

stdin

Standard Input (0)
defaults to the user's terminal keyboard

stdout

Standard Output (1)
defaults to the user's terminal screen

stderr

Standard Error (2)
defaults to the user's terminal screen

bringing it home

Ok, lets make the visualization a little more realistic

The in and out trays are really the three
open file descriptors inherited from the shell:
stdin (0), stdout (1) and **stderr (2)**.

stdout (1)

stdin (0)

stderr (2)

84

Input and Output
File Descriptors

stdout (1)

Now lets start to show the file descriptors as plumbing. They are "bent" because the running process can't see what they are attached to.

OK OUT

IN

stdin (0)

stderr (2)

mistakes OUT
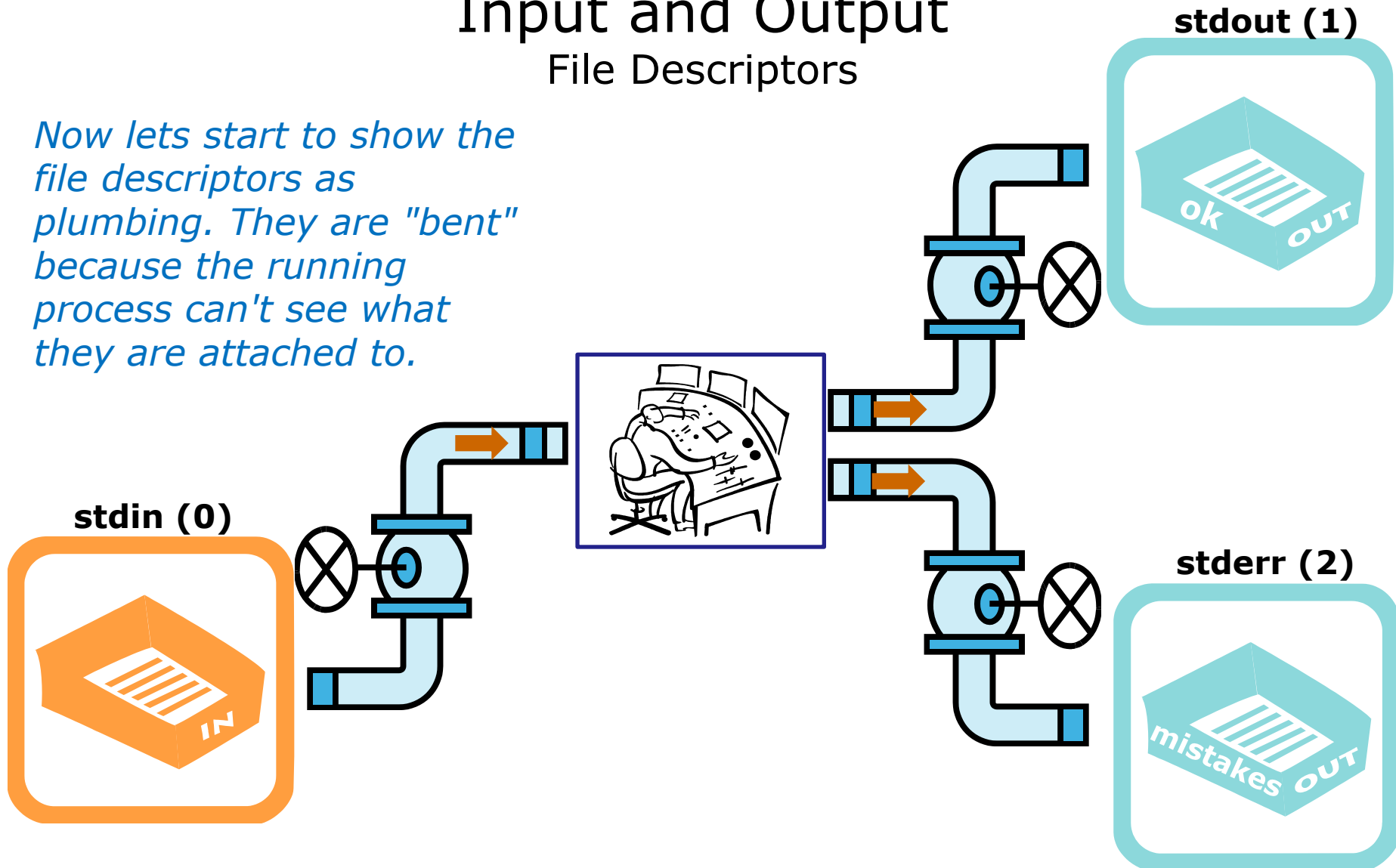
Input and Output
File Descriptors

*Let's replace the little worker with a box. This box represents the **program** that has been loaded into memory and is now executing as a **process.***

stdout

normal output is written to stdout

input (if necessary) is read from stdin

stdin

stderr

errors are written to stderr
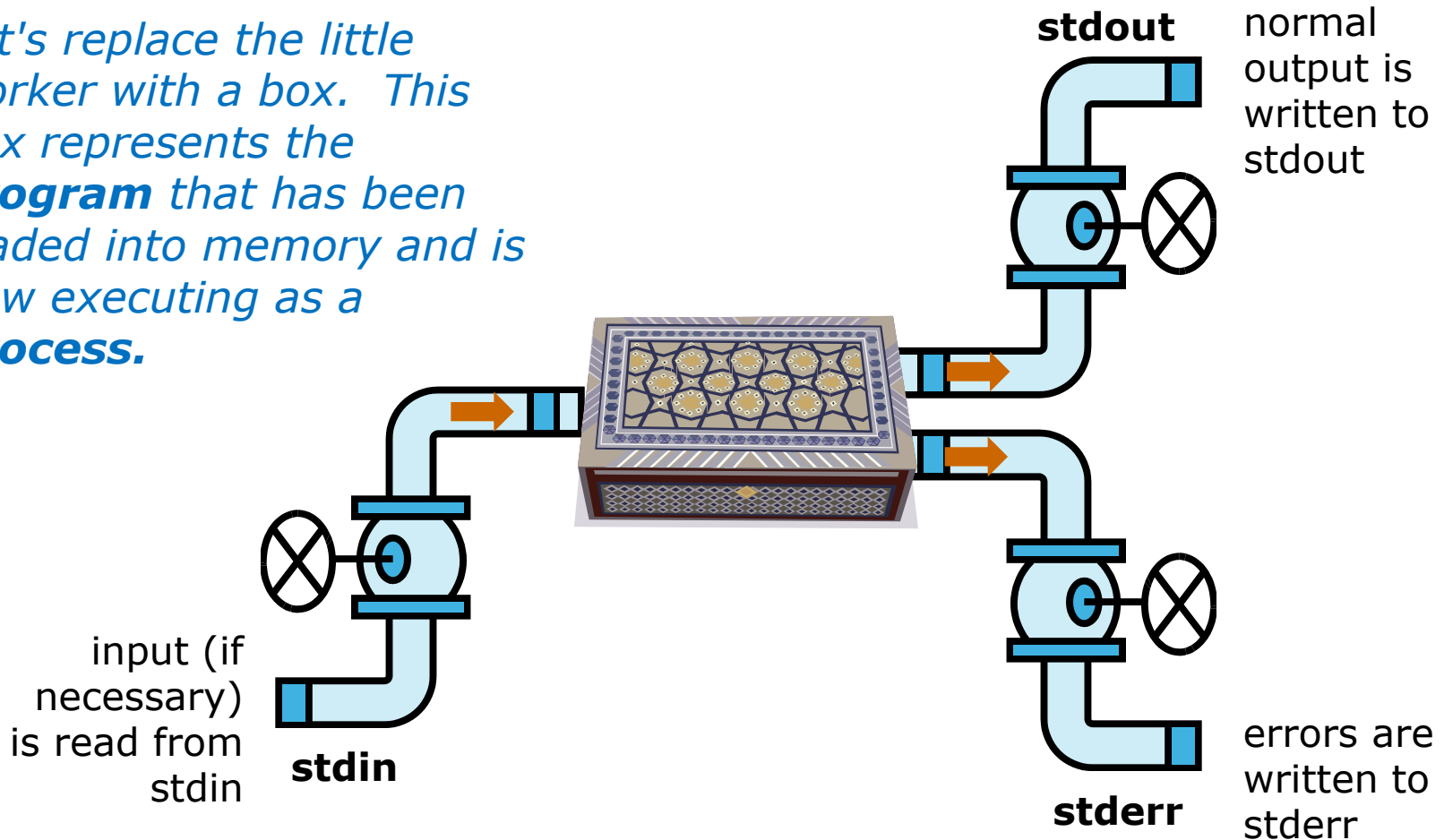
Input and Output
File Descriptors

By default is attached to the user's terminal device (screen)

Finally, lets show the default devices the plumbing is attached to.

stdout

1

0

2

stdin

stderr
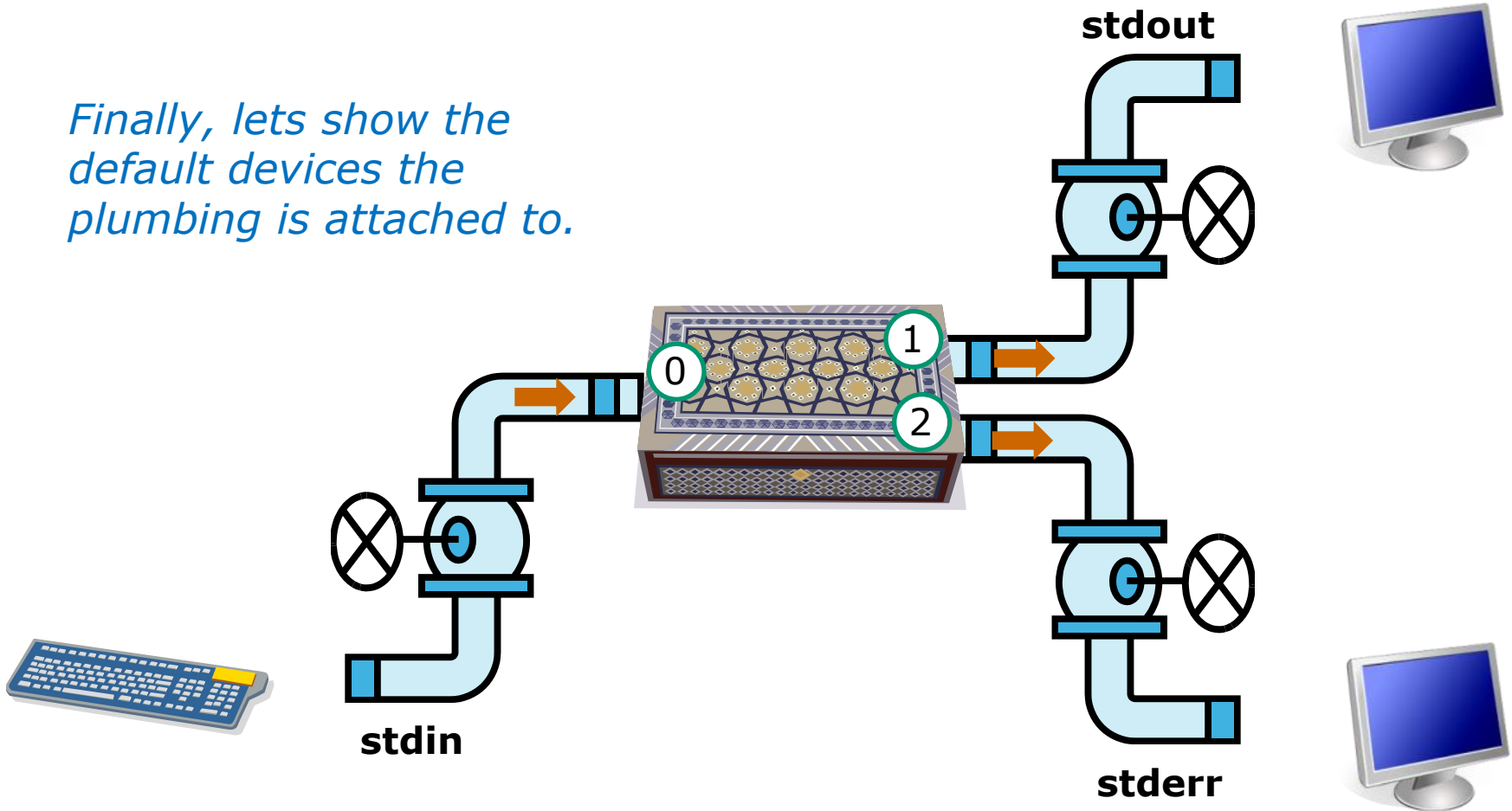
By default is attached to the user's terminal device (keyboard)

By default is attached to the user's terminal device (screen)

Input and Output
File Descriptors

```
[simmsben@opus ~]$ sort
star
benji
duke
homer
benji
duke
homer
star
[simmsben@opus ~]$
```

ctrl D

stdout

Options: NA
Args: NA

0 sort 1

2

```
benji
duke
homer
star
```
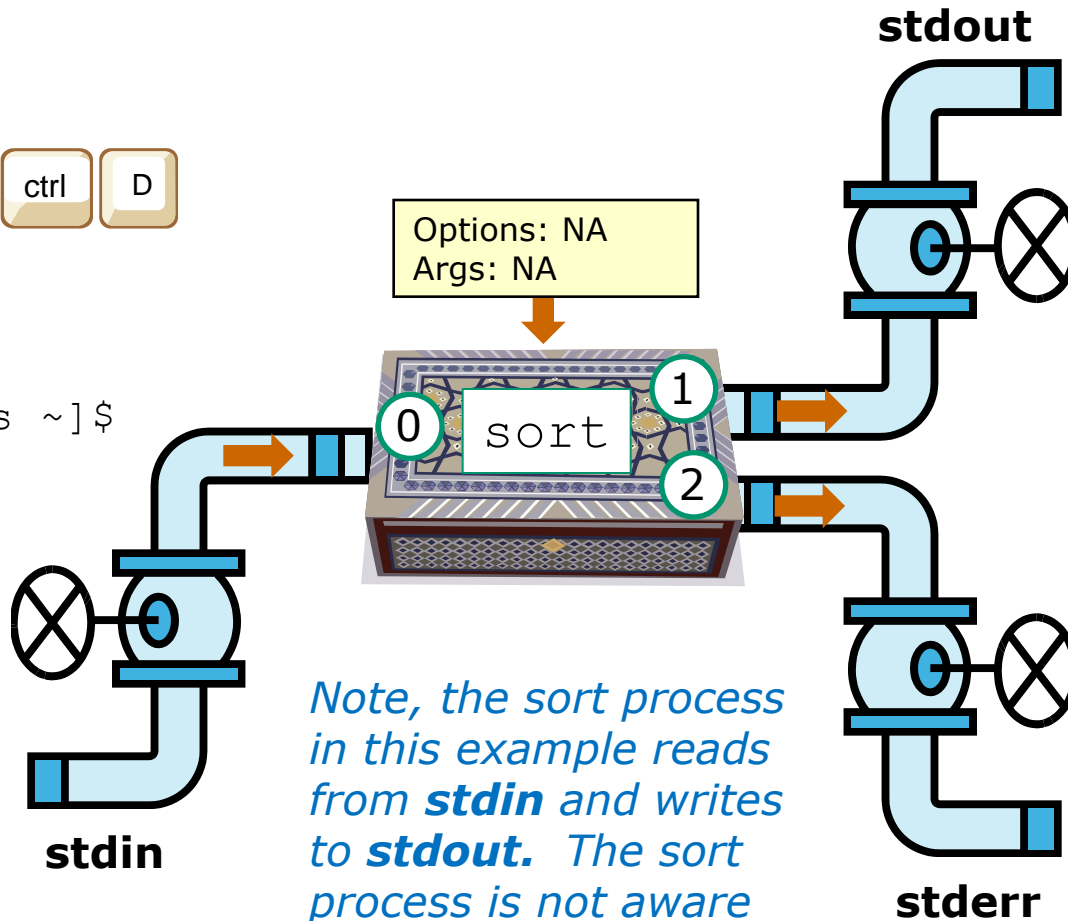
*Note, the sort process in this example reads from **stdin** and writes to **stdout**. The sort process is not aware what **stdin** or **stdout** are attached to*

stdin

stderr

```
star
benji
duke
homer
```

88

File Redirection

Life would be *BORING* if **stdin** was always attached to the terminal (keyboard), and **stdout** and **stderr** to the terminal (screen)!

It would be much more EXCITING if we could change where input comes from or where output goes!

defaults to the user's terminal screen

stdout

stdin

defaults to the user's terminal keyboard

stderr

defaults to the user's terminal screen

90

Input and Output
File Redirection

*Let's look at the
sort example again*

```
/home/cis90/simben $ sort
duke
benji
star
homer
benji
duke
homer
star
/home/cis90/simben $
```

ctrl   D

"End of File"

91

Input and Output
File Redirection

`/home/cis90/simben $ ` **sort**

duke

benji

star

homer

Read from **stdin**

*The sort program reads lines from **stdin** (attached to keyboard)*

ctrl   D

"End of File"

benji

duke

Written to **stdout**

homer

star

*After the EOF it performs the sort and writes to **stdout** (attached to terminal)*

`/home/cis90/simben $`

92

sort command (no arguments)

```
/home/cis90/simben $ sort
duke
benji
star
homer
benji
duke
homer
star
/home/cis90/simben $
```

ctrl D

/dev/pts/0

stdout

Options: NA
Args: NA

benji
duke
homer
star

0 sort 1
2

/dev/pts/0
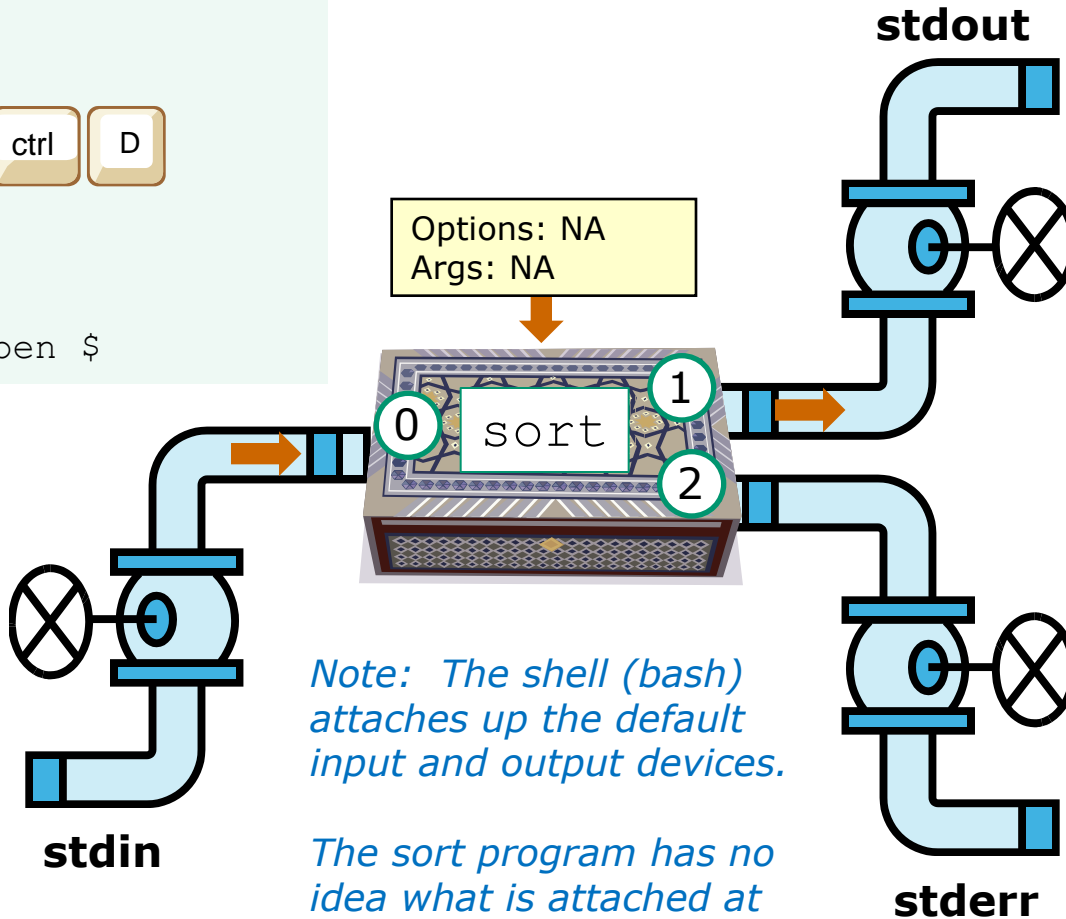
Note: The shell (bash) attaches up the default input and output devices.

stdin

duke
benji
star
homer

The sort program has no idea what is attached at the end of the pipes.

stderr

93

Activity

/home/cis90/simben $ **sort**

Read from **stdin**
duke
benji
star
homer

ctrl D

"End of File"

Written to **stdout**
benji
duke
homer
star
/home/cis90/simben $

Now you try it

94
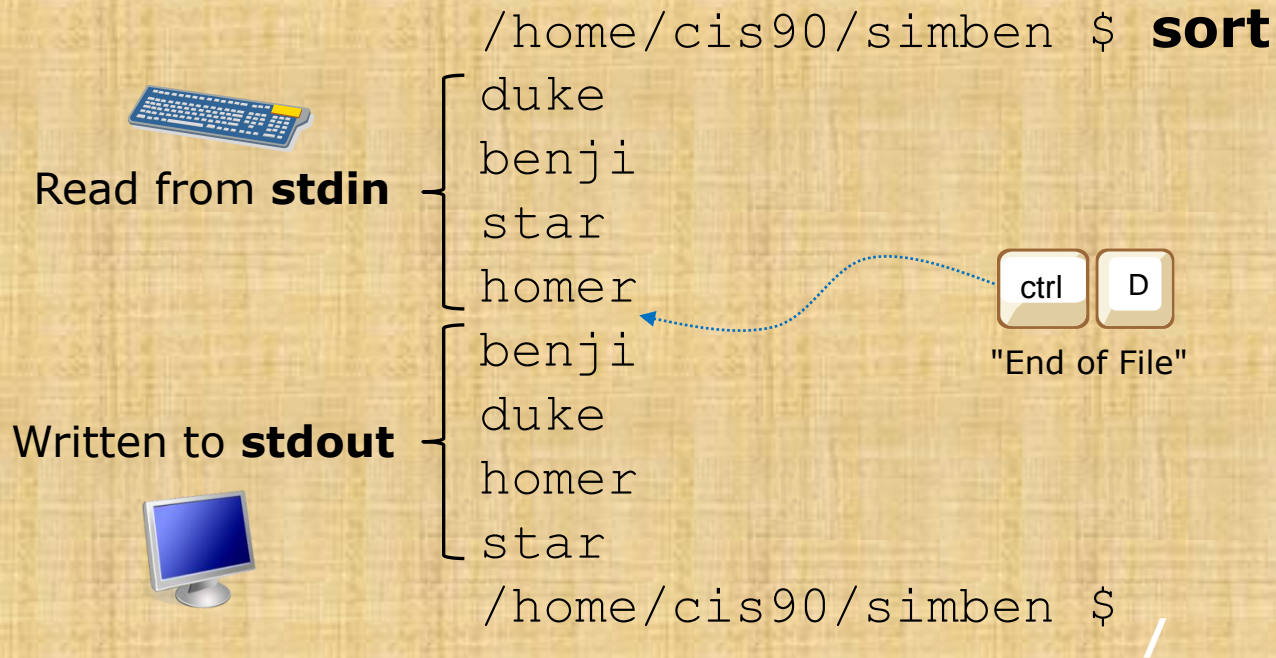
Input and Output
File Redirection

The input and output of a program can be **redirected** from and to other files using **<, >, 2>** and **>>**:
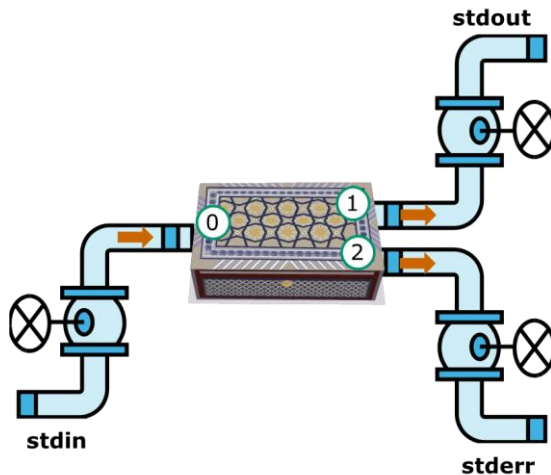
0< filename

*To redirect **stdin** (either 0< or just <)*

1> filename

*To redirect **stdout** (either 1> or just >)*

2> filename

*To redirect **stderr***

>> filename

*To redirect **stdout** and append*

No arguments, redirecting stdout

sort just reads from **stdin** and writes to **stdout**

stdout has been redirected to the file *dogsinorder*

```
[simmsben@opus ~]$ sort > dogsinorder
duke
benji
star
homer
```

If the file *dogsinorder* does not exist, it is created. If it does exist it is emptied!

ctrl D

```
[simmsben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simmsben@opus ~]$
```

No arguments, redirecting stdout

```
$ sort > dogsinorder
duke
benji
star
homer
$
```

ctrl   D

stdout

Options: NA
Args: NA

dogsinorder

```
$ cat dogsinorder
benji
duke
homer
star
```

0   sort   1
             2

/dev/pts/0

Note: sort doesn't know
that input comes from the
keyboard or that output
will be sent to the
dogsinorder file.

stdin

stderr

It just reads from **stdin**
and writes to **stdout**.

duke
benji
star
homer

Now you try it

sort just reads from **stdin** and writes to **stdout**

stdout has been redirected to the file *dogsinorder*

```
[simmsben@opus ~]$ sort > dogsinorder
duke
benji
star
homer
```

If the file *dogsinorder* does not exist, it is created. If it does exist it is emptied!

ctrl D

```
[simmsben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simmsben@opus ~]$
```

98

No arguments, redirecting stdin and stdout

```
[simben@opus ~]$ cat names
duke
benji
star
homer
[simben@opus ~]$ sort < names > dogsinorder
```

input is redirected to come from the file *names*

output is redirected to the file *dogsinorder*

```
[simben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simben@opus ~]$
```

Note: The bash shell handles the command line parsing and redirection. The sort command has no idea what **stdin** or **stdout** are attached to.

99

No arguments, redirecting stdin and stdout

`$` **sort < names > dogsinorder**

Note: sort doesn't know about the *names* or *dogsinorder* files. It just reads from **stdin** and writes to **stdout**.

stdout

```
$ cat names
duke
benji
star
homer
```
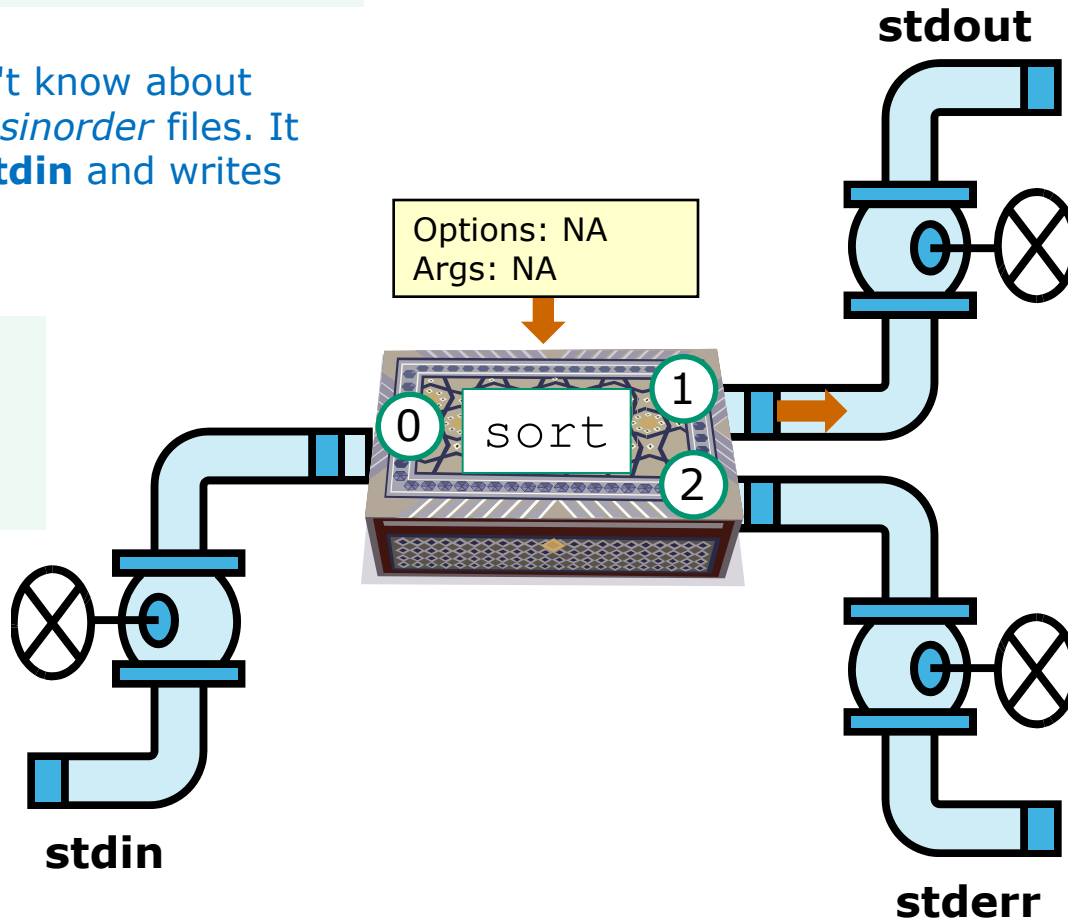
Options: NA
Args: NA

```
sort
```

0 1 2

dogsinorder

```
$ cat dogsinorder
benji
duke
homer
star
```

stdin

names

stderr

In this example, sort is getting it's input from **stdin**, which has been redirected to the *names* file

100

Now you try it

```
[simben@opus ~]$ cat names
duke
benji
star
homer
[simben@opus ~]$ sort < names > dogsinorder
```

input is redirected to come from the file *names*

output is redirected to the file *dogsinorder*

```
[simben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simben@opus ~]$
```

Does the sort program know that its input came from the names file?

Put your answer in the chat window

101

One argument, redirecting stdout

Output written to **stdout** is redirected to the file *dogsinorder*.

The *names* file is parsed as an **argument** and is passed to the sort process to handle.

The shell, not the sort program, opens the *dogsinorder* file.

```
[simben@opus ~]$ sort names > dogsinorder
[simben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simben@opus ~]$
```

The sort program, not the shell, opens and reads directly from the *names* file.

Корисне для наступного вікторини!

One argument, redirecting stdout

```
$ sort names > dogsinorder
```

Note: sort knows about the *names* file but doesn't know about the *dogsinorder* file. It reads directly from the file *names* and writes to **stdout**.

Корисне для наступного вікторини!

stdout

Options: NA
Args: names

dogsinorder

```
$ cat dogsinorder
benji
duke
homer
star
```

1

0 sort

2

read

stdin

names

sort opens and reads file contents from the names file

stderr

In this example, sort is getting it's input directly from the *names* file

103

Now you try it

Output written to **stdout** is redirected to the file *dogsinorder*.

The *names* file is parsed as an **argument** and is passed to the sort process to handle.

The shell, not the sort program, opens the *dogsinorder* file.

```
[simben@opus ~]$ sort names > dogsinorder
[simben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simben@opus ~]$
```

Does the sort program know that its input came from the names file?

Put your answer in the chat window

104

One option, one argument, redirecting stdout

names is parsed as an argument and passed to the sort command

specifying an option
(for reverse order)

sort writes to **stdout**, which is redirected to the file *dogsinorder*

```
[simben@opus ~]$ sort -r names > dogsinorder
[simben@opus ~]$ cat dogsinorder
star
homer
duke
benji
[simben@opus ~]$
```

This -r option does the sort in reverse order

The shell opens the *dogsinorder* file. The sort process is not aware that output is redirected there.

105

One option, one argument, redirecting stdout

`$ sort -r names > dogsinorder`

stdout

dogsinorder

Note: sort does know about the *names* file and the -r option however it doesn't know about the *dogsinorder* file.

sort reads directly from *names* and writes to **stdout**.
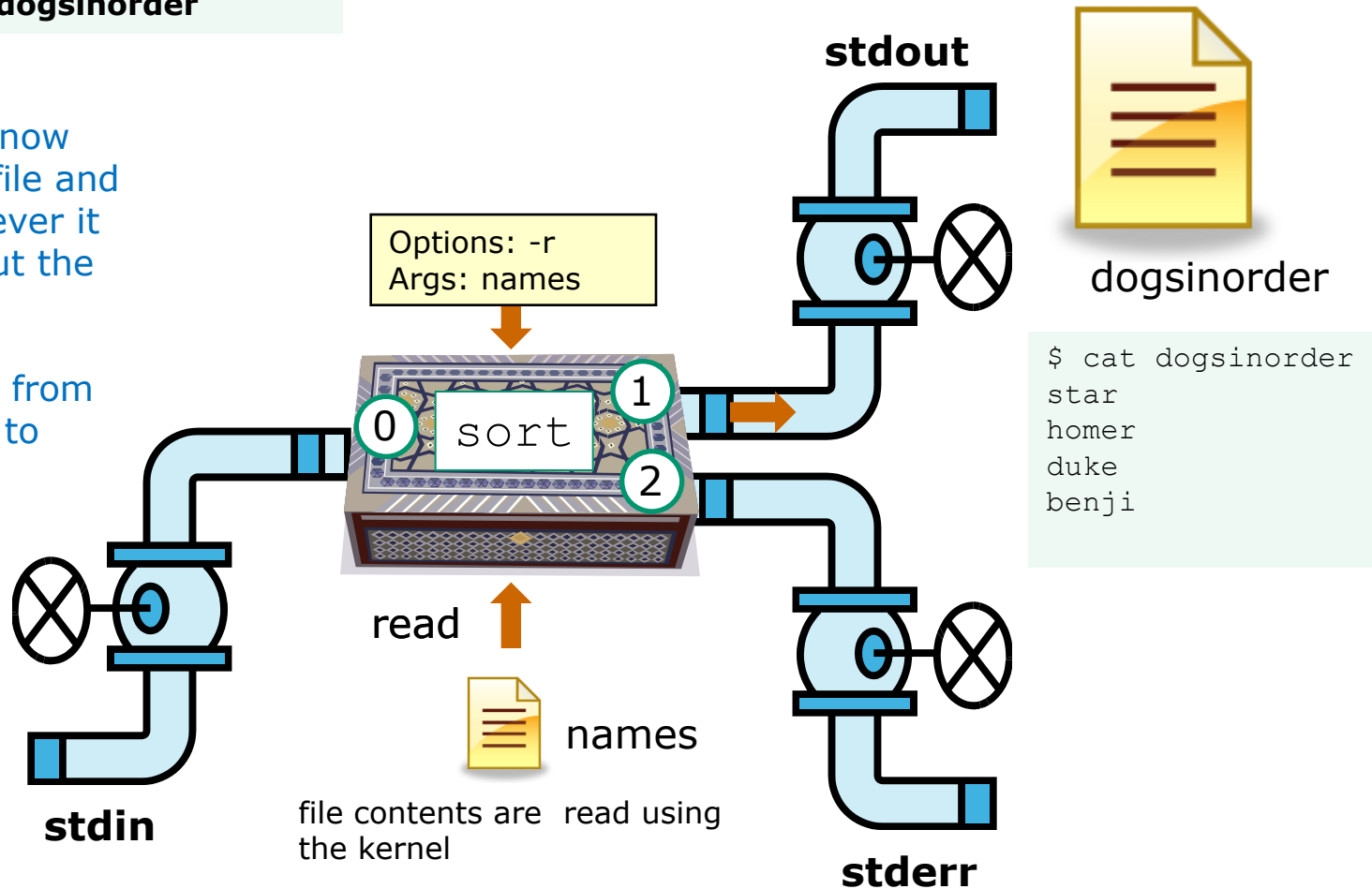
Options: -r
Args: names

```
$ cat dogsinorder
star
homer
duke
benji
```

0 sort 1
2

read

names

file contents are read using the kernel

stdin

stderr

In this example, sort is getting it's input directly from the names file

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Now you try it

names is parsed as an argument and passed to the sort command

specifying an option (for reverse order)

sort writes to **stdout**, which is redirected to the file *dogsinorder*

```
/home/cis90/simben $ sort -r names > dogsinorder
/home/cis90/simben $ cat dogsinorder
star
homer
duke
benji
/home/cis90/simben $
```

Does the sort program know that its output is going to the dogsinorder file?

Put your answer in the chat window

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More redirection examples

Redirecting stdout to another terminal device

/dev/pts/0

```
[simben@opus ~]$ cat names
duke
benji
star
homer
[simben@opus ~]$
[simben@opus ~]$ tty
/dev/pts/0
[simben@opus ~]$ sort names > /dev/pts/1
[simben@opus ~]$
```

Note, everything in UNIX is a file so we can even redirect to another terminal

/dev/pts/1

```
[simben@opus ~]$ tty
/dev/pts/1
[simben@opus ~]$ benji
duke
homer
star
```

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Input from the command line, redirecting stdout

`$` **echo "Hello World" > message**

stdout

Note: In this example echo does not use **stdin**. It gets its input from the command line and writes to **stdout** which is redirected to the file *message*.

Options: NA
Args: "Hello World"

0 echo 1
2

message

```
$ cat message
Hello World
```

In this example, echo is getting it's input from the command line

stdin

stderr

110
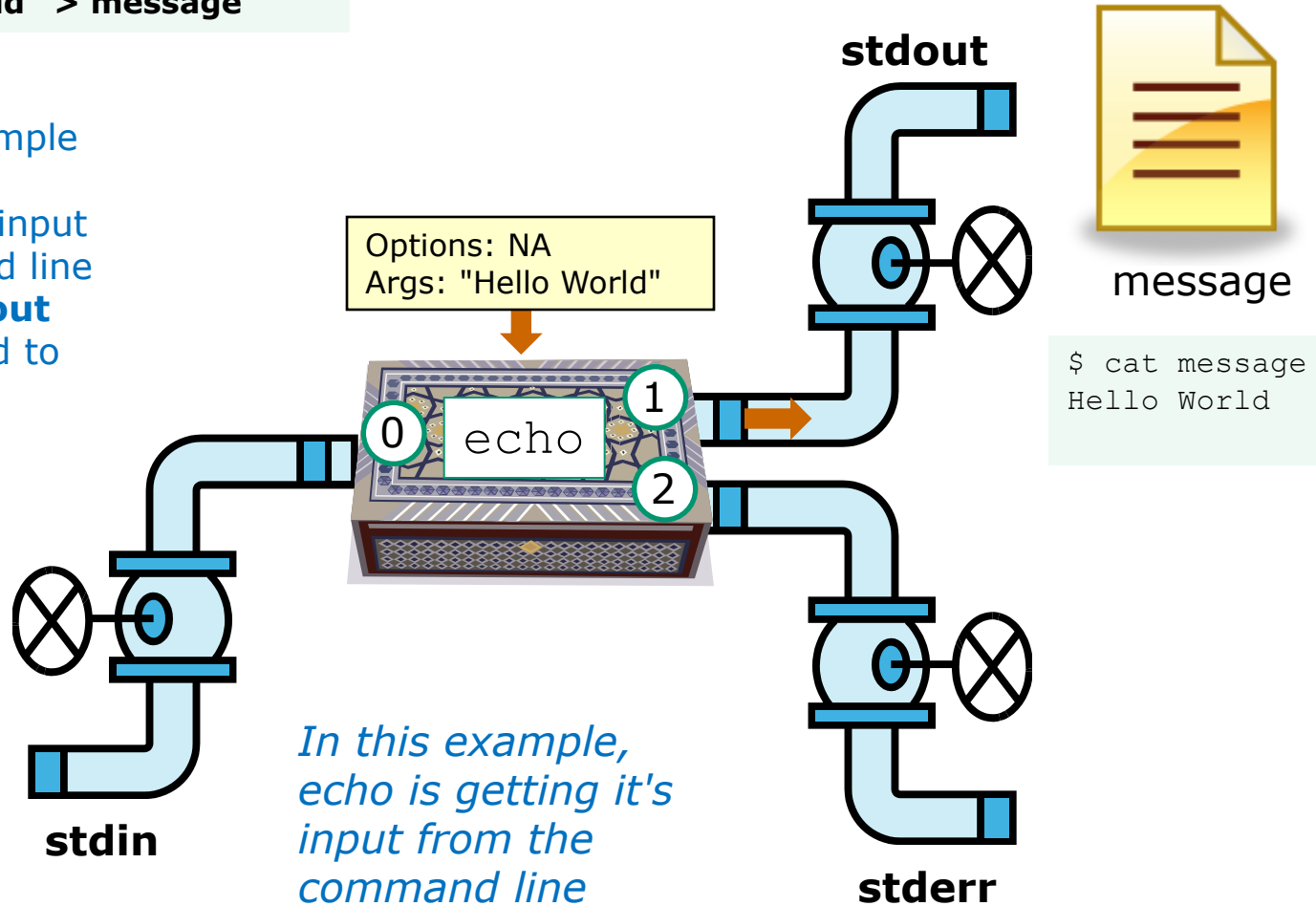
> (overwrites) vs >> (appends)

```
[simben@opus ~]$ echo "Hello World" > message
[simben@opus ~]$ cat message
Hello World
[simben@opus ~]$ echo "Hello Universe" >> message
[simben@opus ~]$ cat message
Hello World
Hello Universe
```

>> does not empty file, just appends to the end

```
[simben@opus ~]$ echo "Oops" > message
[simben@opus ~]$ cat message
Oops
[simben@opus ~]$ > message
[simben@opus ~]$ cat message
[simben@opus ~]$
```

*> empties then **overwrites** anything already in the file!*

111

Redirecting stdout and stderr

Another example ...

```
[simben@opus ~]$ ls -lR > snapshot
ls: ./Hidden: Permission denied
[simben@opus ~]$ head -10 snapshot
.:
total 296
-rw-rw-r--  1 simben cis90      51 Sep 24 17:13 1993
-rw-r--r-- 21 guest90  cis90  10576 Jul 20  2001 bigfile
drwxr-x---  2 simben cis90   4096 Oct  8 09:05 bin
drwx--x---  4 simben cis90   4096 Oct  8 09:00 class
-rw-------  1 simben cis90    484 Sep 24 18:13 dead.letter
drwxrwxr-x  2 simben cis90   4096 Oct  8 09:05 docs
-rw-rw-r--  1 simben cis90     22 Oct 20 10:51 dogsinorder
drwx------  2 simben cis90   4096 Oct 16 09:17 edits
[simben@opus ~]$
```

*Note: errors are written to **stderr**, which is attached by default to the terminal*

```
[simben@opus ~]$ ls -lR > snapshot 2> errors
[simben@opus ~]$ cat errors
ls: ./Hidden: Permission denied
[simben@opus ~]$
```

*> redirects **stdout** to file named snapshot*

*2> redirects **stderr** to file named errors*

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Redirecting stdout and stderr

$ **ls -lR > snapshot 2> errors**

*Note: In this example ls does not use **stdin**. It gets its input from the command line and the OS (kernel) and writes to **stdout** (redirected to snapshot) and **stderr** (redirected to errors).*

stdout

Options: -lR
Args: NA

snapshot

```
[simben@opus ~]$ head -10 snapshot
.:
total 296
-rw-rw-r--  1 simben cis90      51 Sep 24 17:13 1993
-rw-r--r-- 21 guest90 cis90  10576 Jul 20  2001 bigfile
drwxr-x---  2 simben cis90    4096 Oct  8 09:05 bin
drwx--x---  4 simben cis90    4096 Oct  8 09:00 class
-rw-------  1 simben cis90     484 Sep 24 18:13 dead.letter
drwxrwxr-x  2 simben cis90    4096 Oct  8 09:05 docs
-rw-rw-r--  1 simben cis90      22 Oct 20 10:51 dogsinorder
drwx------  2 simben cis90    4096 Oct 16 09:17 edits
```

1

ls

2

0

read

directory contents are read using the kernel

stdin

In this example, ls is getting it's input from the OS

stderr

errors

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```
$ cat errors
ls: ./Hidden: Permission denied
```

Redirecting stdin, stdout and stderr

Using all three (<, > and 2>) on one command

```
[simben@opus ~]$ echo 2+2 > math
[simben@opus ~]$ bc < math
4
```
bc reads input from **stdin** (redirected to *math*) and writes to **stdout** (attached to the terminal)

```
[simben@opus ~]$ echo 4/0 >> math
[simben@opus ~]$ cat math
2+2
4/0
[simben@opus ~]$ bc < math
4
Runtime error (func=(main), adr=5): Divide by zero
```
bc reads inputs from **stdin** (redirected to math), writes to **stdout** (attached to the terminal) and writes errors to **stderr** (attached to the terminal)

```
[simben@opus ~]$ bc < math > answers 2> errors
[simben@opus ~]$ cat answers
4
```
bc reads inputs from **stdin** (redirected to math), writes to **stdout** (redirected to *answers*) and writes errors to **stderr** (redirected to *errors*)

```
[simben@opus ~]$ cat errors
Runtime error (func=(main), adr=5): Divide by zero
```

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redirecting stdin, stdout and stderr

`$` **bc < math > answers 2> errors**

Note: The shell sends no options or arguments from the command line to **bc**. Input is redirected to come from the *math* file, output is redirected to the *answers* file and errors are redirected to the *errors* file.

stdout

Options: NA
Args: NA

1

0

bc

2

answers

4

The bc process has no idea what files are attached to the ends of each pipe

stdin

math

2+2
4/0

stderr

errors

115
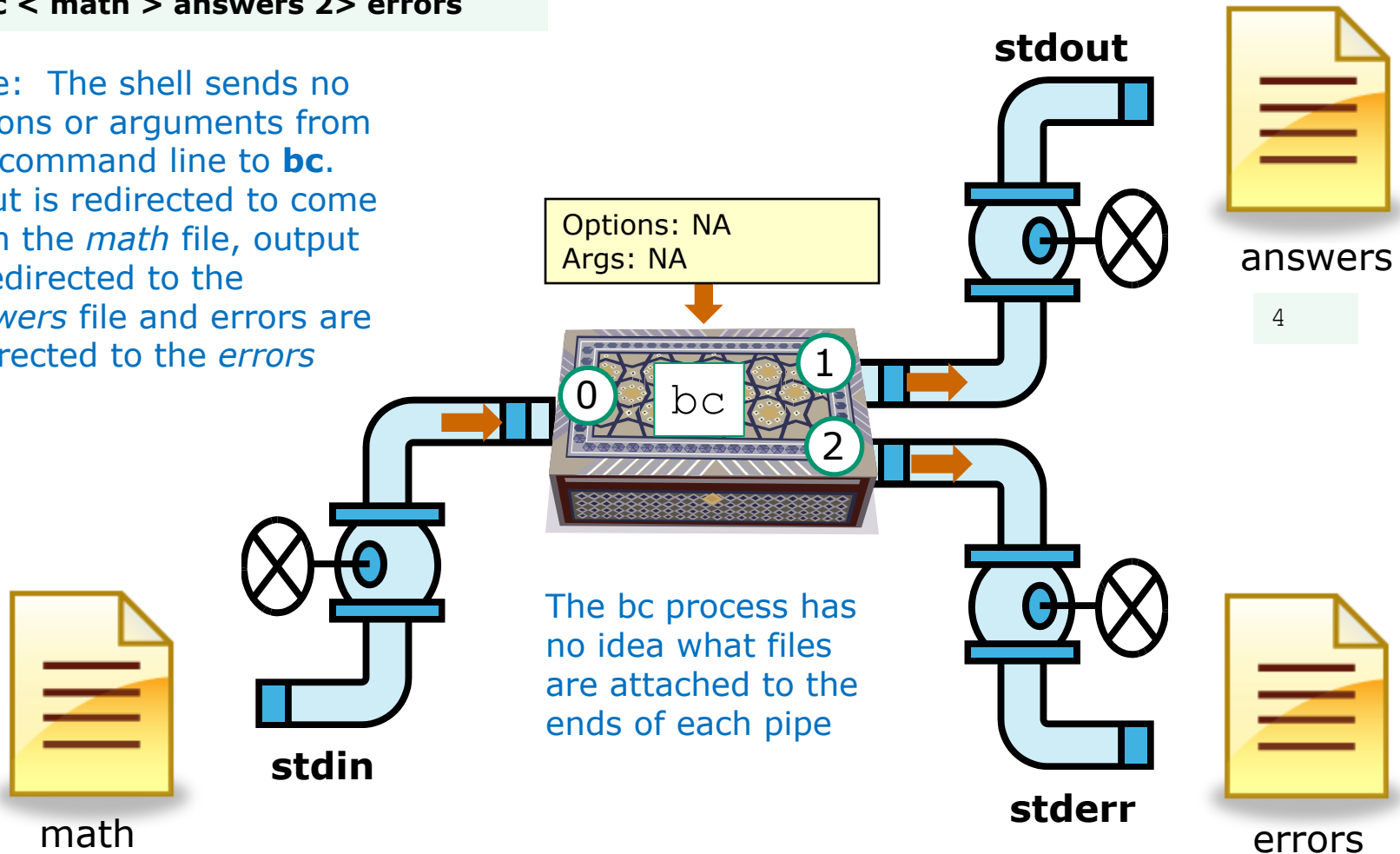
Runtime error (func=(main), adr=5): Divide by zero

The
bit bucket

/dev/null

/dev/null = "bit bucket"

A bit bucket is very handy. You can throw stuff into it and never see it again!

http://www.adri
anmouat.com/bi
t-bucket/

http://didyouk
nowarchive.co
m/?p=1755
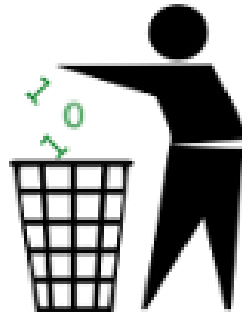
It's like having your own black hole to discard those unwanted bits into!

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/dev/null = "bit bucket"

*Whatever you redirect to /dev/null/
is gone forever*

```
/home/cis90/simben $ echo Clean up your room! > orders
/home/cis90/simben $ cat orders
Clean up your room!
/home/cis90/simben $

/home/cis90/simben $ echo Clean up your room! > /dev/null
/home/cis90/simben $ cat /dev/null
/home/cis90/simben $
```

Корисне для
наступного
вікторини!

This is how you redirect output to the bit bucket

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Pipelines

Input and Output
Pipelines

Commands may be chained together in such a way that the **stdout** of one command is "piped" into the **stdin** of a second process.

Filters
   A program that both reads from **stdin** and writes to **stdout**.

Tees
   A filter program that reads **stdin** and writes it to **stdout and the file** specified as the argument.

Input and Output
Pipelines

Note:

Use **redirection** operators (<, >, >>, 2>) to redirect input and output from and to **files**

Use the **pipe** operator (|) to pipe output from one **command** for use as input to another **command**

Pipeline Example

```
[simben@opus ~]$ cat letter | wc -l
28
```

Counting the lines in the letter file

Counting lines in the letter file

stdout

28

```
$ cat letter | wc -l
```

Options: -l
Args: NA

*cat writes to **stdout** which is piped to **stdin** for wc!*

0 wc 1
2

stdout

stdin

Options: NA
Args: letter

0 cat 1
2

read
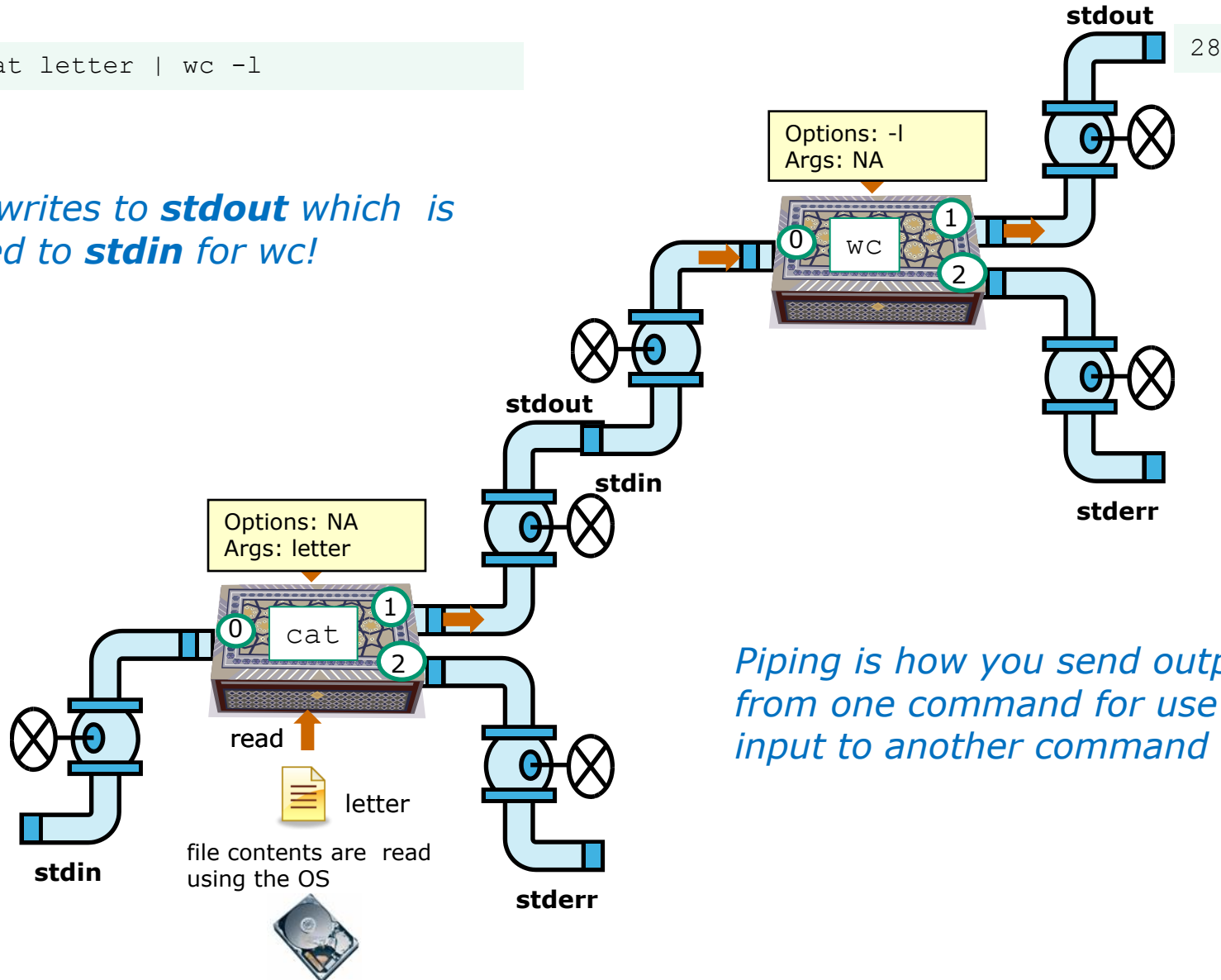
Piping is how you send output from one command for use as input to another command

letter

stdin

file contents are read using the OS

stderr

stderr

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You try it

Counting the lines in the letter file

```
/home/cis90/simben $ cat letter | wc -l
28
```

Counting the number of Shakespeare poems

```
/home/cis90/simben $ ls poems/Shakespeare/ | wc -l
15
```

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More Commands

Tools for your toolbox

find - Find file or content of a file

grep - "Global Regular Expression Print"

sort - sort

spell - spelling correction

wc - word count

tee - split output

cut - cut fields from a line

find command

Find Command

Basic syntax
(see man page for the rest of the story)

find *<start-directory>* **-name** *<filename>*
                         -type *<filetype>*
                         -user *<username>*
                         -group *<groupname>*
                         -exec *<command>* **{} \;**

Use the **find** command to find files by their name, type, owner, group (or other attributes) and optionally run a command on each of the files found.

The find command is **recursive** by default. It will start finding files at the <start directory> and includes all files and sub-directories in that branch of the file tree.

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find command with no options or arguments

*The **find** command by itself lists all files in the current directory and recursively down into any sub-directories.*

```
[simben@opus poems]$ find
.
./Blake
./Blake/tiger
./Blake/jerusalem
./Shakespeare
./Shakespeare/sonnet1
./Shakespeare/sonnet2
./Shakespeare/sonnet3
./Shakespeare/sonnet4
./Shakespeare/sonnet5
./Shakespeare/sonnet7
./Shakespeare/sonnet9
./Shakespeare/sonnet10
./Shakespeare/sonnet15
./Shakespeare/sonnet17
./Shakespeare/sonnet26
./Shakespeare/sonnet35
./Shakespeare/sonnet11
./Shakespeare/sonnet6
./Yeats
./Yeats/whitebirds
./Yeats/mooncat
./Yeats/old
./Anon
./Anon/ant
./Anon/nursery
./Anon/twister
[simben@opus poems]$
```

Because no start directory was specified the find command will start listing files in the current directory (poems)

note: reduced font size so it will fit on this slide

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find command - the starting directory

One or more starting directories in the file tree can be specified as an argument to the find command which will list recursively all files and sub-folders from that directory and down

```
/home/cis90/simben $ find /etc/ssh
/etc/ssh
/etc/ssh/ssh_config
/etc/ssh/ssh_host_dsa_key.pub
/etc/ssh/moduli
/etc/ssh/ssh_host_key
/etc/ssh/ssh_host_dsa_key
/etc/ssh/ssh_host_rsa_key.pub
/etc/ssh/ssh_host_rsa_key
/etc/ssh/ssh_host_key.pub
/etc/ssh/sshd_config
/home/cis90/simben $
```

this find command will start listing files from the /etc/ssh directory

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The find command -name option

Since no starting directory was specified find will start in the current directory (simben90's home directory.

Directs the find command to only look for files whose names start with "sonnet"

```
/home/cis90/simben $ find  -name 'sonnet*'
find: `./Hidden': Permission denied
./poems/Shakespeare/sonnet10
./poems/Shakespeare/sonnet15
./poems/Shakespeare/sonnet26
./poems/Shakespeare/sonnet3
./poems/Shakespeare/sonnet35
./poems/Shakespeare/sonnet6
./poems/Shakespeare/sonnet2
./poems/Shakespeare/sonnet4
./poems/Shakespeare/sonnet1
./poems/Shakespeare/sonnet11
./poems/Shakespeare/sonnet7
./poems/Shakespeare/sonnet5
./poems/Shakespeare/sonnet9
./poems/Shakespeare/sonnet17
/home/cis90/simben $
```

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All those permission errors

An error is printed for every directory lacking read permission!

Where to start finding files ....→

only include files named sonnet6 ..→

```
[simben@opus ~]$ find /home/cis90 -name sonnet6
find: /home/cis90/guest/.ssh: Permission denied
find: /home/cis90/guest/Hidden: Permission denied
/home/cis90/guest/Poems/Shakespeare/sonnet6
find: /home/cis90/guest/.gnupg: Permission denied
find: /home/cis90/guest/.gnome2: Permission denied
find: /home/cis90/guest/.gnome2_private: Permission denied
find: /home/cis90/guest/.gconf: Permission denied
find: /home/cis90/guest/.gconfd: Permission denied
find: /home/cis90/simben/Hidden: Permission denied
```

Yuck! How annoying is this?

<snipped>

```
find: /home/cis90/wichemic/class: Permission denied
find: /home/cis90/crivejoh/Hidden: Permission denied
/home/cis90/crivejoh/poems/Shakespeare/sonnet6
[simben@opus ~]$
```

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Redirecting find errors to the bit bucket

redirecting stderr to the "bit bucket"

```
[simben@opus ~]$ find  /home/cis90 -name sonnet6  2> /dev/null
/home/cis90/guest/Poems/Shakespeare/sonnet6
/home/cis90/simben/poems/Shakespeare/sonnet6
/home/cis90/stanlcha/poems/Shakespeare/sonnet6
/home/cis90/seatocol/poems/Shakespeare/sonnet6
/home/cis90/wrigholi/poems/Shakespeare/sonnet6
/home/cis90/dymesdia/poems/Shakespeare/sonnet6
/home/cis90/lyonsrob/poems/Shakespeare/sonnet6
/home/cis90/ybarrser/poems/Shakespeare/sonnet6
/home/cis90/ybarrser/poems/Sonnets/sonnet6
/home/cis90/valdemar/poems/Shakespeare/sonnet6
/home/cis90/elliokat/poems/Shakespeare/sonnet6
/home/cis90/jessuwes/poems/Shakespeare/sonnet6
/home/cis90/luisjus/poems/Shakespeare/sonnet6
/home/cis90/meyerjas/poems/Shakespeare/sonnet6
/home/cis90/bergelyl/sonnet6
/home/cis90/bergelyl/poems/Shakespeare/sonnet6
/home/cis90/gardnnic/poems/Shakespeare/sonnet6
/home/cis90/mohanchi/poems/Shakespeare/sonnet6
/home/cis90/whitfbob/poems/Shakespeare/sonnet6
/home/cis90/crivejoh/poems/Shakespeare/sonnet6
[simben@opus ~]$
```

Ahhh … much better!

All the annoying error messages are redirected to the bit bucket
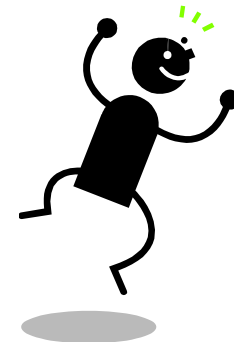
This is why we want a bit bucket

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find command examples

*start findng in /
(the top of the file tree)*

*wc counts the number of
lines read from stdin*

```
[simben@opus ~]$ find / 2> /dev/null | wc -l
154033
```

Корисне для
наступного
вікторини!

*redirect permission
errors into the bit
bucket (discard them)*

*pipe the output of the find
command as input to the wc
command*

*Getting an approximate count of all the files on
Opus and suppressing any permission errors*

find command examples

The directory to start finding files

Redirect errors written to stderr to the bit bucket

```
/home/cis90/simben $ find /home -user root 2> /dev/null
/home
/home/cis175
/home/cis172
/home/cis172/computers.txt
/home/cis172/science.txt
/home/lost+found
/home/cis90/simben $
```

The user that owns the files

Find all files in the /home directory that belong to the root user and discard any error messages

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find command examples

The directory to start finding files

Redirect errors to the bit bucket

```
/home/cis90/simben $ find /home -type d -user milhom90 2> /dev/null
/home/turnin/cis90/milhom90
/home/cis90/milhom
/home/cis90/milhom/Hidden
/home/cis90/milhom/Lab2.0
/home/cis90/milhom/Miscellaneous
/home/cis90/milhom/bin
/home/cis90/milhom/Poems
/home/cis90/milhom/Poems/Shakespeare
/home/cis90/milhom/Poems/Yeats
/home/cis90/milhom/Poems/Blake
/home/cis90/milhom/Lab2.1
/home/cis90/milhom/Lab2.1/filename
/home/cis90/milhom/cis90_html
/home/cis90/milhom/cis90_html/images
/home/cis90/milhom/cis90_html/css
/home/cis90/milhom/.ssh
/home/cis90/simben $
```

Only find type d files (directories)

Only those that belong to milhom90

Find all directories starting in /home that belong to milhom90 and suppress permission errors

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find command examples

specifies only files whose names start with a B, S, Y or A

specifies directories only

start from "here"

```
[simben@opus ~]$ find . -type d  -name '[BSYA]*'
find: ./Hidden: Permission denied
./poems/Blake
./poems/Shakespeare
./poems/Yeats
./poems/Anon
[simben@opus ~]$
```

Find all directories, starting from the current directory that start with a capital B, S, Y or A.

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find command examples

No start directory specified so start in current directory

file type "f" (regular)

file names contain the letter "k"

The command to run on each file found

```
/home/cis90/simben $ find   -type f  -name '*k*'  -exec file {} \;
find: `./Hidden': Permission denied
./edits/spellk: ASCII English text
./.kshrc: ASCII text
./docs/MarkTwain: ASCII English text
./.ssh/known_hosts: ASCII text, with very long lines
/home/cis90/simben $
```

The {} are replaced by filenames as they are found

Escape the ; so it will be passed to the find command

Run the file command on all regular files found starting in the current directory whose names contain the letter "k"

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Now you try it

*specifies only
files whose
names contain
"town"*

start from "here"

```
[simben@opus ~]$ find .  -name '*town*'
find: ./Hidden: Permission denied
./edits/small_town
./edits/better_town
[simben@opus ~]$
```

*Find all files starting from your current location whose
names contain "town"*

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More filter commands

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A command is called a **"filter"** if it can read from *stdin* and write to *stdout*

cat - concatenate

grep - "Global Regular Expression Print"

sort - sort

spell - spelling correction

wc - word count

tee - split output

cut - cut fields from a line

Filters enable building useful pipelines

grep command

grep command

Basic syntax
(see man page for the rest of the story)

grep *<options>* *"search string"* *<filenames…>*

grep -R *<options>* "search string" *<start-directory>*

Use the **grep** command to search the **contents** of files. Use the **-R** option to do a recursive search starting from a directory

Some other useful options:
> **-i** (case insensitive)
> **-w** (whole word)
> **-v** (does not contain)
> **-n** (show line number)
> **--color** (uses color to show matches)

grep for text string

string to search for   *files to search contents of*

```
[simben@opus poems]$ grep love Shakespeare/son*
Shakespeare/sonnet10:For shame deny that thou bear'st love to any,
Shakespeare/sonnet10:Shall hate be fairer lodg'd then gentle love?
Shakespeare/sonnet10:   Make thee another self for love of me,
Shakespeare/sonnet15:   And all in war with Time for love of you,
Shakespeare/sonnet26:Lord of my love, to whom in vassalage
Shakespeare/sonnet26:   Then may I dare to boast how I do love thee,
Shakespeare/sonnet3:Of his self-love, to stop posterity?
Shakespeare/sonnet3:Calls back the lovely April of her prime,
Shakespeare/sonnet4:Unthrifty loveliness, why dost thou spend
Shakespeare/sonnet5:The lovely gaze where every eye doth dwell
Shakespeare/sonnet9:    No love toward others in that bosom sits
```

files that contain love   *Looking for love in all the wrong places?*

Find the word love in Shakespeare's sonnets

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Now you try it

The color option

`grep --color love poems/Shakespeare/*`

```
/home/cis90/simben $ grep --color love poems/Shakespeare/*
poems/Shakespeare/sonnet10:For shame deny that thou bear'st love to any,
poems/Shakespeare/sonnet10:Shall hate be fairer lodg'd then gentle love?
poems/Shakespeare/sonnet10:        Make thee another self for love of me,
poems/Shakespeare/sonnet15:        And all in war with Time for love of you,
poems/Shakespeare/sonnet26:Lord of my love, to whom in vassalage
poems/Shakespeare/sonnet26:        Then may I dare to boast how I do love thee,
poems/Shakespeare/sonnet3:Of his self-love, to stop posterity?
poems/Shakespeare/sonnet3:Calls back the lovely April of her prime,
poems/Shakespeare/sonnet4:Unthrifty loveliness, why dost thou spend
poems/Shakespeare/sonnet5:The lovely gaze where every eye doth dwell
poems/Shakespeare/sonnet9:        No love toward others in that bosom sits
/home/cis90/simben $
```

Searching for love with colors

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grep the output of a grep

string to search for in the output of the previous command

string to search for   *files to search contents of*

```
[simben@opus poems]$ grep love Shakespeare/son* | grep hate
Shakespeare/sonnet10:Shall hate be fairer lodg'd then gentle love?
[simben@opus poems]$
```

Find all lines with both love and hate

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grep using the -n (line number) option

string to search for

file to search contents of

```
/home/cis90/simben $ grep simben90 /etc/passwd
simben90:x:1201:190:Benji Simms:/home/cis90/simben:/bin/bash
```

Show account in /etc/passwd for simben90

Option to show line number

string to search for

file to search contents of

```
/home/cis90/simben $ grep -n simben90 /etc/passwd
52:simben90:x:1201:190:Benji Simms:/home/cis90/simben:/bin/bash
```

Found in line 52 of /etc/passwd

Same as before but include line number it was found on

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grep using the -i (case insensitive) option

```
/home/cis90/simben $ grep "so" poems/Shakespeare/sonnet[345]
poems/Shakespeare/sonnet3:Thou dost beguile the world, unbless some mother.
poems/Shakespeare/sonnet3:For where is she so fair whose unear'd womb
poems/Shakespeare/sonnet3:Or who is he so fond will be the tomb,
poems/Shakespeare/sonnet5:A liquid prisoner pent in walls of glass,
```

Look for "so" in sonnet3, sonnet4 and sonnet5

Use the -i option to make searches case insensitive

```
/home/cis90/simben $ grep -i "so" poems/Shakespeare/sonnet[345]
poems/Shakespeare/sonnet3:Thou dost beguile the world, unbless some mother.
poems/Shakespeare/sonnet3:For where is she so fair whose unear'd womb
poems/Shakespeare/sonnet3:Or who is he so fond will be the tomb,
poems/Shakespeare/sonnet3:So thou through windows of thine age shalt see,
poems/Shakespeare/sonnet4:So great a sum of sums, yet canst not live?
poems/Shakespeare/sonnet5:A liquid prisoner pent in walls of glass,
```

Look for "so" (case insensitive) in sonnet3, sonnet4 and sonnet5

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grep using the -w (whole word) option

```
/home/cis90/simben $ grep so poems/Shakespeare/sonnet[345]
poems/Shakespeare/sonnet3:Thou dost beguile the world, unbless some mother.
poems/Shakespeare/sonnet3:For where is she so fair whose unear'd womb
poems/Shakespeare/sonnet3:Or who is he so fond will be the tomb,
poems/Shakespeare/sonnet5:A liquid prisoner pent in walls of glass,
```

Look for "so" in sonnet3, sonnet4 and sonnet5

Use the -w option for whole word only searches

```
/home/cis90/simben $ grep -w so poems/Shakespeare/sonnet[345]
poems/Shakespeare/sonnet3:For where is she so fair whose unear'd womb
poems/Shakespeare/sonnet3:Or who is he so fond will be the tomb,
```

Look for "so" (whole word only) in sonnet3, sonnet4 and sonnet5

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grep recursively with the -R option

Text string to search for

*starting directory
(. is the current directory)*

*Search recursively
(all sub-directories)*

discard permission errors
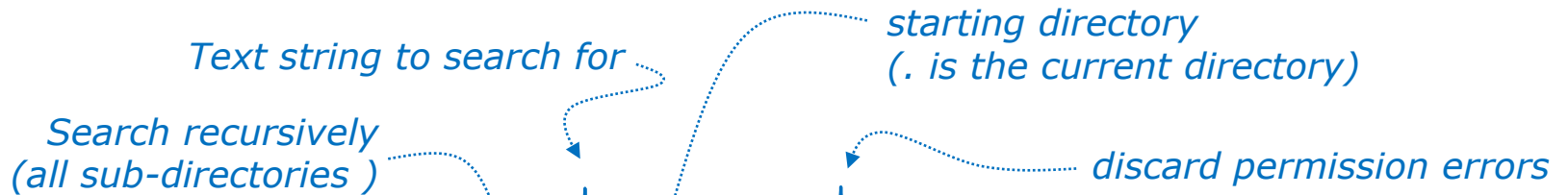
```
/home/cis90/simben $ grep -R kind .  2> /dev/null
./poems/Shakespeare/sonnet10:Be as thy presence is gracious and kind,
./poems/Shakespeare/sonnet10:Or to thyself at least kind-hearted prove:
./poems/Shakespeare/sonnet35:   Let no unkind, no fair beseechers kill;
./poems/Yeats/mooncat:When two close kindred meet,
./poems/Anon/ant:distorted out of kind,
./letter:Mother, Father, kindly disregard this letter.
./bin/enlightenment:   echo "to find out what kind of file \"what_am_i\" is"
./misc/mystery: echo "to find out what kind of file \"what_am_i\" is"
```

Search recursively for files containing "kind"

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grep command

Background

Apache is the worlds most popular web server and it's installed on Opus. Try it, you can browse to oslab.cabrillo.edu.

Every Apache configuration file must specify the location (an absolute pathname) of the documents to publish on the world wide web. This is done with the **DocumentRoot** directive. This directive is found in every Apache configuration file.

All configuration files are kept in /etc.

Tasks

• Can you use **grep** to find the Apache configuration file?
   *Hint: use the **-R** option to recursively search all sub-directories*

• What are the names of the files in Apache's document root directory on Opus?
   *Hint: Use the **ls** command on the document root directory*

spell command

spell command

Basic syntax
(see man page for the rest of the story)

spell *<filepath>*

spell *<filepath>* *<filepath>* …

The **spell** command is used to check spelling of words in one or more text files

spell command

Task: Run a spell check on the magna_cart file

```
/home/cis90/simben $ cd docs
/home/cis90/simben/docs $ ls
magna_carta   MarkTwain   policy
/home/cis90/simben/docs $ spell magna_carta
Anjou
Arundel
Aymeric
Bergh
Daubeny
de
honour
kingdon
Pandulf
Poitou
Poppeley
seneschal
subdeacon
Warin
```

The spell command will show any words not found in the dictionary.

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spell command

Count the number of misspelled words in the magna_carta file

*The -l option instructs the **wc** command to just count the number of lines*

```
/home/cis90/simben/docs $ spell magna_carta | wc -l
14
```

*Pipe the output of the **spell** command (the misspelled words) into the input of the **wc** command*

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Activity

```
/home/cis90/simben $ cat edits/spellk
Spell Check


Eye halve a spelling chequer
It came with my pea sea
It plainly marques four my revue
Miss steaks eye kin knot sea.
Eye strike a key and type a word
And weight four it two say
Weather eye am wrong oar write
It shows me strait a weigh.
As soon as a mist ache is maid
It nose bee fore two long
And eye can put the error rite
Its rare lea ever wrong.
Eye have run this poem threw it
I am shore your pleased two no
Its letter perfect awl the weigh
My chequer tolled me sew.

/home/cis90/simben $
```

How many misspelled word are in your spellk file?

Write your answer in the chat window.

tee command

tee command

Basic syntax
(see man page for the rest of the story)

tee *<filepath>*

The **tee** command, a filter, reads from **stdin** and writes to **stdout** AND to the file specified as the argument.

tee command

For example, the following command sends a sorted list of the current users logged on to the system to the screen, and saves an unsorted list to a file named users.

```
/home/cis90/simben $ who | tee users | sort
caumar98 pts/5        2014-03-17 17:29 (75.140.158.6)
caumar98 pts/6        2014-03-17 17:41 (75.140.158.6)
chejul98 pts/1        2014-03-17 19:42 (acbe4f9e.ipt.aol.com)
goojun172 pts/7        2014-03-17 19:53 (c-67-169-144-100.hsd1.ca.comcast.net)
hovdav98 pts/2        2014-03-16 14:48 (c-76-126-1-130.hsd1.ca.comcast.net)
mmatera  pts/4        2014-03-13 16:06 (2607:f380:80f:f828:e108:c48e:9e1a:57ff)
rsimms   pts/0        2014-03-17 09:40 (2001:470:1f05:9b3:3044:7820:6ce0:8a4)
/home/cis90/simben $


/home/cis90/simben $ cat users
rsimms   pts/0        2014-03-17 09:40 (2001:470:1f05:9b3:3044:7820:6ce0:8a4)
chejul98 pts/1        2014-03-17 19:42 (acbe4f9e.ipt.aol.com)
hovdav98 pts/2        2014-03-16 14:48 (c-76-126-1-130.hsd1.ca.comcast.net)
mmatera  pts/4        2014-03-13 16:06 (2607:f380:80f:f828:e108:c48e:9e1a:57ff)
caumar98 pts/5        2014-03-17 17:29 (75.140.158.6)
caumar98 pts/6        2014-03-17 17:41 (75.140.158.6)
goojun172 pts/7        2014-03-17 19:53 (c-67-169-144-100.hsd1.ca.comcast.net)
/home/cis90/simben $
```

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tee command

```
/home/cis90/simben $ head edits/spellk
Spell Check

Eye halve a spelling chequer
It came with my pea sea
It plainly marques four my revue
Miss steaks eye kin knot sea.
Eye strike a key and type a word
And weight four it two say
Weather eye am wrong oar write
```

The misspelled words from spell are piped to the tee command

The tee command copies the misspelled words to stdout and to the file named mistakes

```
/home/cis90/simben $ spell edits/spellk | tee mistakes | wc -l
1
/home/cis90/simben $ cat mistakes
chequer
```

The wc command counts the misspelled words

output from spell command → **tee** → *input to wc command*

redirected to mistakes file

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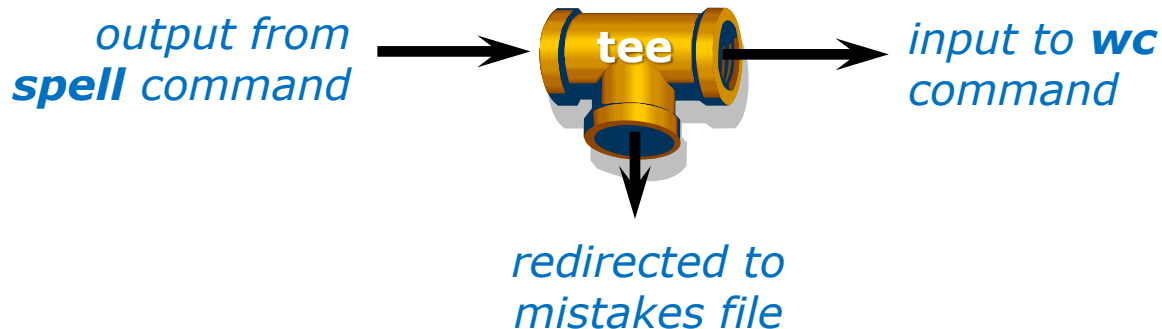
cut command

cut command

Basic syntax
(see man page for the rest of the story)

cut -f *<num>* **-d "***<delimiter-character>***"** *<pathname>*

cut -c *<start column>***-***<end column>* *<pathname>*

*The **cut** command can cut text from a line by delimited fields or by a range of columns.*

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cut command
(cut text using delimited fields)

```
[rsimms@oslab ~]$ grep $LOGNAME /etc/passwd
rsimms:x:201:503:Rich Simms:/home/rsimms:/bin/bash
```

| *1st field* | *2nd field* | *3rd field* | *4th field* | *5th field* | *6th field* | *7th field* |

```
[rsimms@oslab ~]$ grep $LOGNAME /etc/passwd | cut -f 7 -d ":"
/bin/bash
```

Cut the 7th field

Using ":" as the delimiter

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cut command
(cut text by column numbers)

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Jul 20  2001 letter
12345678901234567890123456789012345678901234567890
```

↑ column 2   ↑ column 10

```
/home/cis90/simben $ ls -l letter | cut -c 2-10
rw-r--r--
```
*Cut columns
2 through 10*

```
/home/cis90/simben $ perm=$(ls -l letter | cut -c 2-10)
```
*This puts the output of the pipeline
above into a variable named perm*

```
/home/cis90/simben $ echo The permissions on letter are $perm
The permissions on letter are rw-r--r--
```

*Which we can use to
build a custom message*

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Pipeline Practice

Class Exercise
Pipeline Tasks

Background
The **last** command searches through /var/log/wtmp and prints out a list of users logged in since that file was created.

Task
Can you see the last times you were logged in on a Wednesday and then count them?

    last | grep $LOGNAME
    last | grep $LOGNAME | grep "Wed"
    last | grep $LOGNAME | grep "Wed" | wc -l

On what days do you log in the most? the least?

Class Exercise
Pipeline Tasks

Background
The **cut** command can cut a field out of a line of text where each field is delimitated by some character.

The *etc/passwd* file uses the ":" as the delimiter between fields. The 5th field is a comment field for the user account.

Task
Build up a pipeline, one pipe at a time:

> **cat /etc/passwd**
> **cat /etc/passwd | grep $LOGNAME**
> **cat /etc/passwd | grep $LOGNAME | cut -f 5 -d ":"**

What gets printed with the last pipeline?

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ONLY
If Time Allows

Permissions
"The rest of the story"

- Special Permissions
- ACLs
- Extended Attributes
- SELinux

FYI only

This module is for your information only. We won't use this in CIS 90 but its good to know they exist. More in CIS 191, 192 and 193

FYI
only

Special Permissions

Sticky bit - used on directories, e.g. /tmp, so that only owners can rename or remove files even though other users may have write permission on the directory.

SetUID or SetGID - allows a user to run an program file with the permissions of the file's owner (Set User ID) or the file's group (Set Group ID). Examples include **ping** and **passwd** commands.

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FYI only

Special Permissions

Sticky bit - used on directories, e.g. /tmp, so that only owners can rename or remove files even though other users may have write permission on the directory.

green background with black text

```
/home/cis90/simben $ ls -ld /tmp
drwxrwxrwt. 3 root root 4096 Oct 16 16:13 /tmp

/home/cis90/simben $ mkdir tempdir
/home/cis90/simben $ chmod 777 tempdir/
/home/cis90/simben $ ls -ld tempdir/
drwxrwxrwx. 2 simben90 cis90 4096 Oct 16 15:25 tempdir/
```

set sticky bit

```
/home/cis90/simben $ chmod 1777 tempdir
/home/cis90/simben $ ls -ld tempdir/
drwxrwxrwt. 2 simben90 cis90 4096 Oct 16 15:25 tempdir/
```

sticky bit set

green background with black text

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Special Permissions

FYI only

SetUID or SetGID - allows a user to run a program file with the permissions of the file's owner (Set User ID) or the file's group (Set Group ID). Examples include **ping** and **passwd** commands.

```
/home/cis90/simben $ ls -l /bin/ping /usr/bin/passwd
-rwsr-xr-x. 1 root root 36892 Jul 18  2011 /bin/ping
-rwsr-xr-x. 1 root root 25980 Feb 22  2012 /usr/bin/passwd
```

red background with gray text

```
/home/cis90/simben $ echo banner Hola > hola; chmod +x hola; ls -l hola
-rwxrwxr-x. 1 simben90 cis90 12 Oct 16 16:45 hola

/home/cis90/simben $ chmod 4775 hola
/home/cis90/simben $ ls -l hola
-rwsrwxr-x. 1 simben90 cis90 12 Oct 16 16:45 hola
/home/cis90/simben $ chmod 2775 hola
/home/cis90/simben $ ls -l hola
-rwxrwsr-x. 1 simben90 cis90 12 Oct 16 16:45 hola
```

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FYI
only

ACLs (Access Control Lists)

ACLs - offer a finer granularity of control allowing additional permissions to be set for specific users or groups.

ACLs (Access Control Lists)

FYI only

ACLs - offer a finer granularity of control allowing additional permissions to be set for specific users or groups.

```
/home/cis90/simben $ echo yabadabadoo > yogi
/home/cis90/simben $ chmod 400 yogi
/home/cis90/simben $ ls -l yogi
-r--------. 1 simben90 cis90 12 Oct 16 17:02 yogi

/home/cis90/simben $ getfacl yogi
# file: yogi
# owner: simben90
# group: cis90
user::r--
group::---
other::---
```

Create a file and set permissions to 400

*Use **getfacl** to show ACLs*

```
[milhom90@oslab ~]$ cat ../simben/yogi
cat: ../simben/yogi: Permission denied
```

```
[rodduk90@oslab ~]$ cat ../simben/yogi
cat: ../simben/yogi: Permission denied
```

Homer, a member of the cis90 group can't read the file

Duke, a member of the cis90 group can't read the file either

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ACLs (Access Control Lists)

FYI only

Let's give special permissions to one user

modify

```
/home/cis90/simben $ setfacl -m u:milhom90:rw yogi
/home/cis90/simben $ ls -l yogi
-r--rw----+ 1 simben90 cis90 12 Oct 16 17:02 yogi
/home/cis90/simben $ getfacl yogi
# file: yogi
# owner: simben90
# group: cis90
user::r--
user:milhom90:rw-
group::---
mask::rw-
other::---
```

Allow milhom90 to have read/write access

```
[milhom90@oslab ~]$ cat ../simben/yogi
yabadabadoo
```

```
[rodduk90@oslab ~]$ cat ../simben/yogi
cat: ../simben/yogi: Permission denied
```

Homer can now read the file

But not Duke

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ACLs (Access Control Lists)

FYI only

Let's remove the special permissions to that user

remove all base ACLs

```
/home/cis90/simben $ setfacl -b  yogi
/home/cis90/simben $ ls -l yogi
-r--------. 1 simben90 cis90 12 Oct 16 17:02 yogi
/home/cis90/simben $ getfacl yogi
# file: yogi
# owner: simben90
# group: cis90
user::r--
group::---
other::---
```

Remove all ACLs on yogi file

```
[milhom90@oslab ~]$ cat ../simben/yogi
cat: ../simben/yogi: Permission denied
```

Now Homer can't read it again

```
[rodduk90@oslab ~]$ cat ../simben/yogi
cat: ../simben/yogi: Permission denied
```

Same for Duke

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FYI only

Extended File Attributes

Extended Attributes - the root user can set some extended attribute bits to enhance security.

Extended File Attributes

FYI only

Let's use extended file attributes to totally lock down a file against changes, even by its owner!

```
/home/cis90/simben $ echo yabadabadoo > yogi
/home/cis90/simben $ ls -l yogi
-rw-rw-r--. 1 simben90 cis90 12 Oct 16 17:29 yogi
```

Create a sample file to work on

The root user sets the immutable bit (i) so Benji cannot remove his own file

```
[root@oslab ~]# lsattr /home/cis90/simben/yogi
-------------e- /home/cis90/simben/yogi
[root@oslab ~]# chattr +i /home/cis90/simben/yogi
[root@oslab ~]# lsattr /home/cis90/simben/yogi
----i--------e- /home/cis90/simben/yogi
```

```
/home/cis90/simben $ ls -ld ~
drwxr-xr-x. 17 simben90 cis90 4096 Oct 16 17:29 /home/cis90/simben
/home/cis90/simben $ rm yogi
rm: remove write-protected regular file `yogi'? yes
rm: cannot remove `yogi': Operation not permitted
```

!!

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Extended File Attributes

FYI only

Extended Attributes - the root user can set some extended attribute bits to enhance security.

*The root user removes the **immutable bit (i)** so Benji can remove his own file again*

```
[root@oslab ~]# chattr -i /home/cis90/simben/yogi
[root@oslab ~]# lsattr /home/cis90/simben/yogi
-------------e- /home/cis90/simben/yogi
```

```
/home/cis90/simben $ ls -ld ~
drwxr-xr-x. 17 simben90 cis90 4096 Oct 16 17:29 /home/cis90/simben
/home/cis90/simben $ rm yogi
/home/cis90/simben $
```

FYI only

Extended File Attributes

Let's use extended file attributes to allow the file to be appended (but still not emptied or removed)

```
/home/cis90/simben $ ls -l yogi
-rw-rw-r--. 1 simben90 cis90 12 Oct 16 17:41 yogi
```

*The root user sets the **append only bit (a)** so Benji can only append to his file*

```
[root@oslab ~]# lsattr /home/cis90/simben/yogi
-------------e- /home/cis90/simben/yogi
[root@oslab ~]# chattr +a /home/cis90/simben/yogi
[root@oslab ~]# lsattr /home/cis90/simben/yogi
-----a-------e- /home/cis90/simben/yogi
```

```
/home/cis90/simben $ rm yogi
rm: cannot remove `yogi': Operation not permitted
/home/cis90/simben $ > yogi
-bash: yogi: Operation not permitted
/home/cis90/simben $ echo yowser >> yogi
/home/cis90/simben $
```

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SELinux context

SELinux - Security Enhanced Linux. SELinux is a set of kernel modifications that provide Mandatory Access Control (MAC). In MAC-enabled systems there is a strict set of security policies for all operations which users cannot override. The primary original developer of SELinux was the NSA (National Security Agency).

SELinux context

FYI only

Use the Z option on the ls command to show the SELinux context on a file

```
[root@oslab selinux]# ls -lZ test*
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test01.html
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test02.html
```

user   *role*   *type*   *level*

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SELinux context

FYI only

Create two identical web pages with identical permissions

```
[root@oslab selinux]# cp test01.html test02.html
cp: overwrite `test02.html'? yes

[root@oslab selinux]# ls -lZ test*
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test01.html
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test02.html
```

Use chcon command to change the SELinux context on one file

```
[root@oslab selinux]# chcon -v -t home_root_t test02.html
changing security context of `test02.html'

[root@oslab selinux]# ls -lZ test*
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test01.html
-rw-r--r--. root root unconfined_u:object_r:home_root_t:s0 test02.html
```

*Note, the root user's home files are
not appropriate web content*

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SELinux context

SELinux won't let Apache publish a file with an inappropriate context

```
[root@oslab selinux]# ls -lZ test*
-rw-r--r--. root root unconfined_u:object_r:httpd_sys_content_t:s0 test01.html
-rw-r--r--. root root unconfined_u:object_r:home_root_t:s0 test02.html
[root@oslab selinux]#
```
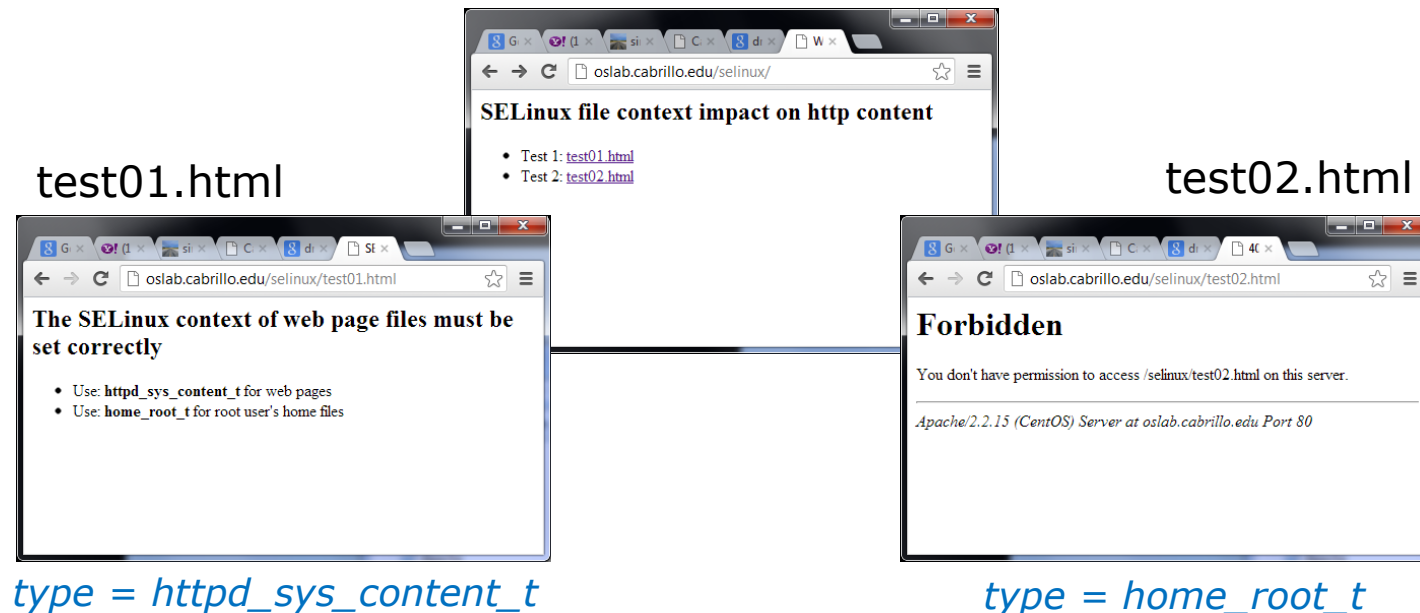
test01.html

test02.html

type = httpd_sys_content_t

type = home_root_t

Wrap up

New commands:

    find   find files or content

    grep   look for text strings

    last   show last logins

    sort   perform sorts

    spell   spell checking

    tee   save output to a file

    wc   count lines or words in a file

Next Class

Assignment: Check Calendar Page on web site to see what is due next week.

Lab 7

Quiz questions for next class:

• How do you redirect error messages to the bit bucket?

• What command could you use to get an approximate count of all the files on Opus and ignore the permission errors?

• For **sort dognames > dogsinorder** where does the sort process obtain the actual names of the dogs to sort?
  a) stdin
  b) the command line
  c) directly from the file dognames

Backup

# Lab 6 Tips

```
/home/cis90/simben $ tree poems/
poems/
├── Anon
│   ├── ant
│   ├── nursery
│   └── twister
├── Blake
│   ├── jerusalem
│   └── tiger
├── Shakespeare
│   ├── sonnet1
│   ├── sonnet10
│   ├── sonnet11
│   ├── sonnet15
│   ├── sonnet17
│   ├── sonnet2
│   ├── sonnet26
│   ├── sonnet3
│   ├── sonnet35
│   ├── sonnet4
│   ├── sonnet5
│   ├── sonnet6
│   ├── sonnet7
│   └── sonnet9
└── Yeats
    ├── mooncat
    ├── old
    └── whitebirds
```

One of the steps in Lab 6

9. Set the permissions of your poems directory and its subdirectories so that you have full permissions as owner, but group and others have no write permission. Group and others should still have read and execute permission.

```
4 directories, 22 files
/home/cis90/simben $
```
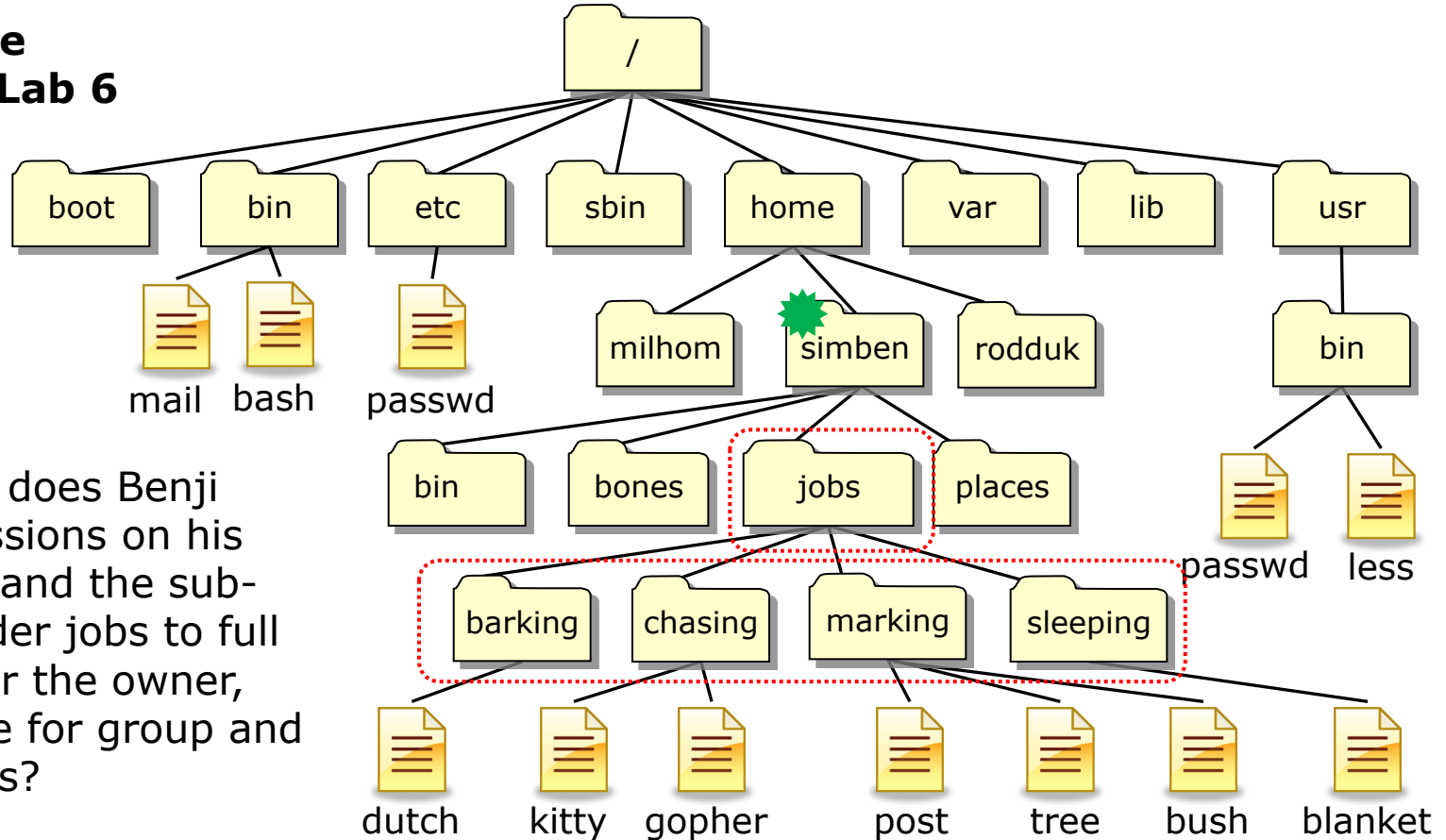
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An example related to Lab 6 Q9

From ✸ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

```
chmod 750 jobs
cd jobs
chmod 750 barking
chmod 750 chasing
chmod 750 marking
chmod 750 sleeping
```

The "elbow grease" method:
It works and takes 6 commands to complete
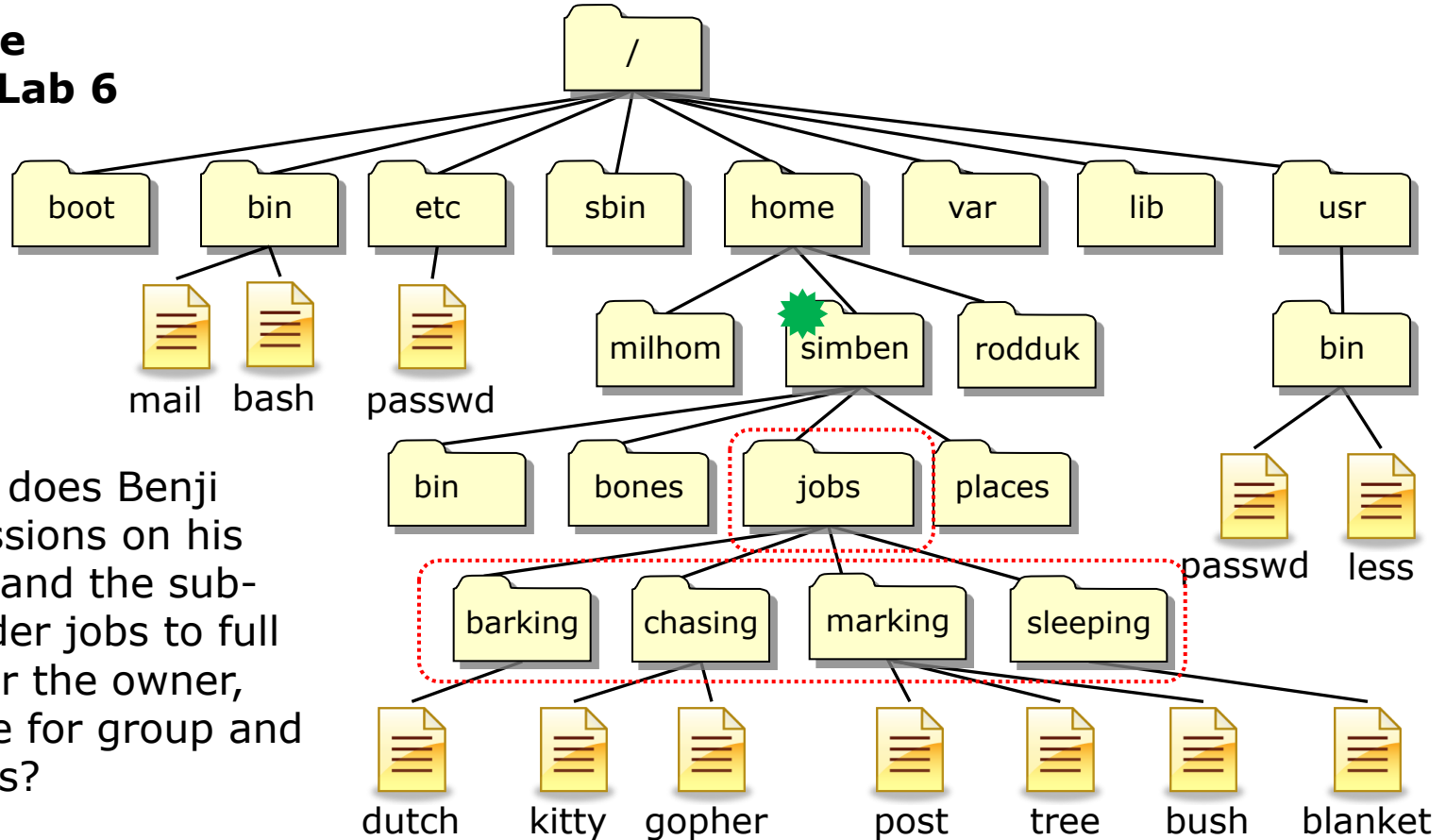
192

An example related to Lab 6 Q9

From ✸ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

chmod 750 jobs
chmod 750 jobs/barking
chmod 750 jobs/chasing
chmod 750 jobs/marking
chmod 750 jobs/sleeping

Using relative paths allows us to do the same thing and uses one less command
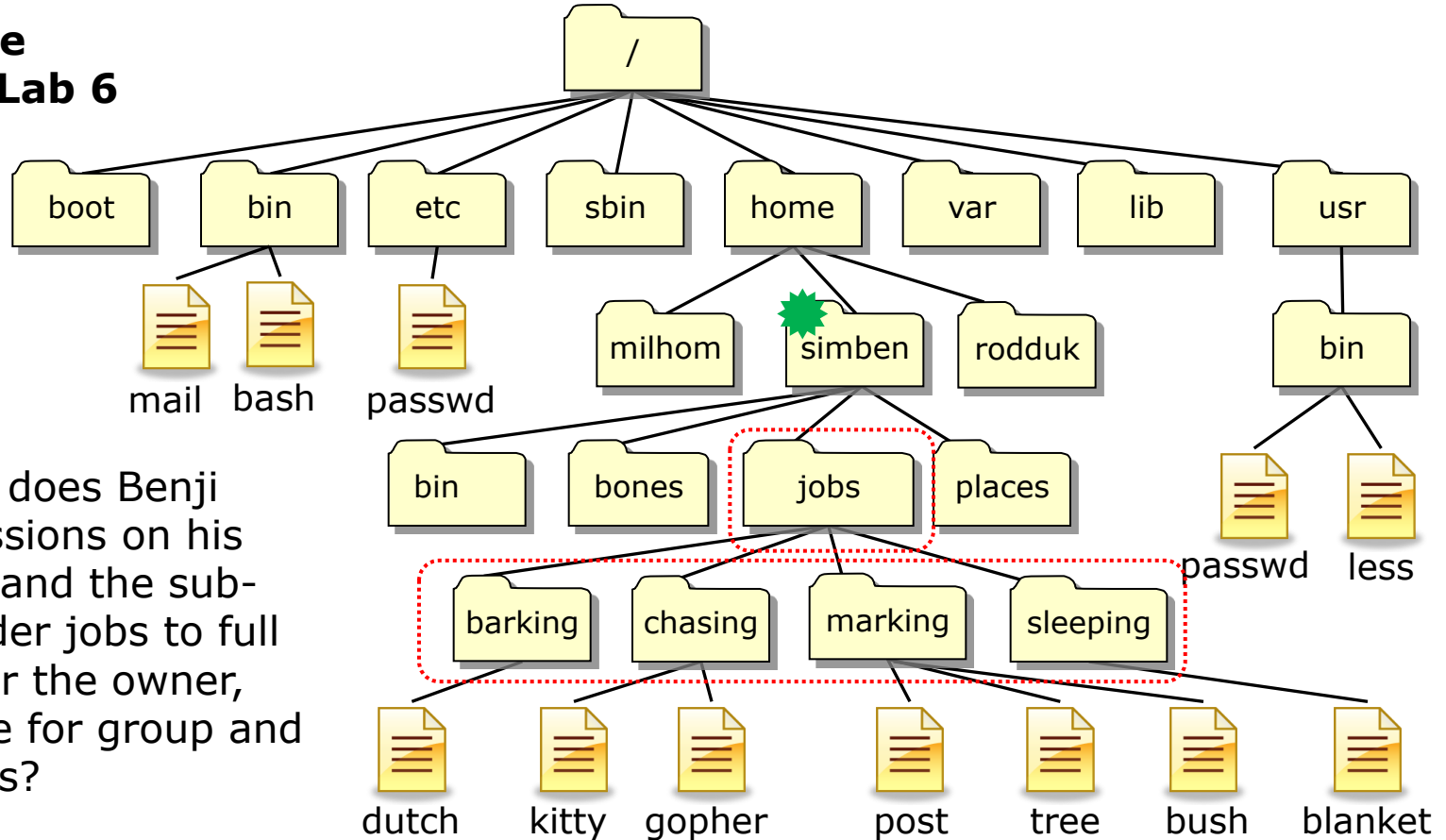
193

An example related to Lab 6 Q9

From ✳ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

chmod 750 jobs
chmod 750 jobs/*

Using relative paths and a filename expansion metacharacter lets us do the same things with only two commands

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An example related to Lab 6 Q9

From ✳ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

chmod 750 jobs jobs/*

The "Linux guru" method:
Using relative paths, filename expansion metacharacter and multiple arguments lets us do the same thing with one command!
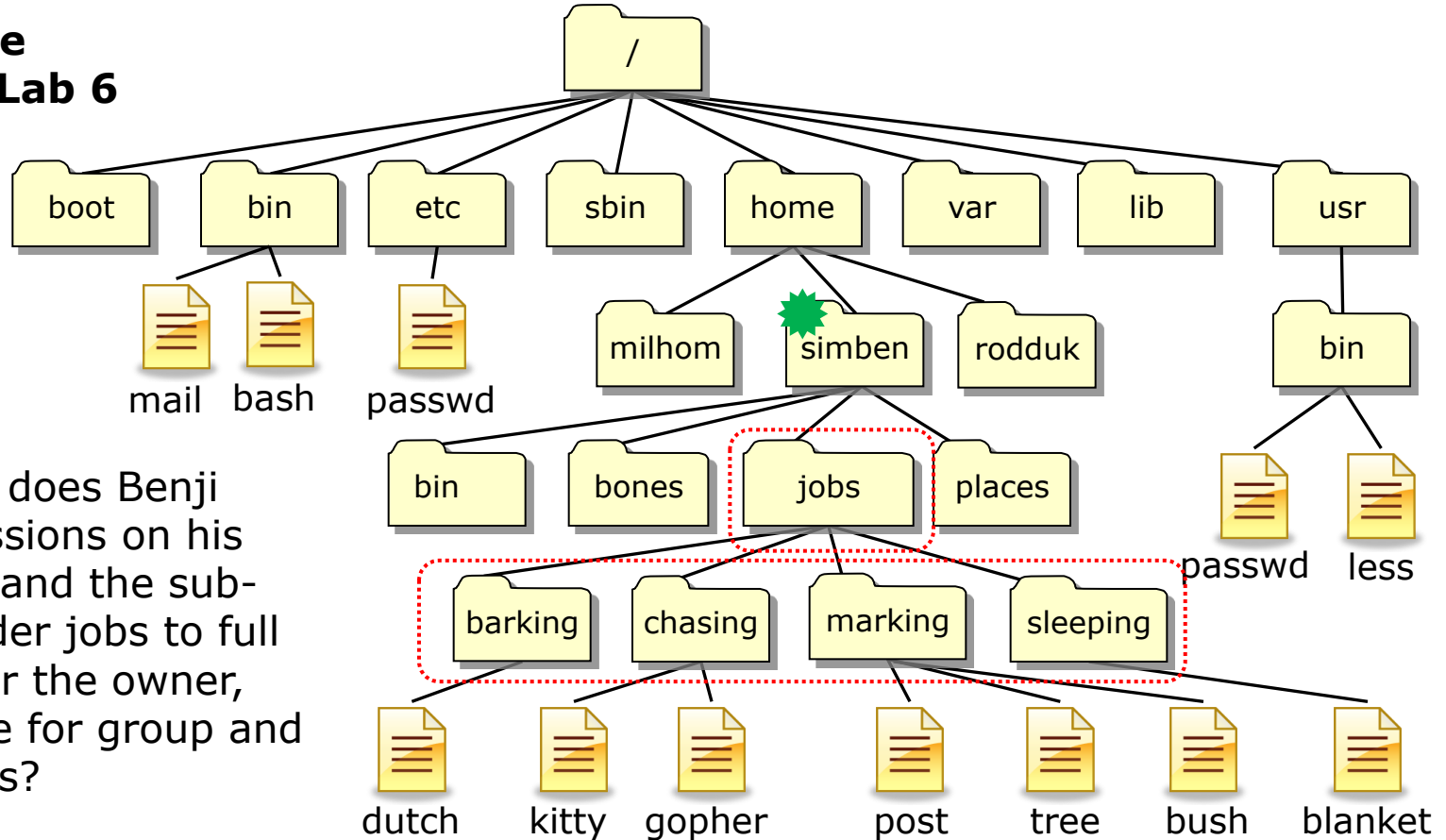
195

An example related to Lab 6 Q9

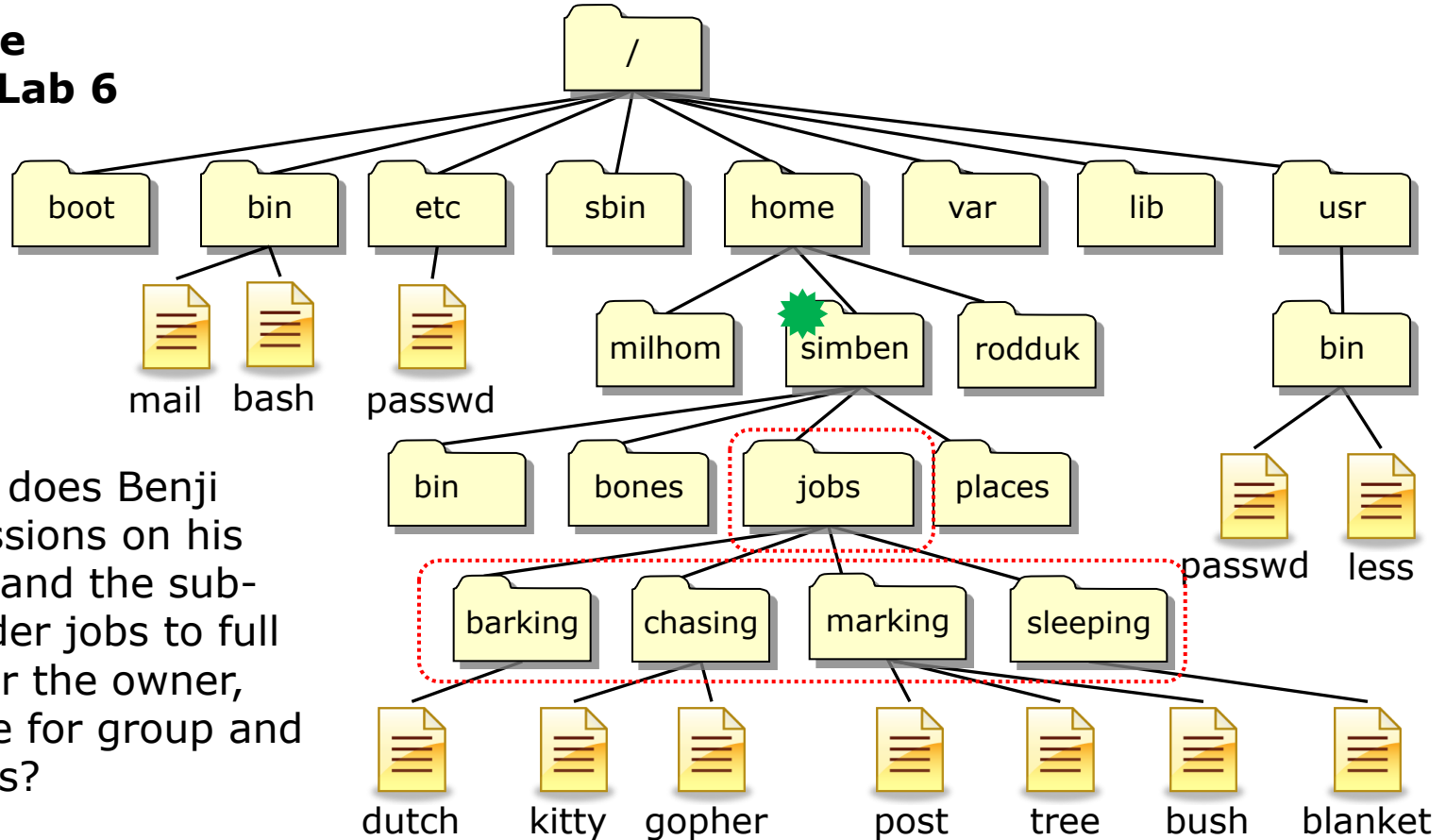From 🟢 how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

The "elbow grease" method:
chmod 750 jobs
cd jobs
chmod 750 barking
chmod 750 chasing
chmod 750 marking
chmod 750 sleeping

Both ways work, the choice is yours!

The "Linux guru" method:
chmod 750 jobs jobs/*

```
/home/cis90/simben $ tree poems/
poems/
├── Anon
│   ├── ant
│   ├── nursery
│   └── twister
├── Blake
│   ├── jerusalem
│   └── tiger
├── Shakespeare
│   ├── sonnet1
│   ├── sonnet10
│   ├── sonnet11
│   ├── sonnet15
│   ├── sonnet17
│   ├── sonnet2
│   ├── sonnet26
│   ├── sonnet3
│   ├── sonnet35
│   ├── sonnet4
│   ├── sonnet5
│   ├── sonnet6
│   ├── sonnet7
│   └── sonnet9
└── Yeats
    ├── mooncat
    ├── old
    └── whitebirds

4 directories, 22 files
/home/cis90/simben $
```

Another step in Lab 6

10. Set all ordinary files under the poems directory to be read only for user, group, and others. We want everyone to read our poetry, but no one should modify it, including ourselves.

See if you can do this using a minimum number of commands. (hint: use filename expansion characters).

An example related to Lab 6 Q10
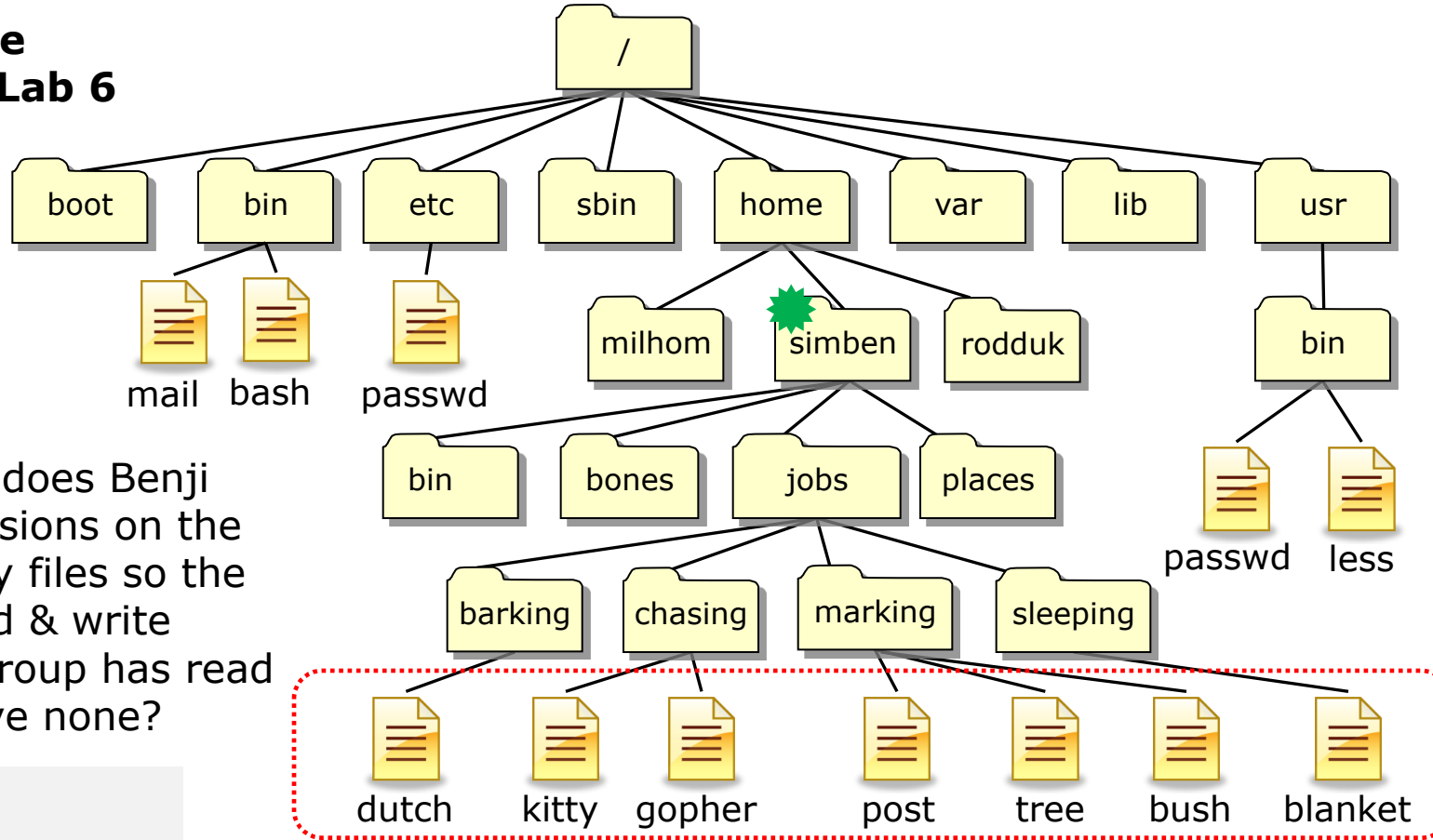
From ✸ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

```
cd jobs
cd barking
chmod 640 dutch
cd ..
```

The "elbow grease" method takes 16 commands
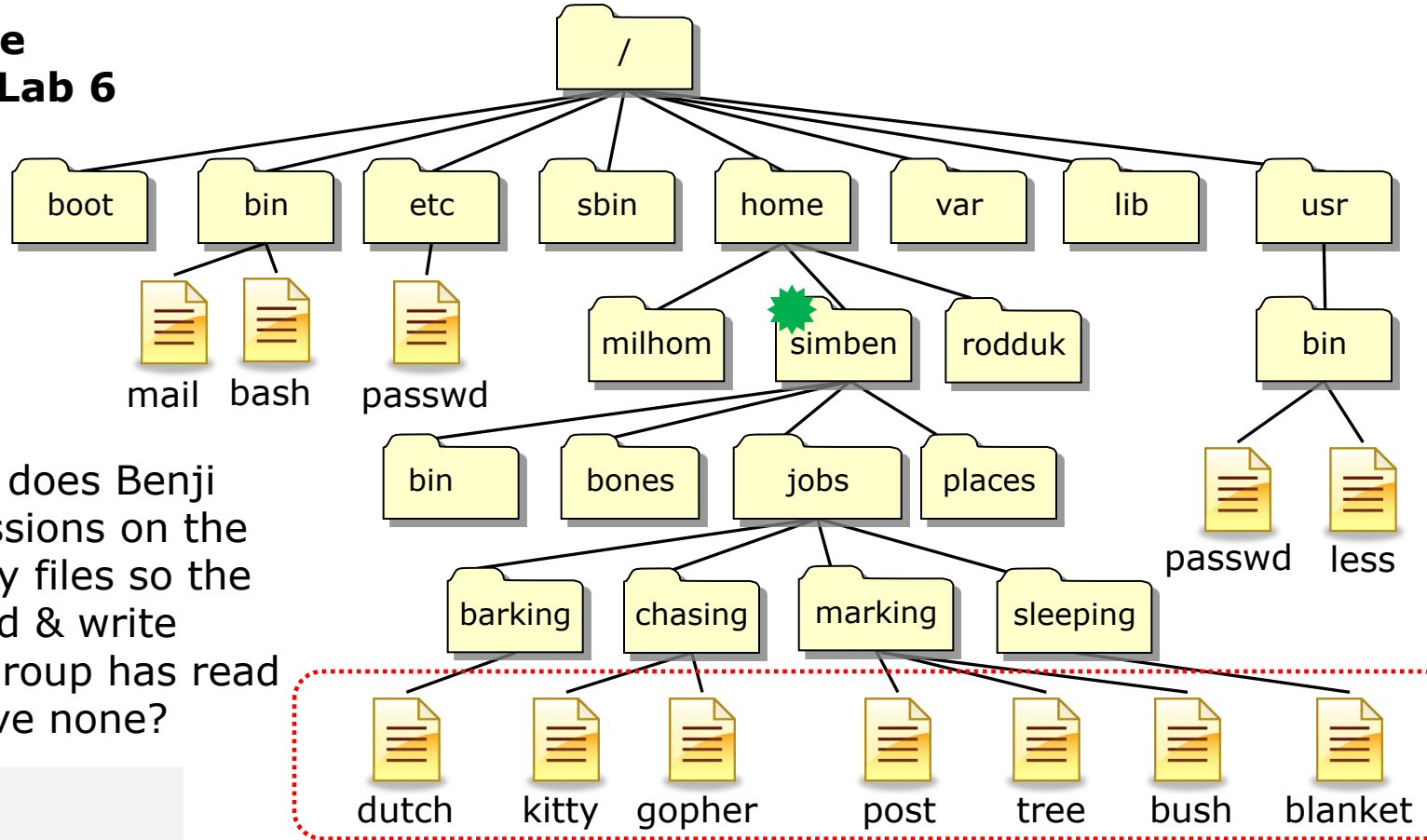
```
cd chasing
chmod 640 kitty
chmod 640 gopher
cd ..
```

```
cd marking
chmod 640 post
chmod 640 tree
chmod 640 bush
cd ..
```

```
cd sleeping
chmod 640 blanket
cd
```

An example related to Lab 6 Q10

From ✳ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

```
cd jobs
cd barking
chmod 640 dutch
cd ..
```

```
cd chasing
chmod 640 kitty gopher
cd ..
```

```
cd marking
chmod 640 post tree bush
cd ..
```

```
cd sleeping
chmod 640 blanket
cd
```

Using multiple arguments on chmod: takes 13 commands

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An example related to Lab 6 Q10

From ✳ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

**cd jobs
cd barking
chmod 640 *
cd ..**

**cd chasing
chmod 640 *
cd ..**

**cd marking
chmod 640 *
cd ..**

**cd sleeping
chmod 640 *
cd**

*Using * (filename expansion metacharacter) takes 13 commands but fewer keystrokes*
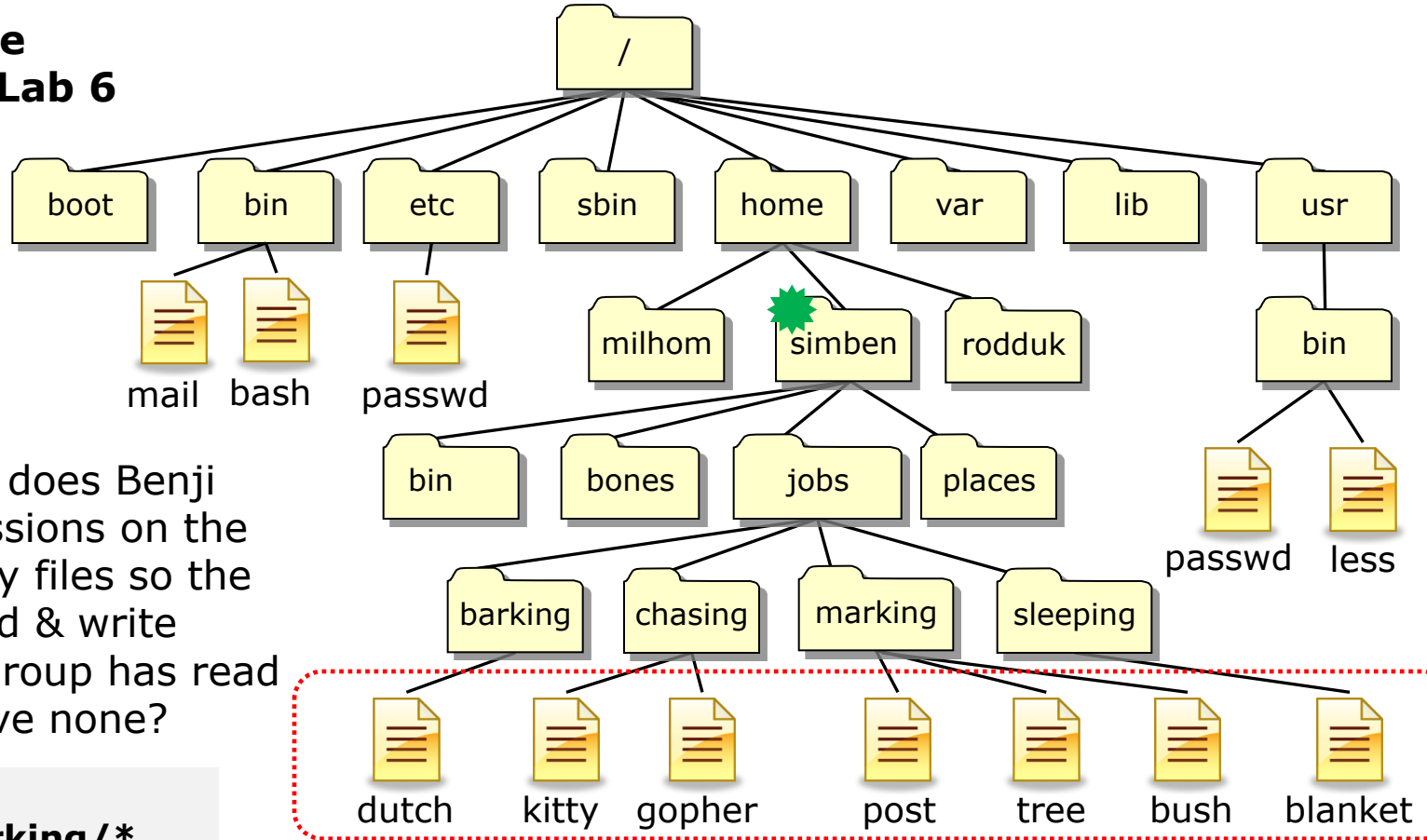
200

An example related to Lab 6 Q10

From ✹ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

```
cd jobs
chmod 640 barking/*
chmod 640 chasing/*
chmod 640 marking/*
chmod 640 sleeping/*
cd ..
```
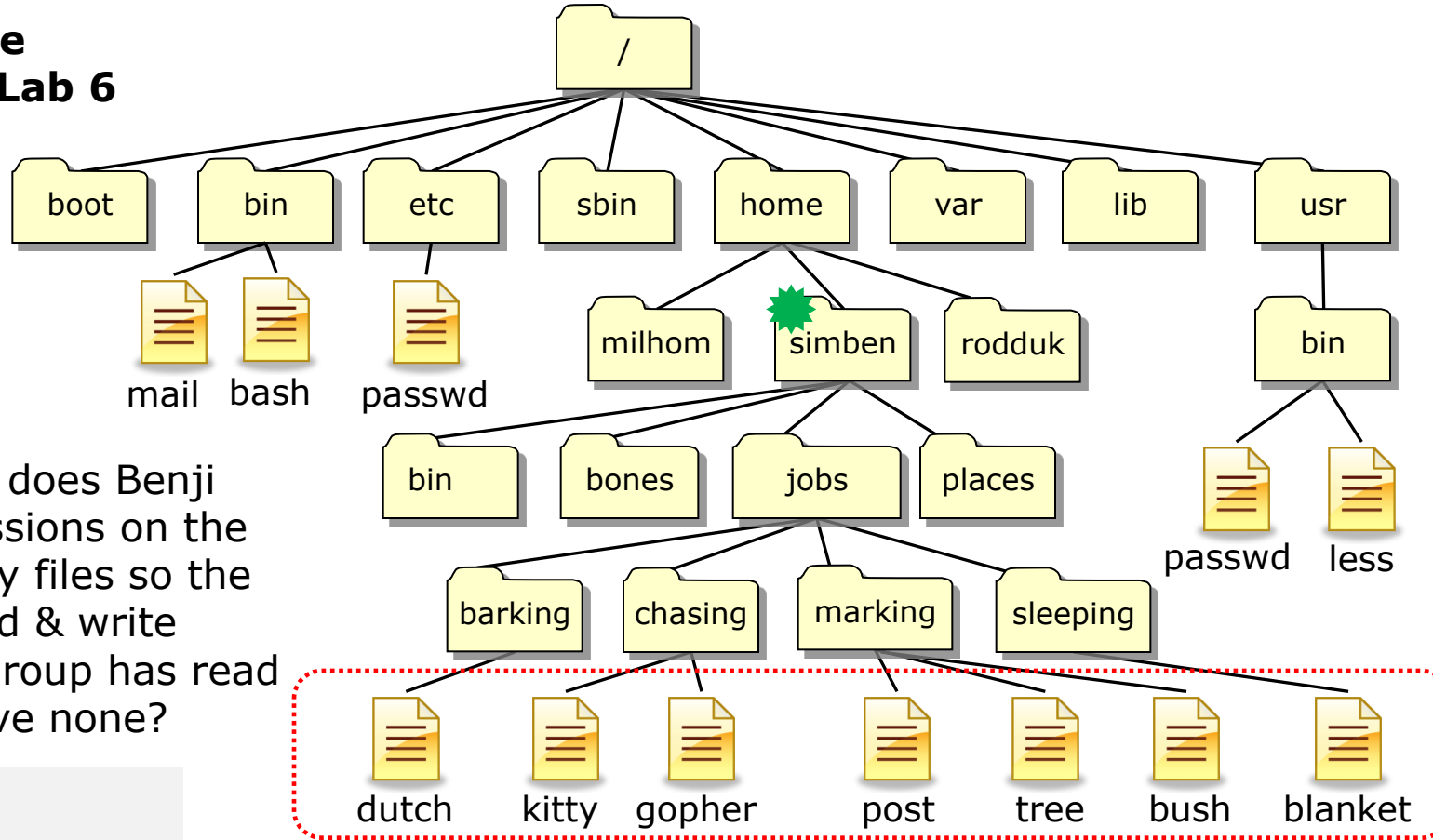
Using relative paths and filename expansion characters takes 6 commands
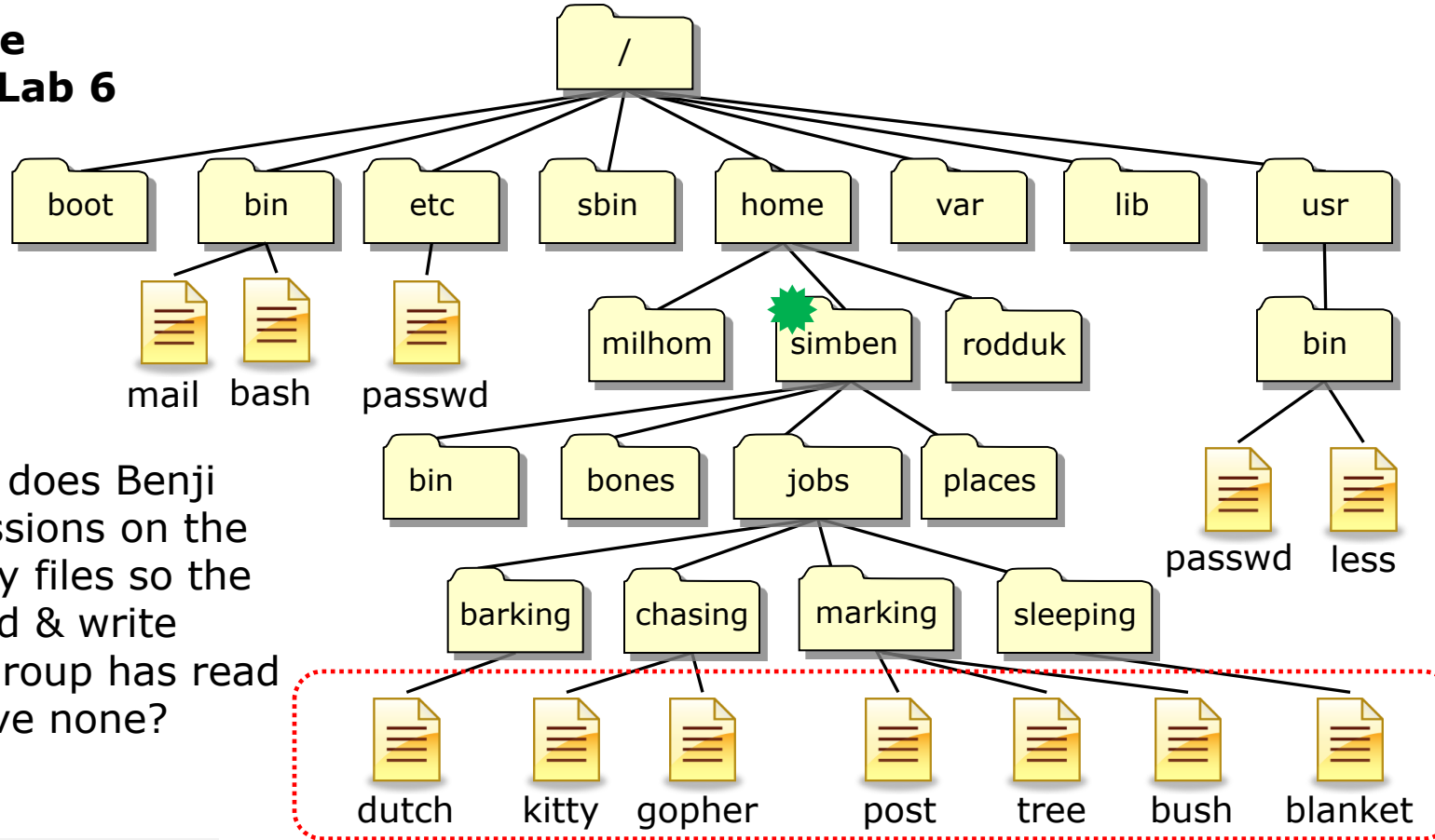
201

An example related to Lab 6 Q10

From ✹ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

chmod 640 jobs/*/*

The Linux guru method:
Using relative paths, filename expansion characters and combining all arguments on a single command line takes one command
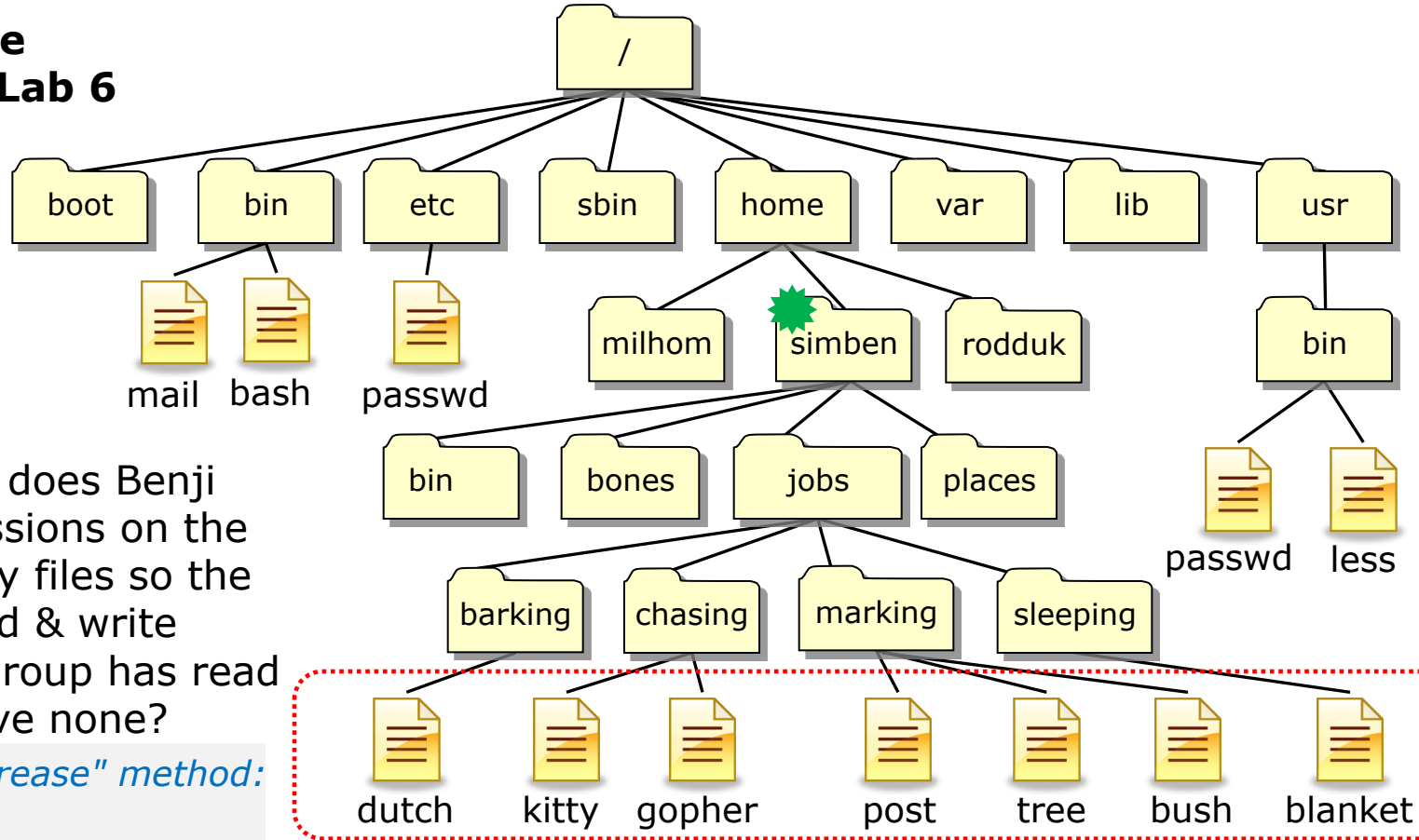
202

An example related to Lab 6 Q10

From ✹ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

The "elbow grease" method:
```
cd jobs
cd barking
chmod 640 dutch
cd ..
cd chasing
chmod 640 kitty
chmod 640 gopher
cd ..
cd marking
chmod 640 post
chmod 640 tree
chmod 640 bush
cd ..
cd sleeping
chmod 640 blanket
cd
```

Both ways work, the choice is yours!

The "Linux guru" method:
chmod 640 jobs/*/*

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Permissions Review

File Permissions
Binary

Permissions are stored internally using binary numbers and they can be specified using decimal numbers

rwx	Binary	Convert	Decimal
- - -	0 0 0	0 + 0 + 0	0
- - x	0 0 1	0 + 0 + 1	1
- w -	0 1 0	0 + 2 + 0	2
- w x	0 1 1	0 + 2 + 1	3
r - -	1 0 0	4 + 0 + 0	4
r - x	1 0 1	4 + 0 + 1	5
r w -	1 1 0	4 + 2 + 0	6
r w x	1 1 1	4 + 2 + 1	7

r (read) is the 4's column
w (write) is the 2's column
x (execute) is the 1's column

File Permissions

An example long listing

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

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File Permissions

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

user
(owner)

group

others

| r | w | - | | r | - | - | | r | - | - |

read write execute   read write execute   read write execute

The permissions on letter:
 The **user** *simben90* has read and write permission
 The **group** *cis90* has read permission
 All **others** have read permission

Use long listings to show permissions

207

File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the simben90 user have execute permission on the letter file?
Type answer in chat window

208

File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the simben90 user have execute permission on the letter file?
No

209

File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the zamhum90 user have write permission on the letter file?
Type answer in chat window

210

File Permissions

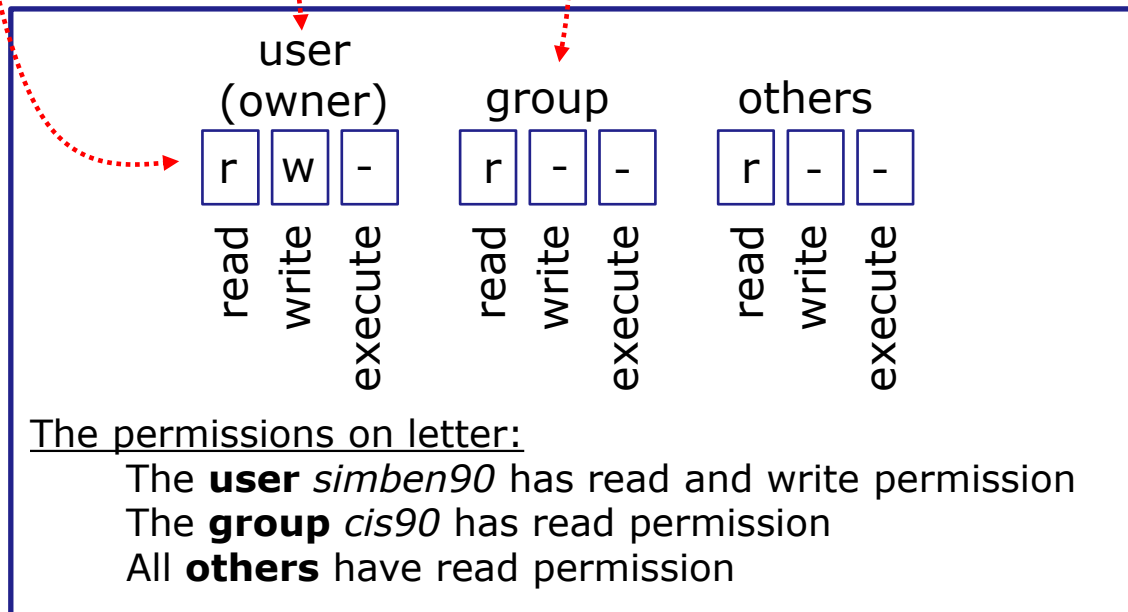*Use long listings to show permissions*

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the zamhum90 user have write permission on the letter file?
No

File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the zamhum90 user have read permission on the letter file?
Type answer in chat window

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File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the zamhum90 user have read permission on the letter file?
Yes

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File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the smimat172 user have read permission on the letter file?
Type answer in chat window

214

File Permissions

Use long listings to show permissions

r=read
w=write
x=execute
-=none

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*The **group***

*The **user***

*Permissions that apply to **others***

*Permissions that apply to the **group***

*Permissions that apply to the **user***

Does the smimat172 user have read permission on the letter file?
Yes

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Tools for managing permissions

chown - Changes the ownership of a file. (Only the superuser has this privilege)

chgrp - Changes the group of a file. (Only to groups that you belong to)

chmod - Changes the file mode "permission" bits of a file.
- Numeric: **chmod 640 letter** (sets the permissions)
- Mnemonic: **chmod ug+rw letter** (changes the permissions)
  u=user(owner), **g**=group, **o**=other
  r=read, **w**=write, **x**=execute

umask – Allows specific permissions to be removed on future newly created files and directories

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Tools for managing permissions

chown

- Changes the ownership of a file. (Only the superuser has this privilege)
- Syntax: **chown *<owner> <pathname>***

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ chown rsimms letter
chown: changing ownership of `letter': Operation not permitted
```

Only root (superuser) can change the ownership of a file

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Tools for managing permissions

chgrp

- Changes the group of a file. (Only to groups the owner belongs to)
- Syntax: **chgrp *<group> <pathname>***

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ groups
cis90 users

/home/cis90/simben $ chgrp users letter

/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 users 1044 Oct 14 20:39 letter
```

The owner can change the group to any he/she belongs to

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Tools for managing permissions

chmod

- Changes the file mode "permission" bits of a file
- "Numeric" syntax: **chmod <*numeric permission*> <*pathname*>**

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ chmod 750 letter
/home/cis90/simben $ ls -l letter
-rwxr-x---. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ chmod 644 letter
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

*Using **numeric** permissions format*

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Tools for managing permissions

chmod

• Changes the file mode "permission" bits of a file.
• "Mnemonic" syntax: **chmod <u|g|o><+|-|=><r|w|x> <pathname(s)>**
         u=user(owner), **g**=group, **o**=other
         r=read, **w**=write, **x**=execute

```
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ chmod u+x,g+w,o-r letter
/home/cis90/simben $ ls -l letter
-rwxrw----. 1 simben90 cis90 1044 Oct 14 20:39 letter

/home/cis90/simben $ chmod u=rw,g=r,o=r letter
/home/cis90/simben $ ls -l letter
-rw-r--r--. 1 simben90 cis90 1044 Oct 14 20:39 letter
```

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*Using **mnemonic** permissions format*

Tools for managing permissions

umask – Allows specific permissions to be removed on future newly created files and directories

sort command

/home/cis90/simben $ **cat misc/salad**
orange
mango
banana
peach
apple
grapes
pear
apricot
kiwi
watermelon
pineapple

Try the sort command on the salad file in your misc/ directory

/home/cis90/simben $ **sort misc/salad**
apple
apricot
banana
grapes
kiwi
mango
orange
peach
pear
pineapple
watermelon

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Pipeline example

```
[simben@opus ~]$ who | sort | tee users | wc -l
4

[simben@opus ~]$ cat users
bolasale pts/4       2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
simben pts/0       2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1       2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2        2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
```

Counting, sorting and recording the currently logged in users

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Why pipelines?

Without pipelines we would have to save the results of each intermediate step in a temporary file

```
[simben@opus ~]$ who
simben pts/0       2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1       2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2      2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
bolasale pts/4      2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
[simben@opus ~]$ who > tempfile
[simben@opus ~]$ sort tempfile
bolasale pts/4      2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
simben pts/0       2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1       2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2      2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
[simben@opus ~]$ sort tempfile > users
[simben@opus ~]$ wc -l users
4 users
[simben@opus ~]$ cat users
bolasale pts/4      2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
simben pts/0       2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1       2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2      2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
```

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Best practices: build pipelines one command at a time so you can see what you are doing

```
[simben@opus ~]$ who       who is logged in
simben pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1        2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2      2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
bolasale pts/4      2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)


[simben@opus ~]$ who | sort      who is logged in and sorted
bolasale pts/4       2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
simben pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1        2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2       2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)


[simben@opus ~]$ who | sort | wc -l      who is logged in, sorted and counted
4


[simben@opus ~]$ who | sort | tee users | wc -l      who is logged in, sorted, counted
4                                                    and saved in file named users


[simben@opus ~]$ cat users
bolasale pts/4        2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
simben pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
simben pts/1        2008-10-19 18:27 (dsl-63-249-103-107.cruzio.com)
rsimms   pts/2       2008-10-20 17:33 (dsl-63-249-103-107.cruzio.com)
```

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