Lesson Module Status
- Slides – draft
- Properties – done
- Flash cards –
- First minute quiz – done
- Web calendar summary – done
- Web book pages – done
- Commands – done
- Lab tested – done
- Supplies – na
- Class PC's – na

- Hide script – na
- Extra Credit Lab X2 preview - done
- CCC Confer wall paper - done
- Materials uploaded – done
- Backup headset charged – done
- Backup slides, CCC info, handouts on flash drive - done

- Check that room headset is charged – done

Email me (risimms@cabrillo.edu) a relatively current photo of your face for 3 points extra credit

First Minute Quiz

Please close your books, notes, lesson materials, forum and answer these questions **in the order** shown:

- What is the numeric permission equivalent of `rwxr-xr--` ?
- With a umask of 002 what permissions would a newly created file have?
- Does chmod o+w give write permission to the owner or to other users?

email answers to: risimms@cabrillo.edu

[ ] Has the phone bridge been added?

[ ] Is recording on?

[ ] Does the phone bridge have the mike?

[ ] Share slides, putty (rsimms, simmsben, roddyduk), and Chrome

[ ] Disable spelling on PowerPoint

Input/Output Processing

Objectives	Agenda
• Identify the three open files 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

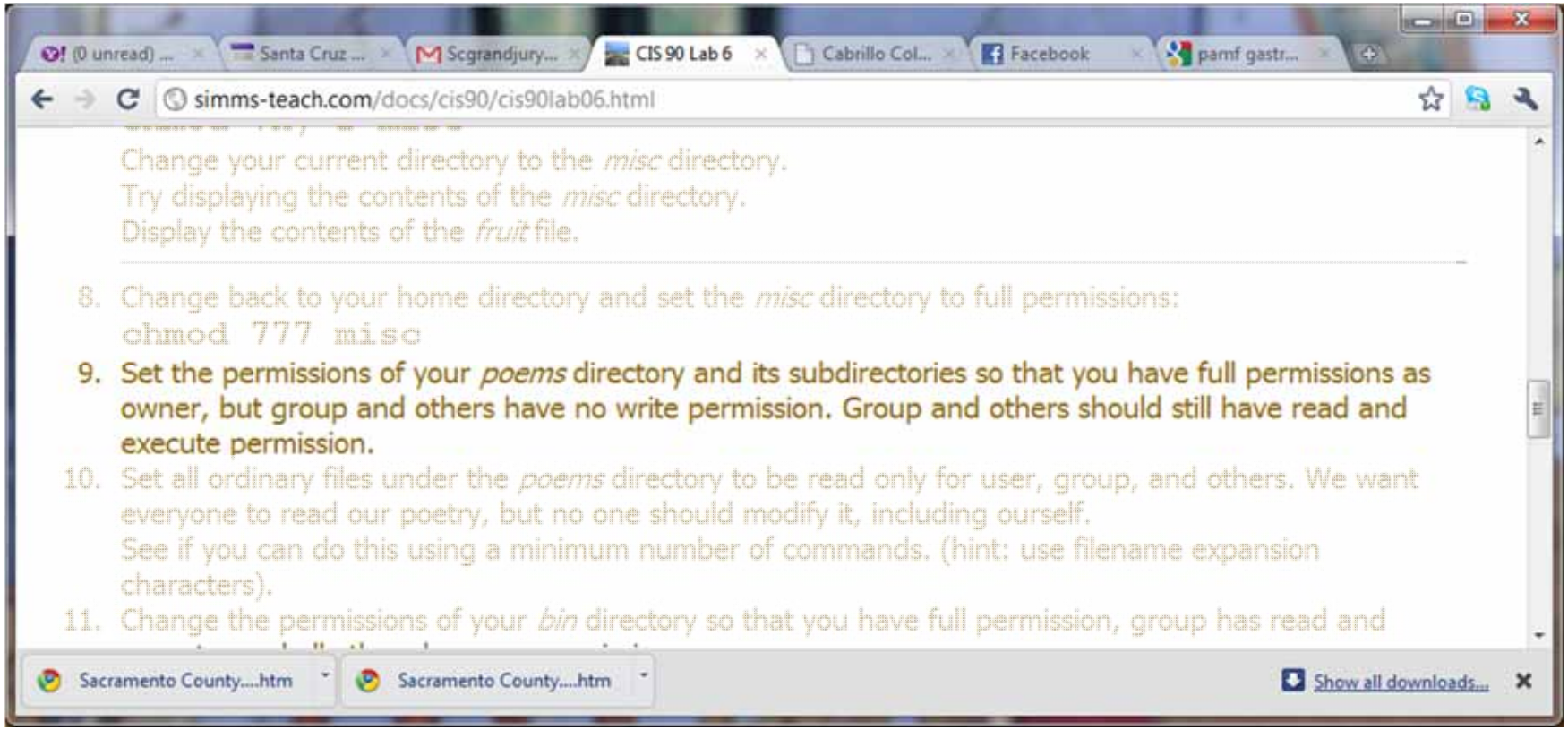
Questions

- Last lab?
- Last class?
- Last test?
- Previous lessons?

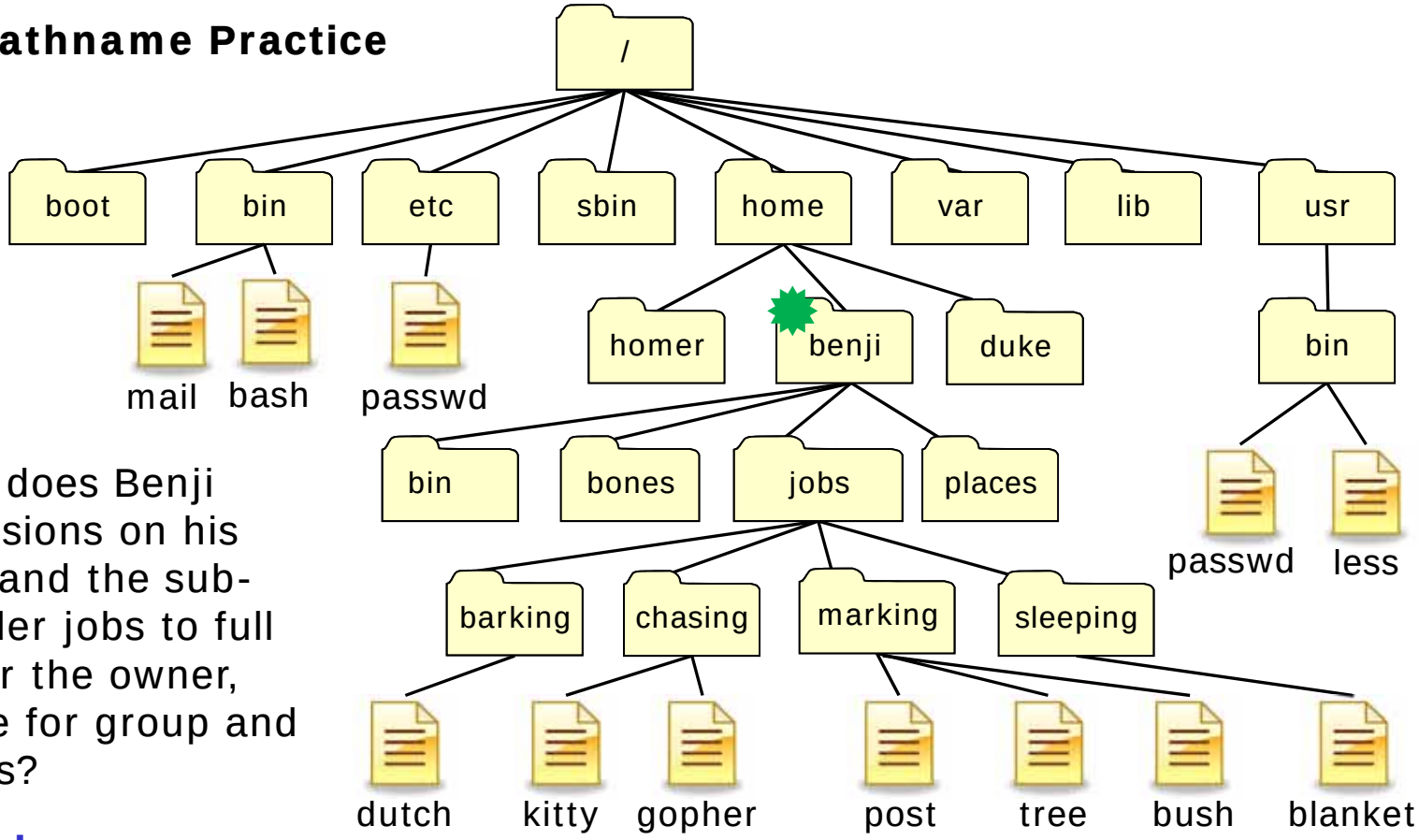
More on pathnames

(useful for Lab 6)

One of the steps in Lab 6



File Tree Pathname Practice

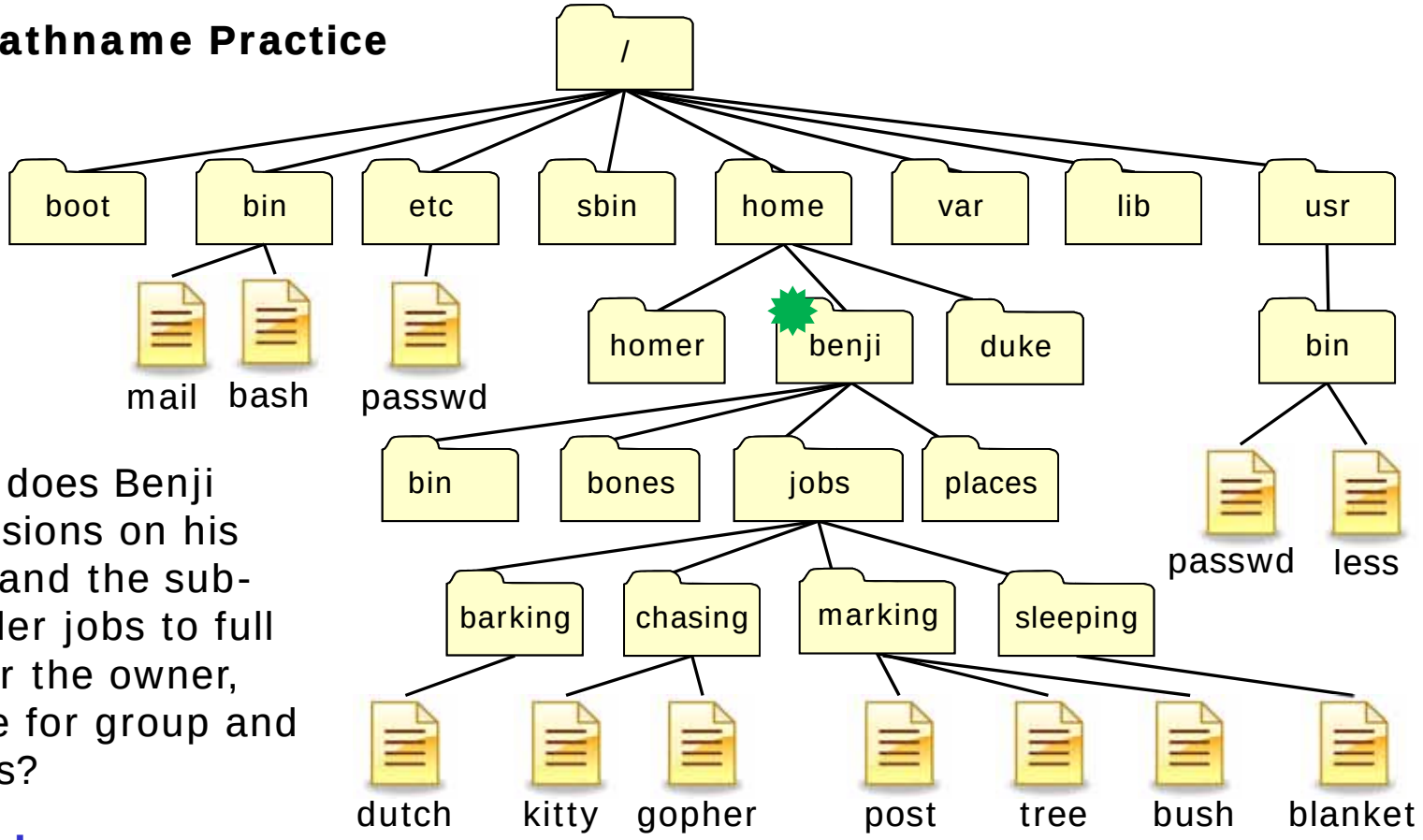


From ✹ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

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

This works and takes 6 commands to complete

File Tree Pathname Practice

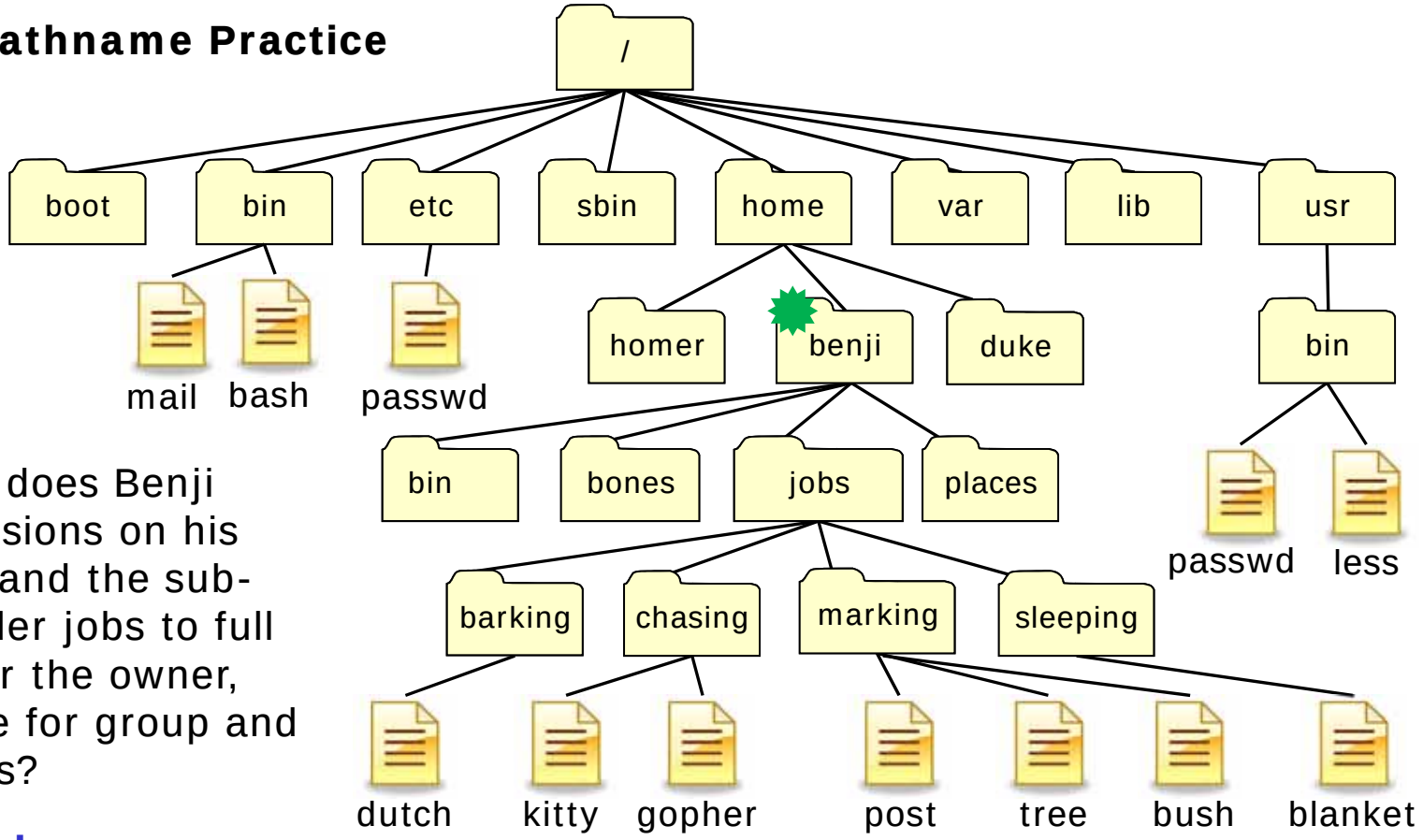


From ✹ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

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

This also works and takes 5 commands to complete

File Tree Pathname Practice

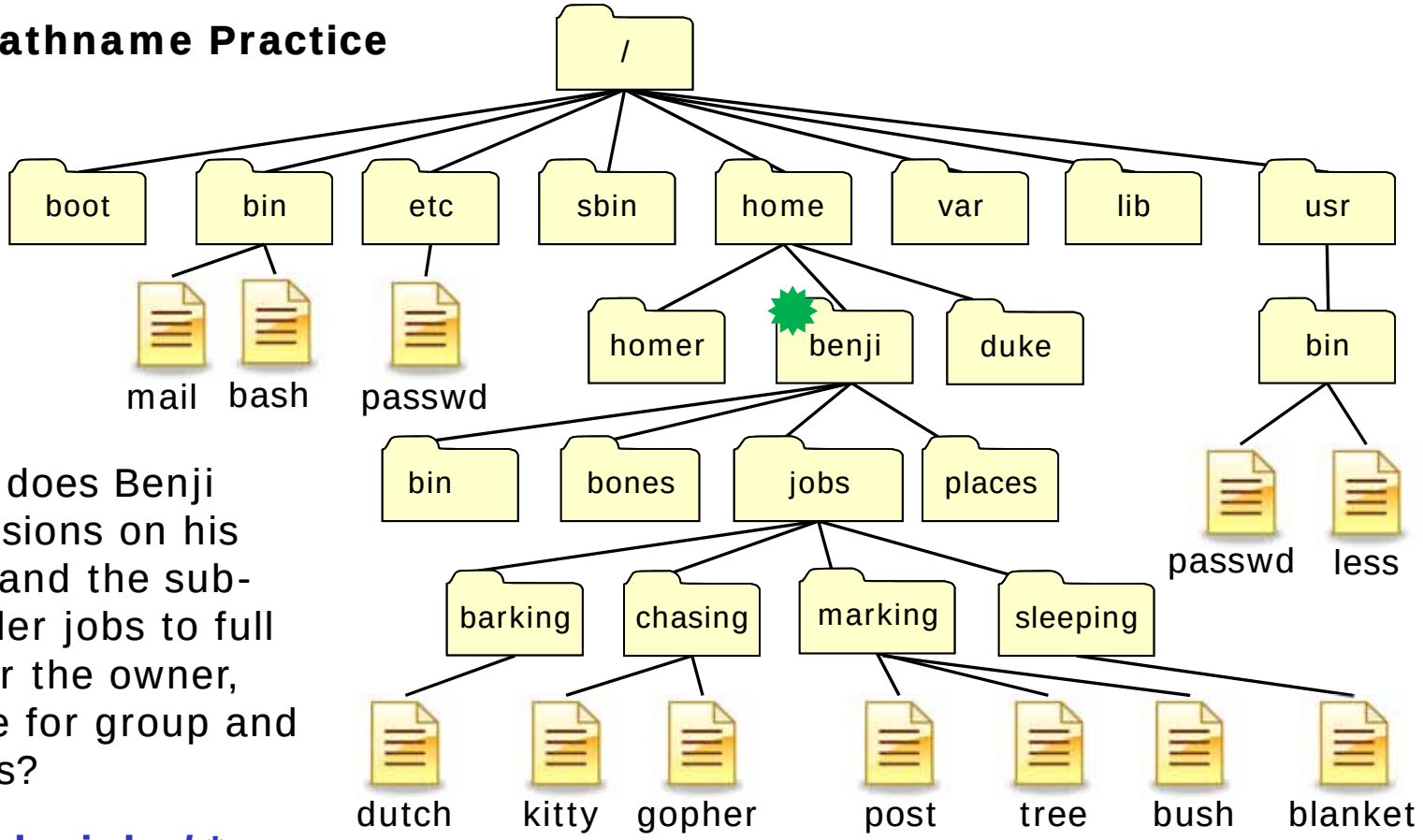


From ✹ how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

chmod 750 jobs
chmod 750 jobs/*

This also works and takes 2 commands to complete

File Tree Pathname Practice

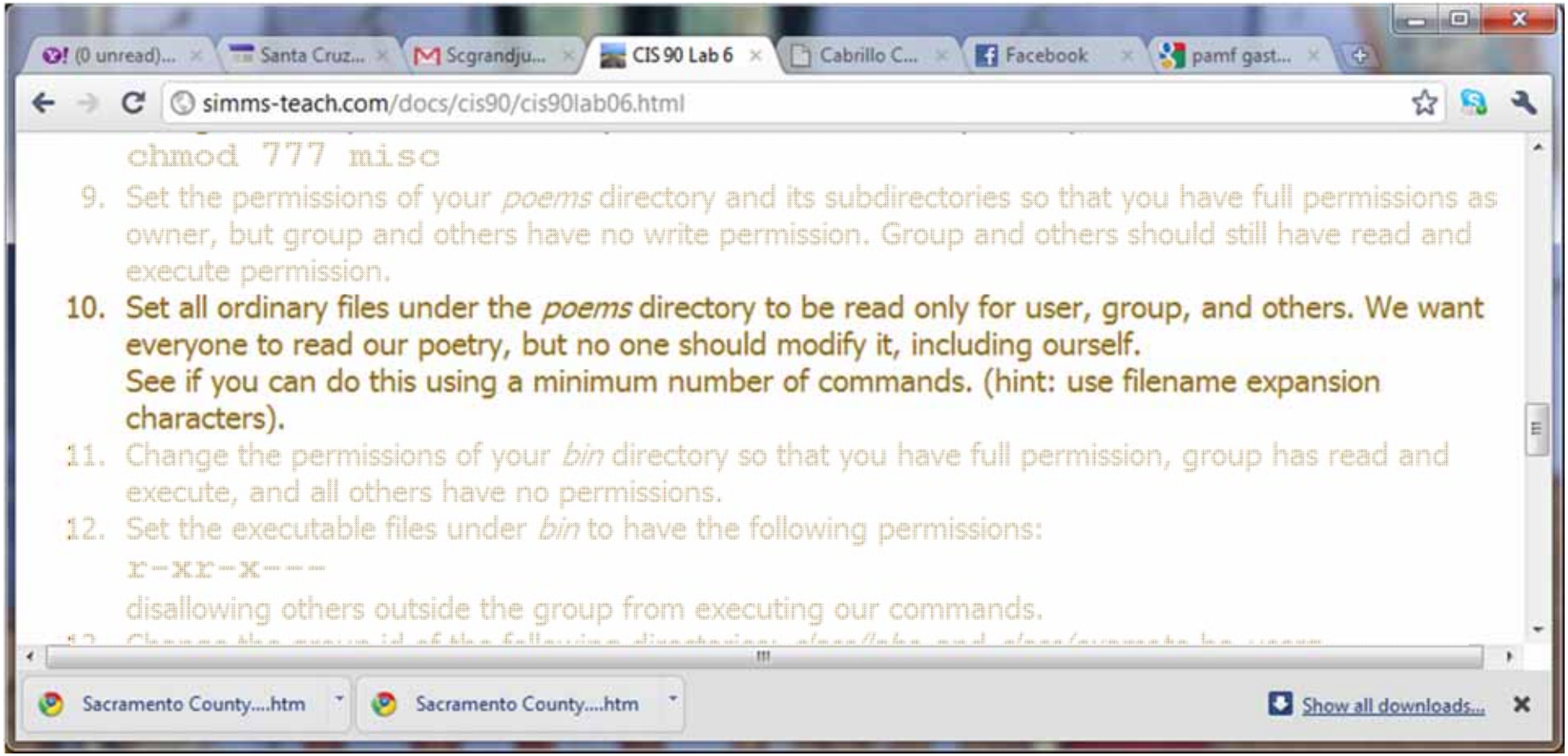


From benji how does Benji change permissions on his jobs directory and the sub-directories under jobs to full permissions for the owner, read & execute for group and none for others?

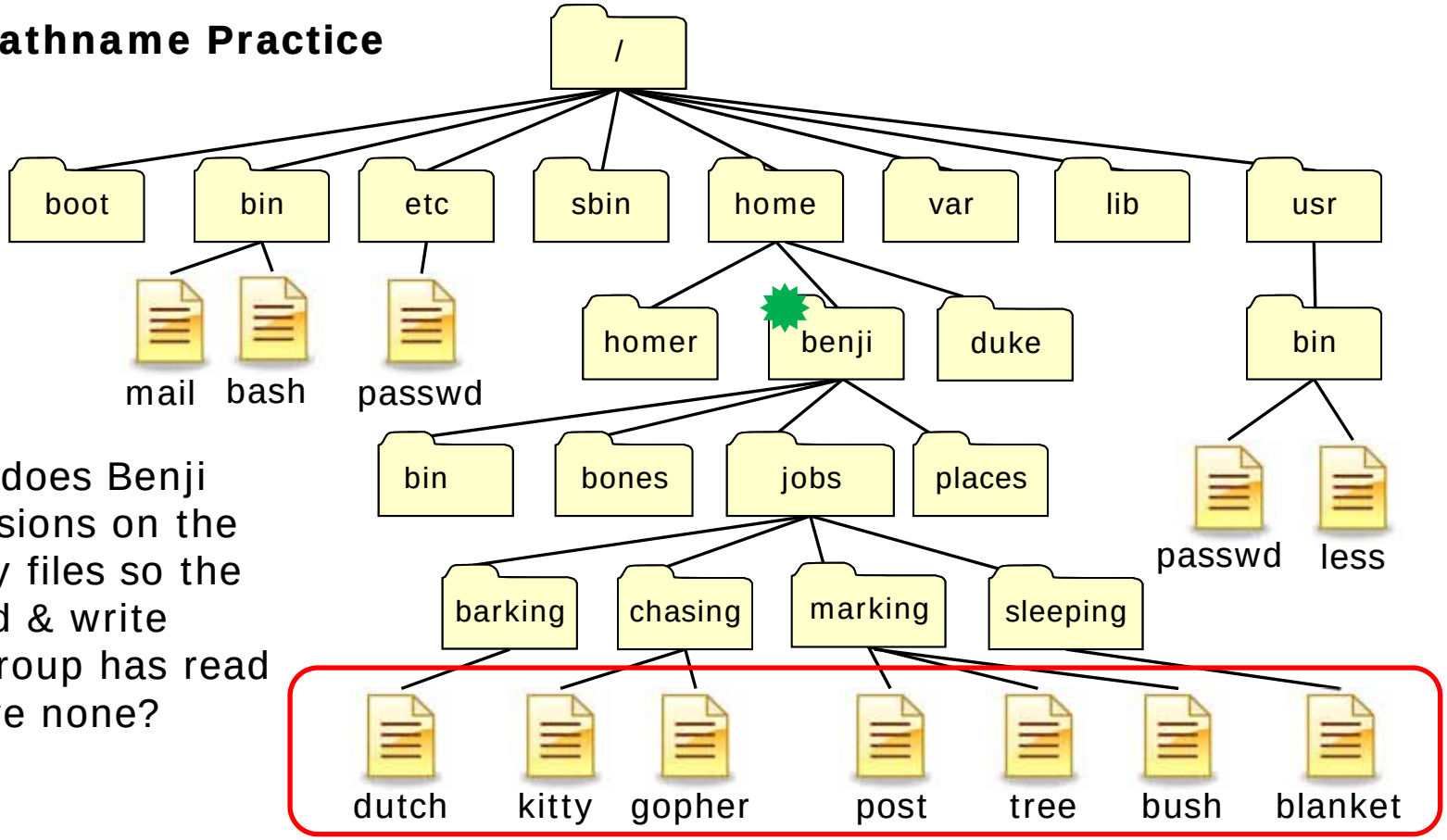
chmod 750 jobs jobs/*

This is how you can do it in a single command

Another step in Lab 6



File Tree Pathname Practice



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 ..
```

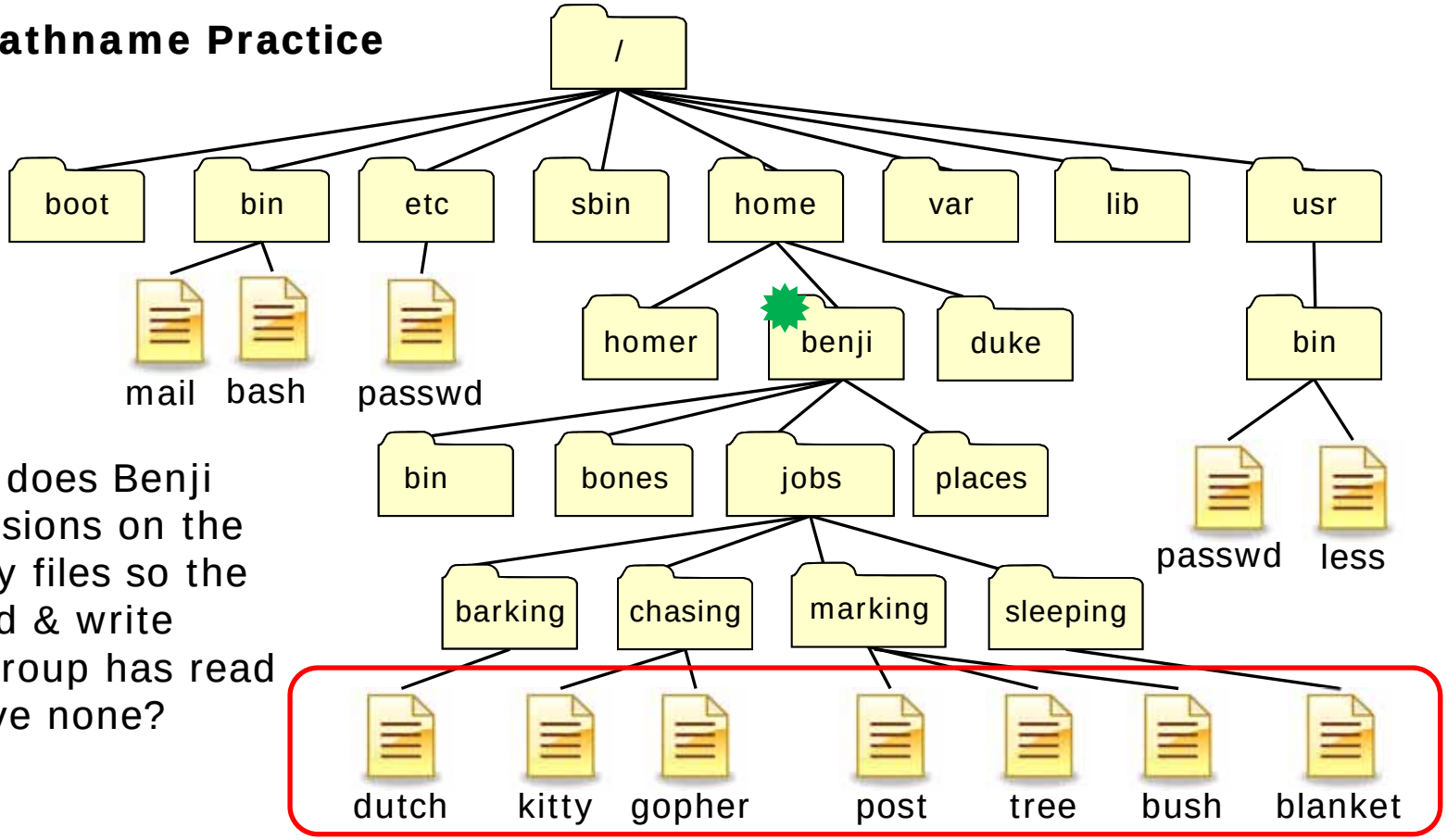
```
cd chasing
chmod 640 kitty
chmod 640 gopher
cd ..
```

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

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

Method 1:
takes 16 commands

File Tree Pathname Practice

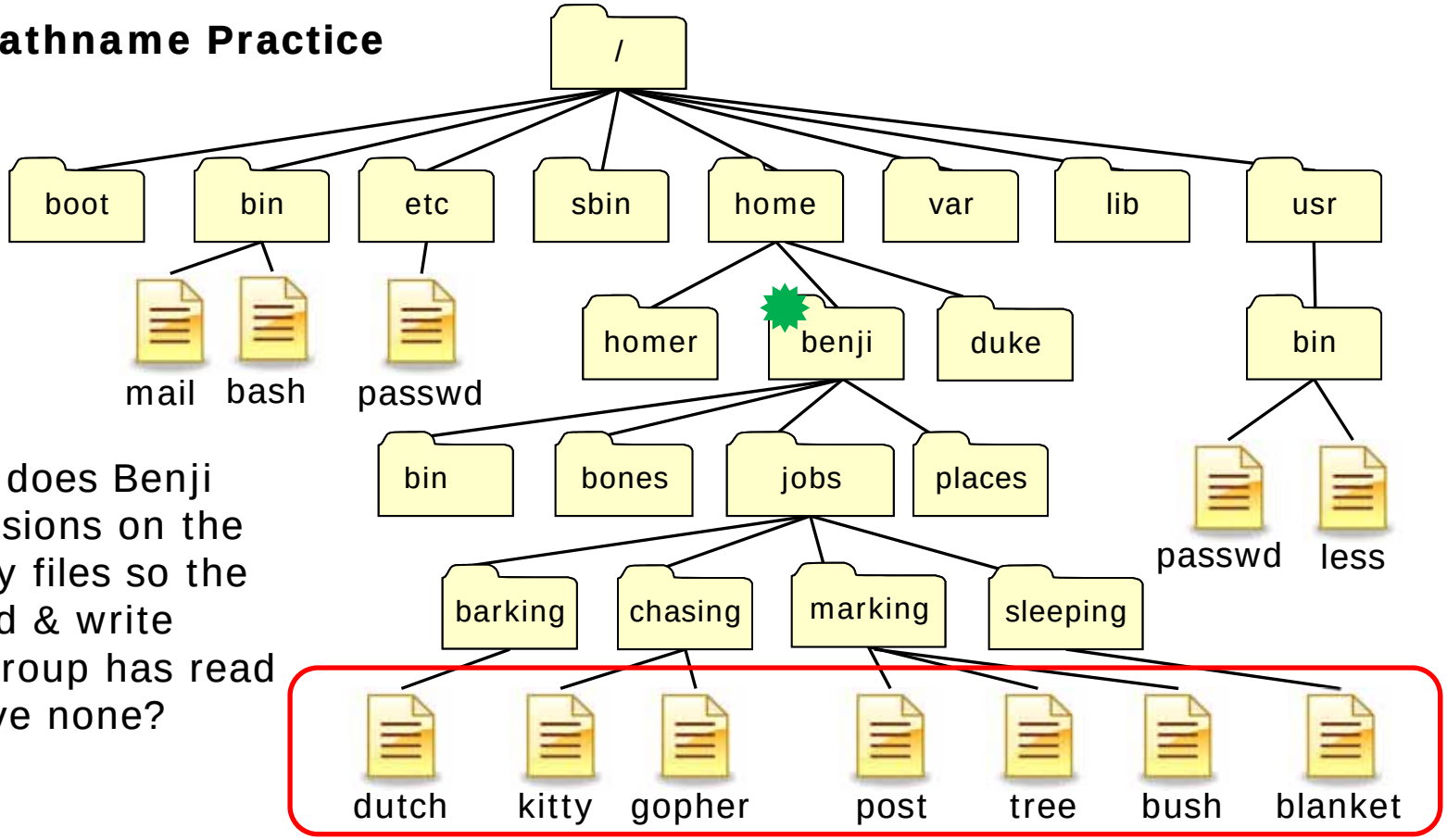


From benji how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

```
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
```

Method 2:
takes 13 commands

File Tree Pathname Practice



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 ..
```

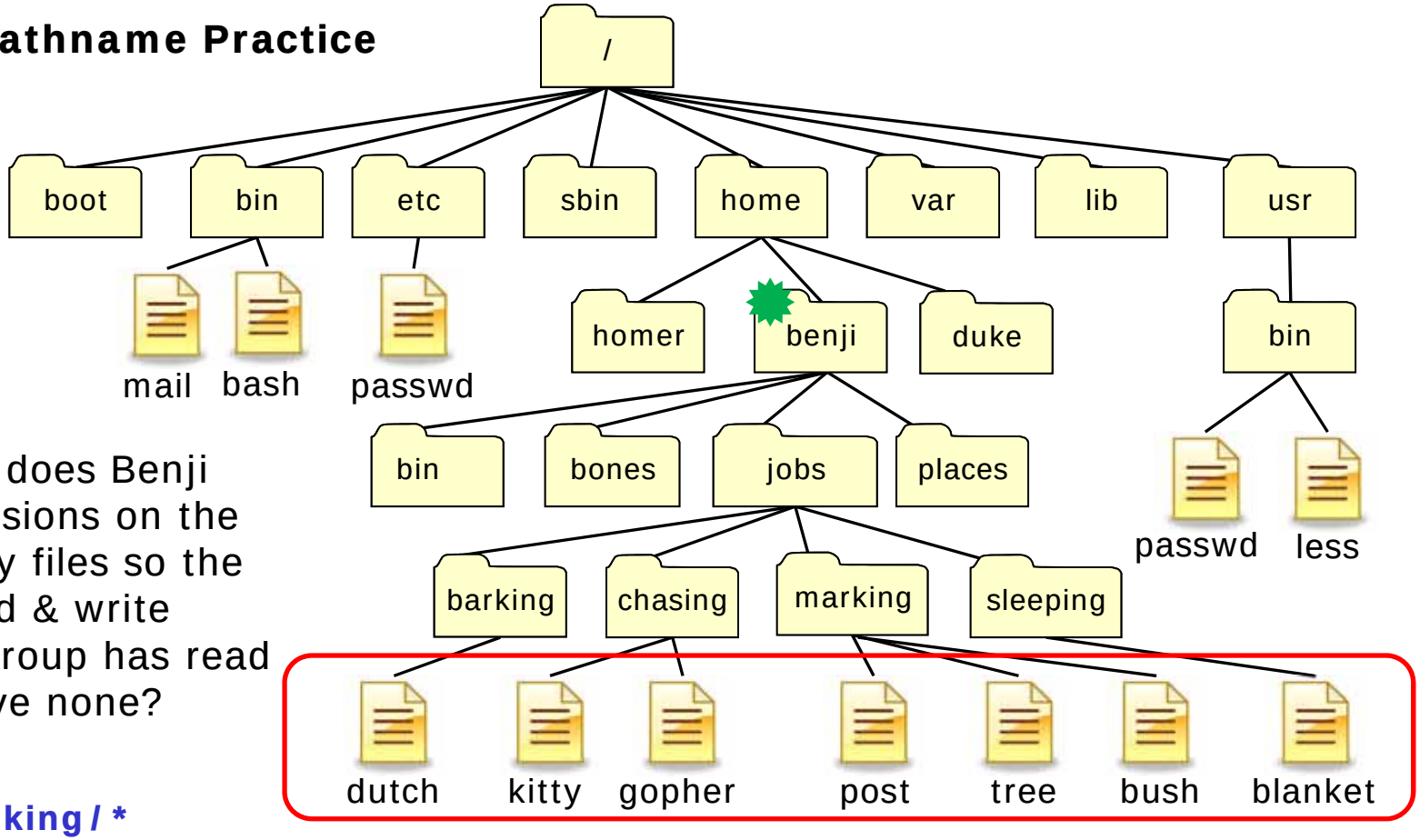
```
cd chasing
chmod 640 *
cd ..
```

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

```
cd sleeping
chmod 640 *
cd
```

Method 3:
takes 13 commands

File Tree Pathname Practice

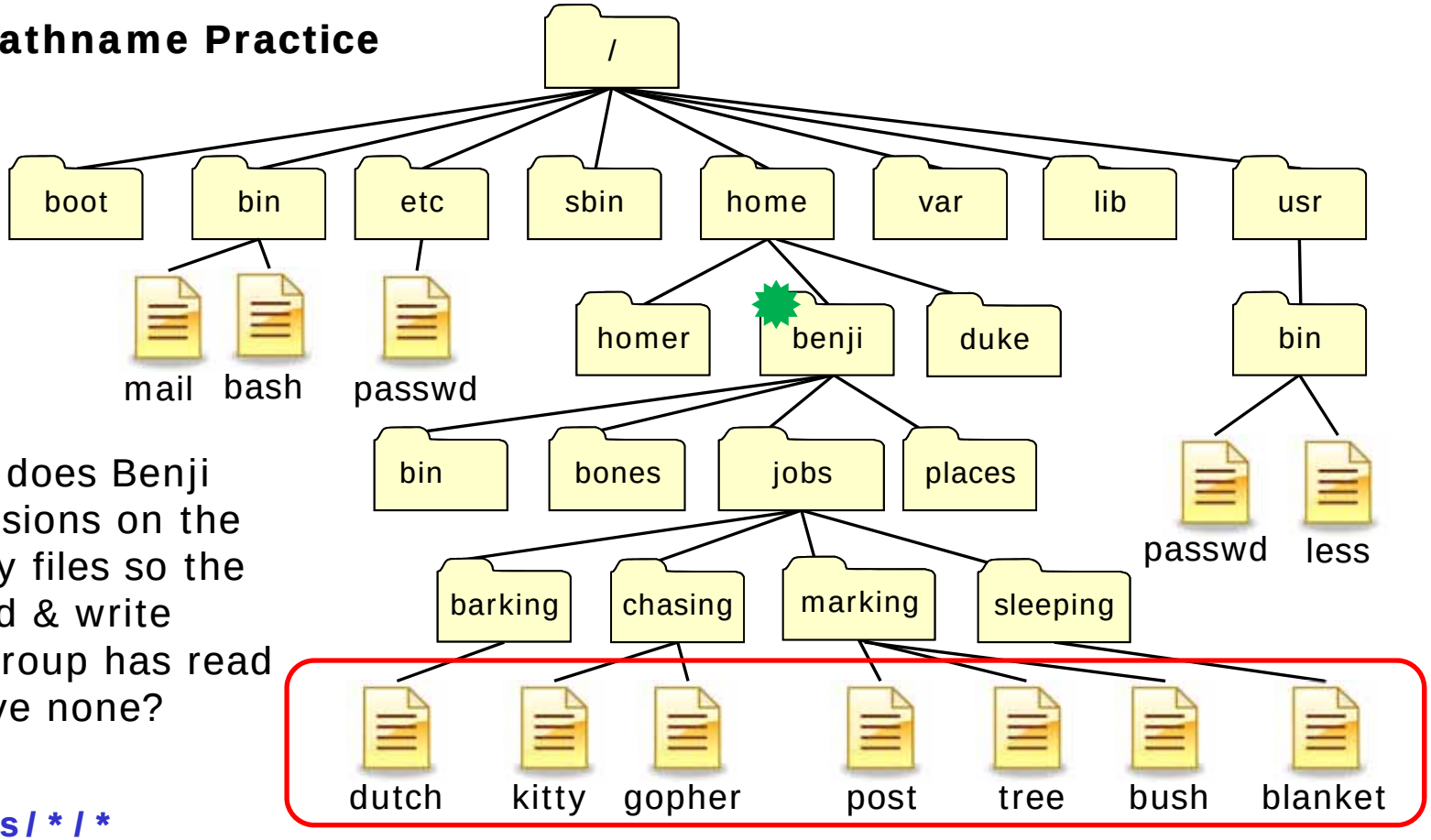


From ✹ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

```
cd jobs
chmod 640 barking/*
chmod 640 chasing/*
chmod 640 marking/*
chmod 640 sleeping/*
cd ..
```

Method 4:
takes 6 commands

File Tree Pathname Practice



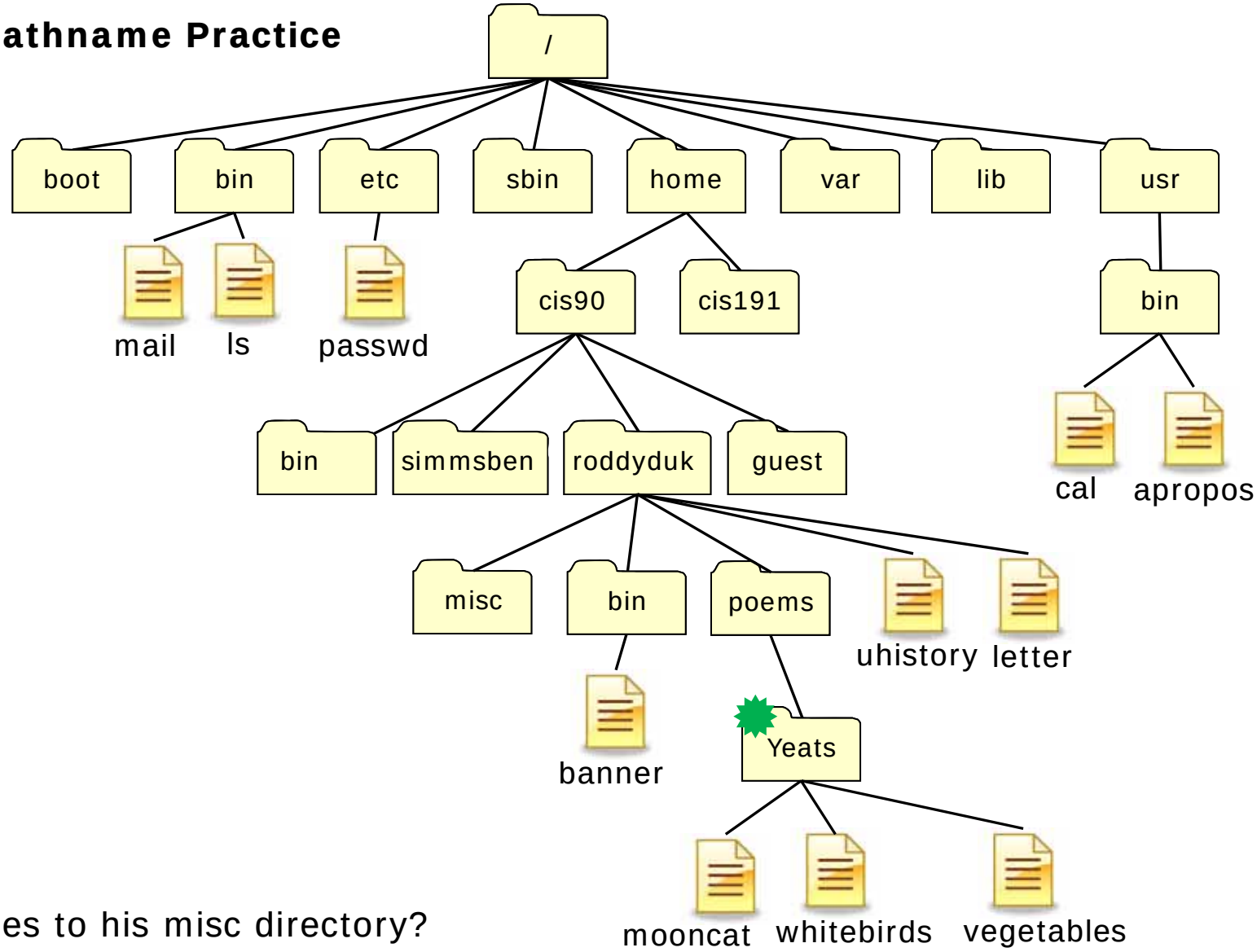
From ✹ how does Benji change permissions on the circled ordinary files so the owner has read & write permissions, group has read and others have none?

chmod 640 jobs/*/*

Method 5:
takes 1 command

Warmup

File Tree Pathname Practice

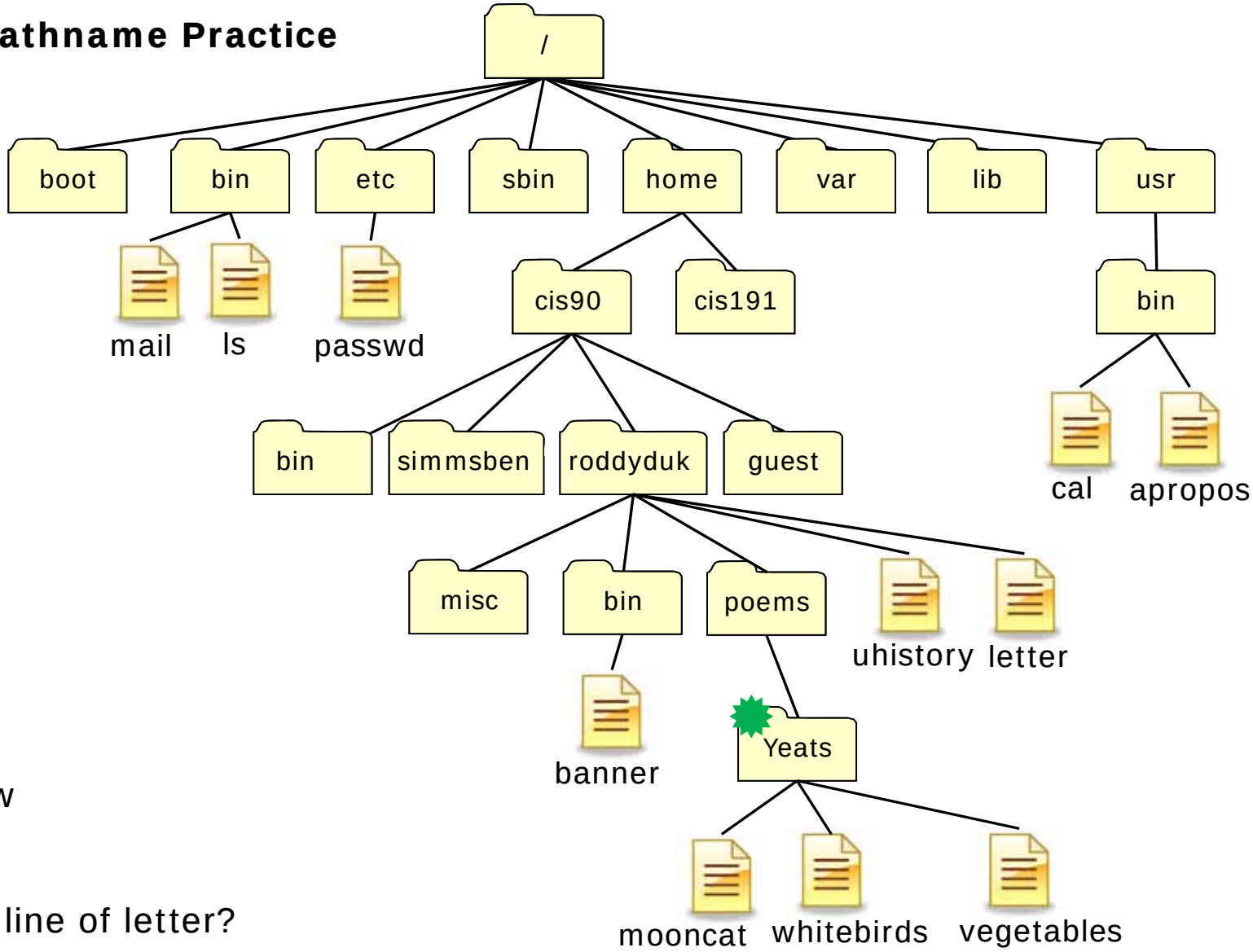


From how does Duke:

Move vegetables to his misc directory?

```
/home/cis90/roddyduk/poems/Yeats $ mv vegetables ../../misc/
```

File Tree Pathname Practice

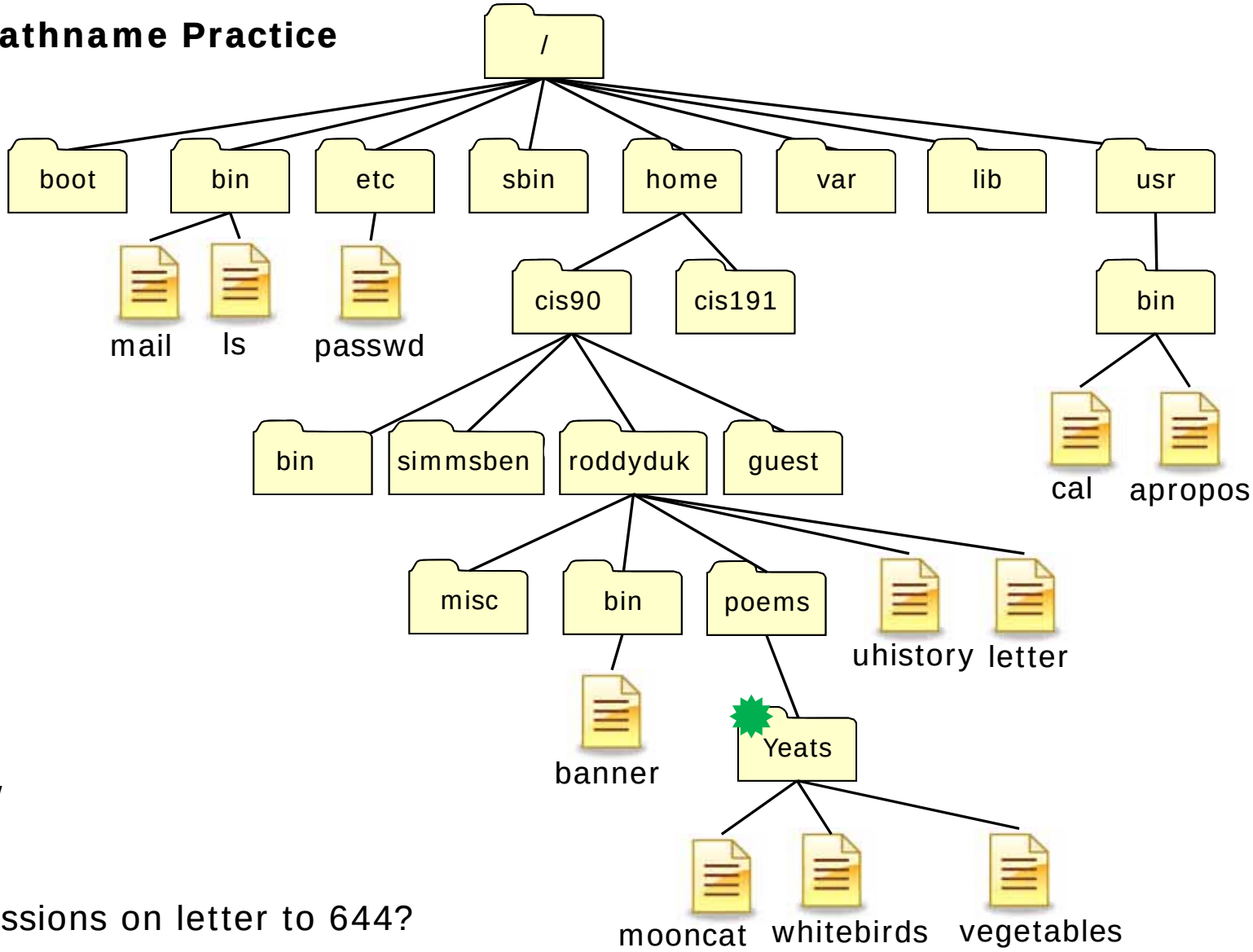


From ✹ how does Duke:

Print the last line of letter?

```
/home/cis90/roddyduk/poems/Yeats $ tail -1 ../../letter
```

File Tree Pathname Practice

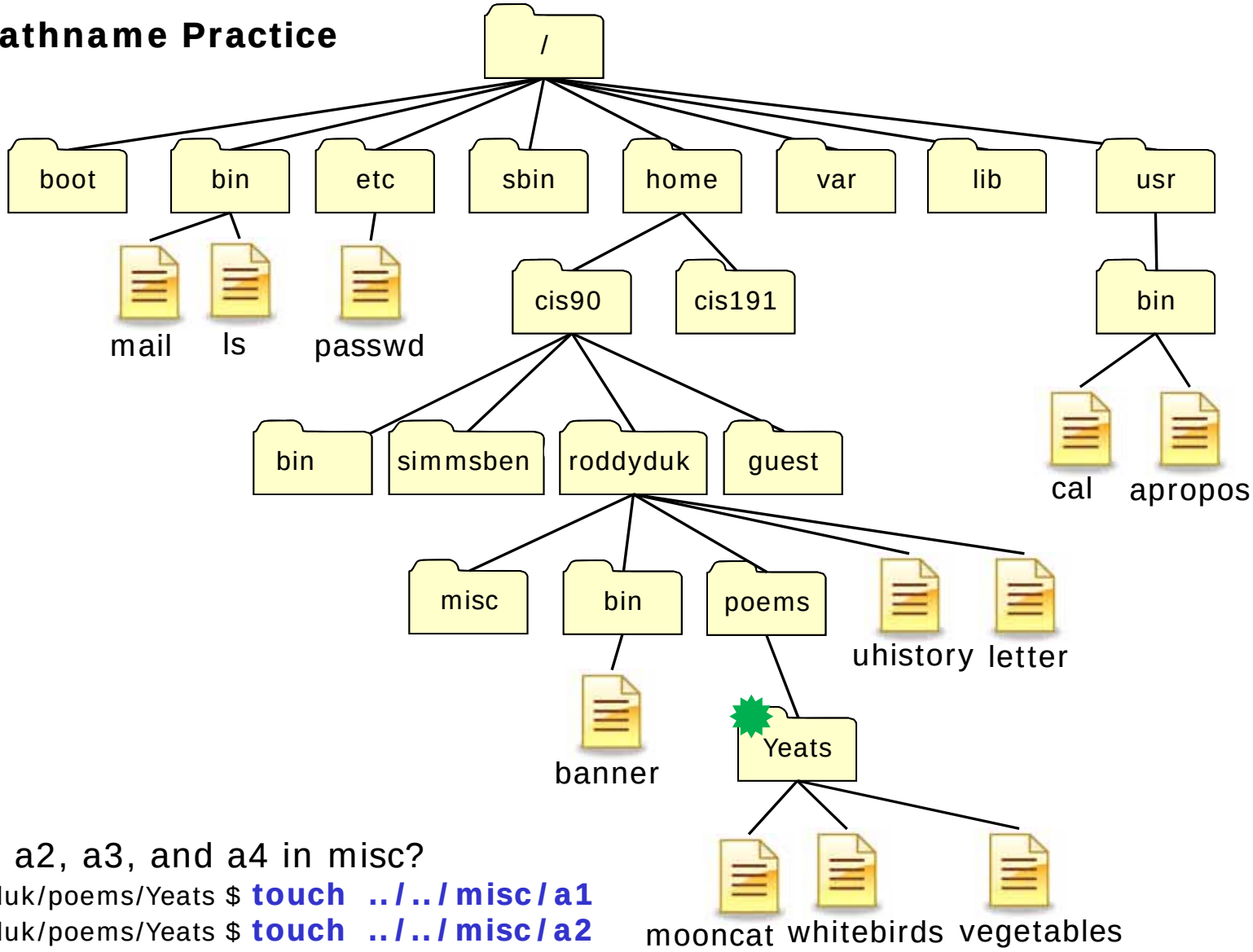


From ✹ how does Duke:

Change permissions on letter to 644?

`/home/cis90/roddyduk/poems/Yeats $` **`chmod 644 ../../letter`**

File Tree Pathname Practice

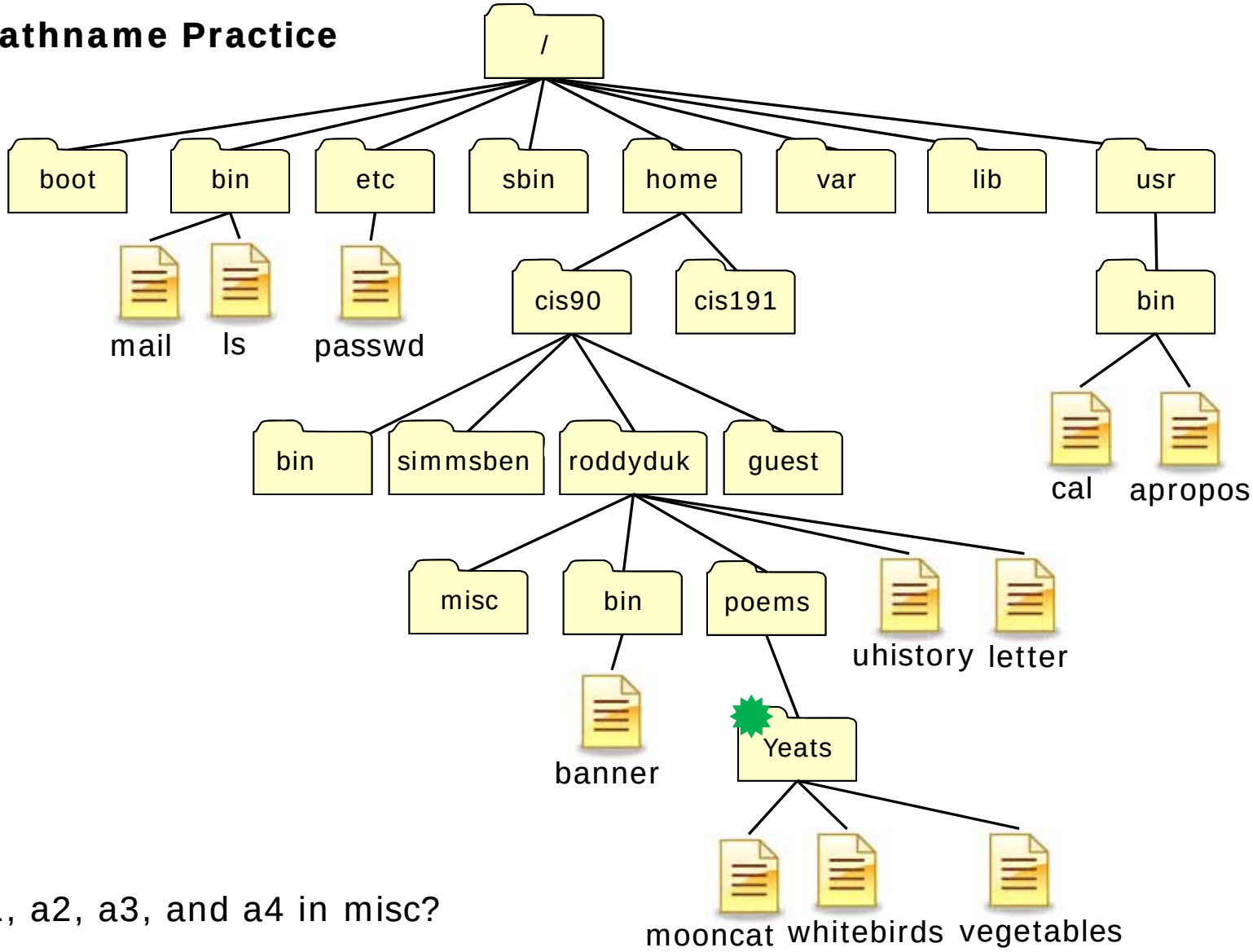


From how does Duke:

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

```
/home/cis90/roddyduk/poems/Yeats $ touch ../../misc/a1
/home/cis90/roddyduk/poems/Yeats $ touch ../../misc/a2
/home/cis90/roddyduk/poems/Yeats $ touch ../../misc/a3
/home/cis90/roddyduk/poems/Yeats $ touch ../../misc/a4
```

File Tree Pathname Practice



From ✹ how does Duke:

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

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

Housekeeping

Previous material and assignment

1. Lab 6 due today
2. Five posts due today
3. Calendar review – spring break!
4. Jesse's cool checkgrades script
5. Early preview of Lab X2

umask

Using umask command

1. New files temporarily start with 666 permissions
2. New directories temporarily start with 777 permissions
3. The umask value is then applied which will **mask** out any unwanted permissions.

For example a umask setting of 027 will mask out write permission for group and all permissions for others:

```
rw- rw- rw- (666) starting point for files
--- -w- rwx (027) umask setting
rw- r-- --- (640) the permissions a new file will have
```

Prove it to yourself using Opus:

```
/home/cis90ol/simmsben $ rm a_new_file
rm: cannot remove `a_new_file': No such file or directory
/home/cis90ol/simmsben $ umask 027
/home/cis90ol/simmsben $ touch a_new_file
/home/cis90ol/simmsben $ ls -l a_new_file
-rw-r----- 1 simmsben cis90ol 0 Mar 31 10:57 a_new_file
```

Sample umask test question

What umask setting would insure that all new directories made would only have read and execute for owner, read only permission for group and no permission for others?

Answer: 237

```
rwx rwx rwx (777) starting point for directories
-w- -wx rwx (237) umask setting
r-x r-- --- (540) the permissions a new file will have
```

Prove it to yourself using Opus:

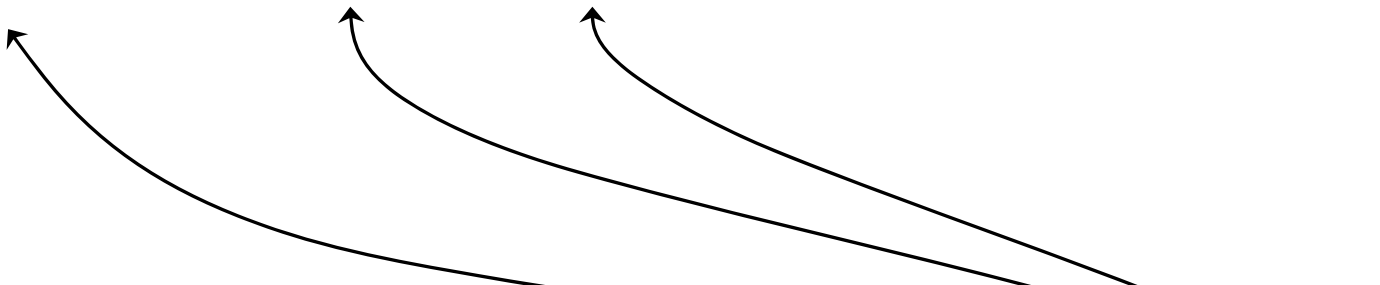
```
/home/cis90ol/simmsben $ umask 237
/home/cis90ol/simmsben $ rmdir a_new_dir
rmdir: a_new_dir: No such file or directory
/home/cis90ol/simmsben $ mkdir a_new_dir
/home/cis90ol/simmsben $ ls -ld a_new_dir/
dr-xr----- 2 simmsben cis90ol 4096 Mar 31 11:08 a_new_dir/
```

Groups and new files

Groups and new files

Groups

```
/home/cis90/roddyduk $ touch mydogs
/home/cis90/roddyduk $ ls -l mydogs
-rw-rw-r-- 1 roddyduk cis90 0 Oct 19 13:16 mydogs
```



When a new file is created:

- *the permissions are based on the umask value*
- *the owner is set to the user creating the file*
- *the group is set to the user's primary group*

Groups

*Use either **id** or **groups** command to determine what groups a user belongs to*

```
[rsimms@opus lab06]$ id roddyduk
uid=1201(roddyduk) gid=90(cis90) groups=90(cis90),100(users)
context=user_u:system_r:unconfined_t
[rsimms@opus lab06]$

[roddyduk@opus ~]$ groups roddyduk
roddyduk : cis90 users
```

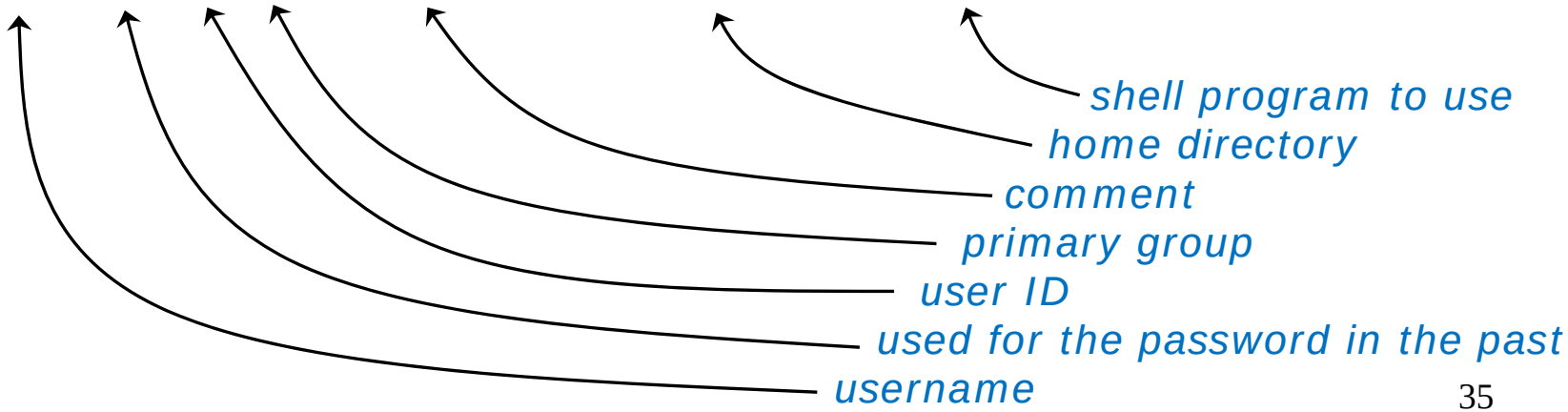
Primary group is cis90. secondary group is users

Groups

The user's primary group is stored in /etc/passwd (the 4th field)

Excerpt from **/etc/passwd**

```
simmsben:x:1200:90:Benji Simms:/home/cis90/simmsben:/bin/bash
roddyduk:x:1201:90:Duke Roddy:/home/cis90/roddyduk:/bin/bash
clastmax:x:1009:191:Max Claston:/home/cis191/clastmax:/bin/bash
derriale:x:1202:90:Alex Derrick:/home/cis90/derriale:/bin/bash
garciton:x:1203:90:Tony Garcia:/home/cis90/garciton:/bin/bash
garibjam:x:1204:90:James Garibay:/home/cis90/garibjam:/bin/bash
rochajua:x:1205:90:Juan Rocha:/home/cis90/rochajua:/bin/bash
delfimik:x:1206:90:Mike Delfin:/home/cis90/delfimik:/bin/bash
dingechr:x:1207:90:Christine Dinges:/home/cis90/dingechr:/bin/bash
blacksea:x:1208:90:Sean Black:/home/cis90/blacksea:/bin/bash
antiden:x:1209:90:Dennis Anti:/home/cis90/antiden:/bin/bash
```



Groups

Secondary groups are recorded in /etc/group

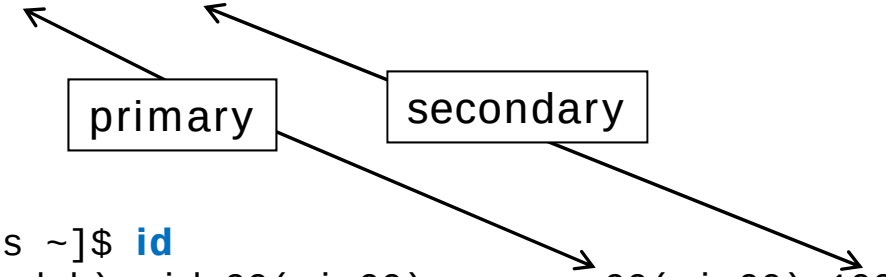
Excerpts from **/etc/group**

```
users:x:100:guest,guest90,jimg,abbenste,arltjef,bolasale,bowerjak,dycktim,farreeli,ga
virxim,gilart,gonzaian,goodmthe,hammoste,kotilnat,lenzpat,maganfra,mattimar,mccarmic,
mchalgeo,mezalui,ortegcar,rochaleo,spadymat,starkmic,vasqucar,vistigab,wallgle,watsoh
ar,quintjos,swansgre,archiand,moonecar,orourpat,pantogab,velasoli,simmsben,roddyduk,c
lastmax,derriale,garciton,garibjam,rochajua,delfimik,dingechr,blacksea,antiden,pirkll
au,birmijam,messison,zilissau,plastadr,brownliz,husemat,botoschr,perezrud,palmilar,sa
linjac,hamiljas,pennitan,valadand,woodjan,henrydal,galbrnat,dakkaabd,cardefra,daviesa
r,hrdinste,redmanic,enriqste,dawadast,menafer,orozcmig,srecklau,mottste,fouric,wattsl
uk,dahlicas,velasliv,pitzemik,komicser,parrijen,beltredt,hernaaar,brownbri,castrsal,m
artiant,joossam,ojedavic,millehom,alvesdes,bejarjoh,bergejoh,breitrob,clarkgal,desotm
at,gardnnic,huangyan,leetheri,lewisgre,studetes,lighttho,lindadav,madrista,normasea,p
oncimar,rochever,schreche,schwajoe,tatlojas,velasjos,lukewat,mikedel,seanbla,veracroc
,simmsmar
utmp:x:22:
utempter:x:35:
< snipped >
mikki:x:501:
guest:x:506:
staff:x:503:jimg,rsimms,gerlinde
cis90:x:90:jimg,guest,rsimms
cis130:x:130:jimg,rsimms
```

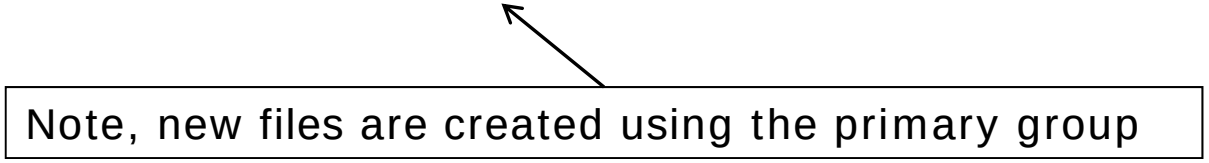
Groups

Every user is a member of a **primary group** (shown in /etc/passwd) and multiple **secondary groups** (shown in /etc/group)

```
/home/cis90/roddyduk $ groups roddyduk
roddyduk : cis90 users
```




```
[roddyduk@opus ~]$ id
uid=1201(roddyduk) gid=90(cis90) groups=90(cis90),100(users)
context=user_u:system_r:unconfined_t


/home/cis90/roddyduk $ touch mydogs
/home/cis90/roddyduk $ ls -l mydogs
-rw-rw-r-- 1 roddyduk cis90 0 Oct 19 13:16 mydogs
```



Permissions Review

Permissions - Review

r	w	x
read	write	execute

r	w	x
read	write	execute

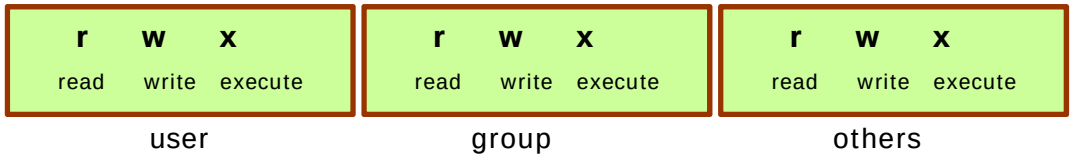
r	w	x
read	write	execute

user group others

```
[rsimms@opus cis90]$ ls -l examples/
total 40
-rw-r--r-- 1 rsimms users  237 Oct 20 07:15 ant
drwxr-xr-x 2 rsimms users 4096 Oct 20 07:16 birds
drwxr-xr-x 2 rsimms users 4096 Oct 20 07:34 dogs
-rw-r--r-- 1 rsimms users  779 Oct 20 07:15 nursery
-rw-r--r-- 1 rsimms users  151 Oct 20 07:16 twister
```

You should now be able to interpret the permissions, user and groups you see on long listings

Permissions - Review



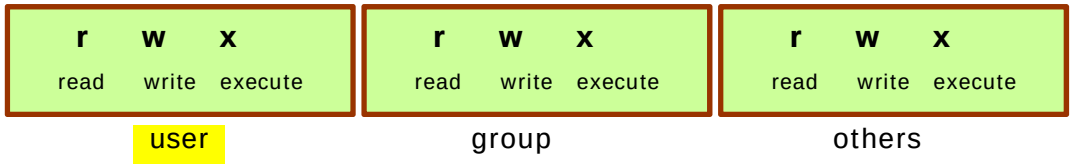
rwx	Binary	Convert	Decimal
_ _ _	0 0 0	0 + 0 + 0	0
_ _ x	0 0 1	0 + 0 + 1	1
_ w _	0 1 0	0 + 2 + 0	2
_ w x	0 1 1	0 + 2 + 1	3
r _ _	1 0 0	4 + 0 + 0	4
r _ x	1 0 1	4 + 0 + 1	5
r w _	1 1 0	4 + 2 + 0	6
r w x	1 1 1	4 + 2 + 1	7

4's column
2's column
1's column

And be able to count in binary

user

Permissions - Practice

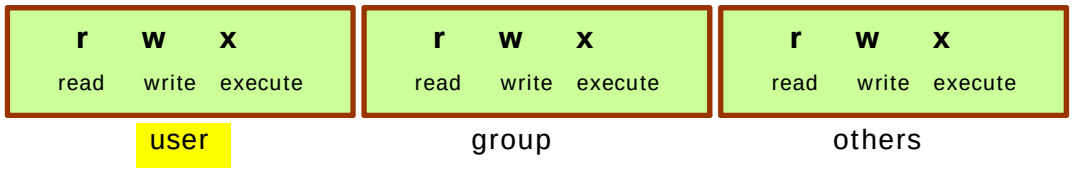



```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

r w -

What is this permission in binary?

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

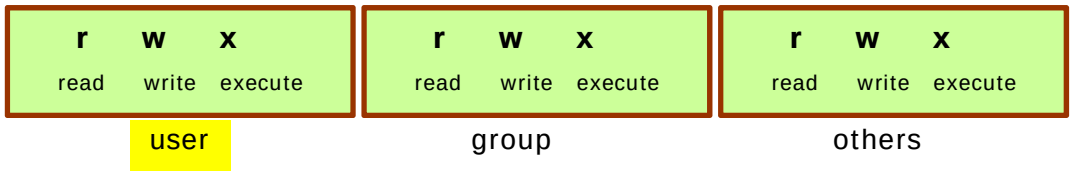
Binary number

r w - = 1 1 0

4's column
2's column
1's column

Now, what is this permission in decimal?

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

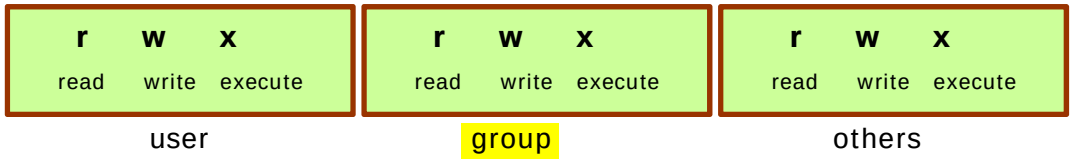
Binary number *Decimal number*

r w - = 1 1 0 = 6 *user is simmsben*

4's column
2's column
1's column

group

Permissions - Practice

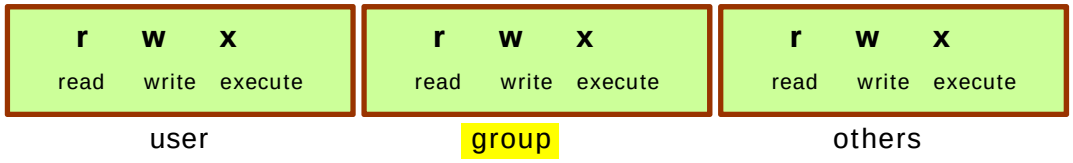



```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

r - x

What is this permission in binary?

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

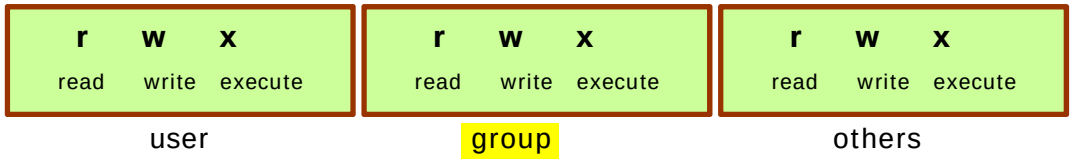
Binary number

r - x = 1 0 1

4's column
2's column
1's column

Now, what is this permission in decimal?

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

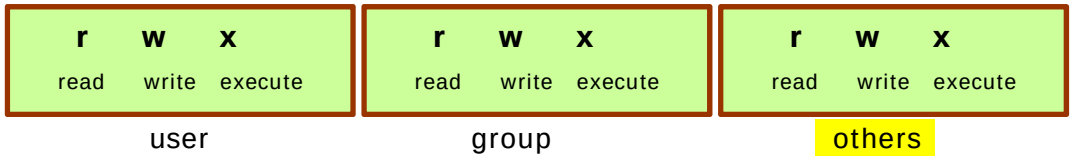
Binary number *Decimal number*

r - x = 1 0 1 = 5 *Group is cis90*

4's column
2's column
1's column

others

Permissions - Practice

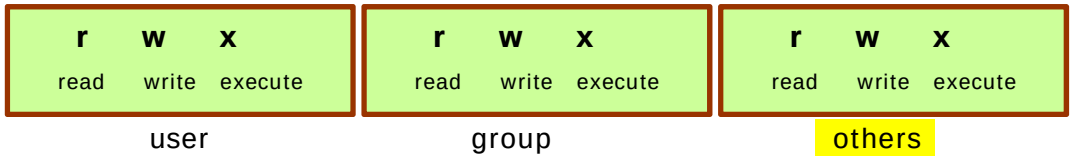



```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

- - -

What is this permission in binary?

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

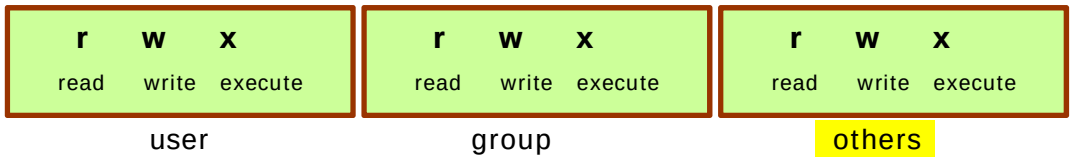
Binary number

- - - = 0 0 0

Now, what is this permission in decimal?

4's column
2's column
1's column

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
/home/cis90/simmsben $
```

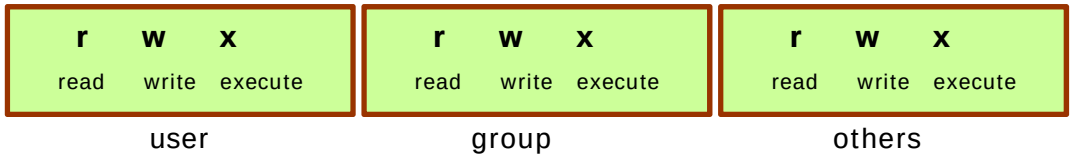
Binary number *Decimal number*

- - - = 0 0 0 = 0 *Others*

4's column
2's column
1's column

all

Permissions - Practice




```
/home/cis90/simmsben $ ls -l myfile
-rw-r-x--- 1 simmsben cis90 0 Oct 19 07:12 myfile
```

		Binary number				*Decimal number*	
r w -	=	1	1	0	=	6	*User is simmsben*
r - x	=	1	0	1	=	5	*Group is cis90*
- - -	=	0	0	0	=	0	*Others*

Permissions Activity

Task: Modify the permissions of the terminal device you are logged in as so the cis90 user has write permission.

Hint: What command shows you the terminal device you are using?
Hint: How do you do a long listing of all terminal devices?

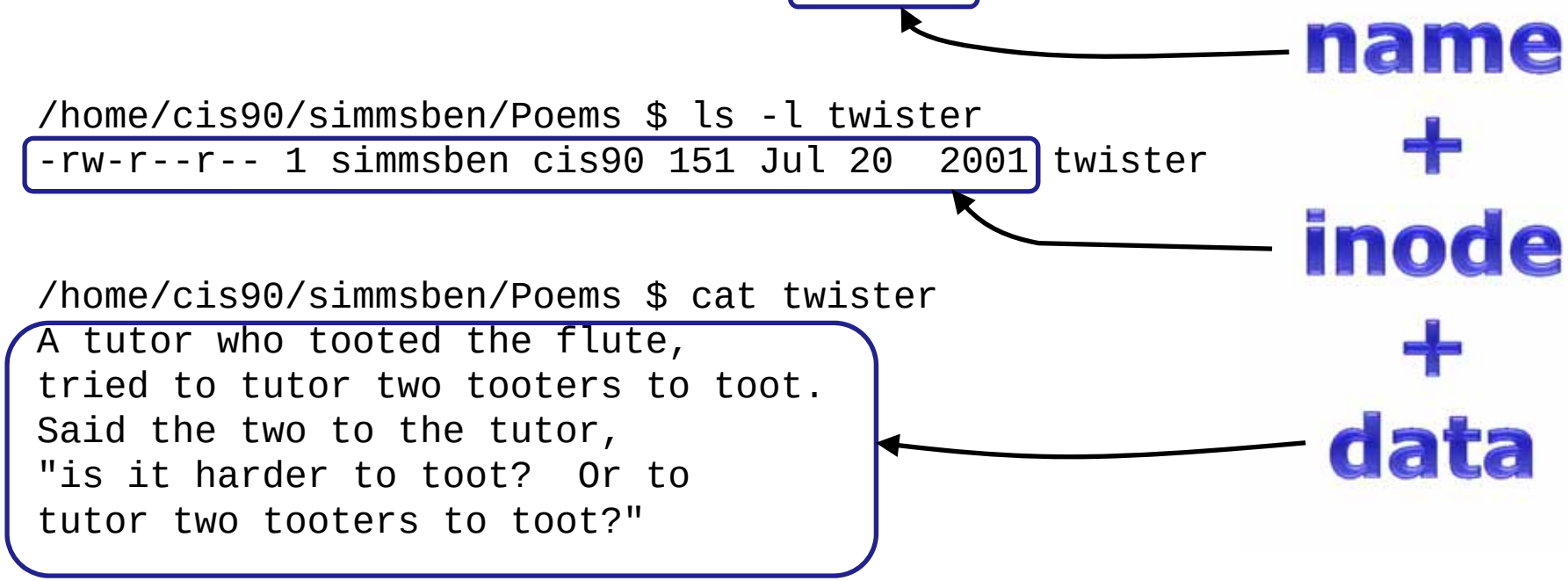
In another Putty session, login as cis90 and write a message to your first session using this command:

banner I did it! > /dev/pts/*xx*
(where ***xx*** is your terminal device)

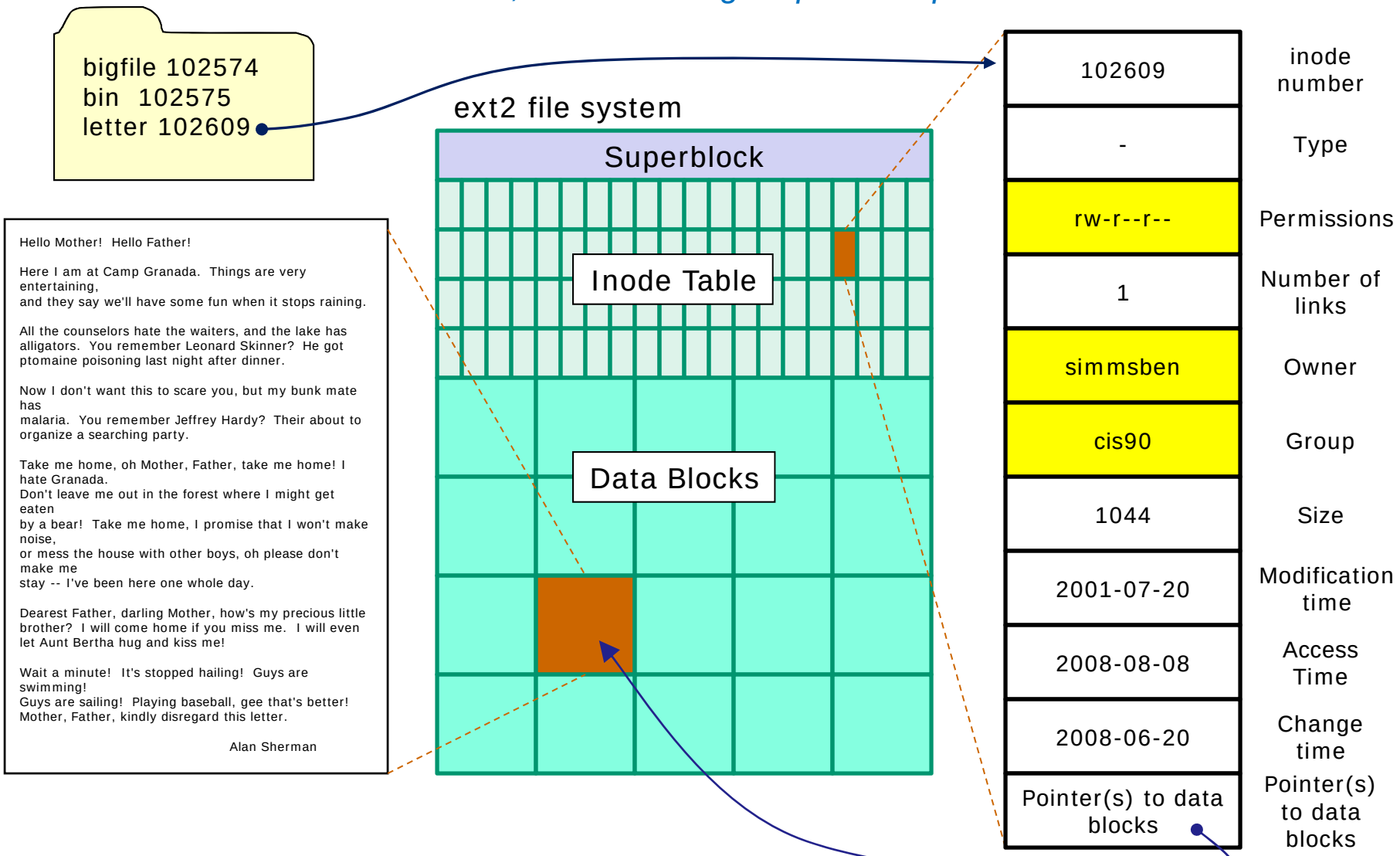
Directory permissions

UNIX Files
The three elements of a file

```
/home/cis90/simmsben/Poems $ ls
ant  Blake  nursery  Shakespeare  twister  Yeats

/home/cis90/simmsben/Poems $ ls -l twister
-rw-r--r-- 1 simmsben cis90 151 Jul 20  2001 twister

/home/cis90/simmsben/Poems $ cat twister
A tutor who tooted the flute,
tried to tutor two tooters to toot.
Said the two to the tutor,
"is it harder to toot?  Or to
tutor two tooters to toot?"
```



Permissions, owner and group are kept in the inode of a file

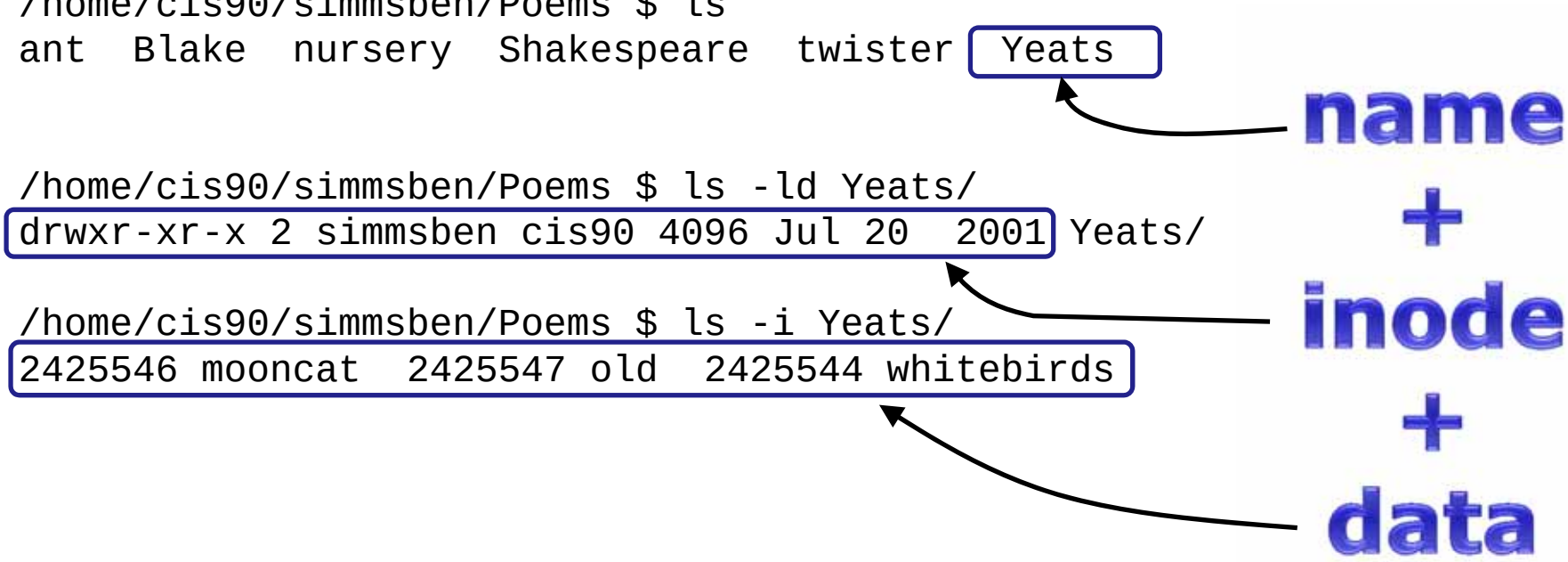


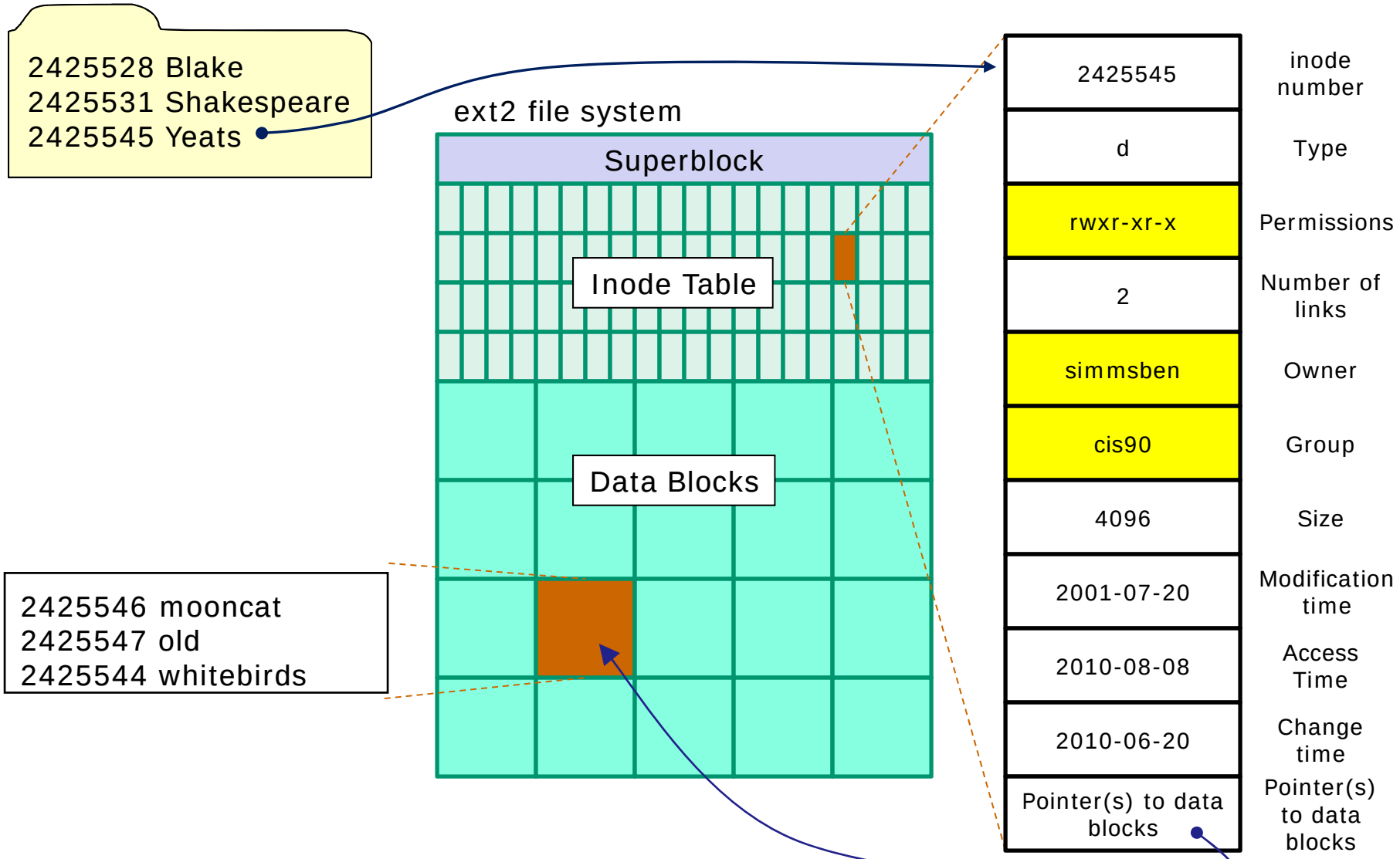

```
[simmsben@opus ~]$ls -il letter
102609 -rw-r--r-- 1 simmsben cis90 1044 Jul 20  2001 letter
```

UNIX Files
The three elements of a file

Directors are files as well. The data portion of a directory contains filename/inode pairs

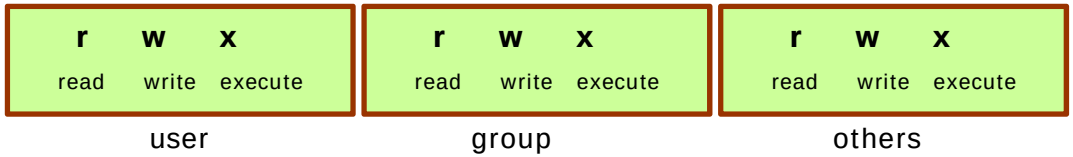
```
/home/cis90/simmsben/Poems $ ls
ant  Blake  nursery  Shakespeare  twister  Yeats

/home/cis90/simmsben/Poems $ ls -ld Yeats/
drwxr-xr-x 2 simmsben cis90 4096 Jul 20  2001 Yeats/

/home/cis90/simmsben/Poems $ ls -i Yeats/
2425546 mooncat  2425547 old  2425544 whitebirds
```






```
/home/cis90/simmsben/Poems $ ls -lid Yeats/
2425545 drwxr-xr-x 2 simmsben cis90 4096 Jul 20  2001 Yeats/
```

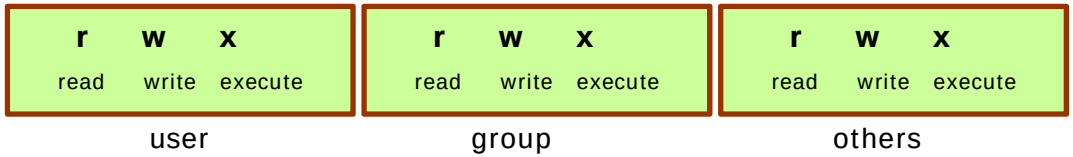
Directory Read Permission



Setup for the next examples:

```
/home/cis90/roddyduk $ mkdir examples
/home/cis90/roddyduk $ cd examples/
/home/cis90/roddyduk/examples $ mkdir birds dogs
/home/cis90/roddyduk/examples $ cd birds
/home/cis90/roddyduk/examples/birds $ echo "Tweet tweet" > abby
/home/cis90/roddyduk/examples/birds $ echo "Tweet tweet" > nibbie
/home/cis90/roddyduk/examples/birds $ cd ../dogs
/home/cis90/roddyduk/examples/dogs $ echo "Woof woof" > benji
/home/cis90/roddyduk/examples/dogs $ echo "Woof woof" > duke
/home/cis90/roddyduk/examples/dogs $ echo "Woof woof" > homer
```

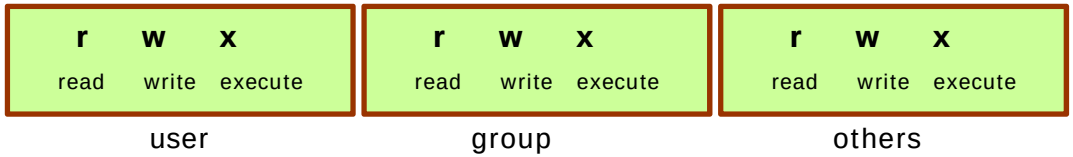
Directory Read Permission



Tree view of examples directory:

```
/home/cis90/roddyduk $ tree examples
examples
|-- birds
|   |-- abby
|   `-- nibbie
`-- dogs
    |-- benji
    |-- duke
    `-- homer

2 directories, 5 files
```

Directory Read Permission



Long listing showing directory and contents:

```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/
```

The directory itself (use the -d option)

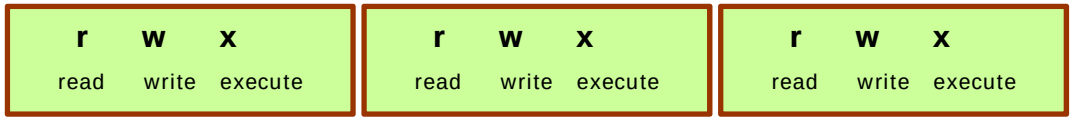
```
/home/cis90/roddyduk $ ls examples/
birds  dogs
```

The contents of the directory

```
/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```

The contents of the directory with inodes (use the -i option)

Directory Read Permission



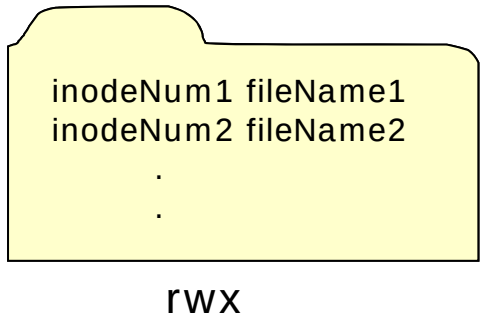
Long listing showing directory and contents:

```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -lR examples/
examples/:
total 16
drwxrwxr-x 2 roddyduk cis90 4096 Oct 19 13:50 birds
drwxrwxr-x 2 roddyduk cis90 4096 Oct 19 13:51 dogs

examples/birds:
total 16
-rw-rw-r-- 1 roddyduk cis90 12 Oct 19 13:50 abby
-rw-rw-r-- 1 roddyduk cis90 12 Oct 19 13:50 nibbie

examples/dogs:
total 24
-rw-rw-r-- 1 roddyduk cis90 10 Oct 19 13:51 benji
-rw-rw-r-- 1 roddyduk cis90 10 Oct 19 13:51 duke
-rw-rw-r-- 1 roddyduk cis90 10 Oct 19 13:51 homer
```

Use the -R option to recursively show contents of all subdirectories

Directory permissions READ

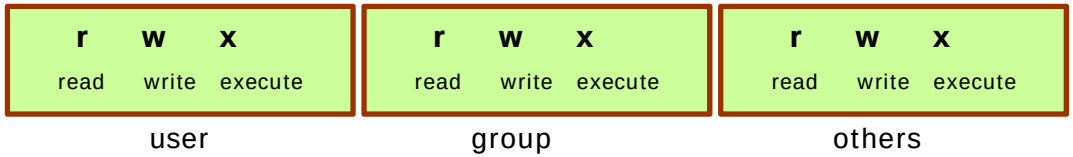
Directory Read Permission



Permission	File	Directory
Read (4)	cat, more, file, head, tail, cp	ls
Write (2)	vi, saving mail	cp (into), mv, rm, ln
Execute (1)	$ command	cd, ls -l, find

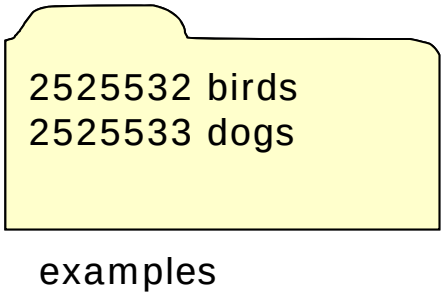
*Use the **ls** command to read the contents of a directory.*
Note, having read permission is required!

Directory Read Permission



Start with normal directory permissions:

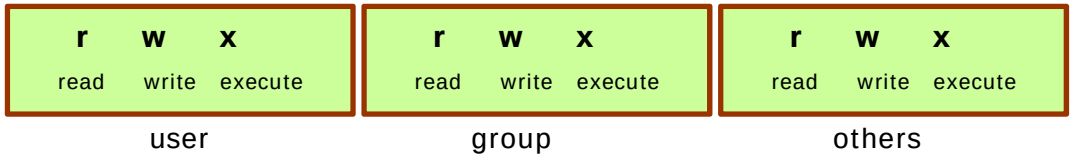
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If read permission is removed from the directory ...

Can we still list the directory contents?

Directory Read Permission



Remove read permission and confirm it's gone

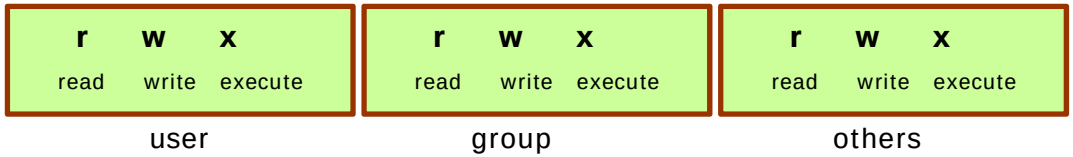
```
/home/cis90/roddyduk $ chmod u-r examples
/home/cis90/roddyduk $ ls -ld examples
d-wxrwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples
```

Can we still list the directory contents?

```
/home/cis90/roddyduk $ ls -l examples/
ls: examples/: Permission denied
/home/cis90/roddyduk $
```

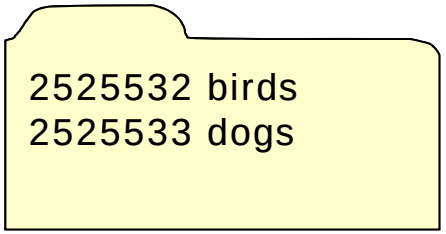
NO!

Directory Read Permission



Start with normal directory permissions:

```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```

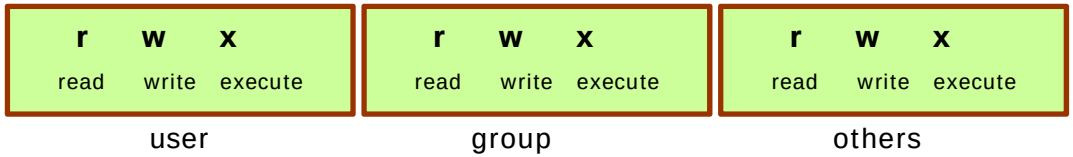


examples

If read permission is removed from the directory …

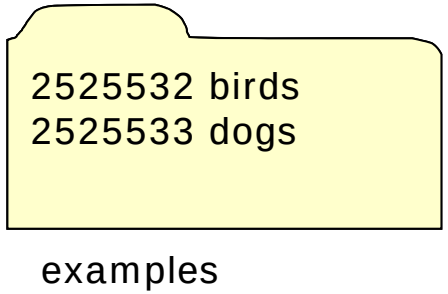
*Can we still **cd** into the directory?*

Directory Read Permission



Remove read permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-r examples
/home/cis90/roddyduk $ ls -ld examples
d-wxrwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples
```



*Can we still **cd** into the directory?*

```
/home/cis90/roddyduk $ cd examples/
/home/cis90/roddyduk/examples $ ls
ls: .: Permission denied
/home/cis90/roddyduk/examples $ ls birds
abby  nibbie
```

Yes, but ...

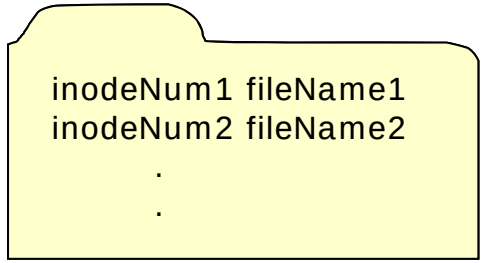
- *we still can't list the contents,*
- *yet we can still access anything in the directory!*

It's like walking into a pitch black room. You can't see anything, but if you know where things are you can still use them.

Directory permissions WRITE

Directory Write Permission

rwx

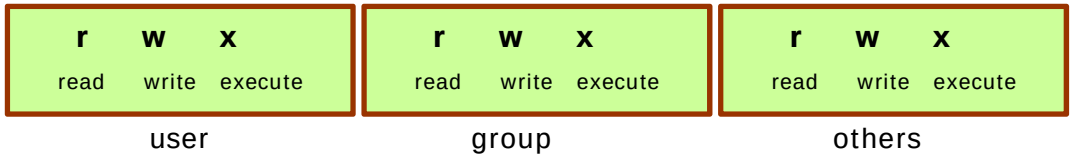


rwx

Permission	File	Directory
Read (4)	cat, more, file, head, tail, cp	ls
Write (2)	vi, saving mail	cp, mv, rm, ln
Execute (1)	$ command	cd, ls -l, find

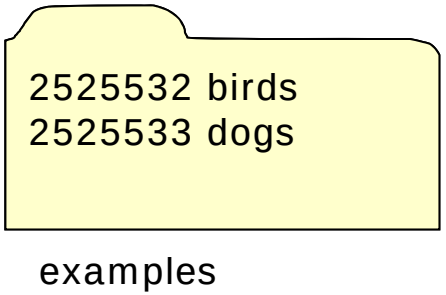
Removing directory w permission
- *can't cp files to it,*
- *can't remove files,*
- *can't move files out,*
- *can't add links*

Directory Read Permission



Start with normal directory permissions:

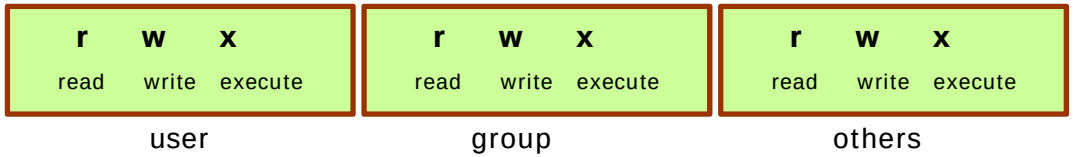
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If write permission is removed from the directory …

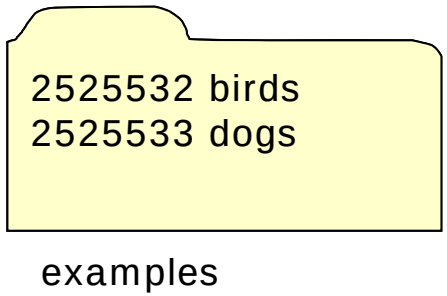
Can we remove files from the directory?

Directory Read Permission



Remove write permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-w examples
/home/cis90/roddyduk $ ls -ld examples
dr-xrwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```



Can we remove files form the directory?

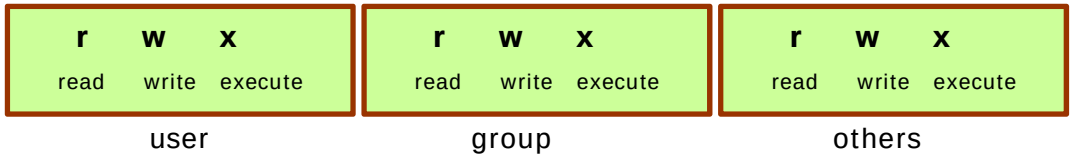
```
/home/cis90/roddyduk/examples $ rmdir dogs
rmdir: dogs: Permission denied
```

NO!

Yet we can cd into and list directory contents

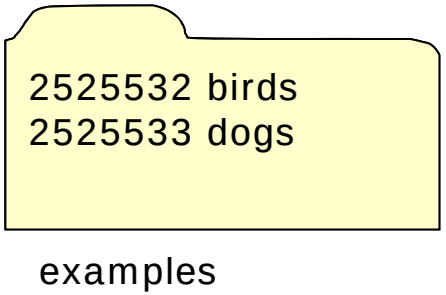
```
/home/cis90/roddyduk $ cd examples/
/home/cis90/roddyduk/examples $ ls
birds  dogs
```

Directory Read Permission



Start with normal directory permissions:

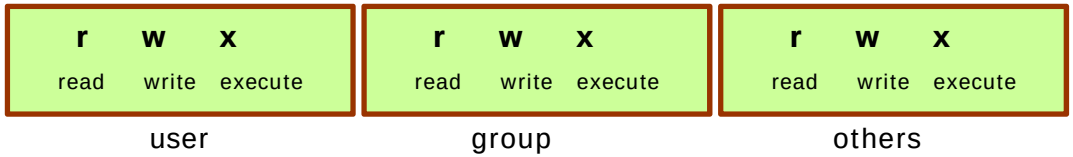
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If write permission is removed from the directory …

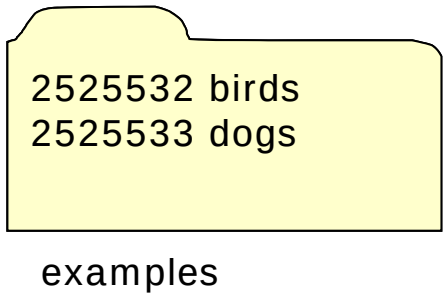
Can we create new files or copy/move files into the directory?

Directory Read Permission



Remove write permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-w examples
/home/cis90/roddyduk $ ls -ld examples
dr-xrwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```



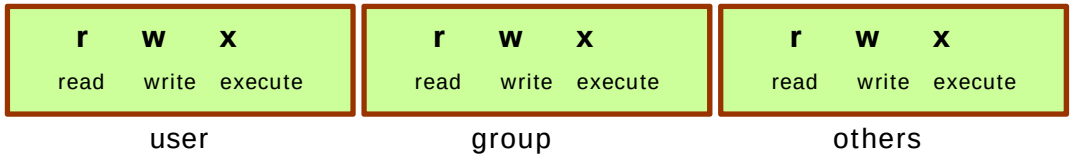
Can we create new files or copy/move files into the directory?

```
/home/cis90/roddyduk $ cp letter examples/
cp: cannot create regular file `examples/letter': Permission denied
/home/cis90/roddyduk $ mv letter examples/
mv: cannot move `letter' to `examples/letter': Permission denied
/home/cis90/roddyduk $ touch examples/newfile
touch: cannot touch `examples/newfile': Permission denied
/home/cis90/roddyduk $
```

NO!

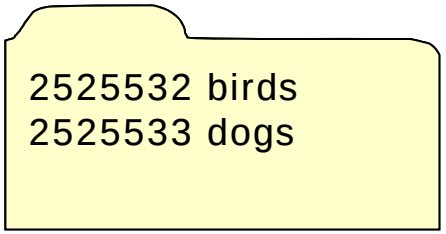
To change the contents of a directory (either add or remove files) requires write permission

Directory Read Permission



Start with normal directory permissions:

```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```

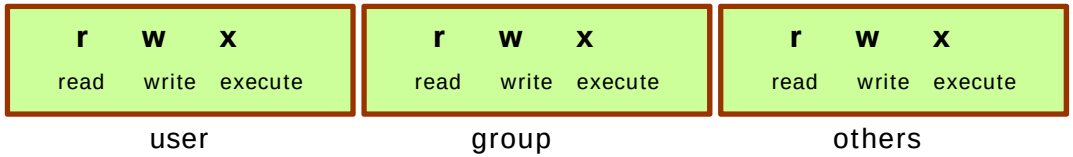


examples

If write permission is removed from the directory …

Can we move files out of the directory?

Directory Read Permission



Remove write permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-w examples
/home/cis90/roddyduk $ ls -ld examples
dr-xrwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```

Can we move files out of the directory?

```
/home/cis90/roddyduk $ mv examples/birds .
mv: cannot move `examples/birds' to `./birds': Permission denied
```

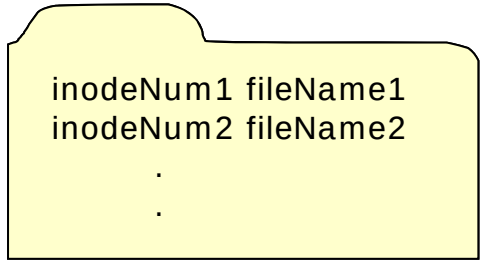
NO!

To change the contents of a directory (either add or remove files) requires write permission

Directory permissions EXECUTE

Directory Execute Permission

rwx



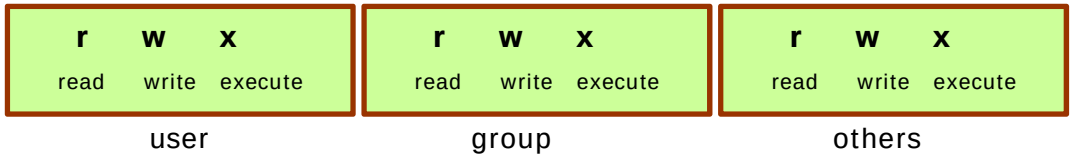
rwx

Permission	File	Directory
Read (4)	cat, more, file, head, tail, cp	ls
Write (2)	vi, saving mail	cp, mv, rm, ln
Execute (1)	$ command	cd, ls -l, find

Removing directory x permission

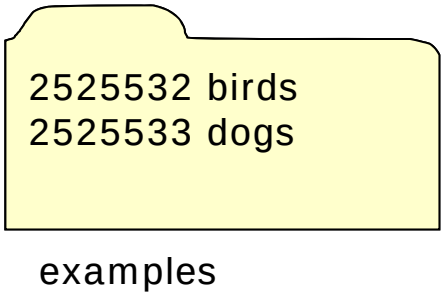
- ***cannot*** *retrieve inode information (ls –l)*
  (which means no file data either)
- ***cannot*** *cd into directory*

Directory Read Permission



Start with normal directory permissions:

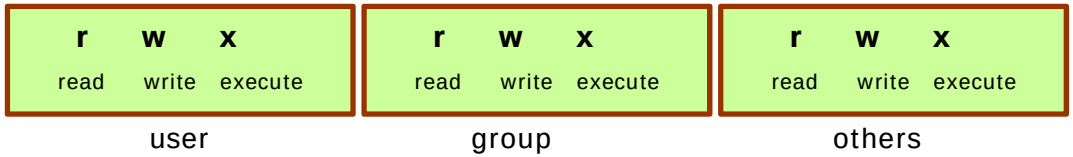
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If execute permission is removed from the directory …

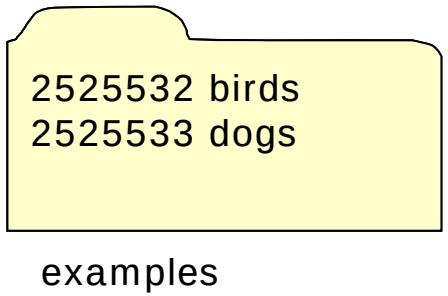
Can we change into (cd) the directory?

Directory Read Permission



Remove execute permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-x examples
/home/cis90/roddyduk $ ls -ld examples
drw-rwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```



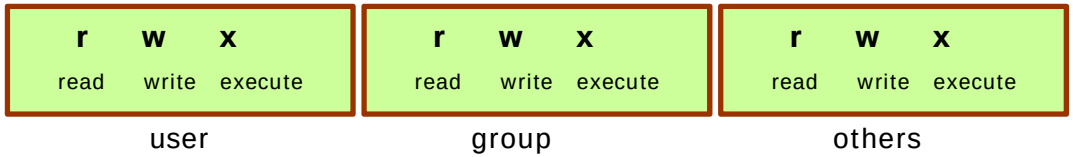
Can we change into (cd) the directory?

```
/home/cis90/roddyduk $ cd examples/
-bash: cd: examples/: Permission denied
/home/cis90/roddyduk $
```

NO!

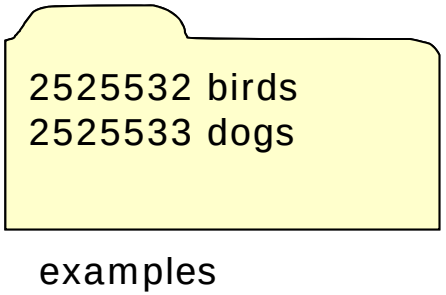
Execute permission is required to change into a directory or to get inode based information for any of the files in the directory. Note, without inode information you can't get to a file's data.

Directory Read Permission



Start with normal directory permissions:

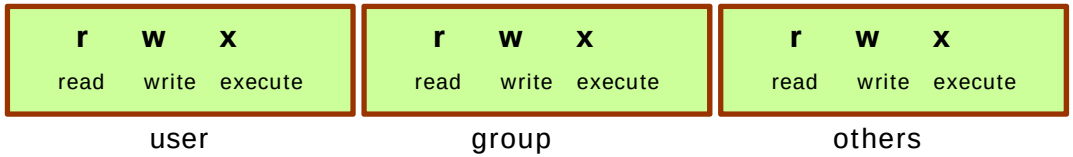
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If execute permission is removed from the directory …

Can we list directory contents?

Directory Read Permission



Remove execute permission and confirm it's gone

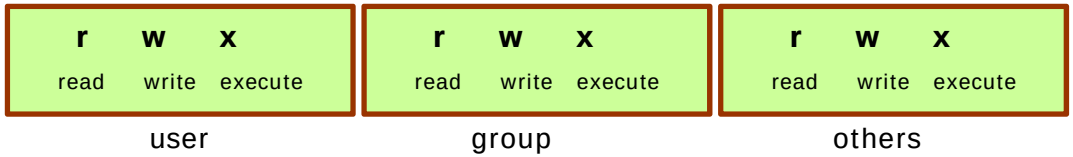
```
/home/cis90/roddyduk $ chmod u-x examples
/home/cis90/roddyduk $ ls -ld examples
drw-rwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```

Can list directory contents?

```
/home/cis90/roddyduk $ ls examples/
birds  dogs
```

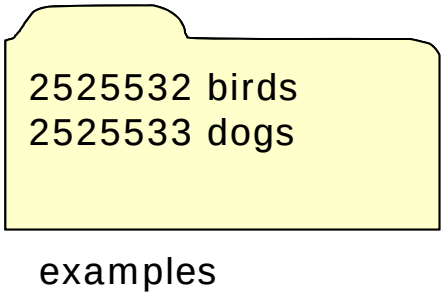
Yes

Directory Read Permission



Start with normal directory permissions:

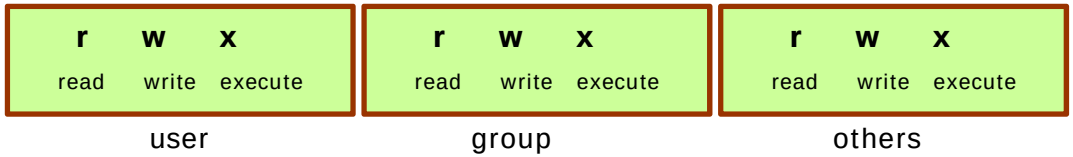
```
/home/cis90/roddyduk $ ls -ld examples/
drwxrwxr-x 5 roddyduk cis90 4096 Oct 19 13:49 examples/

/home/cis90/roddyduk $ ls -i examples/
2525532 birds  2525533 dogs
```



If execute permission is removed from the directory …

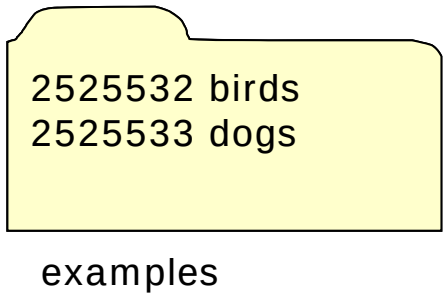
Can we do a long listing of the directory?

Directory Read Permission



Remove execute permission and confirm it's gone

```
/home/cis90/roddyduk $ chmod u-x examples
/home/cis90/roddyduk $ ls -ld examples
drw-rwxr-x 4 roddyduk cis90 4096 Oct 19 13:59 examples/
```



Can we do a long listing (show inode information) of the directory?

```
/home/cis90/roddyduk $ ls -l examples/
total 0
?--------- ? ? ? ?            ? birds
?--------- ? ? ? ?            ? dogs
```

Incomplete! Only file names. No information kept in the file's inode is shown!

We can read the filenames, but without execute permission we can't retrieve information from the inode

permissions fun

Go slowly and follow all directions

Permissions Exercise

Find the hidden treasure trove

- Find the buried treasure in your Hidden folder.
- Beware! - once you find it, make sure you set permissions to protect your treasure from *everyone!*

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

Input and Output

File Descriptors

Example program: sort command

```
/home/cis90/roddyduk $ cat names
duke
benji
homer
lucy
scout
chip
/home/cis90/roddyduk $ sort names
benji
chip
duke
homer
lucy
scout
```

*The sort command will sort the lines in a file and send the sorted lines to **stdout** (defaults to the terminal)*

Input and Output

File Descriptors

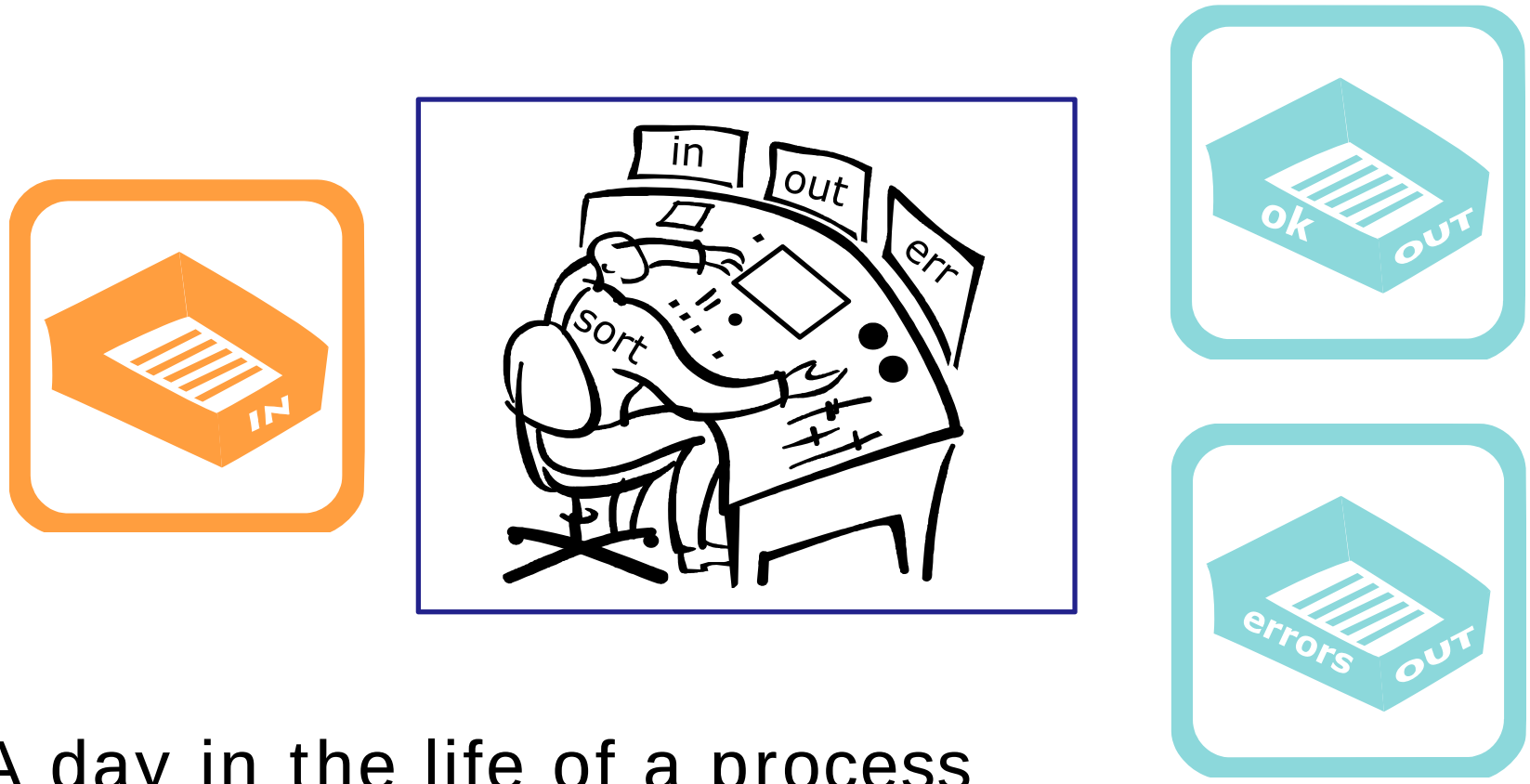
Example program: sort command

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

*If a file name is not specified as an argument on the command line, then the **sort** command will start reading from **stdin** (defaults to the keyboard) until it gets an EOF (End of File).*

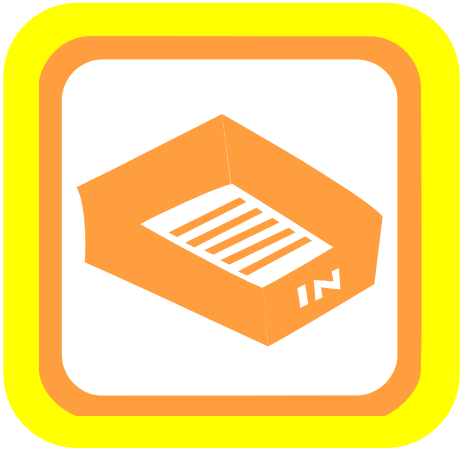
*After getting the EOF, the lines are sorted and sent to **stdout** (defaults to the terminal)*

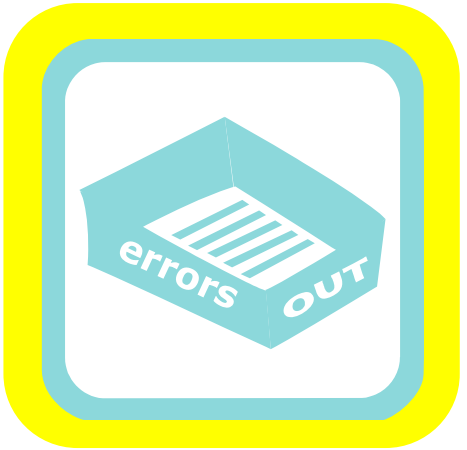
Lets visualize the sort program being loaded into memory and running as a process by the kernel



A day in the life of a process

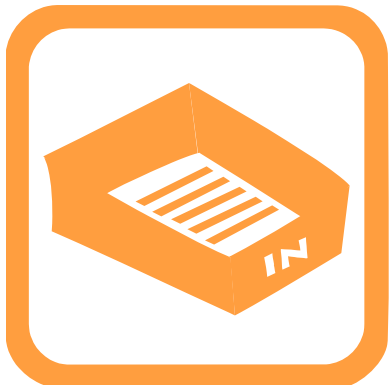
There is one in tray and two out trays

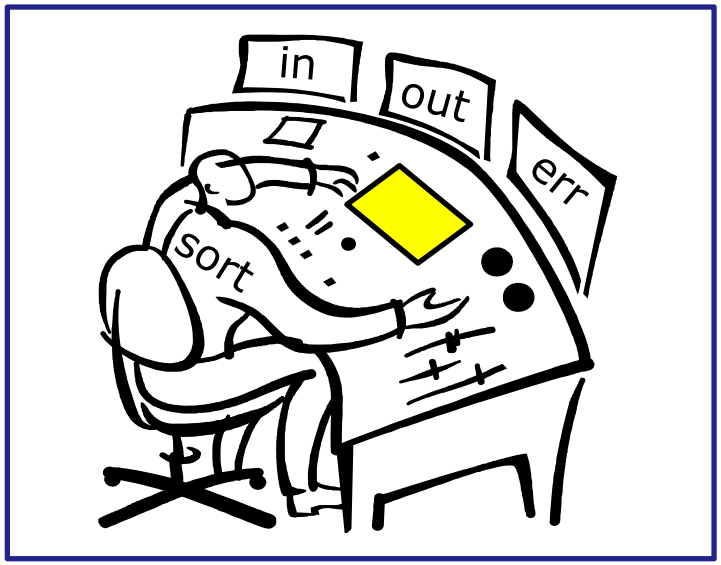




A day in the life of a process

There is also a place where the process can check to see if there were any options or arguments specified on the command line



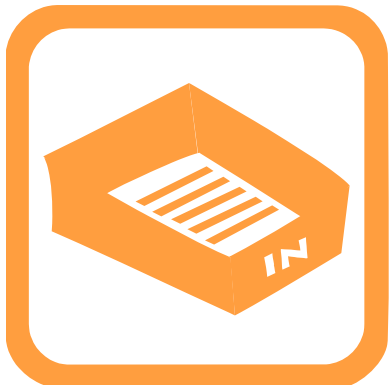


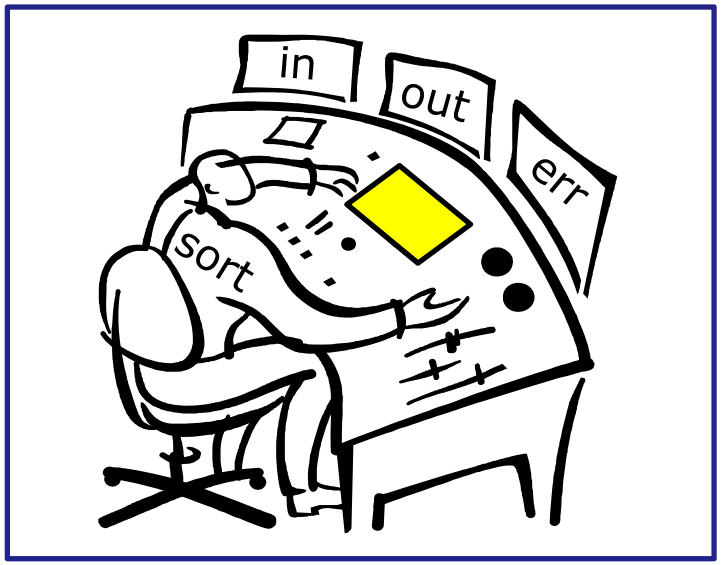
A day in the life of a process

sort process example no args

/home/cis90/roddyduk $ sort

The sort process begins by checking to see if there are any options or arguments collected (and expanded) by the shell. In this case there are no options and no arguments.



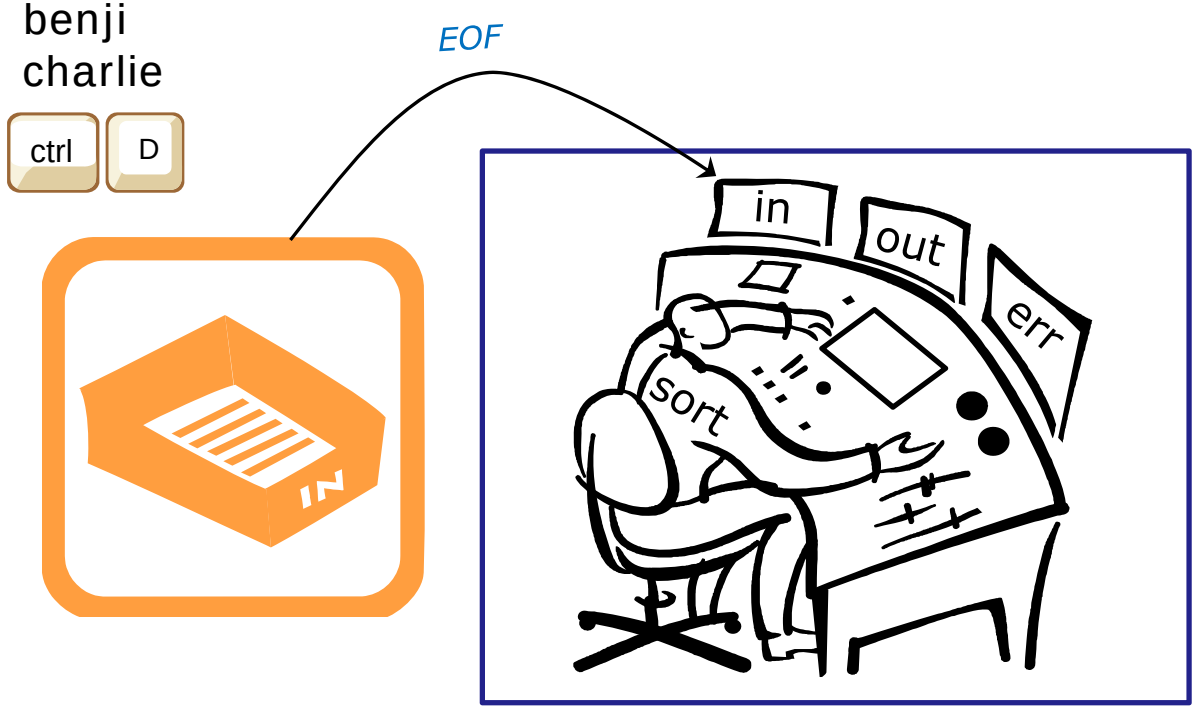


You check your little instruction window and see no options or arguments to handle. Given that you reach into your in tray to grab the first line to sort.

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

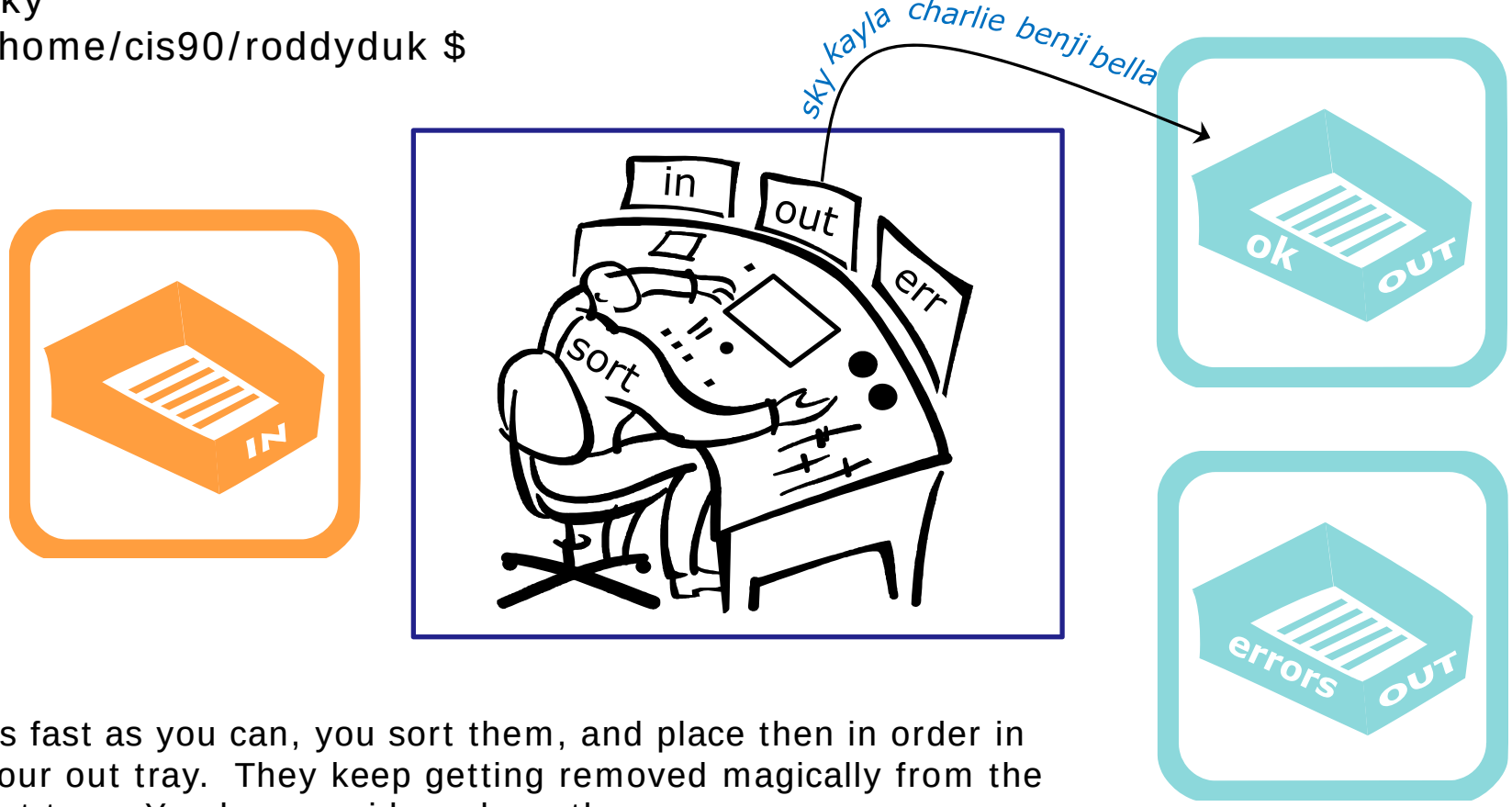
Note: You work so hard and fast. Every time your reach into the in tray there is another line for you. They just magically keep appearing from somewhere into your in tray. You have no idea where they are coming from.

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



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

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

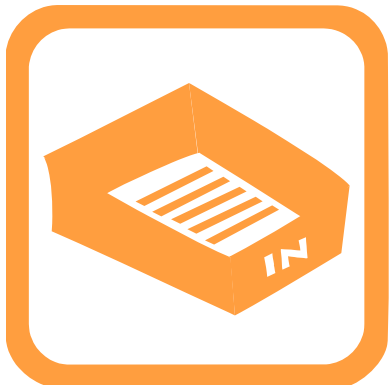


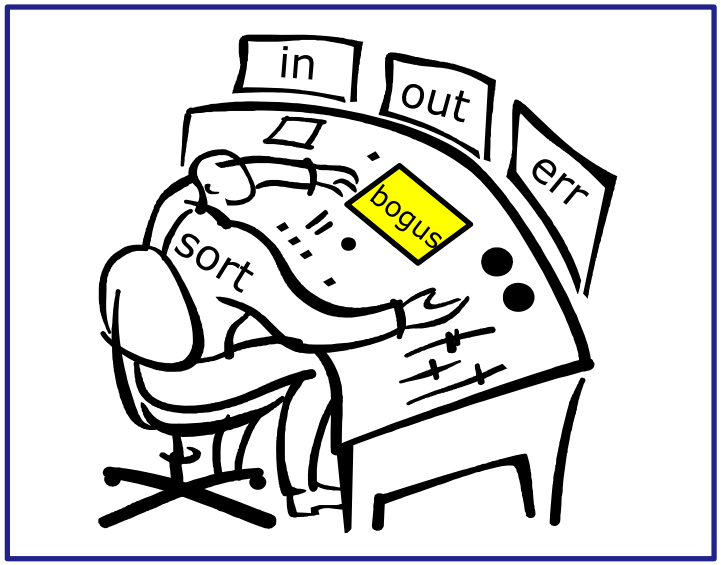
As fast as you can, you sort them, and place then in order in your out tray. They keep getting removed magically from the out tray. You have no idea where they go.

sort process example bad arg

/home/cis90/roddyduk $ sort bogus

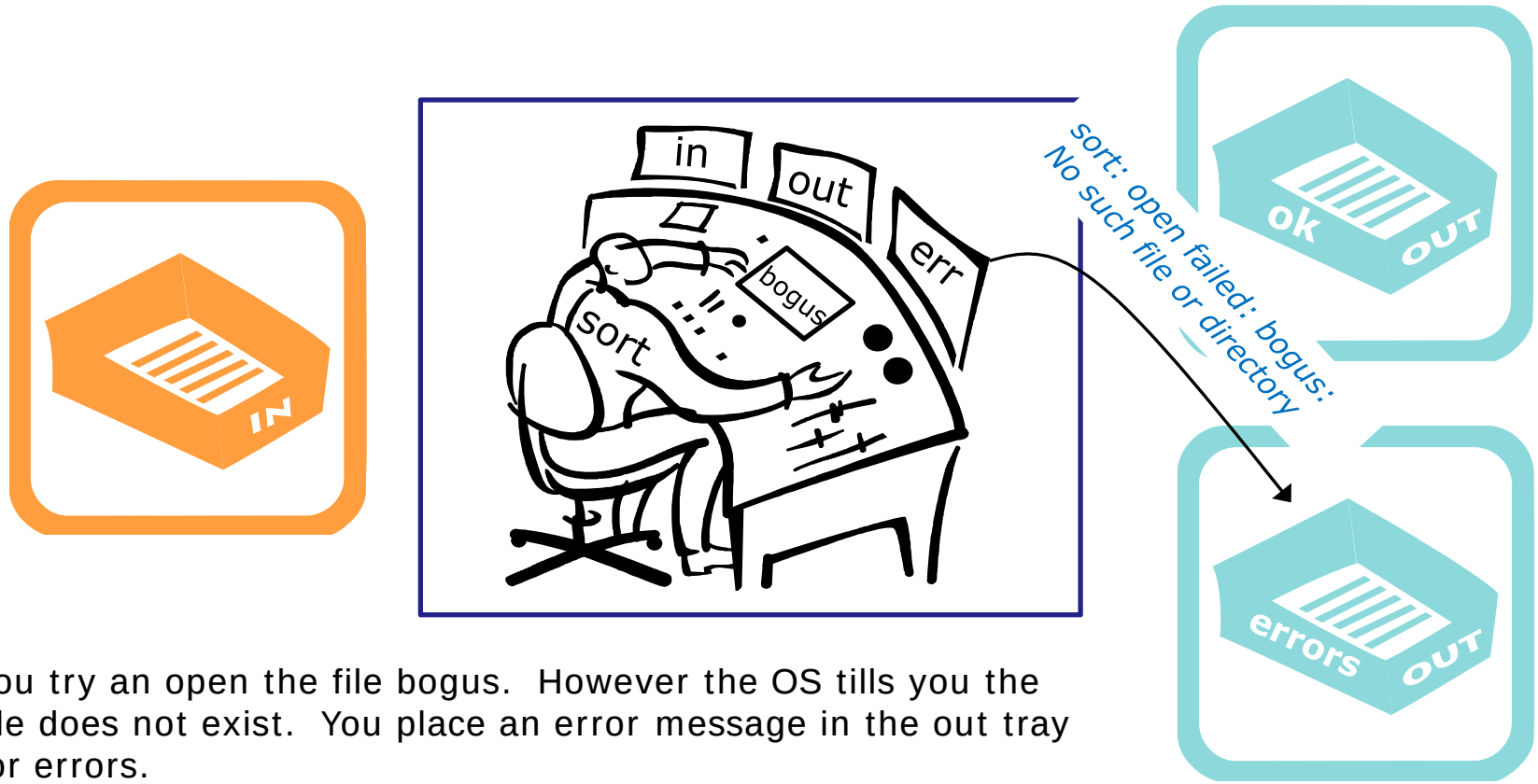
The sort process begins by checking to see if there are any options or arguments collected (and expanded) by the shell. In this case there is one argument: bogus





You check your little instruction window and see an argument (bogus). You know (your internal DNA) tells you this must be a file name containing lines to sort

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



You try an open the file bogus. However the OS tills you the file does not exist. You place an error message in the out tray for errors.

bringing it home

Ok, lets make the visualization a little more realistic

stdout (1)

stdin (0)

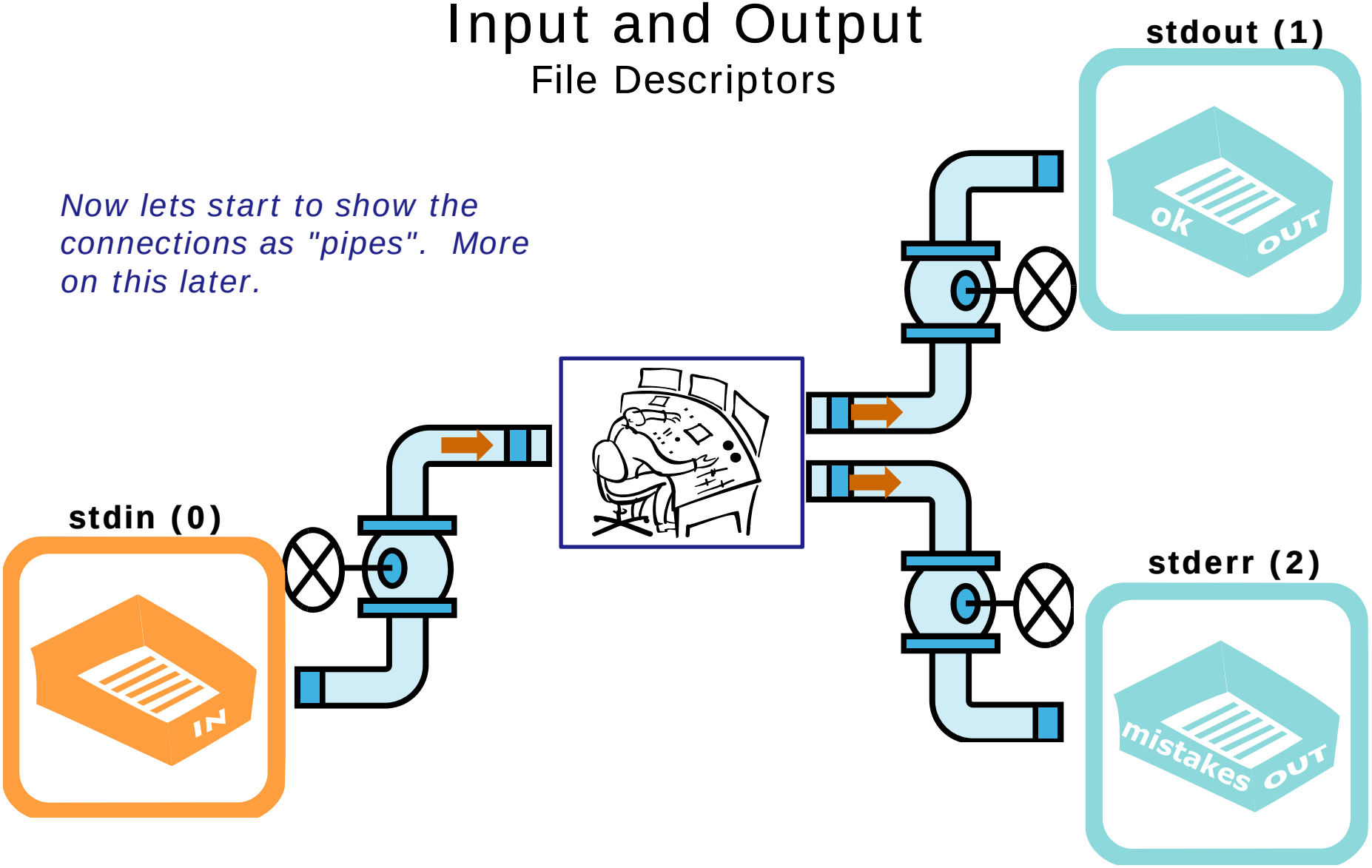
stderr (2)

The actual in and out trays have names as well as numbers **… stdin (0) stdout (1**) and **stderr (2)**.

Input and Output

File Descriptors

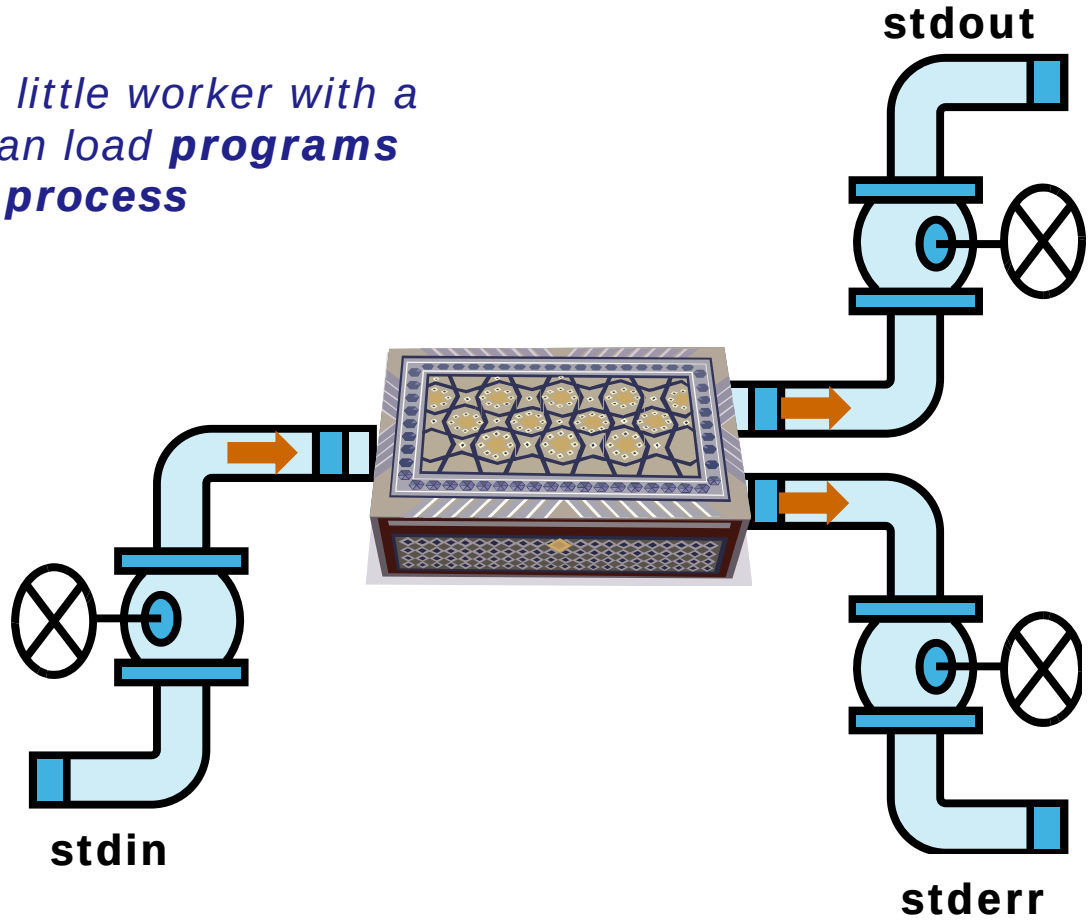
Now lets start to show the connections as "pipes". More on this later.



Input and Output

File Descriptors

*Lets replace the little worker with a box where we can load **programs** into to run as a **process***



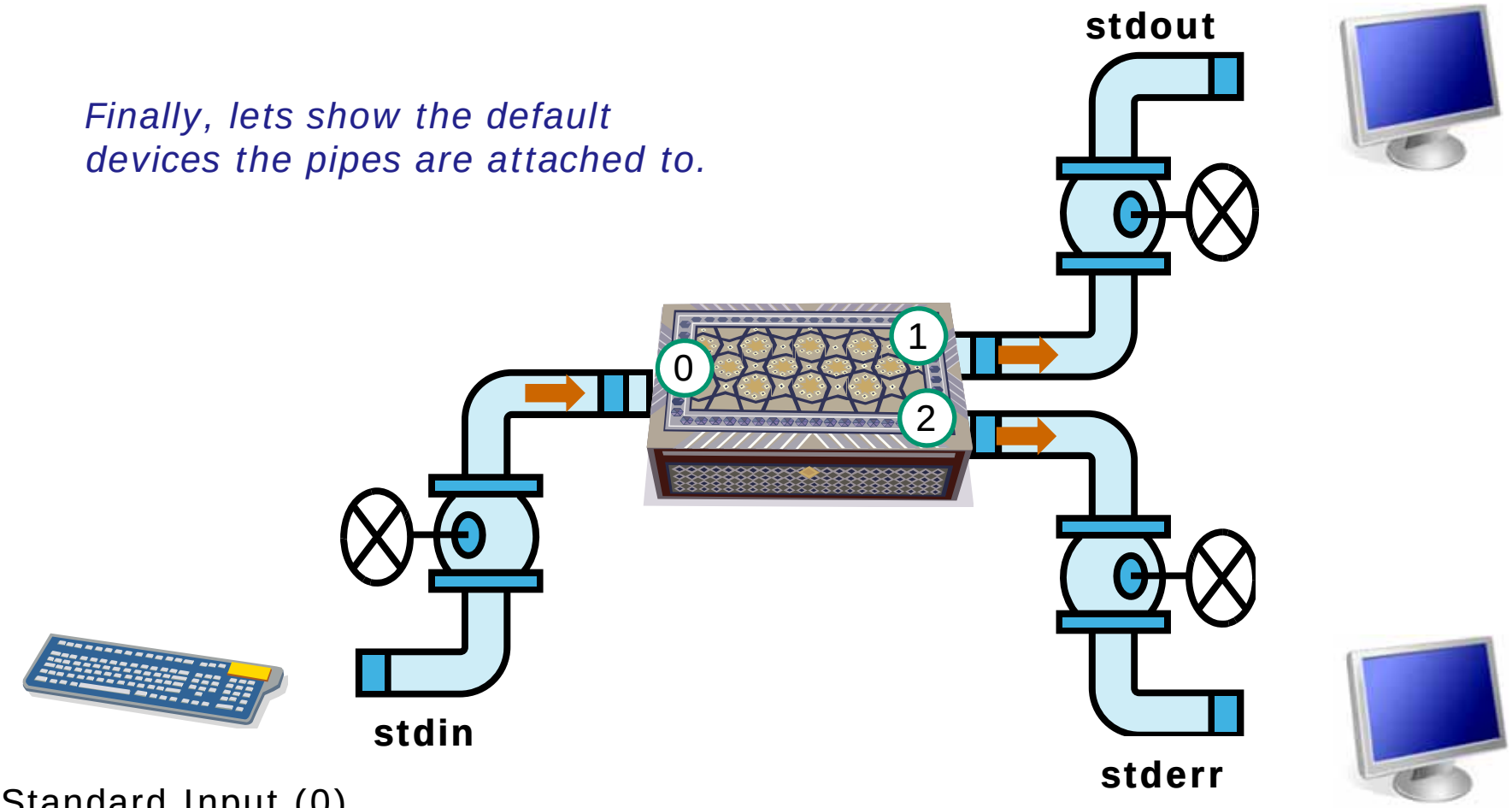
normal output is written to stdout

input (if necessary) is read from stdin

errors are written to stderr

Input and Output
File Descriptors

Finally, lets show the default devices the pipes are attached to.



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

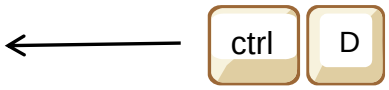
Standard Output (1)
defaults to the user's terminal

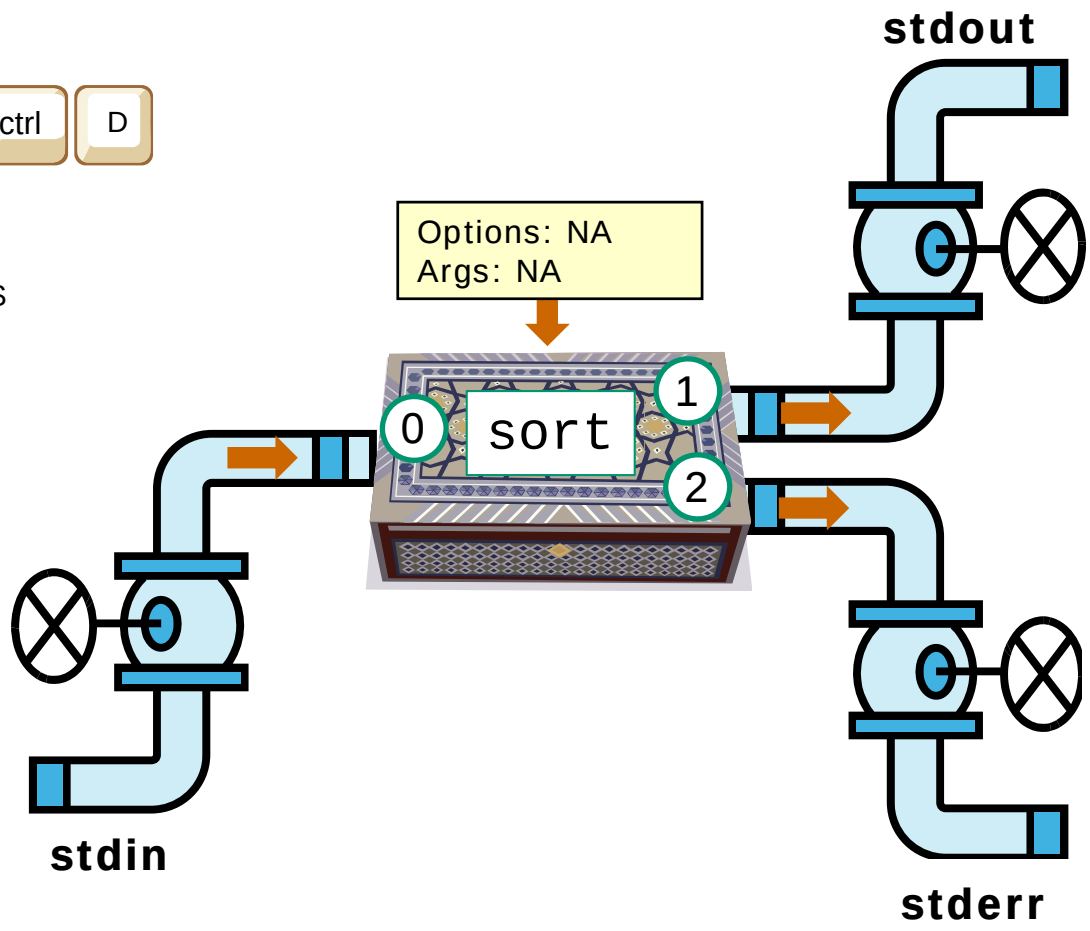
Standard Error (2)
defaults to the user's terminal

Input and Output

File Descriptors

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





```
benji
duke
homer
star
```

```
star
benji
duke
homer
```

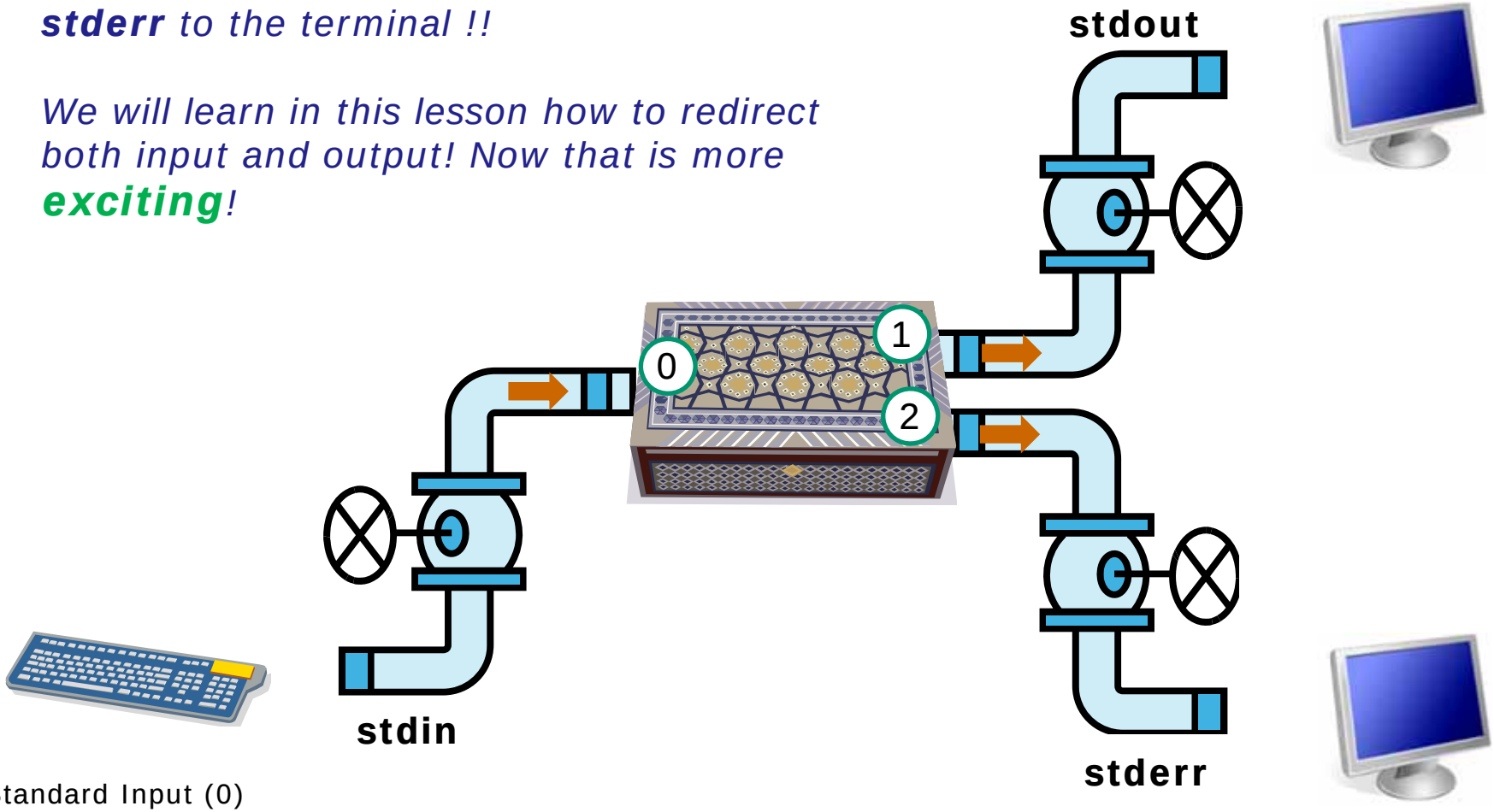
*Note, the sort program in this example gets its input from the keyboard via **stdin***

File Redirection

*Life would be **boring** if **stdin** was always attached to the keyboard, and **stdout** and **stderr** to the terminal !!*

*We will learn in this lesson how to redirect both input and output! Now that is more **exciting**!*

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



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

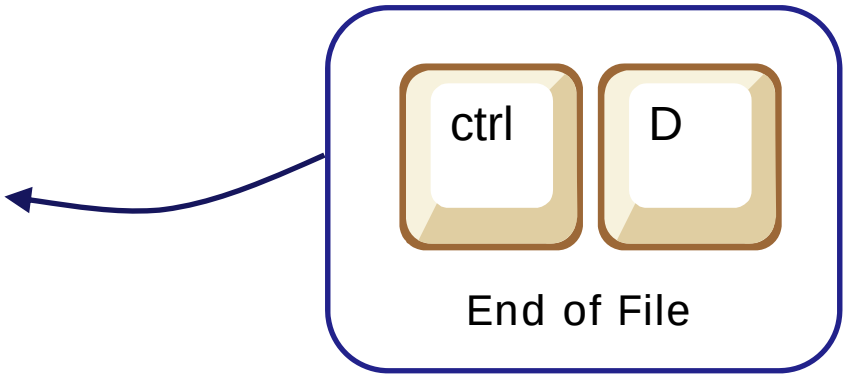
Standard Error (2)
defaults to the user's terminal

Input and Output

File Redirection

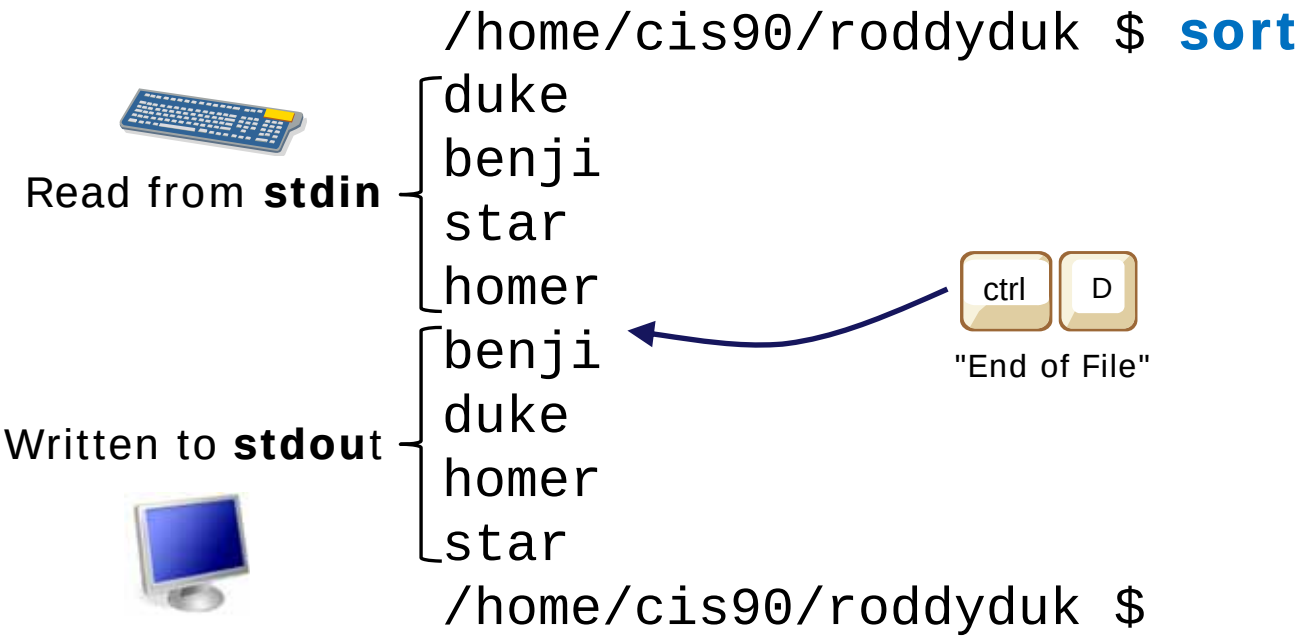
Let's look at the sort example again

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



Input and Output

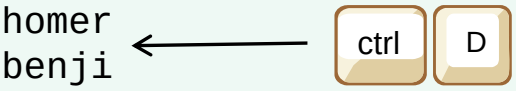
File Redirection



*The sort program reads lines from **stdin** (attached to keyboard), performs the sort, then writes to **stdout** (attached to terminal)*

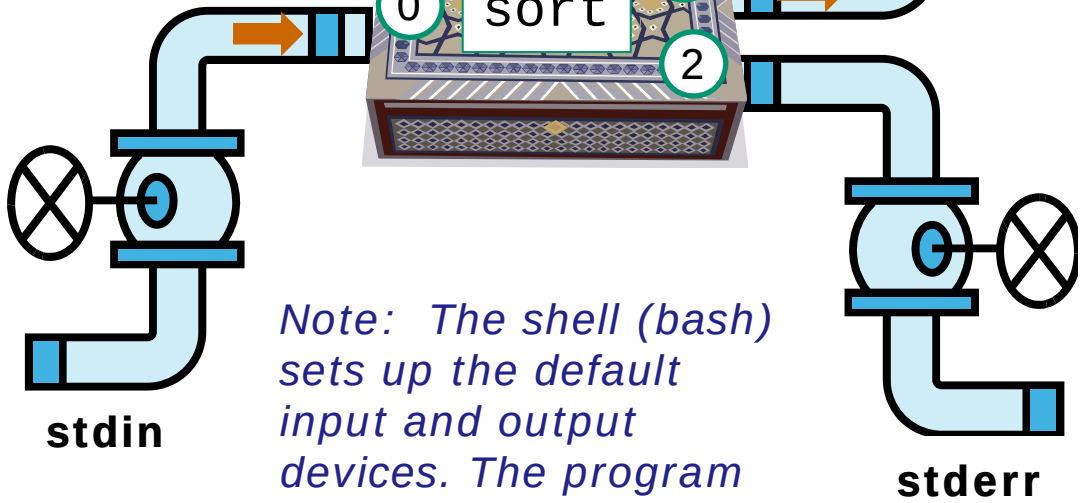
Example program to process: sort command

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



/dev/pts/0

duke
benji
star
homer



/dev/pts/0

benji
duke
homer
star

Note: The shell (bash) sets up the default input and output devices. The program is never even aware of what is at the end of the pipes.

Input and Output

File Redirection

But what if we could tell the shell (bash) to change the devices at the end of the pipes? We can!

The input and output of a program can be **redirected** from and to other files:

0< filename

Input will now come from filename rather than the keyboard.

1> filename

Output will now go to filename instead of the terminal.

2> filename

Error messages will now go to filename instead of the terminal.

>> filename

Output will now be appended to filename.

The redirection is specified on the command line using the syntax specified below ...

Input and Output
File Redirection

The input and output of a program can be **redirected** from and to other files:

0< filename

Input will now come from filename rather than the keyboard.

1> filename

Output will now go to filename instead of the terminal.

2> filename

Error messages will now go to filename instead of the terminal.

>> filename

Output will now be appended to filename.

The 0 in 0< is not necessary, just use < to redirect stdin
The 1 in 1> is not necessary, just use > to redirect stdout
The 2 in 2> is necessary, always use 2> to redirect stderr

Input and Output

File Redirection

Lets try redirecting stdout ...

sort writes to stdout, and stdout has been redirected to the file dogsinorder

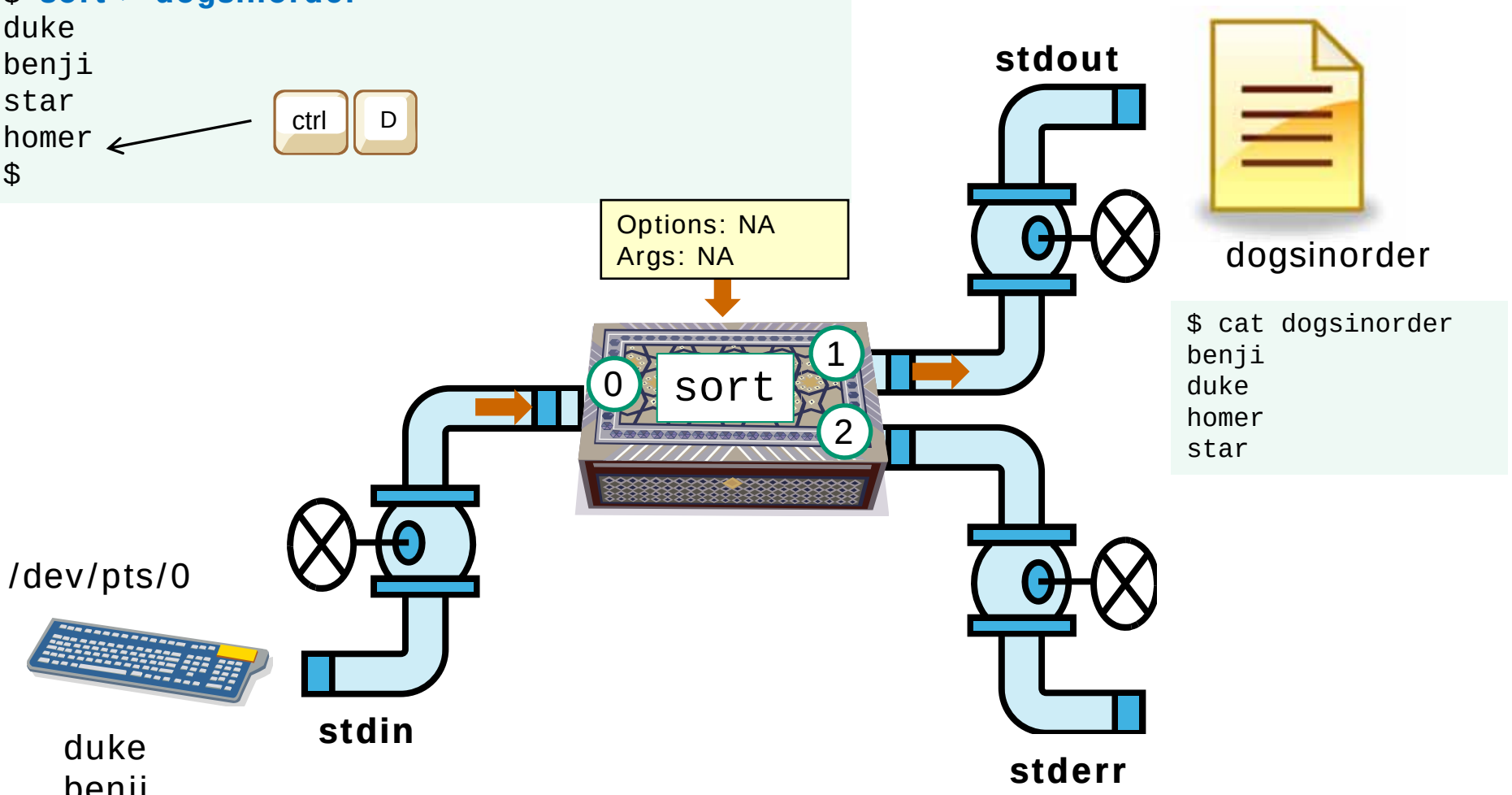
```
[simmsben@opus ~]$ sort > dogsinorder
duke
benji
star
homer
[simmsben@opus ~]$ cat dogsinorder
benji
duke
homer
star
[simmsben@opus ~]$
```

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

Example program to process: sort command

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

ctrl D




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

*Note: sort doesn't know about the keyboard (/dev/pts/0) or dogsinorder file. It just reads from **stdin** and writes to **stdout**.*

Input and Output

File Redirection

Create a file named names and fill it with your favorite dog names to use in the next example

```
/home/cis90/roddyduk $ echo duke  > names
/home/cis90/roddyduk $ echo benji >> names
/home/cis90/roddyduk $ echo star  >> names
/home/cis90/roddyduk $ echo homer >> names
```

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

Note, the use of >> to append the output of the echo command to the end of the names file

Input and Output

File Redirection

Let's try redirecting stdin and stdout …

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

input is redirected from the file names

output is redirected to the file dogsinorder

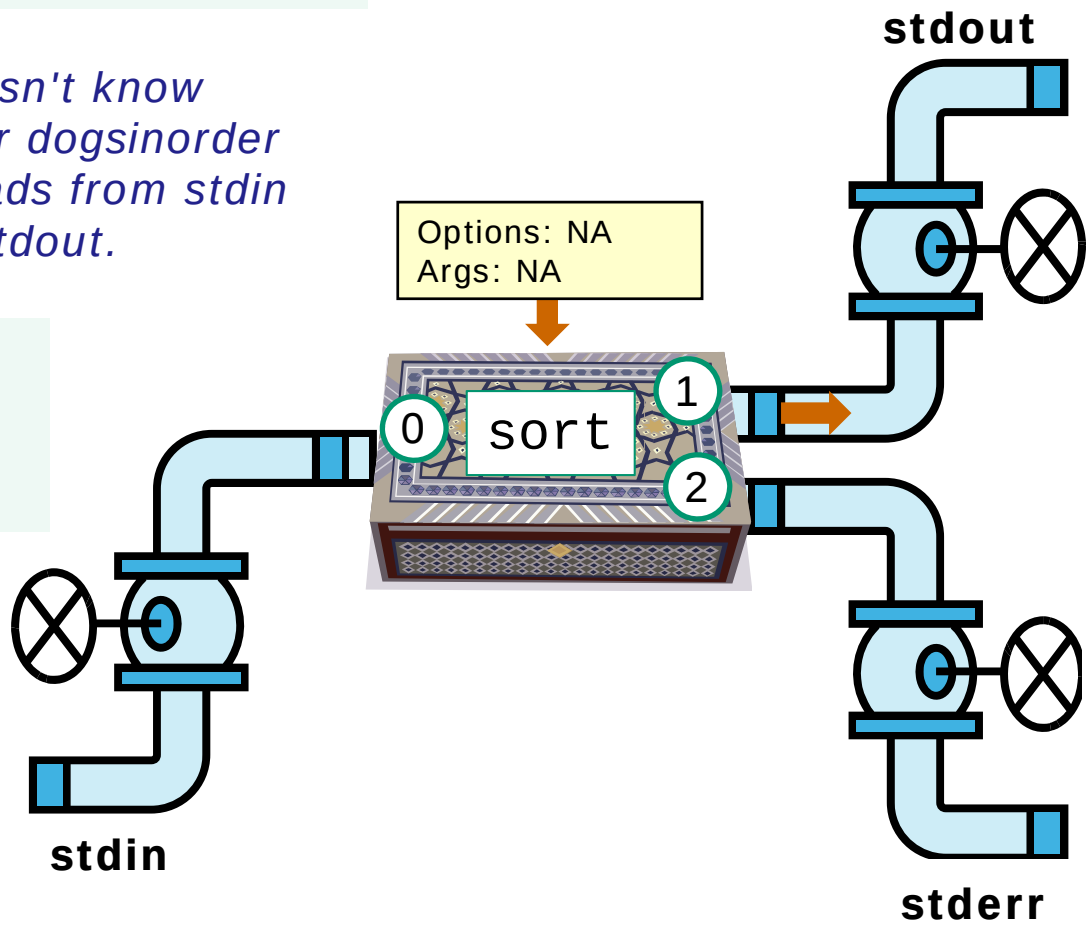
```
[roddyduk@opus ~]$ cat dogsinorder
benji
duke
homer
star
[roddyduk@opus ~]$
```

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

Example program to process: sort command

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

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



dogsinorder

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

```
$ cat names
duke
benji
star
homer
```

names

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

Input and Output

File Redirection

*Now let's try something different. The difference on the command line is very subtle. The names file is now an **argument** passed to sort from the command line.*

*Output is redirected to the file dogsinorder. The sort program writes to **stdout** and has no idea **stdout** is really connected to the file dogsinorder. It is the shell that opens the file dogsinorder.*

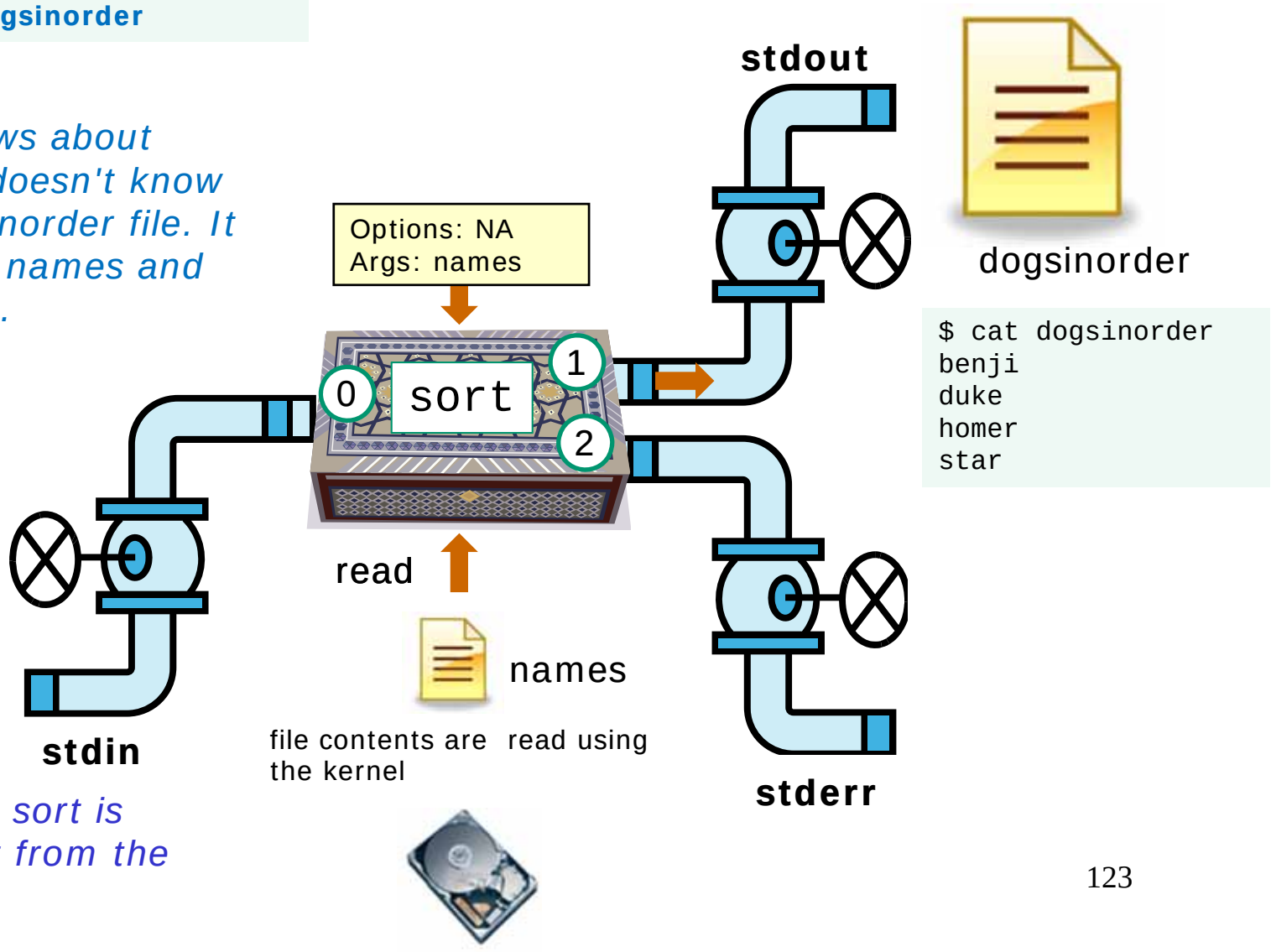
```
[roddyduk@opus ~]$ sort names > dogsinorder
[roddyduk@opus ~]$ cat dogsinorder
benji
duke
homer
star
[roddyduk@opus ~]$
```

The sort program is fully aware of the names file. It is the sort program's responsibility to directly open this file and read it. This is done by the sort code making requests to the kernel to read data from the file on the hard drive.

Example program to process: sort command

```
$ sort names > dogsinorder
```

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




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

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

Input and Output

File Redirection

OK, another little twist, lets pass in an option as well this time

specifying an option (for reverse order)

names is an argument passed to the sort command

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

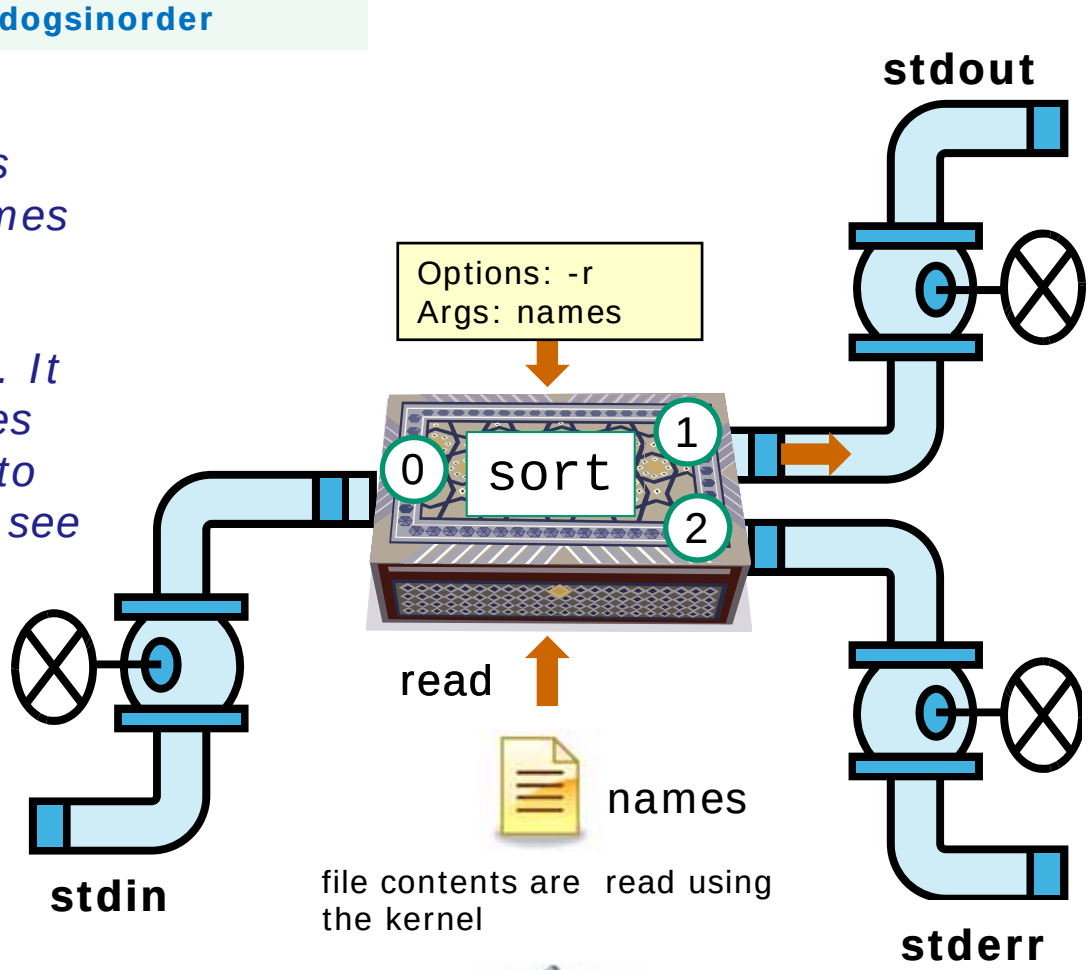
```
[roddyduk@opus ~]$ sort -r names > dogsinorder
[roddyduk@opus ~]$ cat dogsinorder
star
homer
duke
benji
[roddyduk@opus ~]$
```

This –r option does the sort in reverse order

Example program to process: sort command

```
$ sort -r names > dogsinorder
```

Note: sort does know about names file but doesn't know about dogsinorder file. It just reads names file and writes to stdout. It does see the option and modifies how it sorts.



dogsinorder

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

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

Input and Output

File Redirection

/dev/pts/0

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

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

/dev/pts/1

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

Input and Output

File Redirection

Another example …

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

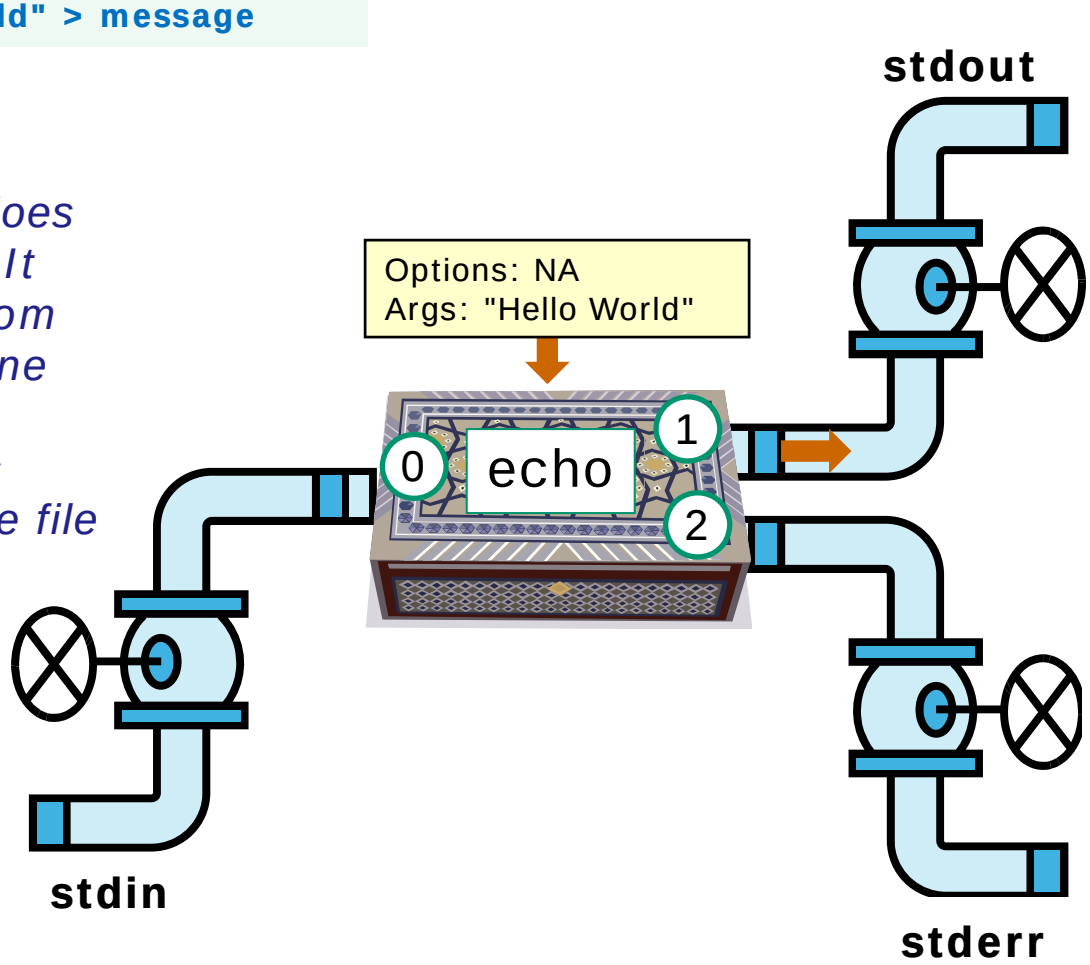
>> appends to the end of the file

*> will **overwrite** anything already in the file!*

Example program to process: echo command

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

*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.*




```
$ cat cat message
Hello World
```

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

Input and Output

File Redirection

Another example …

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

Note: errors are written to stderr, which defaults to the terminal

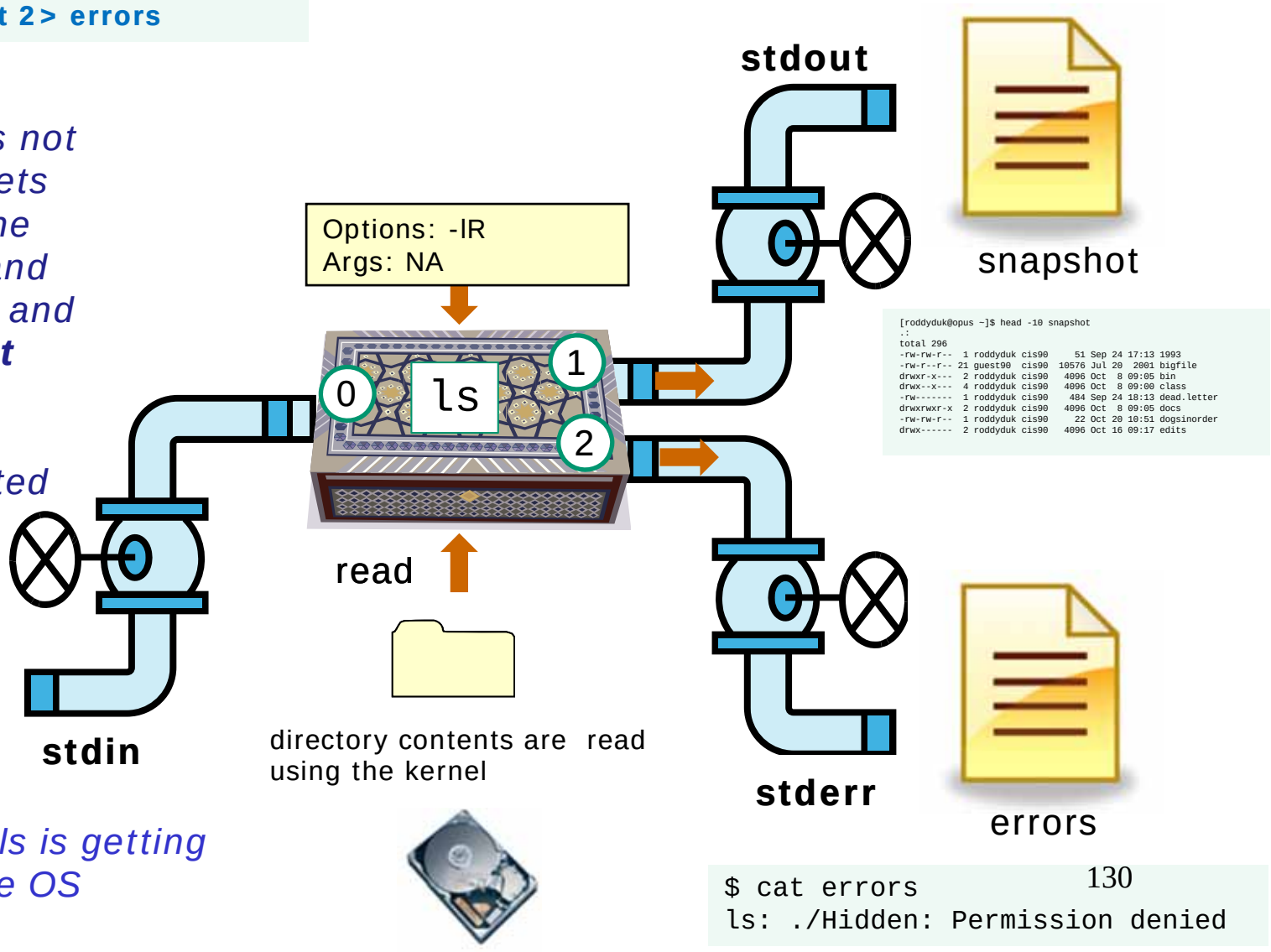
> redirects stdout to file named snapshot

2> redirects stderr to file named errors

Example program to process: ls command

```
$ 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).*



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

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

Input and Output

File Redirection

Another example … using all three

```
[roddyduk@opus ~]$ echo 2+2 > math
[roddyduk@opus ~]$ bc < math
4
[roddyduk@opus ~]$ echo 4/0 >> math
[roddyduk@opus ~]$ cat math
2+2
4/0
[roddyduk@opus ~]$ bc < math
4
Runtime error (func=(main), adr=5): Divide by zero
[roddyduk@opus ~]$ bc < math > answers 2> errors
[roddyduk@opus ~]$ cat answers
4
[roddyduk@opus ~]$ cat errors
Runtime error (func=(main), adr=5): Divide by zero
[roddyduk@opus ~]$
```

Note: bc reads from stdin which is redirected to math

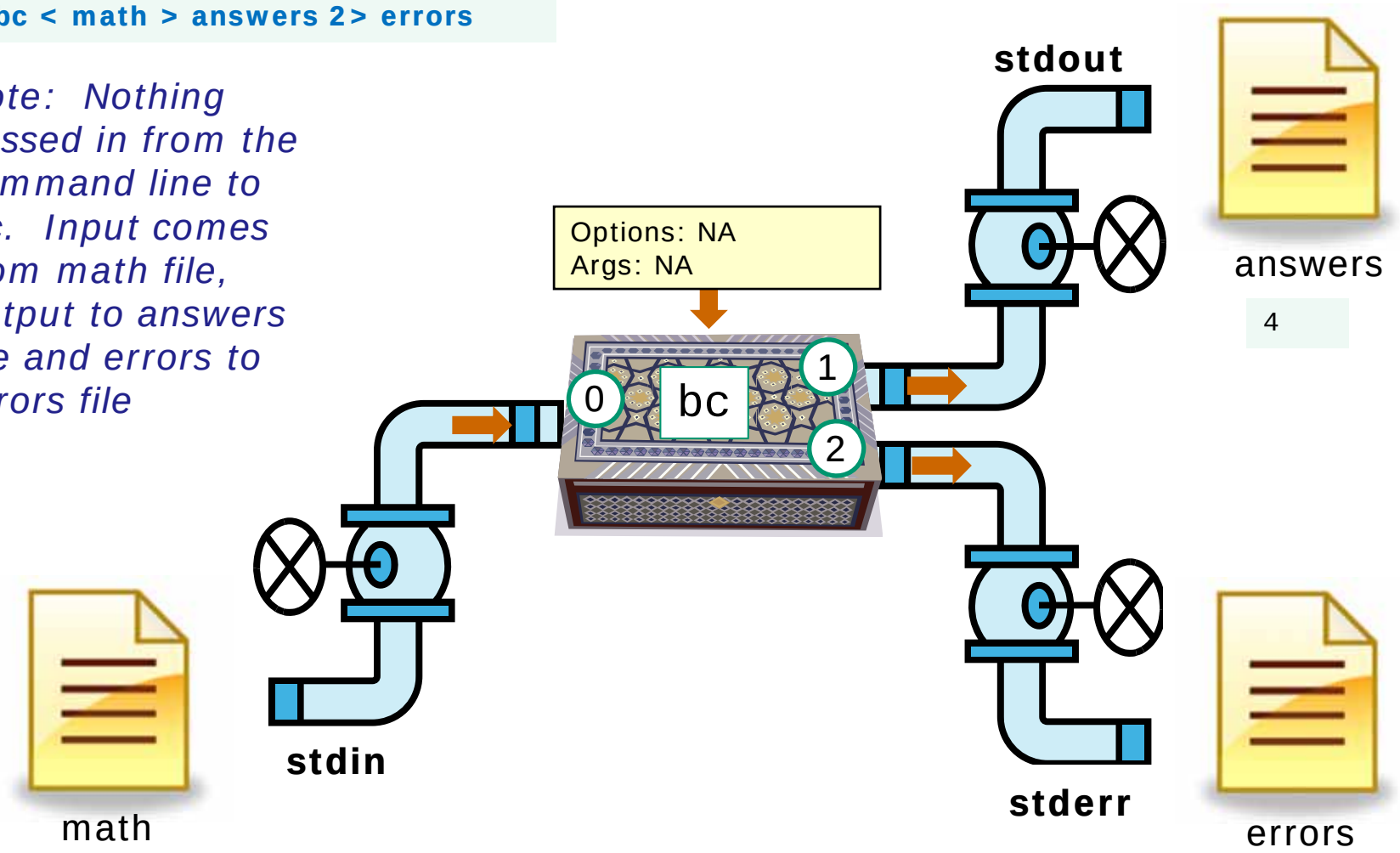
dividing by zero always results in an error

*input from math (via **stdin**), normal output to answers (via **stdout**) and error output to errors (via **stderr**)*

Example program to process: bc command

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

*Note: Nothing passed in from the command line to **bc**. Input comes from math file, output to answers file and errors to errors file*

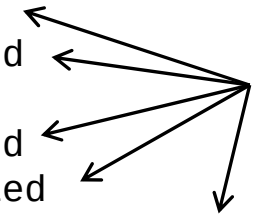


Input and Output

File Redirection

Introducing the bit bucket

```
[roddyduk@opus ~]$ find . -name sonnet6
find: ./Hidden: Permission denied
./poems/Shakespeare/sonnet6

[roddyduk@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/roddyduk/Hidden: Permission denied

<snipped>

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



Yuck! How annoying is this?

Input and Output

File Redirection

/dev/null AKA the "bit bucket"

Introducing the bit bucket

```
[roddyduk@opus ~]$ find /home/cis90 -name sonnet6 2> /dev/null
/home/cis90/guest/Poems/Shakespeare/sonnet6
/home/cis90/roddyduk/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
[roddyduk@opus ~]$
```

Much better!

All error messages are redirected to the bit bucket

This is how you can discard output you don't want to see

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.

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 the file users.

```
who | tee users | sort
```

Important! Redirection sends output to another file. Pipes send output to another process.

Input and Output

Pipelines

Let's count the lines in letter

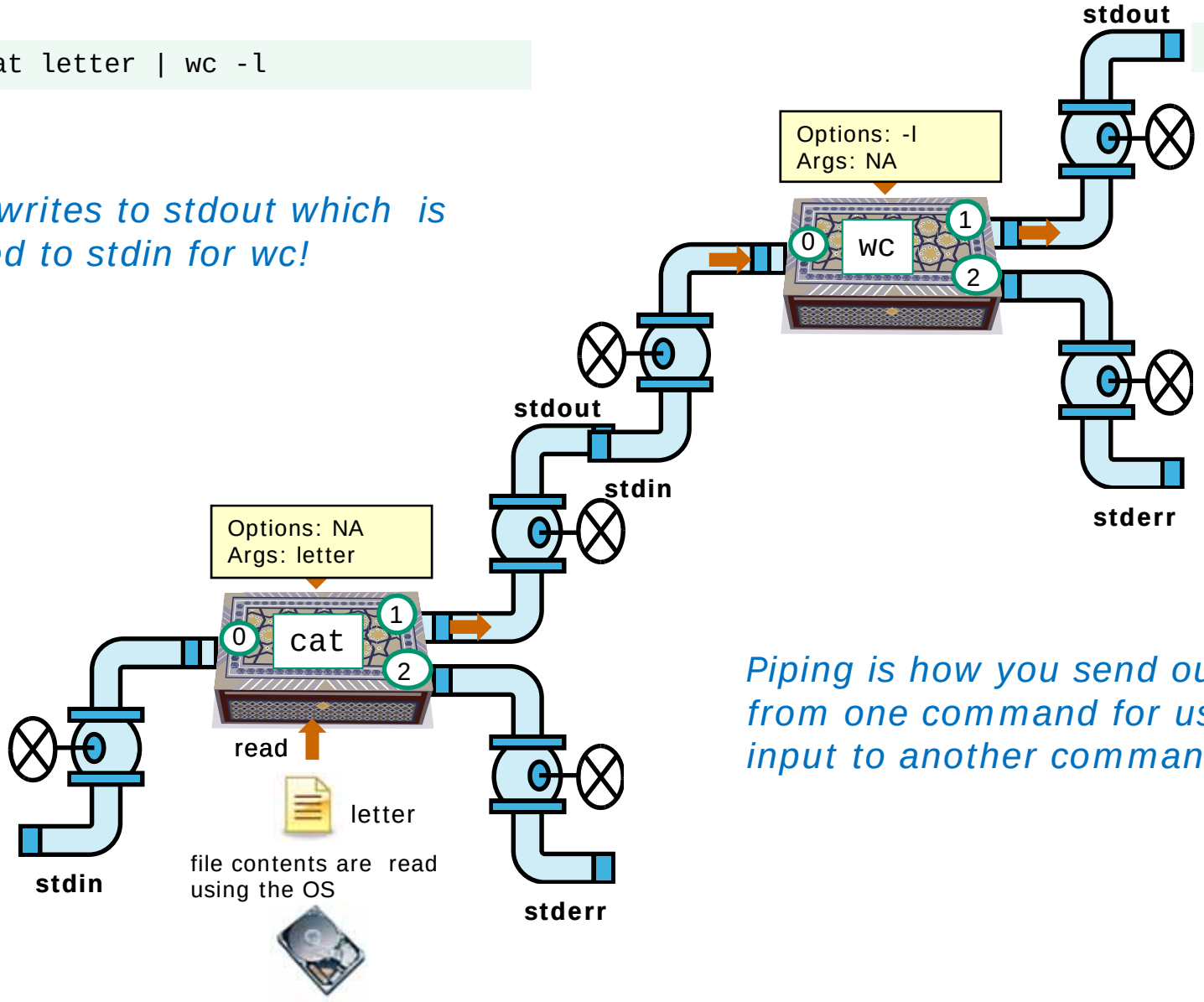
```
[roddyduk@opus ~]$ cat letter | wc -l
28
[roddyduk@opus ~]$
```

Example program to process: cat and wc commands

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

28

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



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

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***

Input and Output

Pipelines

Task: I would like to save a sorted list of users and a count of how many users are logged on

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


Method I – use temporary files

Input and Output

Pipelines

Task: I would like to save a sorted list of users and a count of how many users are logged on

```
[roddyduk@opus ~]$ who | sort | tee users | wc -l
4
[roddyduk@opus ~]$ cat users
bolasale pts/4        2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
roddyduk pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
roddyduk 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)
[roddyduk@opus ~]$
```

Method II – uses pipes

Input and Output

Pipelines

Let break it down a little to see what's going on ...

```
[roddyduk@opus ~]$ who  who is logged in
roddyduk pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
roddyduk 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)
[roddyduk@opus ~]$ who | sort  who is logged it and sorted
bolasale pts/4        2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
roddyduk pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
roddyduk 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)
[roddyduk@opus ~]$ who | sort | wc -l  who is logged in, sorted and counted
4
[roddyduk@opus ~]$ who | sort | tee users | wc -l  who is logged in, sorted, counted and
4                                                  saved in file named users
[roddyduk@opus ~]$ cat users
bolasale pts/4        2008-10-21 10:43 (dsl-63-249-97-17.cruzio.com)
roddyduk pts/0        2008-10-19 18:36 (dsl-63-249-103-107.cruzio.com)
roddyduk 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)
```

Miscellaneous Commands

Input and Output

Miscellaneous Commands

find – Find file or content of a file
grep – "Global Regular Expression Print"
✓ **sort** - sort
spell – spelling correction
✓ **wc** – word count

We will learn how to string commands together shortly using pipelines. The commands above are useful by themselves and in pipelines.

Lets explore the commands we haven't covered yet then get into pipelines.

Input and Output

Miscellaneous Commands

find – Find file or content of a file

grep – "Global Regular Expression Print"
sort - sort
spell – spelling correction
wc – word count

*The **find** command can be used to search for files from any point in the UNIX file tree and working down from there.*

find command

*The **find** command by itself lists all files from the directory specified and down into any sub-directories.*

```
[roddyduk@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
[roddyduk@opus poems]$
```

find command issued in the poems directory

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

find command

Task: How many files (approximately) are on Opus?

start searching in / (the top of the file tree)

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

*use the output of the **find** command as input to the **wc** command to count the number of files*

redirect permission errors into the bit bucket (discard them)

Note, this will not count any files in directories you don't have read permission for. Is there a user on Opus that will get a higher count when using this command?

find command

Task: Find files whose names start with "sonnet" in current home directory (including its sub-directores)

```
[roddyduk@opus ~]$ find -name "sonnet*"
find: ./Hidden: Permission denied
./poems/Shakespeare/sonnet1
./poems/Shakespeare/sonnet2
./poems/Shakespeare/sonnet3
./poems/Shakespeare/sonnet4
./poems/Shakespeare/sonnet5
./poems/Shakespeare/sonnet7
./poems/Shakespeare/sonnet9
./poems/Shakespeare/sonnet10
./poems/Shakespeare/sonnet15
./poems/Shakespeare/sonnet17
./poems/Shakespeare/sonnet26
./poems/Shakespeare/sonnet35
./poems/Shakespeare/sonnet11
./poems/Shakespeare/sonnet6
[roddyduk@opus ~]$
```

Note:

No starting point for the search is specified, so find will start in the current directory which in this example is roddyduk's home directory

***-name "sonnet*"** is an option passed to the find command directing it to only look for files with names starting with "sonnet"*

find command

Task: Find sonnet6 files starting in parent directory

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

Note:

.. *is a relative pathname to the parent directory. This is where the find command will start searching from.*

-name "sonnet6" *is an option passed to the find command directing it to only look for files named "sonnet6"*

2> /dev/null *redirects stderr to the "bit bucket" which discards any permission errors*

find command

Find all directories here in my home directory and down

```
[roddyduk@opus ~]$ find . -type d
.
./.mozilla
./.mozilla/extensions
./.mozilla/plugins
./bin
./Hidden
find: ./Hidden: Permission denied
./poems
./poems/Blake
./poems/Shakespeare
./poems/Yeats
./poems/Anon
./olddir
./newdir
./edits
./docs
./etc
./class
./class/labs
./class/exams
./misc
[roddyduk@opus ~]$
```

Note:

. *is a relative pathname to "here". This is where the find command will start searching from.*

-type d *is an option passed to the find command directing it to only look for directories*

find command

Task: Find all directories, starting here in my home directory, that start with a capital B, S, Y or A.

start from "here"

specifies directories only

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

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

Task: Find all files starting your current location that contain town

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

find command

Task: Find all ordinary files, starting in the /home directory, containing the word bones.

do not descend into directories on other file systems

ordinary files only. Other types are l (symbolic link), d (directory)

```
$ find /home -mount -type f -exec grep -l "bones" {} \; 2> /dev/null
/home/cis90/roddyduk/stash
$
```

execute this command

Input and Output

Miscellaneous Commands

find – Find file or content of a file

grep – "Global Regular Expression Print"

sort - sort
spell – spelling correction
wc – word count

*The **grep** command is used to look for content inside of files*

grep command

Task: Find the word love in Shakespeare's sonnets

```
[roddyduk@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
[roddyduk@opus poems]$
```

Looking for love in all the wrong places?

grep command

Task: Find all lines with love and hate

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

grep command

Task: Find simmsben in /etc/passwd

```
[roddyduk@opus poems]$ grep simmsben /etc/passwd
simmsben:x:1160:103:Benji Simms:/home/cis90/simmsben:/bin/bash
```

Task: Now show what line it is on

```
[roddyduk@opus poems]$ grep -n simmsben /etc/passwd
53:simmsben:x:1160:103:Benji Simms:/home/cis90/simmsben:/bin/bash
```

grep command

Background
Apache is the worlds most popular web server and it's installed on Opus. Try it, you can browse to opus.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*

Input and Output

Miscellaneous Commands

find – Find file or content of a file
grep – "Global Regular Expression Print"
sort – sort

spell – spelling correction

wc – word count

*The **spell** command is used to check spelling*

spell command

Task: Run a spell check on the magna_cart file

```
/home/cis90/roddyduk $ cd docs
/home/cis90/roddyduk/docs $ ls
magna_carta  MarkTwain  policy
/home/cis90/roddyduk/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.

Task: Count the number of misspelled words

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

Pipeline Tasks

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

Class Exercise
Pipeline Tasks

Background
The cut command can cut a field out of a line of text where each field is deliminated 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
What does this command print?

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

Wrap up

New commands:

find	find files or content
grep	look for text strings
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.

Spring Break
Lab 7

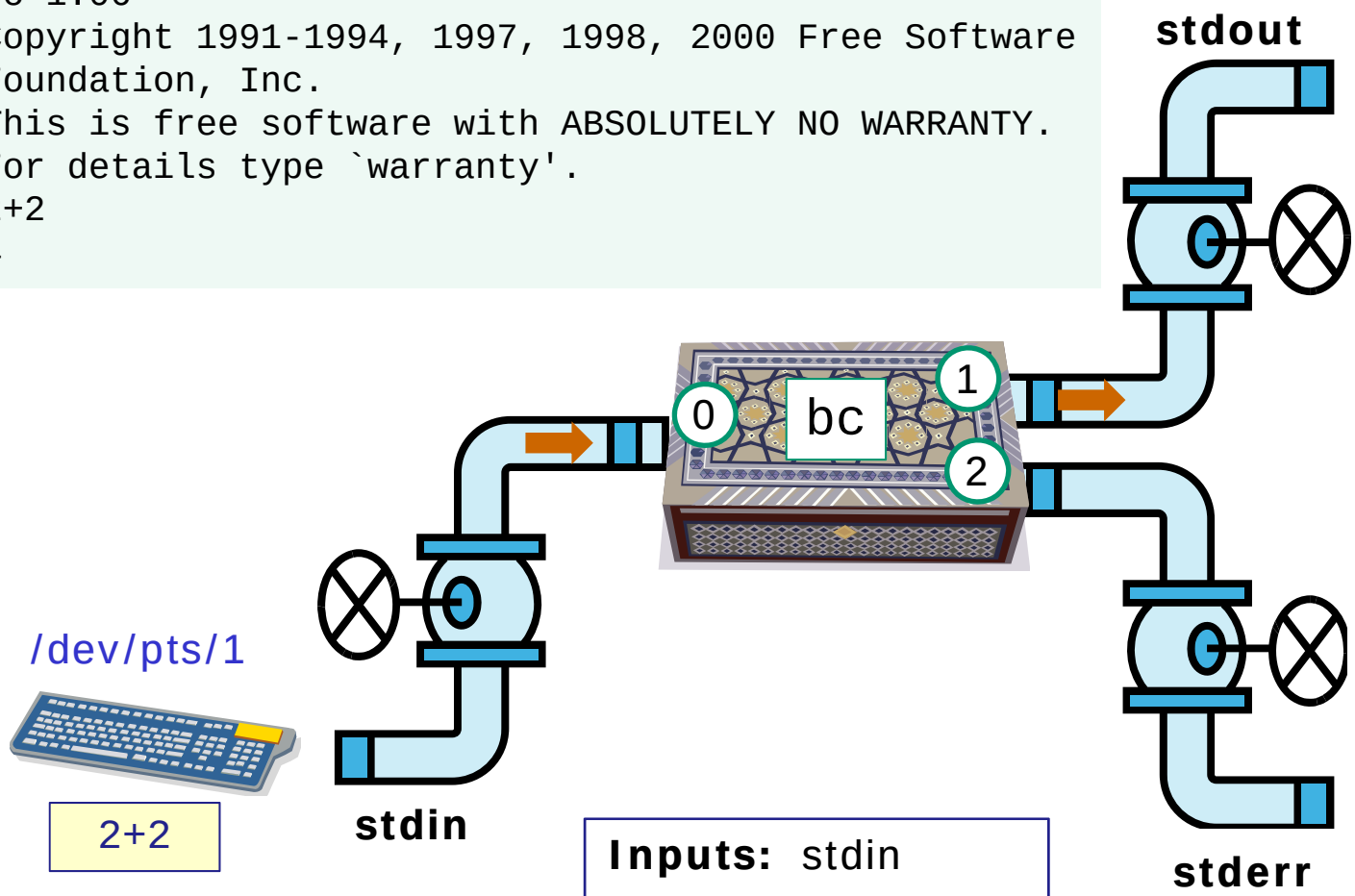
Quiz questions for next class:

- 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

Example program to process: bc command

```
/home/cis90/simmsben $ bc
bc 1.06
Copyright 1991-1994, 1997, 1998, 2000 Free Software
Foundation, Inc.
This is free software with ABSOLUTELY NO WARRANTY.
For details type `warranty'.
2+2
4
```



Inputs: stdin

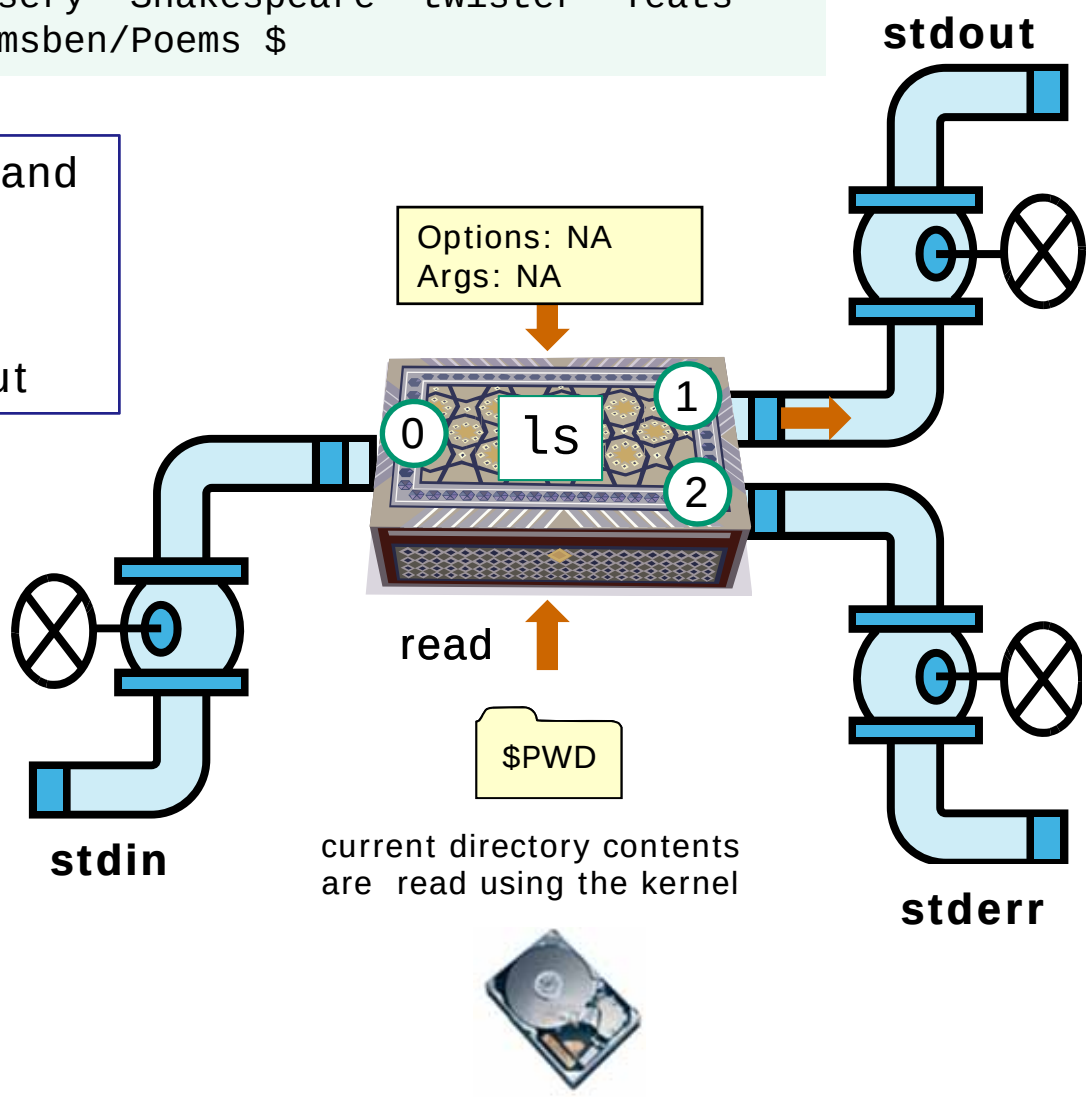
Outputs: stdout

Example program to process: ls command

```
/home/cis90/simmsben/Poems $ ls
ant  Blake  nursery  Shakespeare  twister  Yeats
/home/cis90/simmsben/Poems $
```

Inputs: Command line & Operating System

Outputs: stdout



File Permissions

exercise

```
/home/cis90: drwxr-x---
/home/cis90/simmsben: drwxr-xr-x
/home/cis90/simmsben/Directory1: drwxr-x--x

file1: -rw-rw-r--
        owner           __modify        __delete        __read          __execute
        group           __modify        __delete        __read          __execute
        other           __modify        __delete        __read          __execute

file2: -rwxr-xr-x
        owner           __modify        __delete        __read          __execute
        group           __modify        __delete        __read          __execute
        other           __modify        __delete        __read          __execute

file3: -r-xr-xr--
        owner           __modify        __delete        __read          __execute
        group           __modify        __delete        __read          __execute
        other           __modify        __delete        __read          __execute

/home/cis90/simmsben/Directory2: drwxrwxr-x

file1: -rwxr-xr-x
        owner           __modify        __delete        __read          __execute
        group           __modify        __delete        __read          __execute
        other           __modify        __delete        __read          __execute
```

File Permissions

/home/cis90: drwxr-x---
/home/cis90/simmsben: drwxr-xr-x
/home/cis90/simmsben/Directory1: drwxr-x—x

file1: -rw-rw-r--

owner	modify	delete	read	execute
group	modify	delete	read	execute
other	modify	delete	read	execute

file2: -rwxr-xr-x

owner	modify	delete	read	execute
group	modify	delete	read	execute
other	modify	delete	read	execute

file3: -r-xr-xr--

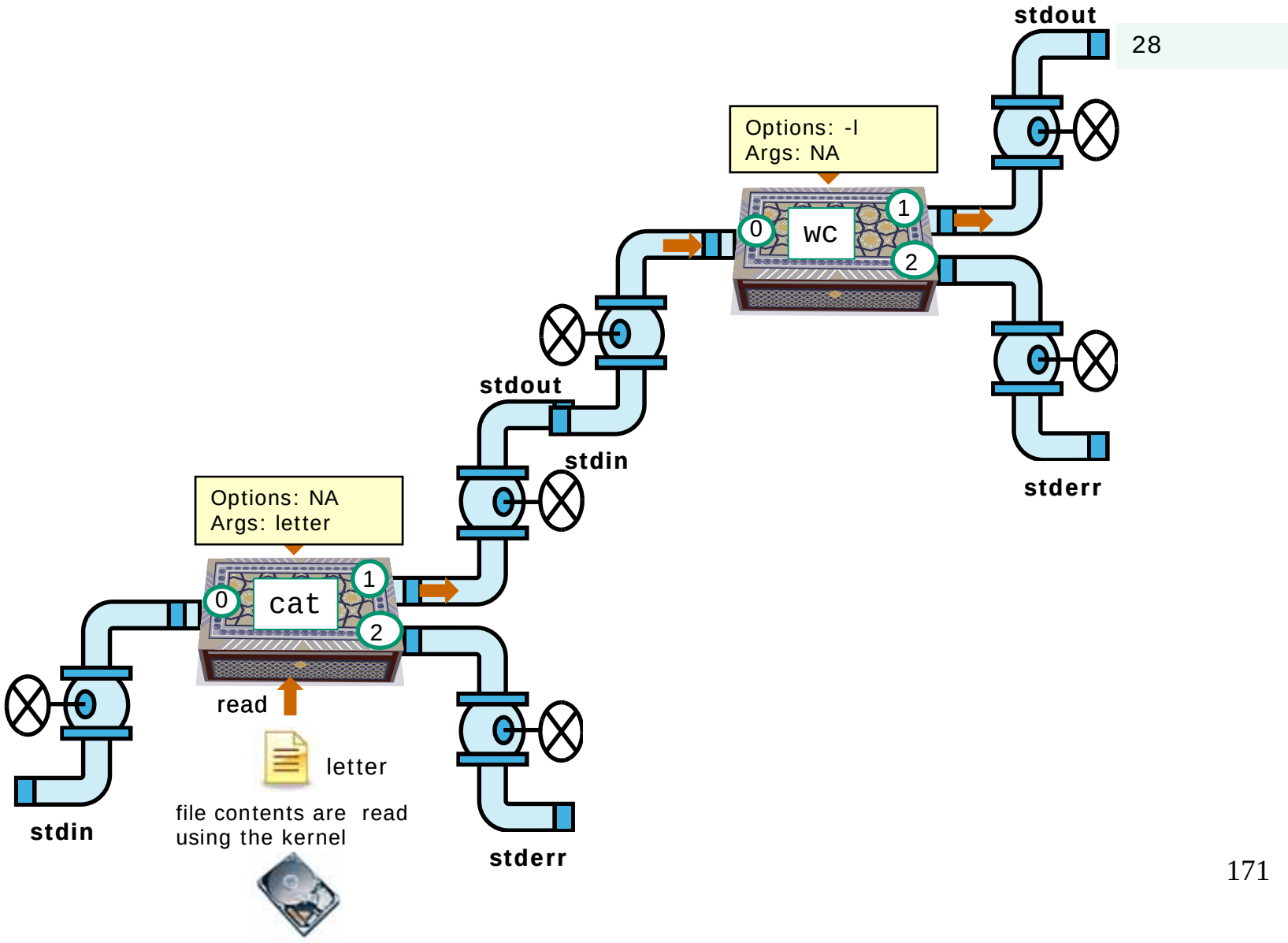
owner	modify	delete	read	execute
group	modify	delete	read	execute
other	modify	delete	read	execute

/home/cis90/simmsben/Directory2: drwxrwxr-x

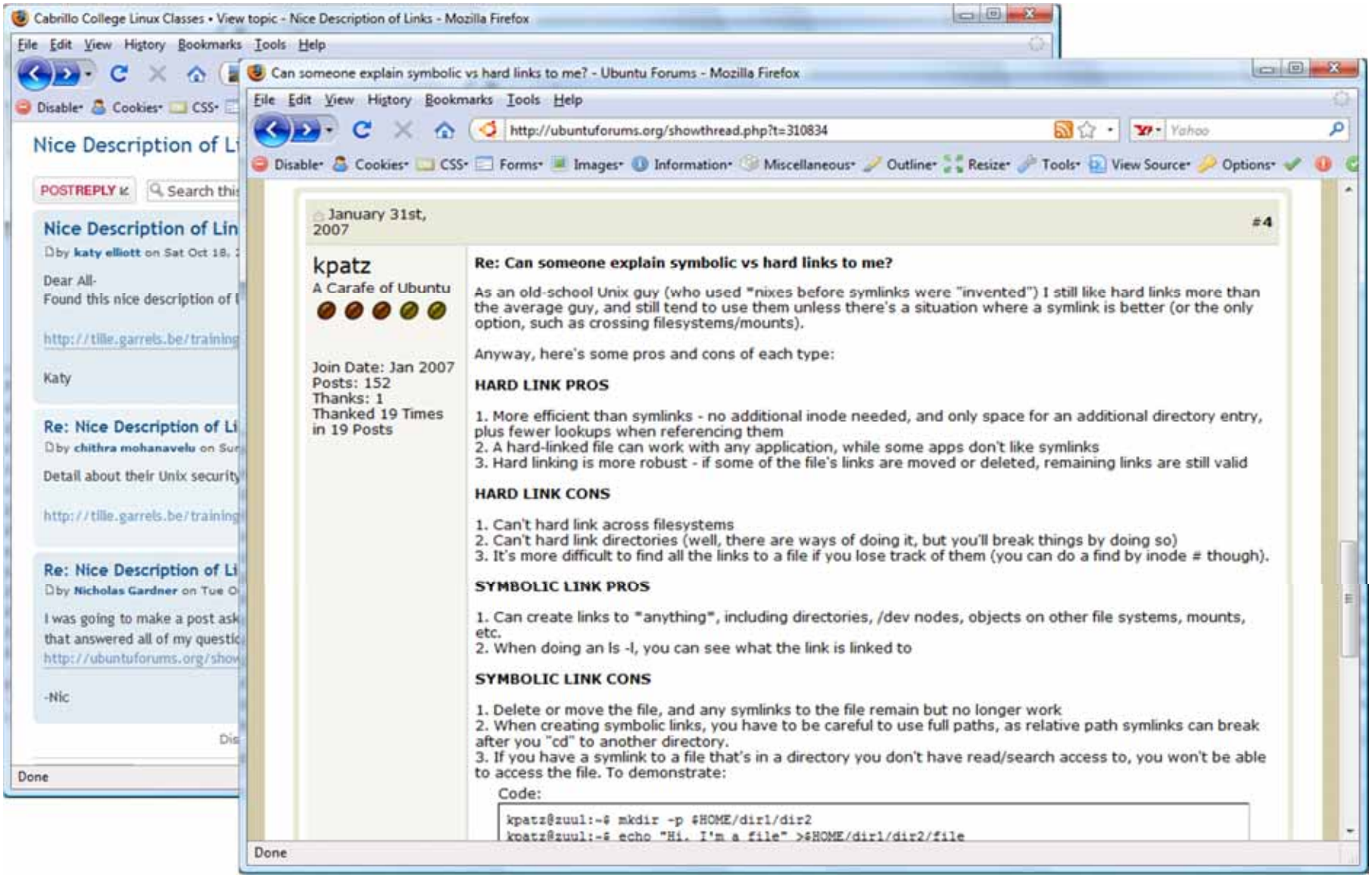
file1: -rwxr-xr-x

owner	modify	delete	read	execute
group	modify	delete	read	execute
other	modify	delete	read	execute

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



Hard and Soft Links Forum Posts



Sticky Bit

The Sticky Bit

A closer look at the /tmp directory

```
[root@opus /]# chmod 777 temp777
[root@opus /]# chmod 1777 temp777S
[root@opus /]# ls -ld *
drwxr-xr-x   2 root root    4096 Jun 17 16:25 bin
drwxr-xr-x   3 root root    4096 Jun 17 15:00 boot
drwxr-xr-x  11 root root    3660 Sep 16 12:59 dev
drwxr-xr-x  98 root root   12288 Oct 21 04:02 etc
drwxr-xr-x  16 root root    4096 Jun 20 11:07 home
drwxr-xr-x  14 root root    4096 Jun 17 16:22 lib
drwx------   2 root root   16384 Jun 16 08:35 lost+found
drwxr-xr-x   2 root root    4096 Jun 17 15:10 media
drwxr-xr-x   2 root root       0 Sep 10 21:48 misc
drwxr-xr-x   2 root root    4096 Oct 10  2006 mnt
drwxr-xr-x   2 root root    4096 Oct 10  2006 opt
dr-xr-xr-x 123 root root       0 Sep 10 14:48 proc
drwxr-x---  21 root root    4096 Sep 17 17:25 root
drwxr-xr-x   2 root root   12288 Jun 17 16:25 sbin
drwxrwxrwx   2 root root    4096 Oct 22 14:04 temp777
drwxrwxrwt   2 root root    4096 Oct 22 13:59 temp777S
drwxrwxrwt   8 root root    4096 Oct 22 13:52 tmp
drwxr-xr-x  14 root root    4096 Jun 16 15:38 usr
drwxr-xr-x  26 root root    4096 Jun 17 22:16 var
```

A closer look at the /tmp directory

Sticky Bit

```
[root@opus /]# ls -ld t* bin etc
drwxr-xr-x  2 root root  4096 Jun 17 16:25 bin
drwxr-xr-x 98 root root 12288 Oct 21 04:02 etc
drwxrwxrwx  2 root root  4096 Oct 22 14:21 temp777
drwxrwxrwt  2 root root  4096 Oct 22 13:59 temp777S
drwxrwxrwt  8 root root  4096 Oct 22 13:52 tmp
[root@opus /]#
```

The other directories in / are set to 755 permission. The /tmp is 777 so anyone can view, create and remove files there

```
[roddyduk@opus simmsric]$ cd /temp777
[roddyduk@opus temp777]$ touch duke
[roddyduk@opus temp777]$ echo hi > benji
[roddyduk@opus temp777]$ rm benji
[roddyduk@opus temp777]$
```

sticky bit not set

Without the sticky bit set, one user can delete files belonging to another.

```
[simmsben@opus simmsric]$ cd /temp777
[simmsben@opus temp777]$ touch benji
[simmsben@opus temp777]$ echo hi > duke
[simmsben@opus temp777]$ rm duke
[simmsben@opus temp777]$
```

A closer look at the /tmp directory

Sticky Bit

```
[root@opus /]# ls -ld t* bin etc
drwxr-xr-x  2 root root  4096 Jun 17 16:25 bin
drwxr-xr-x 98 root root 12288 Oct 21 04:02 etc
drwxrwxrwx  2 root root  4096 Oct 22 14:21 temp777
drwxrwxrwt  2 root root  4096 Oct 22 13:59 temp777S
drwxrwxrwt  8 root root  4096 Oct 22 13:52 tmp
[root@opus /]#
```

The other directories in / are set to 755 permission. The /tmp is 777 so anyone can view, create and remove files there

```
[roddyduk@opus temp777S]$ touch duke
[roddyduk@opus temp777S]$ echo hi > benji
[roddyduk@opus temp777S]$ rm benji
rm: cannot remove `benji': Operation not permitted
[roddyduk@opus temp777S]$ rm duke
[roddyduk@opus temp777S]$
```

sticky bit set

With the sticky bit set, a user can delete there own files but not those belonging to another.

```
[simmsben@opus temp777S]$ touch benji
[simmsben@opus temp777S]$ echo hi > duke
[simmsben@opus temp777S]$ rm duke
rm: cannot remove `duke': Operation not permitted
[simmsben@opus temp777S]$ rm benji
[simmsben@opus temp777S]$
```

```
-rw-rw-r-- 1 simmsben cis90 3 Oct 22 14:27 benji
-rw-rw-r-- 1 roddyduk cis90 3 Oct 22 14:26 duke
```

Directory Write Permission

r	w	x
read	write	execute

user | group | others

```
[simmsben@opus ~]$ cd examples/dogs/
[simmsben@opus dogs]$ cp duke duke.bak
[simmsben@opus dogs]$ mv homer Homer
[simmsben@opus dogs]$ rm duke
[simmsben@opus dogs]$ ln benji mydog
[simmsben@opus dogs]$ ls -li
total 32
104704 -rw-r--r-- 2 simmsben cis90 20 Oct 20 08:27 benji
104743 -rw-r--r-- 1 simmsben cis90 20 Oct 20 09:24 duke.bak
104684 -rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 Homer
104704 -rw-r--r-- 2 simmsben cis90 20 Oct 20 08:27 mydog
[simmsben@opus ~]$ chmod u-w examples/dogs/
[simmsben@opus ~]$ cd examples/dogs/
[simmsben@opus dogs]$ cp duke.bak /tmp
[simmsben@opus dogs]$ cp duke.bak duke
cp: cannot create regular file `duke': Permission denied
[simmsben@opus dogs]$ mv duke.bak duke
mv: cannot move `duke.bak' to `duke': Permission denied
[simmsben@opus dogs]$ rm duke.bak
rm: cannot remove `duke.bak': Permission denied
[simmsben@opus dogs]$ ln duke.bak /tmp/mydog
ln: creating hard link `/tmp/mydog' to `duke.bak': Invalid cross-device link
[simmsben@opus dogs]$ ln Homer herdog
ln: creating hard link `herdog' to `Homer': Permission denied
```

__All is well__ when the directory has write permission

All is __not well__ without write permission ... why?
Because filenames are stored in a directory. cp, mv, rm and ln commands need to change filenames, therefore they need write access to the directory

Removing directory w permission
- *__cannot__ cp files into it, can't remove files, can't move files out, can't add links*
- *but you __can__ cp files out*

Directory Execute Permission

r	w	x	r	w	x	r	w	x
read	write	execute	read	write	execute	read	write	execute
user			group			others		

Benji removes x permission on his dogs directory

```
[simmsben@opus ~]$ chmod g-x examples/dogs/
[simmsben@opus ~]$ ls -ld examples/
drwxrwxr-x 4 simmsben cis90 4096 Oct 20 08:27 examples/
[simmsben@opus ~]$ ls -lR examples/
examples/:
total 40
-rw-r--r-- 1 simmsben cis90  237 Oct 20 08:27 ant
drwxr-xr-x 2 simmsben cis90 4096 Oct 20 08:27 birds
drwxr--r-x 2 simmsben cis90 4096 Oct 20 08:27 dogs
-rw-r--r-- 1 simmsben cis90  779 Oct 20 08:27 nursery
-rw-r--r-- 1 simmsben cis90  151 Oct 20 08:27 twister

examples/birds:
total 16
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 abby
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 nibbie

examples/dogs:
total 24
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 benji
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 duke
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 homer
[simmsben@opus ~]$
```

```
[roddyduk@opus ~]$ ls -ld ../simmsben/examples/
drwxrwxr-x 4 simmsben cis90 4096 Oct 20 08:27 ../simmsben/exa
[roddyduk@opus ~]$ ls -lR ../simmsben/examples/
../simmsben/examples/:
total 40
-rw-r--r-- 1 simmsben cis90  237 Oct 20 08:27 ant
drwxr-xr-x 2 simmsben cis90 4096 Oct 20 08:27 birds
drwxr--r-x 2 simmsben cis90 4096 Oct 20 08:27 dogs
-rw-r--r-- 1 simmsben cis90  779 Oct 20 08:27 nursery
-rw-r--r-- 1 simmsben cis90  151 Oct 20 08:27 twister

../simmsben/examples/birds:
total 16
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 abby
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 nibbie

../simmsben/examples/dogs:
total 0
?--------- ? ? ? ?            ? benji
?--------- ? ? ? ?            ? duke
?--------- ? ? ? ?            ? homer
[roddyduk@opus ~]$
```


Now Duke can see filenames but no inode information

Directory Execute Permission

user			group			others		
r	w	x	r	w	x	r	w	x
read	write	execute	read	write	execute	read	write	execute

Benji removes x permission on his dogs directory

```
[simmsben@opus ~]$ chmod g-x examples/dogs/
[simmsben@opus ~]$ ls -ld examples/
drwxrwxr-x 4 simmsben cis90 4096 Oct 20 08:27 examples/
[simmsben@opus ~]$ ls -lR examples/
examples/:
total 40
-rw-r--r-- 1 simmsben cis90  237 Oct 20 08:27 ant
drwxr-xr-x 2 simmsben cis90 4096 Oct 20 08:27 birds
drwxr--r-x 2 simmsben cis90 4096 Oct 20 08:27 dogs
-rw-r--r-- 1 simmsben cis90  779 Oct 20 08:27 nursery
-rw-r--r-- 1 simmsben cis90  151 Oct 20 08:27 twister

examples/birds:
total 16
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 abby
-rw-r--r-- 1 simmsben cis90 24 Oct 20 08:27 nibbie

examples/dogs:
total 24
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 benji
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 duke
-rw-r--r-- 1 simmsben cis90 20 Oct 20 08:27 homer
[simmsben@opus ~]$
```

```
[roddyduk@opus ~]$ cd ../simmsben
[roddyduk@opus simmsben]$ cd examples/
[roddyduk@opus examples]$ cd birds
[roddyduk@opus birds]$ cd ..
[roddyduk@opus examples]$ cd dogs/
-bash: cd: dogs/: Permission denied
[roddyduk@opus examples]$
[roddyduk@opus examples]$ cat dogs/duke
cat: dogs/duke: Permission denied
[roddyduk@opus examples]$
```

*Duke **cannot cd** into the directory and he **cannot retrieve any file data** for the files in the directory*