YORK UNIVERSITÉ UNIVERSITY

Linux Introduction

EECS 2031

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Acknowledgement

- Some of the covered materials are based on previous EECS2031 offerings:
  - Uyen Trang (UT) Nguyen, Pooja Vashisth, Hui Wang, Manos Papagelis

Unix File

- Files: store information
  - a sequence of **0 or more bytes** containing arbitrary information

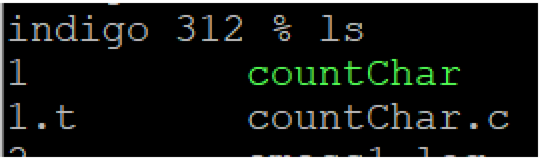
- What's in a filename?
  - Case matters; the limitation is 255 bytes

  - Special characters such as -, and spaces are allowed, but you shouldn’t use them in a filename
    - Can you think of the reasons ?

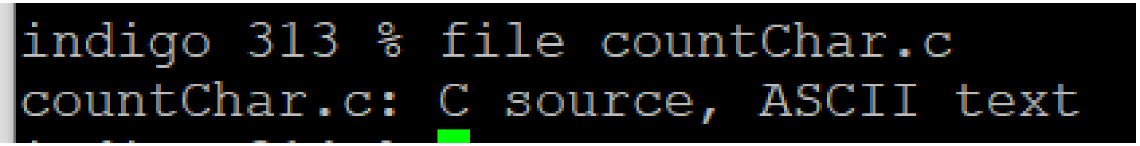
  - Dot files are hidden, i.e., normally not listed by command ***ls***
    - To display all files, including hidden files, use ls -a

What’s in a file?

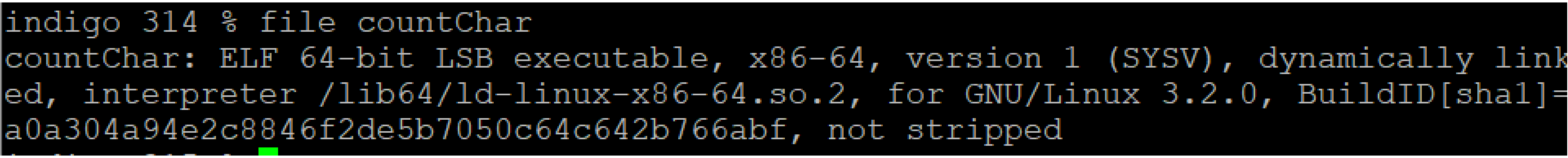
- So far, we learnt that files are organized in a hierarchical directory structure
  - Each file has a name, resides under a directory, is associated with some admin info (**permission, owner**)
- Contents of file:
  - Text (ASCII) file (such as your C/C++ source code)
  - Executable file (commands)
  - A link to other files, …
  - Virtual file:
    - /proc: a pseudo-filesystem, contains user-accessible objects on runtime state of kernel and executing processes
- To check the type of file: “*file <filename>*”



```
indigo 312 % ls
1          countChar
1.t        countChar.c
```



```
indigo 313 % file countChar.c
countChar.c: C source, ASCII text
```



```
indigo 314 % file countChar
countChar: ELF 64-bit LSB executable, x86-64, version 1 (SYSV), dynamically link
ed, interpreter /lib64/ld-linux-x86-64.so.2, for GNU/Linux 3.2.0, BuildID[sha1]=
a0a304a94e2c8846f2de5b7050c64c642b766abf, not stripped
```

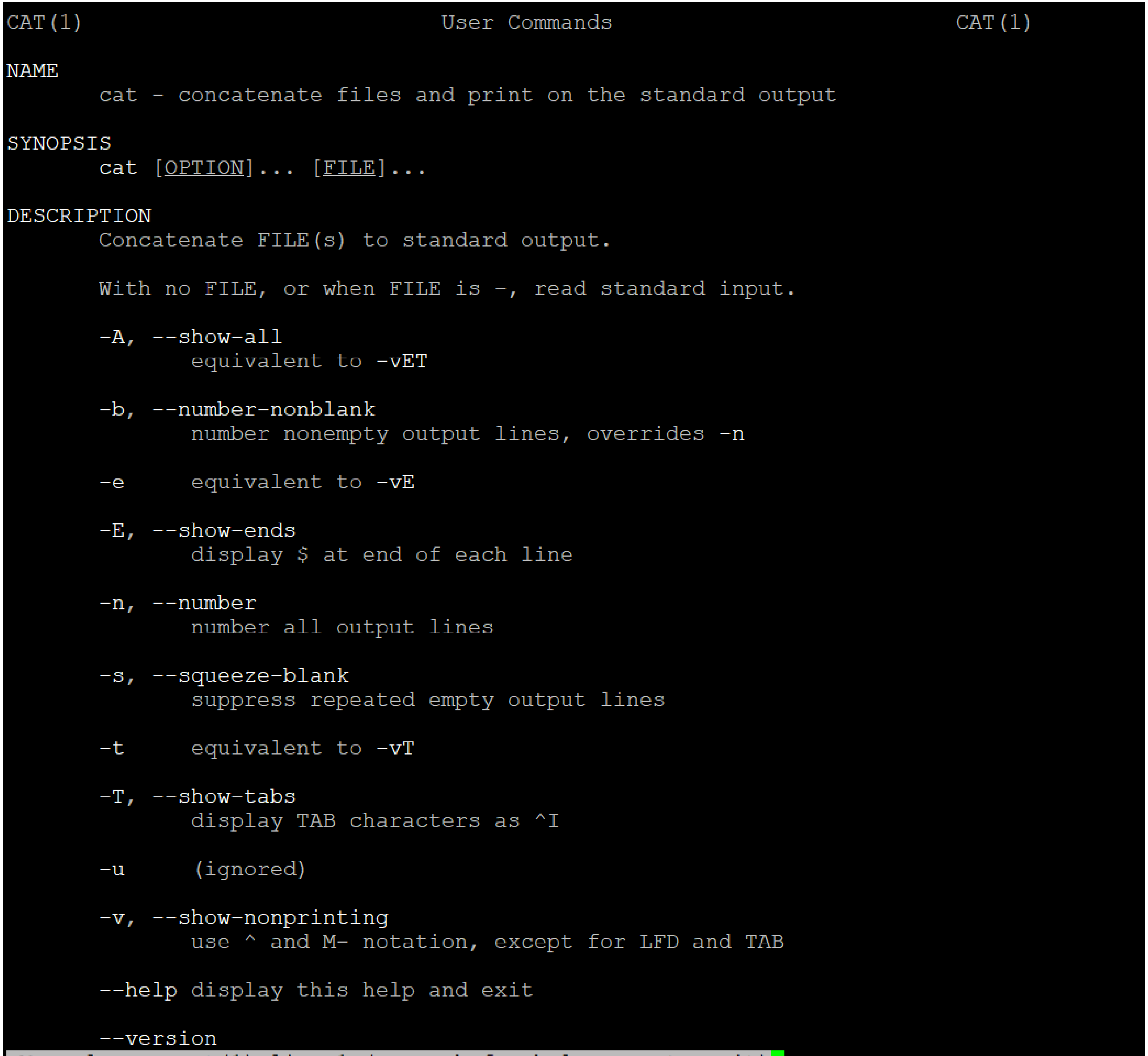
File Viewing Commands

- **cat**: concatenate files and display on standard output (i.e., the terminal window)
  - *cat [option] … [file] …*
  - *cat proj1.c*
  - *cat proj1.c proj2.c*
  - *cat –n proj1.c // display the file with line #*

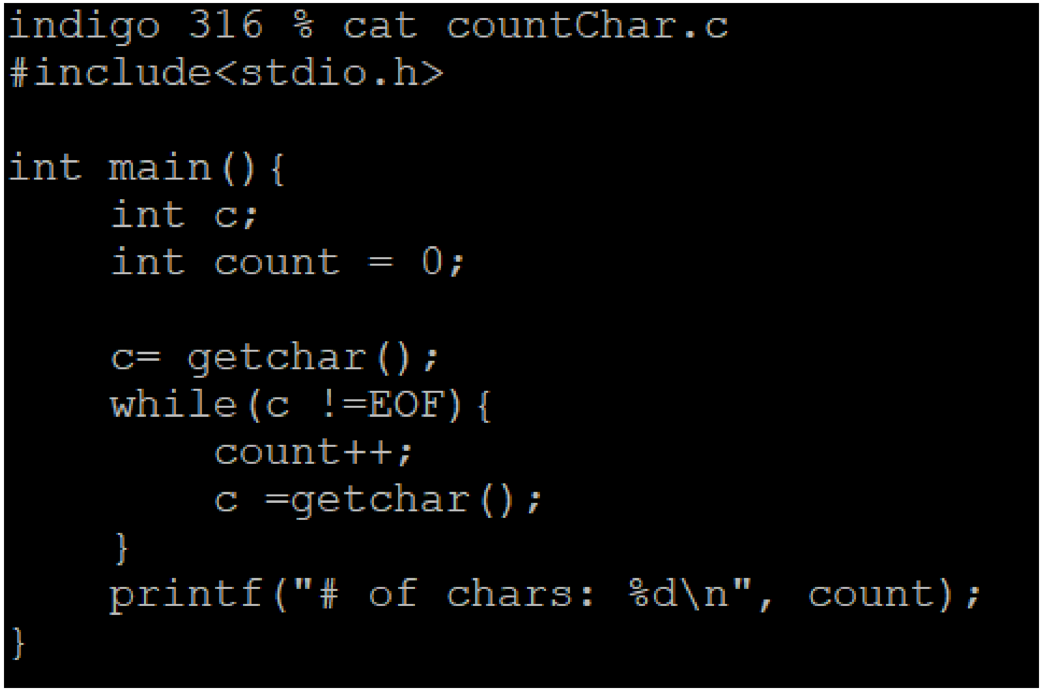
[ ] means the argument is optional
… means there can be multiple arguments of this type

- **more**: file perusal filter (i.e., displaying file one screen at a time)
  - *more proj1.cpp*

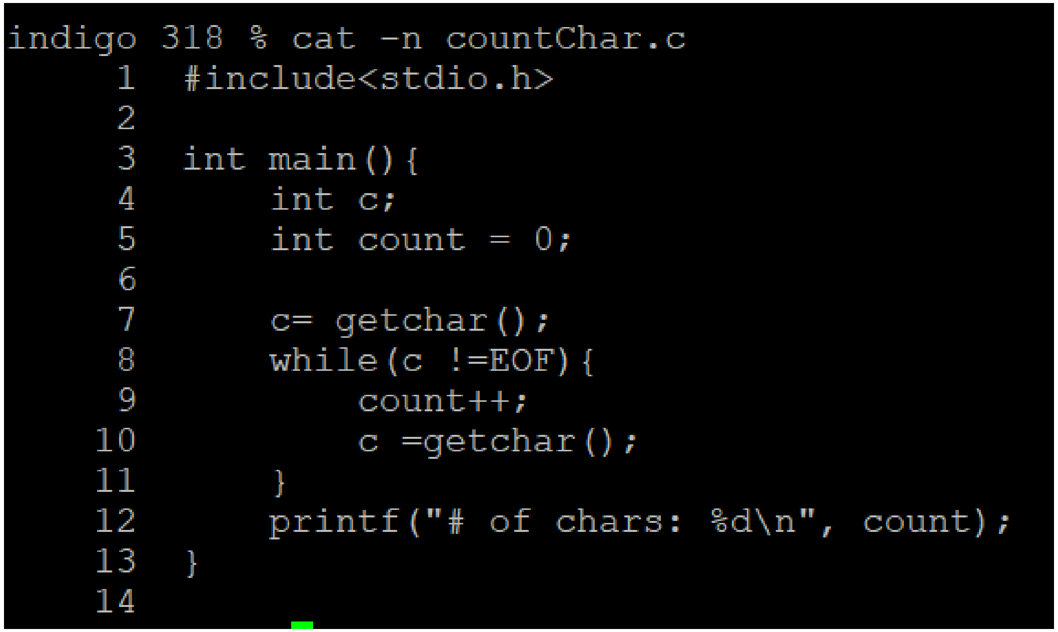
- **head, tail**: display the beginning or ending lines of a file
  - ***tail -f output // display the file, append more lines as the file grows***



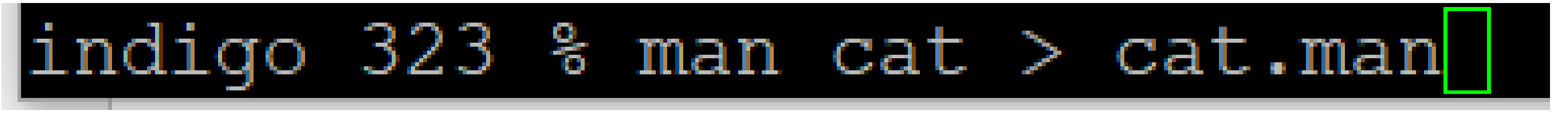
```
CAT(1)                          User Commands                          CAT(1)

NAME
       cat - concatenate files and print on the standard output

SYNOPSIS
       cat [OPTION]... [FILE]...

DESCRIPTION
       Concatenate FILE(s) to standard output.

       With no FILE, or when FILE is -, read standard input.

       -A, --show-all
              equivalent to -vET

       -b, --number-nonblank
              number nonempty output lines, overrides -n

       -e     equivalent to -vE

       -E, --show-ends
              display $ at end of each line

       -n, --number
              number all output lines

       -s, --squeeze-blank
              suppress repeated empty output lines

       -t     equivalent to -vT

       -T, --show-tabs
              display TAB characters as ^I

       -u     (ignored)

       -v, --show-nonprinting
              use ^ and M- notation, except for LFD and TAB

       --help display this help and exit

       --version
```



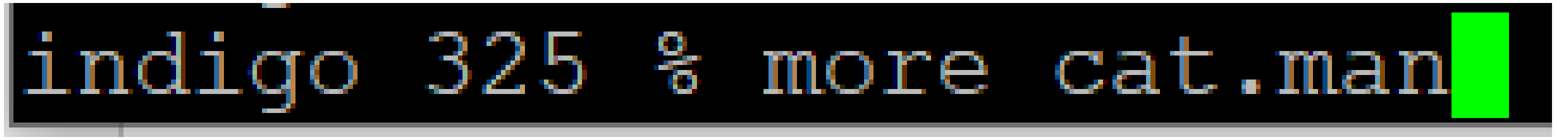
```
indigo 316 % cat countChar.c
#include<stdio.h>

int main(){
    int c;
    int count = 0;

    c= getchar();
    while(c !=EOF){
        count++;
        c =getchar();
    }
    printf("# of chars: %d\n", count);
}
```



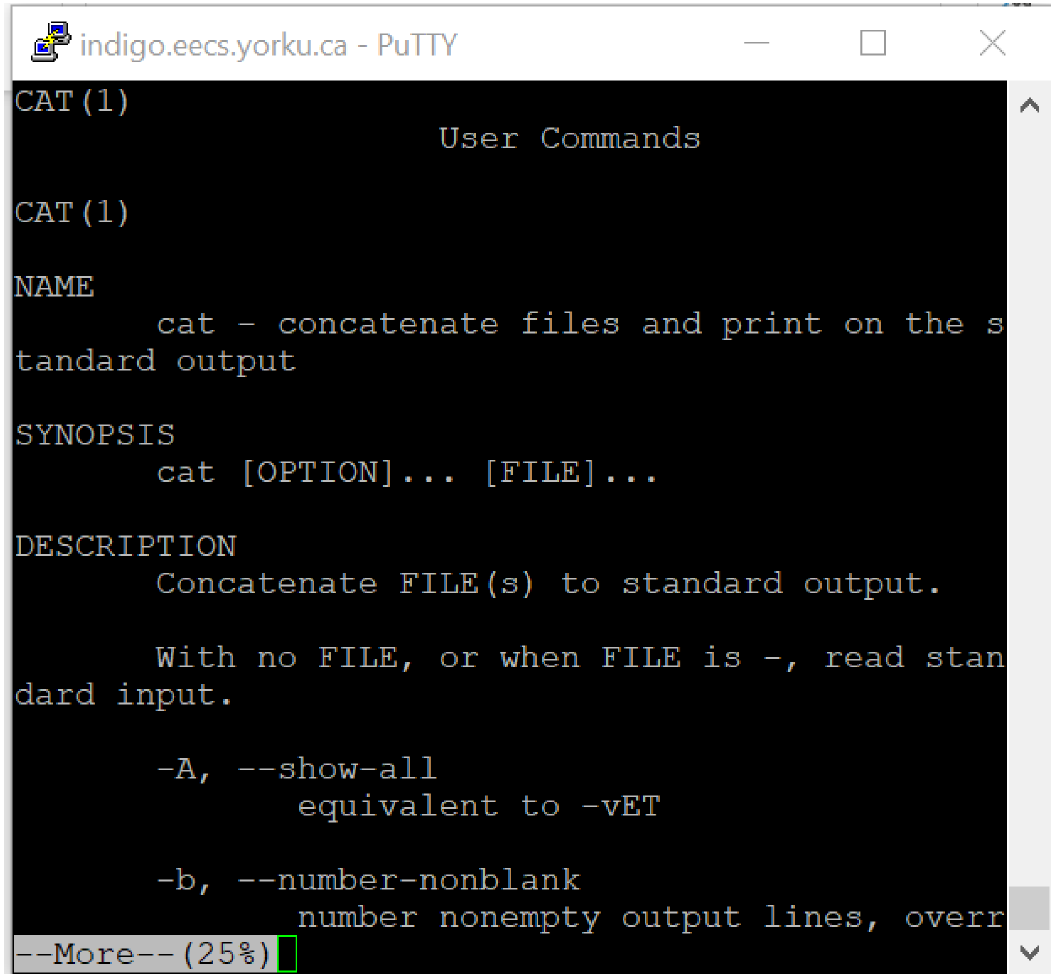
```
indigo 318 % cat -n countChar.c
     1  #include<stdio.h>
     2
     3  int main(){
     4      int c;
     5      int count = 0;
     6
     7      c= getchar();
     8      while(c !=EOF){
     9          count++;
    10          c =getchar();
    11      }
    12      printf("# of chars: %d\n", count);
    13  }
    14
```



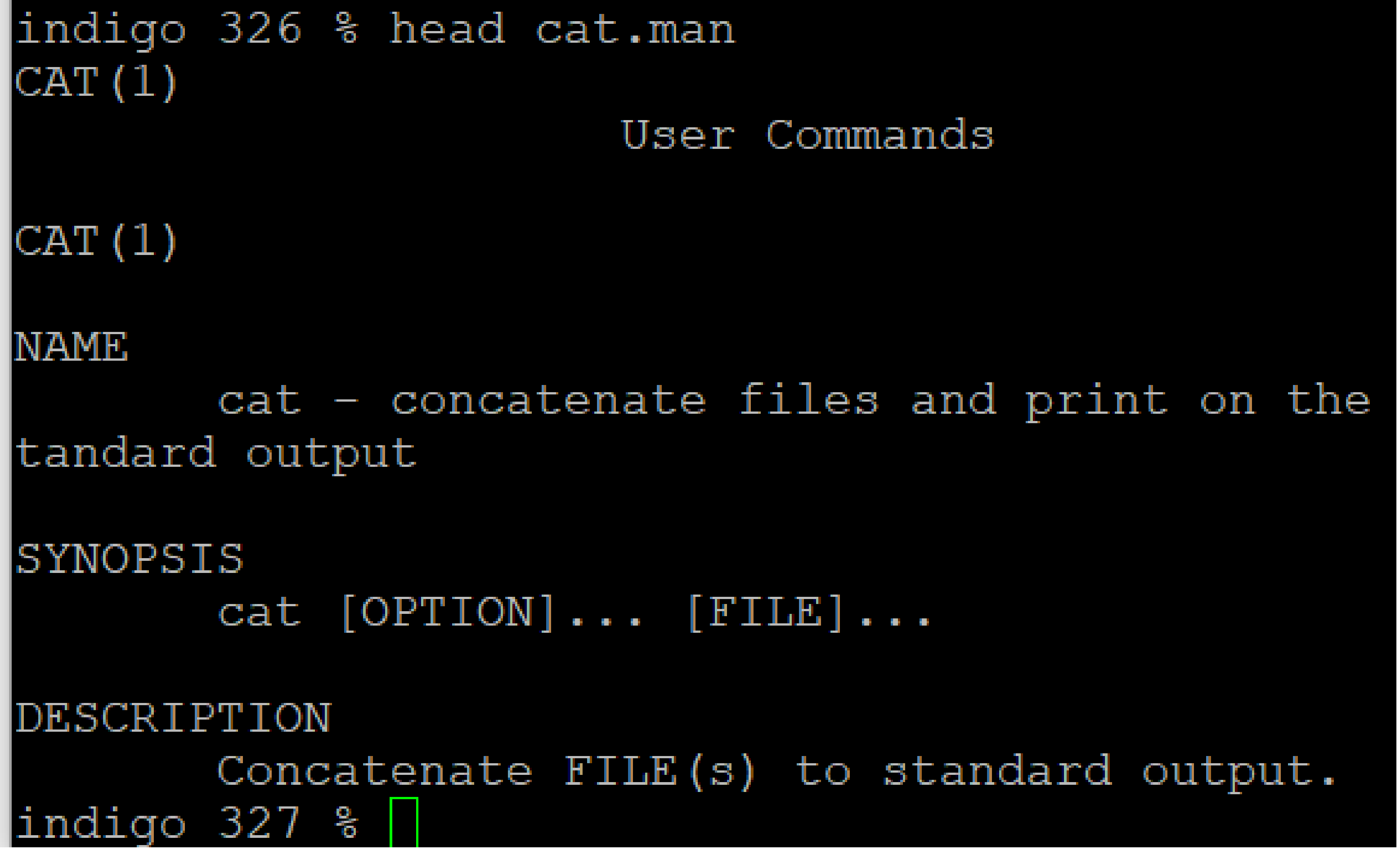
```
indigo 323 % man cat > cat.man
```



```
indigo 325 % more cat.man
```

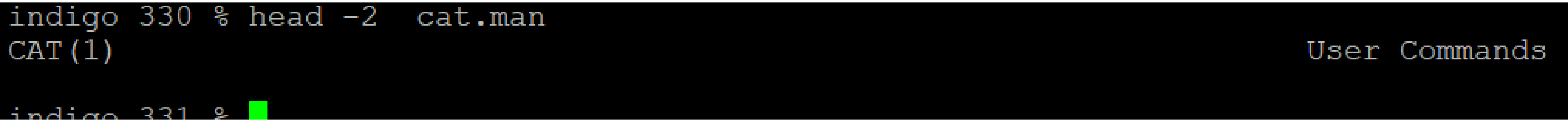


```
CAT(1)
                    User Commands

CAT(1)

NAME
       cat - concatenate files and print on the s
tandard output

SYNOPSIS
       cat [OPTION]... [FILE]...

DESCRIPTION
       Concatenate FILE(s) to standard output.

       With no FILE, or when FILE is -, read stan
dard input.

       -A, --show-all
              equivalent to -vET

       -b, --number-nonblank
              number nonempty output lines, overr
--More--(25%)
```

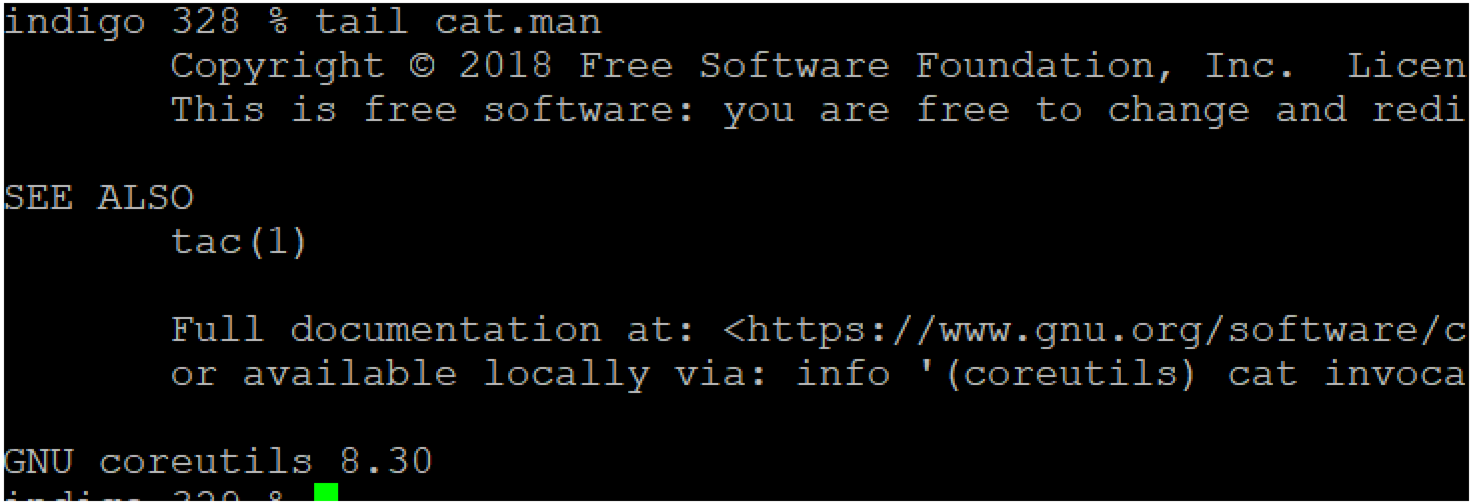


```
indigo 326 % head cat.man
CAT(1)
                     User Commands


CAT(1)


NAME
       cat - concatenate files and print on the
tandard output

SYNOPSIS
       cat [OPTION]... [FILE]...

DESCRIPTION
       Concatenate FILE(s) to standard output.
indigo 327 % 
```

- First n (on default 10) line

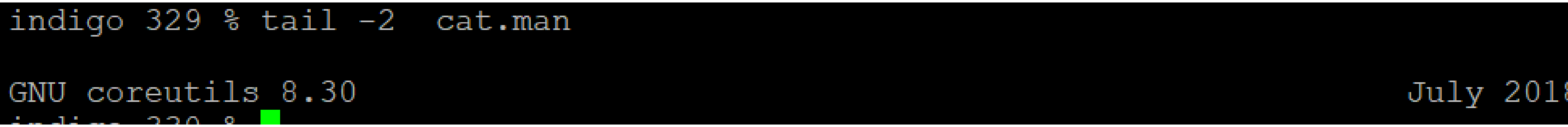


```
indigo 330 % head -2  cat.man
CAT(1)                                              User Commands

indigo 331 % 
```



```
indigo 328 % tail cat.man
       Copyright © 2018 Free Software Foundation, Inc.  Licen
       This is free software: you are free to change and redi

SEE ALSO
       tac(1)

       Full documentation at: <https://www.gnu.org/software/c
       or available locally via: info '(coreutils) cat invoca

GNU coreutils 8.30
indigo 329 %
```

- Last n (on default 10) line



```
indigo 329 % tail -2  cat.man

GNU coreutils 8.30                                                    July 2018
indigo 330 %
```

File manipulation commands

- **rm**: remove one or multiple files or directories
  - *rm [option] … FILE …*
  - *rm temp*
  - *rm temp1 temp2*

- Wildcards (metacharacter) can be used in the command line
  - Letter * matches with any string
    - *rm *.o: remove all .o files* **(be careful !!!)**
  - ?: match any one character
  - [abc]: match with letter a or b or c

- *rm –r*: remove directories and their sub-dirs recursively
- *rm –i* : confirm with user before removing files

File manipulation commands (2)

- cp: copy file or directory
  - *cp [OPTION] SOURCE DESTINATION*

- To make a backup copy of your program before dramatic change
  - ***cp proj1.c proj1.c.bak***

- To make a backup copy of a whole directory
  - *cp* ***–r*** *lab1_dir lab1_dir_backup*
  - *-R, -r, --recursive*: copy directories recursively

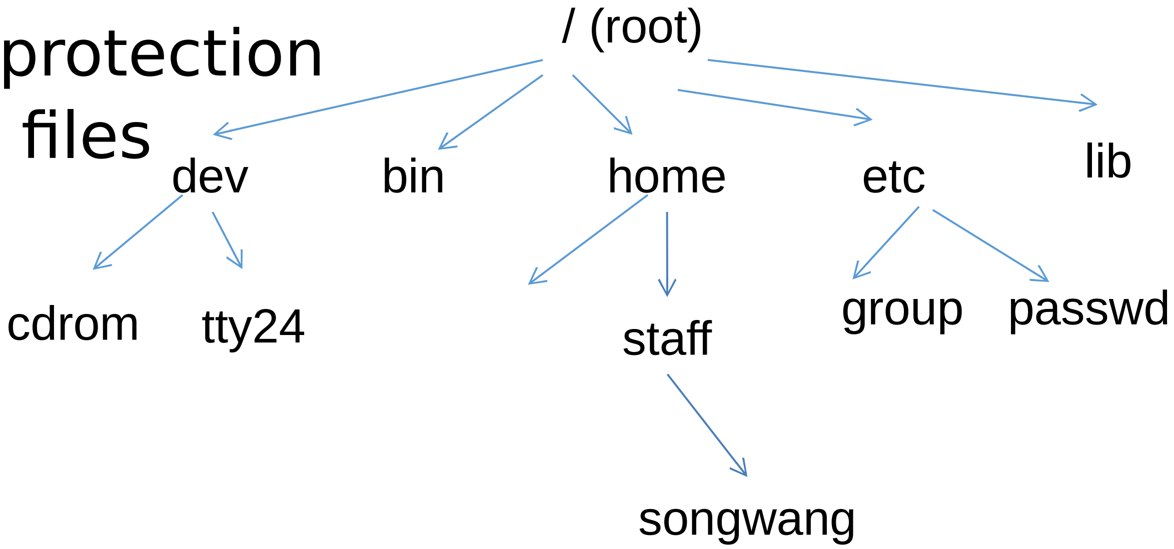
File manipulation commands (3)

- mv: move (rename) files/directories
  - *mv [OPTION] SOURCE DEST*
    - Rename SOURCE to DEST
    - *mv proj1.c lab1.c*

  - *mv [OPTION]… SOURCE… DIRECTORY*
    - Move SOURCE to DIRECTORY
    - *mv lab1.c lab2.c EECS2031*

Hierarchical file system

- Directory: a file that can hold other files
- Advantages of hierarchical file system:
  - Files can have same names, as long as they are under different directories
  - Easier for protection
  - Organized files



/ (root)

dev

bin

home

etc

lib

cdrom

tty24

staff

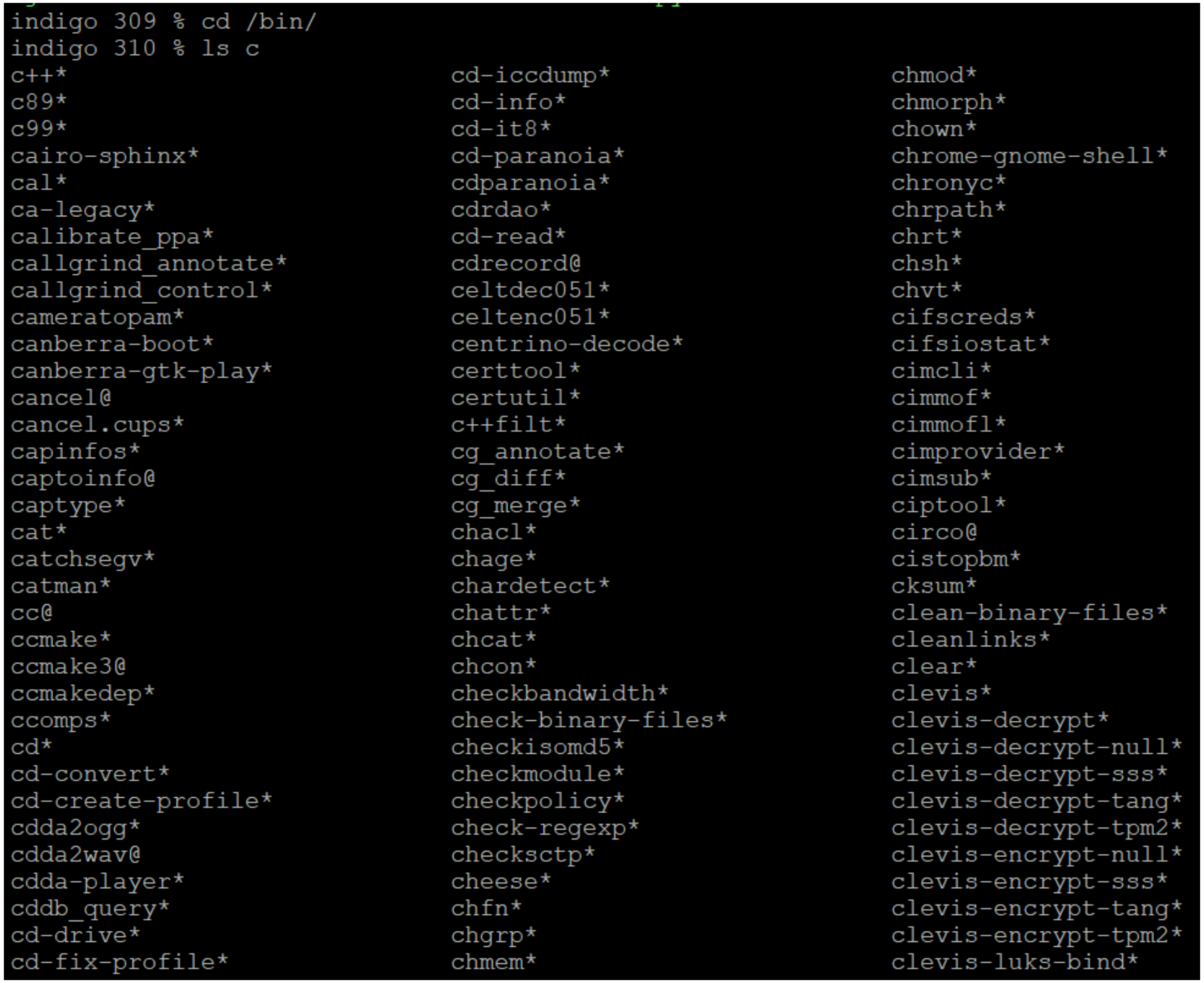
group

passwd

songwang

/bin

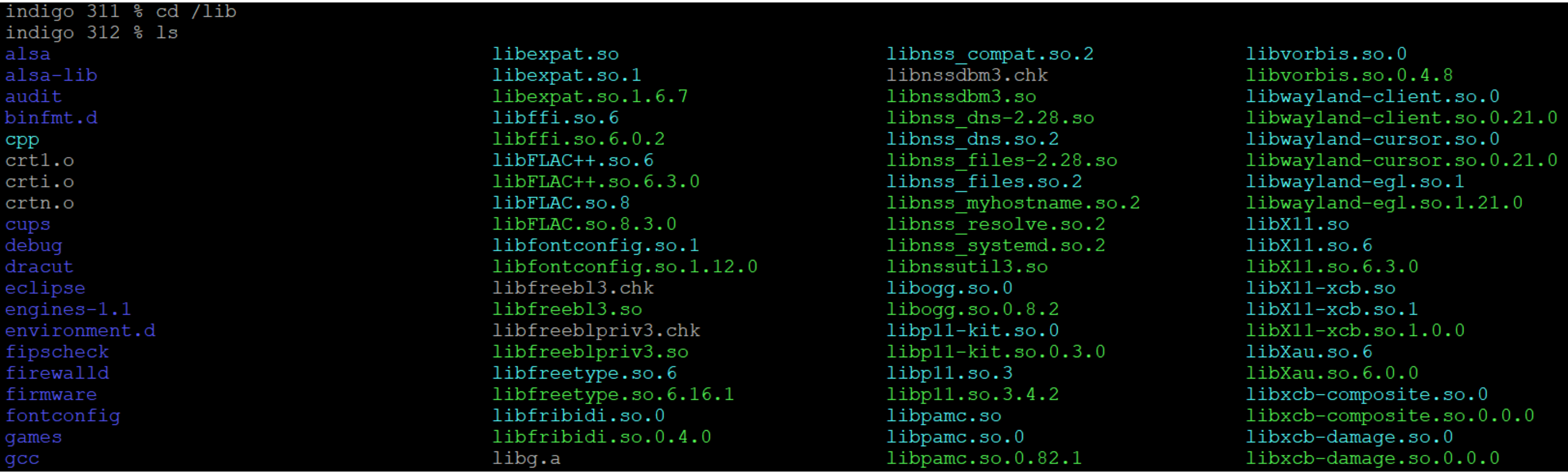
- Essential ready-to-run programs (binaries), include the most basic commands such as *ls* and *cp*.



```
indigo 309 % cd /bin/
indigo 310 % ls c
c++*                          cd-iccdump*                   chmod*
c89*                          cd-info*                      chmorph*
c99*                          cd-it8*                       chown*
cairo-sphinx*                 cd-paranoia*                  chrome-gnome-shell*
cal*                          cdparanoia*                   chronyc*
ca-legacy*                    cdrdao*                       chrpath*
calibrate_ppa*                cd-read*                      chrt*
callgrind_annotate*           cdrecord@                     chsh*
callgrind_control*            celtdec051*                   chvt*
cameratopam*                  celtenc051*                   cifscreds*
canberra-boot*                centrino-decode*              cifsiostat*
canberra-gtk-play*            certtool*                     cimcli*
cancel@                       certutil*                     cimmof*
cancel.cups*                  c++filt*                      cimmofl*
capinfos*                     cg_annotate*                  cimprovider*
captoinfo@                    cg_diff*                      cimsub*
captype*                      cg_merge*                     ciptool*
cat*                          chacl*                        circo@
catchsegv*                    chage*                        cistopbm*
catman*                       chardetect*                   cksum*
cc@                           chattr*                       clean-binary-files*
ccmake*                       chcat*                        cleanlinks*
ccmake3@                      chcon*                        clear*
ccmakedep*                    checkbandwidth*               clevis*
ccomps*                       check-binary-files*           clevis-decrypt*
cd*                           checkisomd5*                  clevis-decrypt-null*
cd-convert*                   checkmodule*                  clevis-decrypt-sss*
cd-create-profile*            checkpolicy*                  clevis-decrypt-tang*
cdda2ogg*                     check-regexp*                 clevis-decrypt-tpm2*
cdda2wav@                     checksctp*                    clevis-encrypt-null*
cdda-player*                  cheese*                       clevis-encrypt-sss*
cddb_query*                   chfn*                         clevis-encrypt-tang*
cd-drive*                     chgrp*                        clevis-encrypt-tpm2*
cd-fix-profile*               chmem*                        clevis-luks-bind*
```

/lib

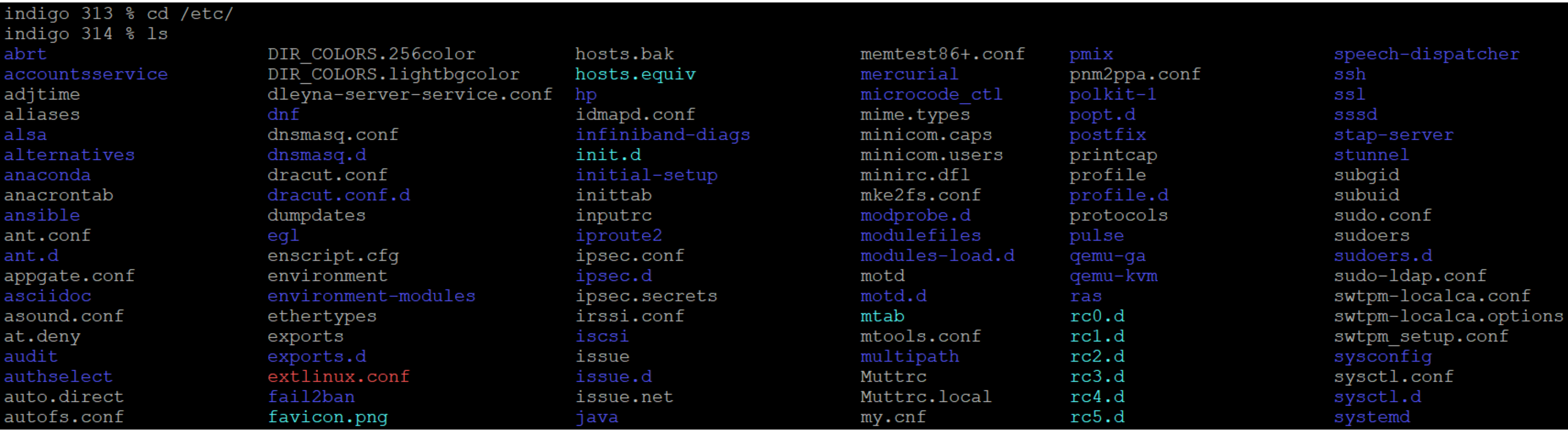
- Contains kernel modules and those shared library images (the C programming code library) needed to boot the system and run the commands in the root filesystem, ie. the binaries in /bin and /sbin.



```
indigo 311 % cd /lib
indigo 312 % ls
alsa                                      libexpat.so                       libnss_compat.so.2             libvorbis.so.0
alsa-lib                                  libexpat.so.1                     libnssdbm3.chk                 libvorbis.so.0.4.8
audit                                     libexpat.so.1.6.7                 libnssdbm3.so                  libwayland-client.so.0
binfmt.d                                  libffi.so.6                       libnss_dns-2.28.so             libwayland-client.so.0.21.0
cpp                                       libffi.so.6.0.2                   libnss_dns.so.2                libwayland-cursor.so.0
crt1.o                                    libFLAC++.so.6                    libnss_files-2.28.so           libwayland-cursor.so.0.21.0
crti.o                                    libFLAC++.so.6.3.0                libnss_files.so.2              libwayland-egl.so.1
crtn.o                                    libFLAC.so.8                      libnss_myhostname.so.2         libwayland-egl.so.1.21.0
cups                                      libFLAC.so.8.3.0                  libnss_resolve.so.2            libX11.so
debug                                     libfontconfig.so.1                libnss_systemd.so.2            libX11.so.6
dracut                                    libfontconfig.so.1.12.0           libnssutil3.so                 libX11.so.6.3.0
eclipse                                   libfreebl3.chk                    libogg.so.0                    libX11-xcb.so
engines-1.1                               libfreebl3.so                     libogg.so.0.8.2                libX11-xcb.so.1
environment.d                             libfreeblpriv3.chk                libp11-kit.so.0                libX11-xcb.so.1.0.0
fipscheck                                 libfreeblpriv3.so                 libp11-kit.so.0.3.0            libXau.so.6
firewalld                                 libfreetype.so.6                  libp11.so.3                    libXau.so.6.0.0
firmware                                  libfreetype.so.6.16.1             libp11.so.3.4.2                libxcb-composite.so.0
fontconfig                                libfribidi.so.0                   libpamc.so                     libxcb-composite.so.0.0.0
games                                     libfribidi.so.0.4.0               libpamc.so.0                   libxcb-damage.so.0
gcc                                       libg.a                            libpamc.so.0.82.1              libxcb-damage.so.0.0.0
```

/etc

- It stores storage system configuration files, executables required to boot the system, and some log files.

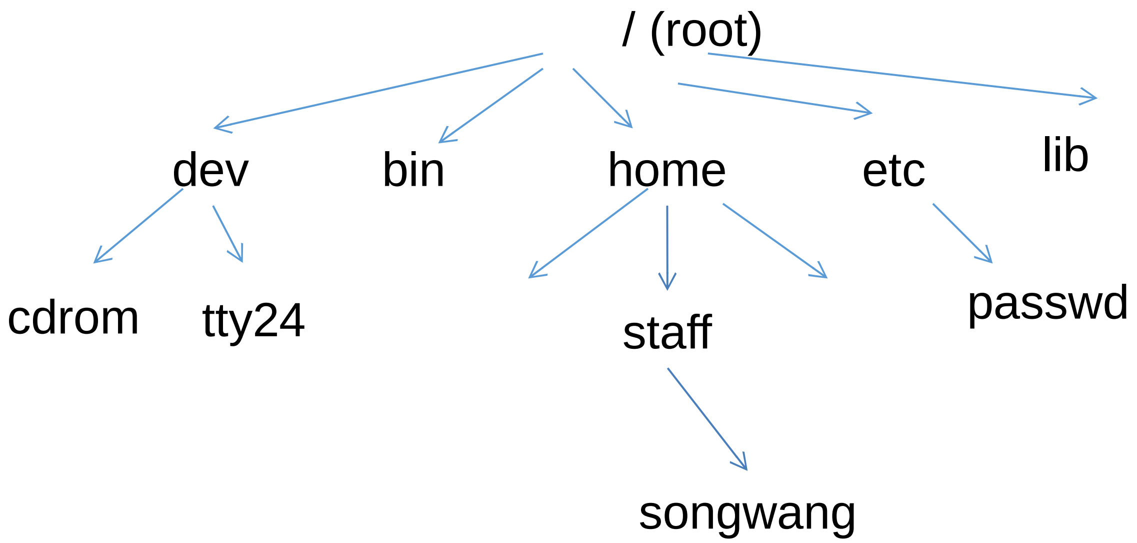


```
indigo 313 % cd /etc/
indigo 314 % ls
abrt                    DIR_COLORS.256color         hosts.bak                 memtest86+.conf    pmix                    speech-dispatcher
accountsservice         DIR_COLORS.lightbgcolor     hosts.equiv               mercurial          pnm2ppa.conf            ssh
adjtime                 dleyna-server-service.conf  hp                        microcode_ctl      polkit-1                ssl
aliases                 dnf                         idmapd.conf               mime.types         popt.d                  sssd
alsa                    dnsmasq.conf                infiniband-diags          minicom.caps       postfix                 stap-server
alternatives            dnsmasq.d                   init.d                    minicom.users      printcap                stunnel
anaconda                dracut.conf                 initial-setup             minirc.dfl         profile                 subgid
anacrontab              dracut.conf.d               inittab                   mke2fs.conf        profile.d               subuid
ansible                 dumpdates                   inputrc                   modprobe.d         protocols               sudo.conf
ant.conf                egl                         iproute2                  modulefiles        pulse                   sudoers
ant.d                   enscript.cfg                ipsec.conf                modules-load.d     qemu-ga                 sudoers.d
appgate.conf            environment                 ipsec.d                   motd               qemu-kvm                sudo-ldap.conf
asciidoc                environment-modules         ipsec.secrets             motd.d             ras                     swtpm-localca.conf
asound.conf             ethertypes                  irssi.conf                mtab               rc0.d                   swtpm-localca.options
at.deny                 exports                     iscsi                     mtools.conf        rc1.d                   swtpm_setup.conf
audit                   exports.d                   issue                     multipath          rc2.d                   sysconfig
authselect              extlinux.conf               issue.d                   Muttrc             rc3.d                   sysctl.conf
auto.direct             fail2ban                    issue.net                 Muttrc.local       rc4.d                   sysctl.d
autofs.conf             favicon.png                 java                      my.cnf             rc5.d                   systemd
```

/home

- Personal directories for users, holds your documents, files, settings, etc.

Absolute pathname, path



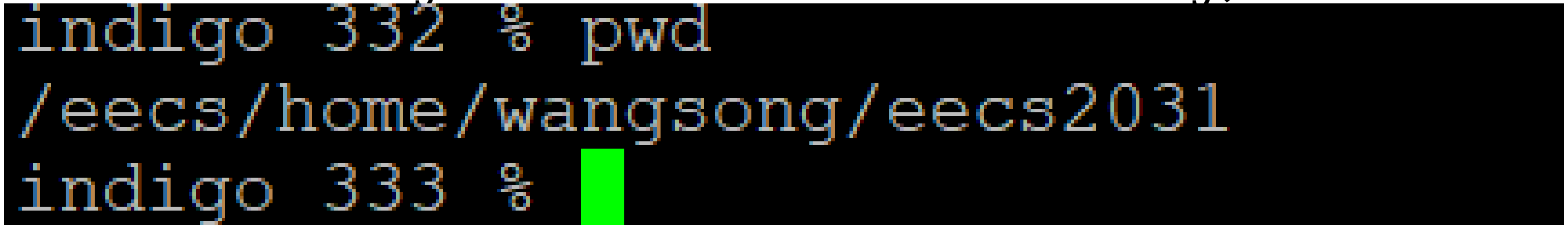
- Pathname of a file/directory: location of file/directory in the file system
  - How do you tell other where your prog. Is located ?
- Absolute pathname: path name specified relative to root, i.e., starting with the root (/)
  - e.g., /home/staff/songwang
  - What’s the absolute pathname for the “passwd” file?

Home directory

- Every user has a home directory created for him/her
  - When you log in, you are in your home directory
  - In home directory, a user usually has permission to create files/directories, remove files ..
  - ~ to refer to current user’s home directory
  - ~username to refer to username’s home directory

Current directory & Relative Pathname

- Tiring to specify absolute pathname each time
- To make life easier: working directory
  - User can move around the file system, shell remembers where the user is (i.e., current directory)
- To check your current directory, use



```
indigo 332 % pwd
/eecs/home/wangsong/eecs2031
indigo 333 %
```

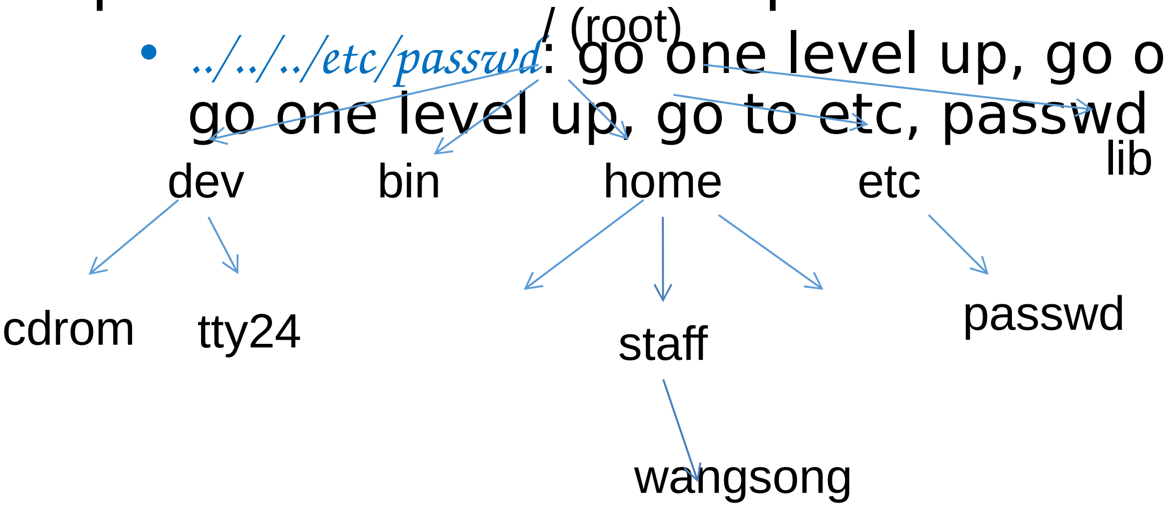
Getting around in the file system

- To create a subdirectory:
  - *mkdir [option]… directory…*
  - cd
  - mkdir labtest2
  - cd labtest2
  - mkdir question

- To remove a directory:
  - *rmdir [option]… directory…*
  - Report failure if directory is not empty
    - Can use rm –rf to remove non-empty directory

Relative pathname

- Absolute pathname: specified relative to root
- Relative pathname: specified relative to current directory
  - . (current directory), .. (parent directory, one level up)
  - If current directory is at */home/staff/wangsong*, what is the relative pathname of the file passwd?
    - *../../../etc/passwd*: go one level up, go one level up, go one level up, go to etc, passwd is there



- Path1: /eecs/home/wangsong/eecs2031
- Path2: /eecs/home/wangsong/eecs3311

- Assume your “pwd” is
  - /eecs/home/wangsong/eecs2031/lab1/feedback

- How to navigate to?
  - /eecs/home/wangsong/eecs3311/lab2

Users

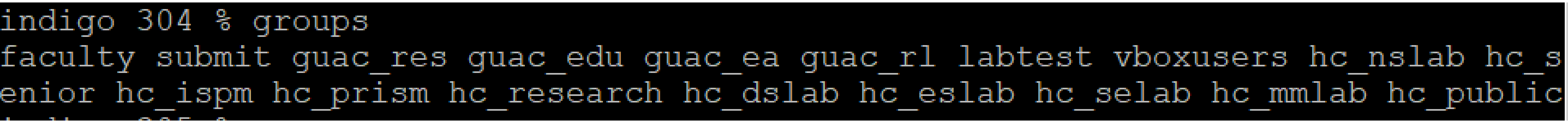
Unix/Linux is a multi-user operating system.

- Every program/process is run by a user.
- Every file is owned by a user.
- Every user has a unique integer ID number (UID).

- Different users have different access permissions, allowing users to:
  - read or write a given file
  - browse the contents of a directory
  - execute a particular program
  - install new software on the system
  - change global system settings
  - ...

Groups

command	description
groups	list the groups to which a user belongs
chgrp	change the group associated with a file



```
indigo 304 % groups
faculty submit guac_res guac_edu guac_ea guac_rl labtest vboxusers hc_nslab hc_s
enior hc_ispm hc_prism hc_research hc_dslab hc_eslab hc_selab hc_mmlab hc_public
```

Groups

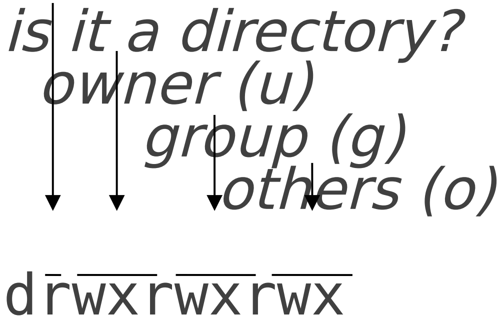
command	description
`groups`	list the groups to which a user belongs
`chgrp`	change the group associated with a file

- **group**: A collection of users, used as a target of permissions.
  - a group can be given access to a file or resource
  - a user can belong to many groups
  - see who's in a group using grep <groupname> /etc/group
- Every file has an associated group.
  - the owner of a file can grant permissions to the group
- Every group has a unique integer ID number (GID).
- *Exercise*: create a file, see its default group, and chang it

File permissions

command	description
`chmod`	change permissions for a file
`umask`	set default permissions for new files

- ***types***: read (`r`), write (`w`), execute (`x`)
- ***people***: owner (`u`), group (`g`), others (`o`)
  - on Windows, .exe files are executable programs; on Linux, any file with `x` permission can be executed
  - permissions are shown when you type `ls -l`



People & Permissions

- **People**: each user fits into only **<u>one</u>** of three permission sets:
  - owner (u) – if you create the file you are the owner, the owner can also be changed (using `chown`)
  - group (g) – by default a group (e.g. student, faculty) is associated with each file
  - others (o) – everyone other than the owner and people who are in the particular group associated with the file

You are in the most restrictive set that applies to you – e.g. if you are the owner, those permissions apply to you.

- **Permissions**: For regular files, permissions work as follows:
  - read (r) – allows file to be open and read
  - write (w) – allows contents of file to be modified or truncated
  - execute (x) – allows the file to be executed (use for executables or scripts)

* Directories also have permissions (covered later). Permission to delete or rename a file is controlled by the permission of its parent directory.

File permissions Examples

Permissions are shown when you type ls –l:

```
-rw-r--r--  1 wangsong faculty   319 Sep  6 16:43
 myfile.txt
-rw--w----  1 wangsong faculty   203 Oct  3 13:06
 grades.dat
```

`myfile.txt`:

- **owner** of the file (wangsong) has read & write permission
- **group** (faculty) members have read permission
- **others** have read permission

`grades.dat`:

- **owner** of the file (wangsong) has read & write permission
- **group** (faculty) members have write permission (but no read permission – can add things to the file but cannot cat it)
- **others** have no permissions (cannot read or write)

Changing permissions

- letter codes: `chmod` ***who***`(+-)`***what*** `filename`

  `chmod u+rw myfile.txt` (allow owner to read/write)

  `chmod +x banner` (allow everyone to execute)

  `chmod ug+rw,o-rwx grades.dat` (owner/group can read and write; others nothing)

  note: -R for recursive

  Note, no space after the comma!

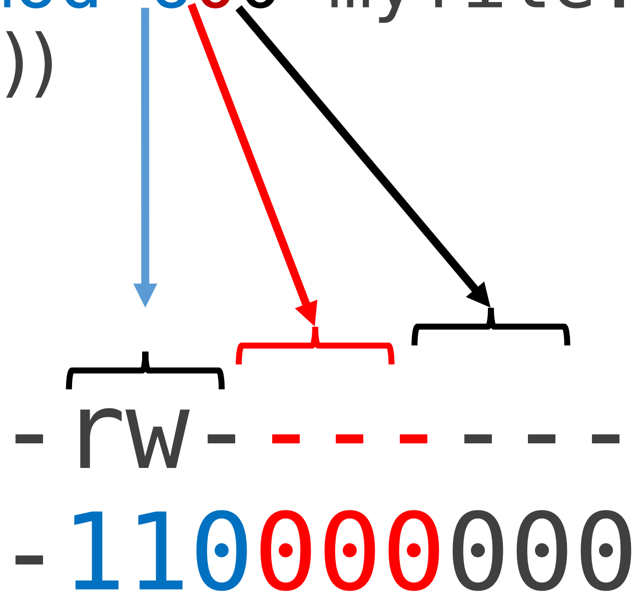
- octal (base-8) codes: `chmod` ***NNN*** `filename`
  - three numbers between 0-7, for owner (u), group (g), and others (o)
  - each gets +4 to allow read, +2 for write, and +1 for execute

  `chmod 600 myfile.txt` (owner can read/write (rw))

  `chmod 664 grades.dat` (owner rw; group rw; other r)

  `chmod 751 banner` (owner rwx; group rx; other x)

- `chmod 600 myfile.txt` (owner can read/write (rw))



```
-rw-------
-110000000
```

chmod

`chmod u+rw myfile.txt` (allow owner to read/write)

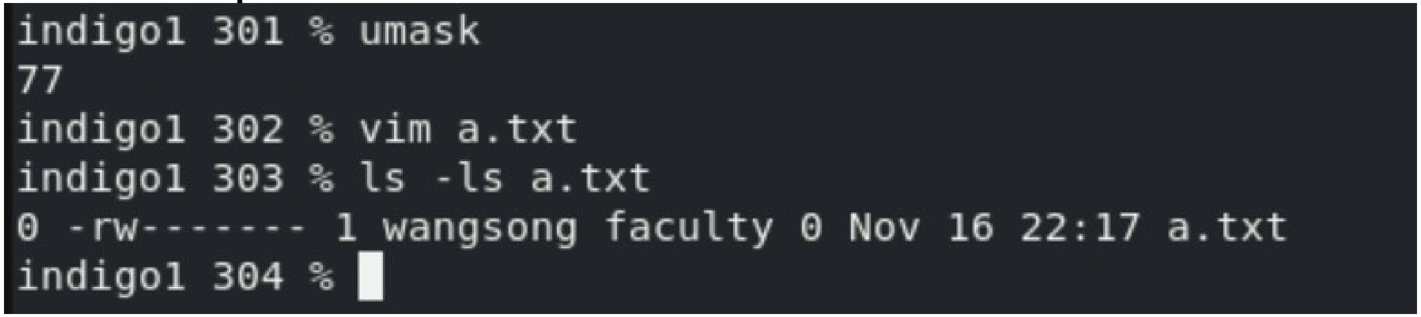
Note: leaves “group” and “other” permissions as they were.

`chmod 664 grades.dat` (owner rw; group rw; other r)

Note: sets permissions for “owner”, “group” and “other” all at once.

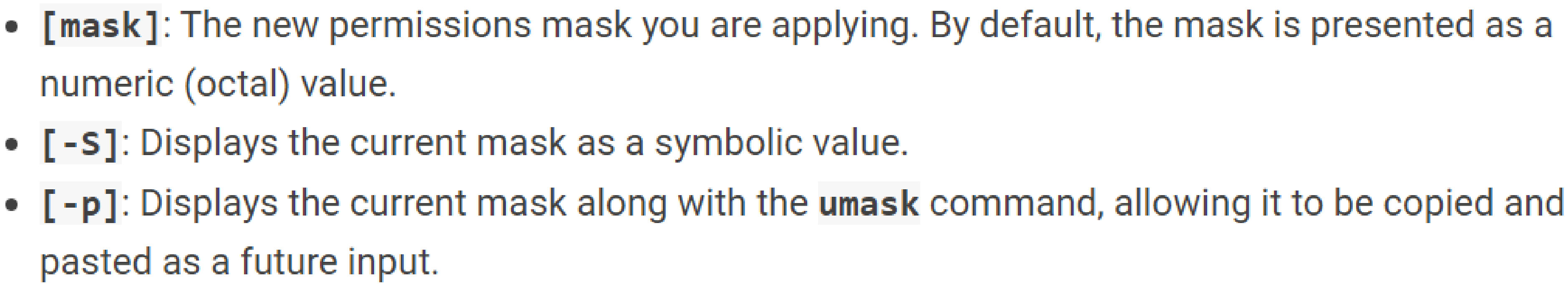
Umask (user file-creation mode)

- When creating a new file or directory, Linux applies the default set of permissions. The umask command lets you change these default permissions.



```
indigo1 301 % umask
77
indigo1 302 % vim a.txt
indigo1 303 % ls -ls a.txt
0 -rw------- 1 wangsong faculty 0 Nov 16 22:17 a.txt
indigo1 304 % 
```

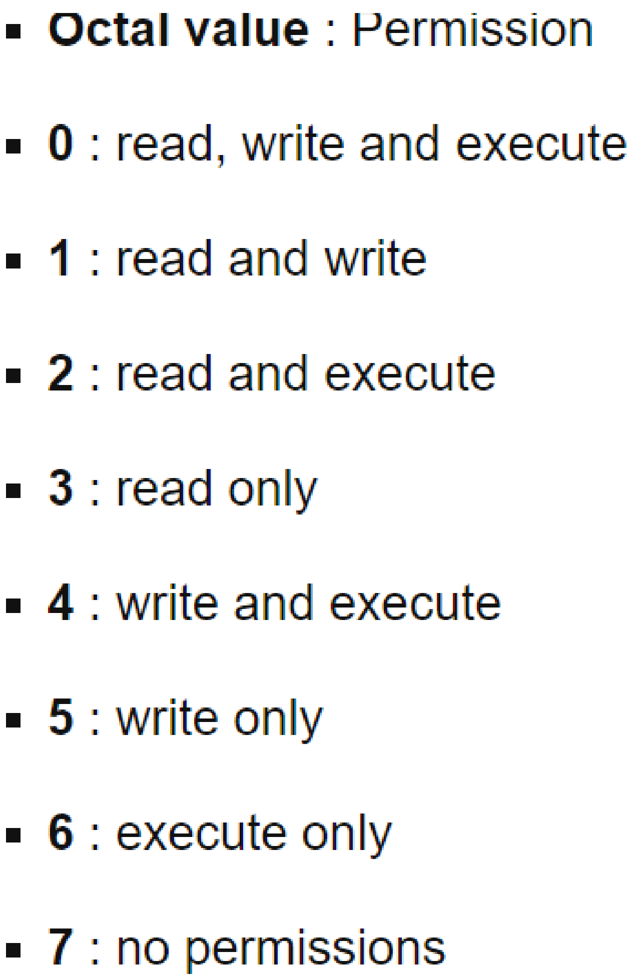
umask [-p] [-S] [mask]



- `[mask]`: The new permissions mask you are applying. By default, the mask is presented as a numeric (octal) value.
- `[-S]`: Displays the current mask as a symbolic value.
- `[-p]`: Displays the current mask along with the `umask` command, allowing it to be copied and pasted as a future input.

Umask (user file-creation mode)

A mask can have the following numeric, and the corresponding symbolic, values:



- **Octal value** : Permission
- **0** : read, write and execute
- **1** : read and write
- **2** : read and execute
- **3** : read only
- **4** : write and execute
- **5** : write only
- **6** : execute only
- **7** : no permissions

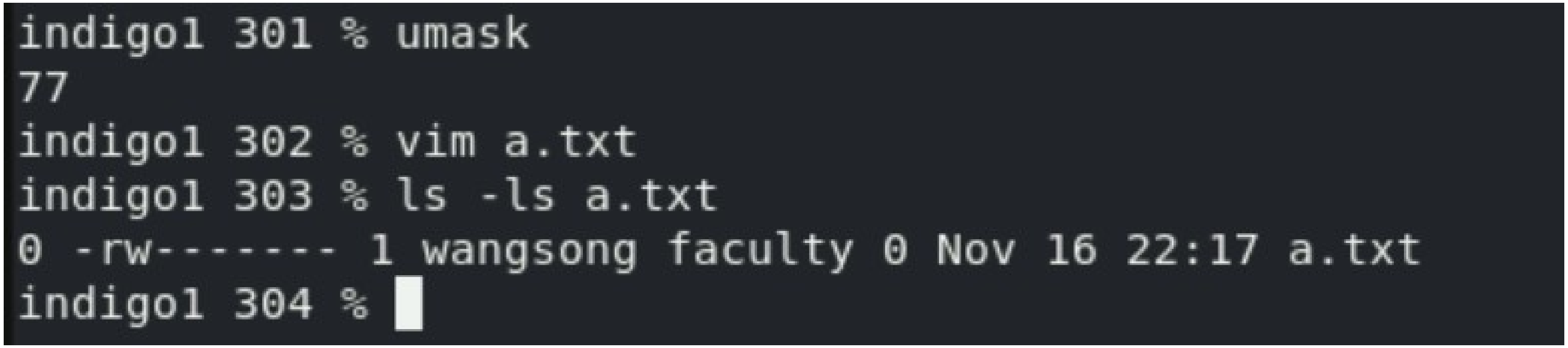
How to Calculate Umask Values

- The system default permission values are **777** (rwxrwxrwx) for folders and **666** (rw-rw-rw-) for files.

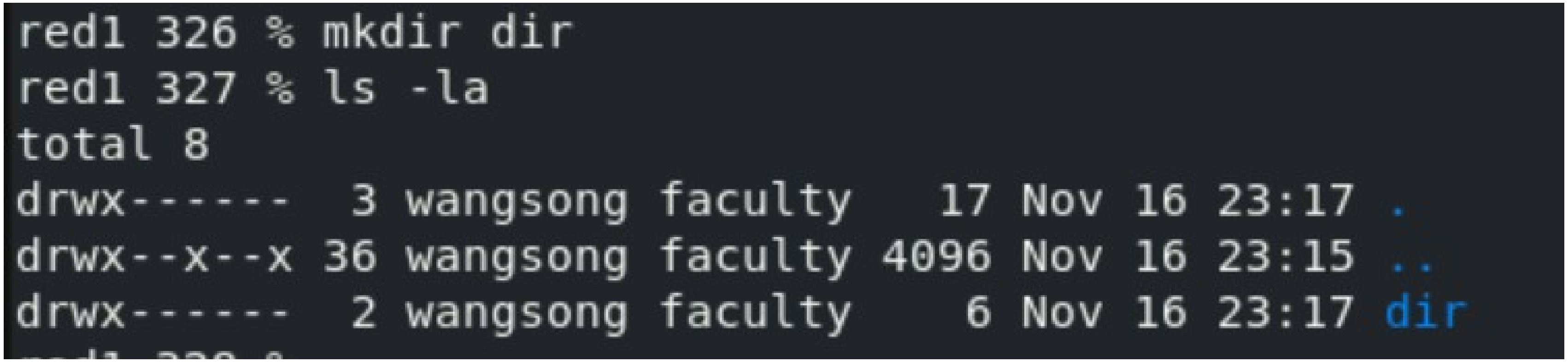
- **The default mask for a non-root user is 002**, changing the folder permissions to 775 (rwxrwxr-x), and file permissions to 664 (rw-rw-r--).

- **The default mask for a root user us 022**, changing the folder permissions to 755 (rwxr-xr-x), and file permissions to 644 (rw-r--r--).

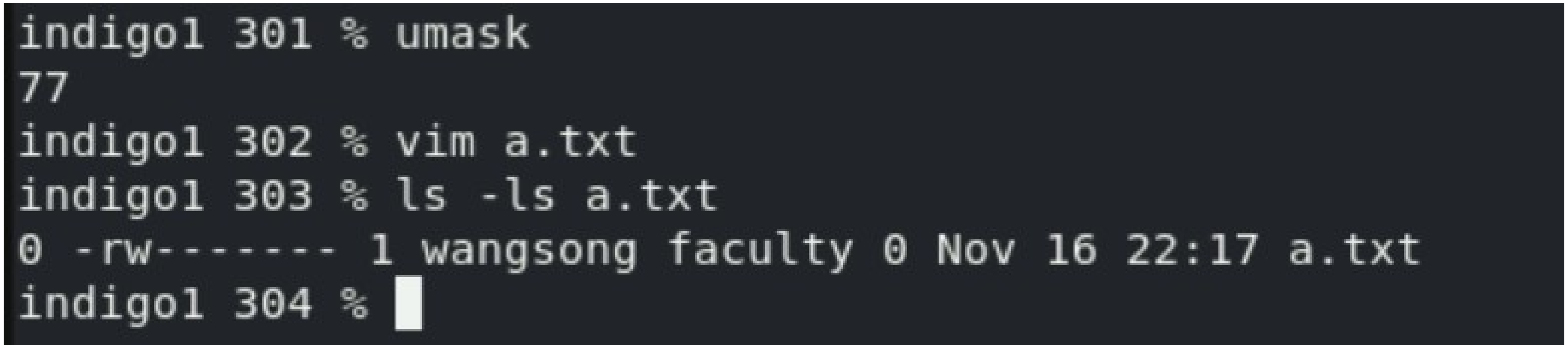
final permission value is the result of subtracting the umask value form the default permission value (e.g., 777 or 666)



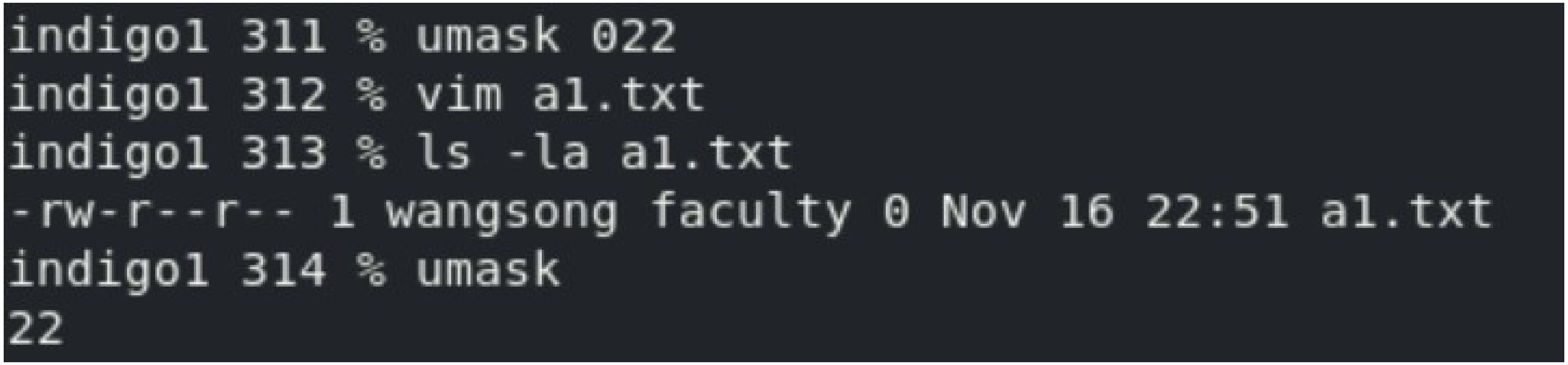
```
indigo1 301 % umask
77
indigo1 302 % vim a.txt
indigo1 303 % ls -ls a.txt
0 -rw------- 1 wangsong faculty 0 Nov 16 22:17 a.txt
indigo1 304 % 
```



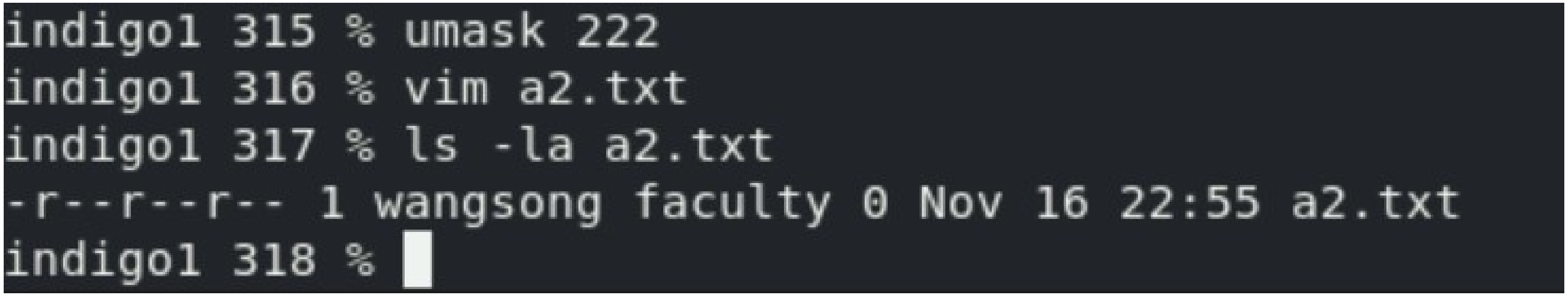
```
red1 326 % mkdir dir
red1 327 % ls -la
total 8
drwx------  3 wangsong faculty   17 Nov 16 23:17 .
drwx--x--x 36 wangsong faculty 4096 Nov 16 23:15 ..
drwx------  2 wangsong faculty    6 Nov 16 23:17 dir
red1 328 %
```



```
indigo1 301 % umask
77
indigo1 302 % vim a.txt
indigo1 303 % ls -ls a.txt
0 -rw------- 1 wangsong faculty 0 Nov 16 22:17 a.txt
indigo1 304 %
```



```
indigo1 311 % umask 022
indigo1 312 % vim a1.txt
indigo1 313 % ls -la a1.txt
-rw-r--r-- 1 wangsong faculty 0 Nov 16 22:51 a1.txt
indigo1 314 % umask
22
```



```
indigo1 315 % umask 222
indigo1 316 % vim a2.txt
indigo1 317 % ls -la a2.txt
-r--r--r-- 1 wangsong faculty 0 Nov 16 22:55 a2.txt
indigo1 318 %
```

Exercises

- Change the permissions on `myfile.txt` so that:
    - Others cannot read it.
    - Group members can execute it.
    - Others cannot read or write it.
    - Group members & Others can read and write it.
    - Everyone has full access.

Exercises (Solutions)

- Change the permissions on `myfile.txt` so that:
  - Others cannot read it. chmod o-r myfile.txt
  - Group members can execute it. chmod g+x myfile.txt
  - Others cannot read or write it. chmod o-rw myfile.txt
  - Group members & Others can read and write it. chmod go+rw myfile.txt
  - Everyone has full access. chmod ugo+rwx myfile.txt

- Now try this:
  - Deny all access from everyone. chmod ugo-rwx myfile.txt

Directory Permissions

- Read, write, execute a directory?
  - **Read** - permitted to read the contents of directory (view files and sub-directories in that directory, run ls on the directory)
  - **Write** - permitted to write in to the directory (add, delete, or rename & create files and sub-directories in that directory)
  - **Execute** - permitted to enter into that directory (cd into that directory)
- It is possible to have any combination of these permissions:

  Try these:
  - Have **read** permission for a directory, but NOT **execute** permission
    - ????
  - Have **execute** permission for a directory, but NOT **read** permission
    - ???

***Note:** permissions assigned to a directory **are not inherited** by the files within that directory

Directory Permissions

- Read, write, execute a directory?
  - **Read** - permitted to read the contents of directory (view files and sub-directories in that directory, run ls on the directory)
  - **Write** - permitted to write in to the directory (add, delete, or rename & create files and sub-directories in that directory)
  - **Execute** - permitted to enter into that directory (cd into that directory)
- It is possible to have any combination of these permissions:
  - Have **read** permission for a directory, but NOT **execute** permission
    - Can do an ls from outside of the directory but cannot cd into it, cannot access files in the directory
  - Have **execute** permission for a directory, but NOT **read** permission
    - Can cd into the directory, can access files in that directory if you already know their name, but cannot do an ls of the directory

***Note:** permissions assigned to a directory **are not inherited** by the files within that directory

Permissions don’t travel

- Note in the previous examples that permissions are separate from the file
  - If I disable read access to a file, I can still look at its permissions
  - If I upload a file to a directory, its permissions will be the same as if I created a new file locally

- Takeaway: permissions, users, and groups reside on the particular machine you’re working on. If you email a file or throw it on a thumb drive, no permissions information is attached.
  - Why? Is this a gaping security hole?

Careful with -R

- Say I have a directory structure, with lots of .txt files scattered
  - I want to remove all permissions for Others on all of the text files
  - First attempt:
    - `chmod –R o-rwx *.txt`
    - What happened?

This command will:

- change permissions on all the files that end with .txt in the current directory, AND
- it will **recursively change the permissions on all files in directories whose name end in .txt**
  (you probably do not have any directories whose names end that way!)
- This is not really recursive in the way you meant it to be! (see next slide…)

Careful with –R (fix)

- Say I have a directory structure, with lots of .txt files scattered
  - I want to remove all permissions for Others on all of the text files
  - First attempt:
    - chmod –R o-rwx *.txt
    - What happened?
  - Try and fix this using find and xargs!
    - find –name "*.txt"
    - find –name "*.txt" | xargs chmod o-rwx

Super-user (root)

command	description
sudo	run a single command with root privileges (prompts for password)
su	start a shell with root privileges (so multiple commands can be run)

- **super-user**: An account used for system administration.
  - has full privileges on the system
  - usually represented as a user named root

- Most users have more limited permissions than root
  - protects system from viruses, rogue users, etc.
  - if on your own box, why ever run as a non-root user?

Playing around with power...

- Create a file, remove all permissions
  - Now, login as root and change the owner and group to root
  - Bwahaha, is it a brick in a user's directory?

- Different distributions have different approaches
  - Compare Fedora to Ubuntu in regards to sudo and su…

- Power can have dangerous consequences
  - rm * might be just what you want to get rid of everything in a local directory
  - but what if you happened to be in /bin… and you were running as root…

tar files

	description
tar	create or extract .tar archives (combines multiple files into one .tar file)

- Originally used to create “tape archive” files
- Combines multiple files into a single .tar file
- You probably always want to use –f option and IT SHOULD COME LAST

- To **create** a single file from multiple files:

```
$ tar -cf filename.tar stuff_to_archive
```

  - -c **creates** an archive
  - -f read to/from a file
  - stuff_to_archive - can be a list of filenames or a directory

- To **extract** files from an archive:

```
$ tar -xf filename.tar
```

Compressed files

command	**description**
`zip`, `unzip`	create or extract .zip compressed archives
`gzip`, `gunzip`	GNU free compression programs (single-file)
`bzip2`, `bunzip2`	slower, optimized compression program (single-file)

- To **compress** a file:

  `$ gzip` ***filename*** produces: ***filename.gz***

- To **uncompress** a file:

  `$ gunzip` ***filename.gz*** produces: ***filename***

Similar for zip, bzip2. See man pages for more details.

.tar .gz archives

- Many Linux programs are distributed as .tar.gz archives (sometimes called .tgz)
- You could unpack this in two steps:
  1. **`gzip foo.tar.gz`** produces: foo.tar
  2. **`tar –xf foo.tar`** extracts individual files
- You can also use the tar command to create/extract compressed archive files all in one step:

```
$ tar -xzf filename.tar.gz
```

- -x **extracts** files from an archive
- -z filter the archive through gzip (compress/uncompress it)
- -f read to/from a file

Handy tip: You can use the “`file`” command to see what type a file is, just changing the file extension on a file does **not** change its type.

tar examples

You can combine options (-v, -z, etc.) various ways:

Create a single .tar archive file from multiple files (without compression):

```
$ tar -cvf filename.tar stuff_to_archive
```

- -c **creates** an archive file called ***filename***`.tar`
- -v verbosely list the files processed
- -f read to/from a file (as opposed to a tape archive)
- stuff_to_archive - can be filenames or a directory

Add –z option and use ***filename***`.tar.gz` to use compression:

```
  $ tar -cvzf filename.tar.gz stuff_to_archive
```