Week 1
Introduction to Linux

01 October 2018

CS 35L Lab 4

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Syllabus

- Can be found on the class website:
  https://web.cs.ucla.edu/classes/fall18/cs35L/

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- Lab Structure
  - Two parts
    - First half will usually be lecture
    - Second half will usually be time to work on your assignment

Course Outline

- Topics we will cover
  - Week 1: Introduction, files, and editing
  - Week 2: Commands and basic scripting
  - Week 3: More scripting, VMs, and construction tools
  - Week 4: Change management
  - Week 5: Low-level construction and debugging
  - Week 6: Systems programming
  - Week 7: Faults, failures, errors, and holes
  - Week 8: Security basics
  - Week 9: Parallelism
  - Week 10: The crystal ball

Grading

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  - 50% Homework (all equally weighted)
  - 50% Final Exam

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- Lateness Penalty
  - For an assignment submitted N to $N+1$ days late, the penalty is $2^N\%$ of the assignments value
- Academic Integrity
  - Reminder that any work **you** submit should be done by **you**

Assignments

- Assignment #1 is due at the end of this week
  - 06 October 2018
  - Due by 11:55 pm on that day

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- The other assignments are posted
  - Tentative, but likely won’t change much
  - You can work on future assignments if you wish

Assignments

- ➔ Important notes for future assignments
  - ◆ Assignment 7
    - Requires use of a BeagleBone Green Wireless Development Board
      - Seeed Studio BeagleBone Green Wireless Development Board
    - Alternatively, you can purchase the larger kit which includes the basic unit you will need
      - Seeed Studio BeagleBone Green Wireless IOT Kit
      - This larger kit is currently being used in CS 111
    - Does require a teammate for the lab

Assignments

- ➔ Important notes for future assignments
  - ◆ Assignment 10
    - You should begin working on this now
    - Includes both a written report and an oral presentation
    - I will send out a form to handle scheduling presentations in the coming weeks
      - Some people may need to present as early as 5th week

For those not currently enrolled

News for UCLA Computer Science 35L, Fall 2018

[35L home]

Here are news items that affect the core assignments and class material.

2018-09-25

- Assignment 1 and Assignment 10 are available. Please see Assignments for other assignments. These other assignments are tentative and may change before the week they are due.
- Create your SEASnet account and then check that it works as soon as you can, as there are occasionally delays before your account is activated.
- Here are suggestions if you're interested in the course but are neither enrolled nor on the waiting list.
  - Read Enrollment in Computer Science Classes and follow its advice.
  - Any PTEs are not typically given out until the end of the second week, to make sure that enough resources are available. You can try coming to classes before then. Sign up on any attendance sheet that is being passed around.

$Id: news.html,v 1.241 2018/09/25 18:13:04 eggert Exp $

Questions?

Introduction to Linux

Running Linux

- Seasnet linux servers
  - You will need a seasnet account
  - https://www.seasnet.ucla.edu/lnxsrv/
- Virtual Machines
  - Oracle VirtualBox
  - VMware

Command Line Interface VS Graphical User Interface

Command Line Interface VS Graphical User Interface

Steep Learning Curve	Intuitive
Pure Control	Limited Control
Cumbersome Multitasking	Easy Multitasking
Speed	Limited by pointing
Convenient Remote Access	Bulky Remote Access

Unix File System

- Everything is a file
  - This includes directories (folders) and devices
- Or a process
  - Processes are executing programs
- Files are organized in a tree hierarchy
  - “ / ” - the root directory
    - The topmost directory of the tree
  - “ ~ ” - the home directory
    - User specific
  - “ . ” - the current directory
  - “ .. ” - the parent directory

Moving Around

- pwd
  - print working directory
  - Print the path to the directory you are currently in
- cd
  - change directory
  - Moves the working directory to the specified directory
- man
  - Will open up a manual for any command
  - For example try man man
  - Hit “q” to exit the manual

Basic File Commands

- mv
  - Move a file
  - Alternatively, it is used to rename files
- cp
  - Copy a file
- rm
  - Remove a file
- mkdir
  - Make a directory

Basic File Commands

- rmdir
  - Remove an *empty* directory
- ls
  - List the contents of a directory
  - Some useful options
    - -d: lists only directories
    - -a: lists all files, including hidden files
    - -l: lists the long listing which includes file permissions
    - -s: shows size of each file, in blocks

Command History

- < up arrow >
  - Previous command
  - Can continue to scroll through more previous commands
- < tab >
  - Auto-complete
    - ie complete the filename that you began typing
  - Hitting a second time will give you auto-complete options
- !!
  - Replace with previous command

Other Useful Commands

Look these up using man

- ➔ echo
- ➔ cat
- ➔ head
- ➔ tail
- ➔ ps
- ➔ kill

Redirection

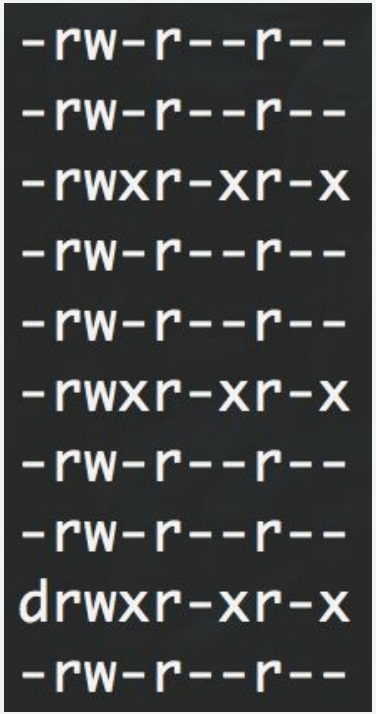
- > *file*
  - Writes stdout to a file
- >> *file*
  - Append stdout to a file
- < *file*
  - Use contents of a file as stdin

Changing File Attributes

- What are file attributes?
  - The metadata attached to files
- touch
  - Updates the access and modification time to the current time
  - Additionally allows options to specify a time
- ln
  - Creates a link to a file
  - Hard links
    - Point to a file's physical data
  - Symbolic links (soft links)
    - Point to the file

File Permissions

- ➔ Every file has permissions that determine how a user may interact with it
- ➔ These can easily be seen with the command “ ls -l ”
- ➔ The first character is a “d” if the file is a directory
- ➔ The other letters represent:



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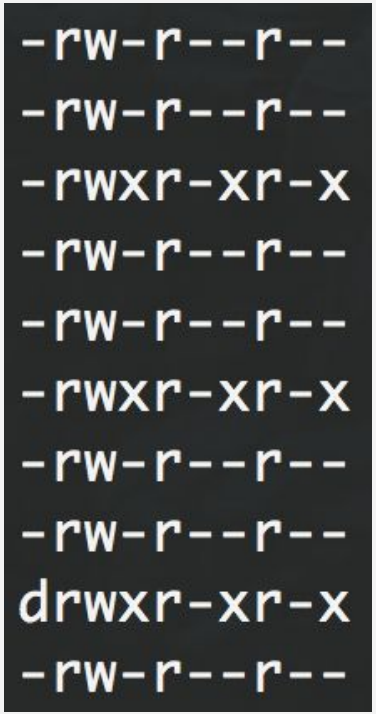
  - ◆ “r” - read



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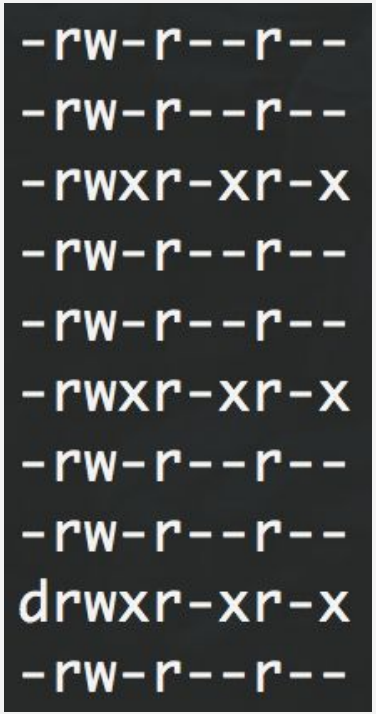

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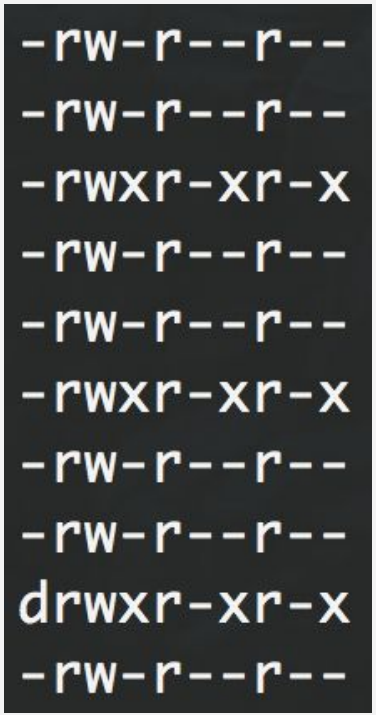
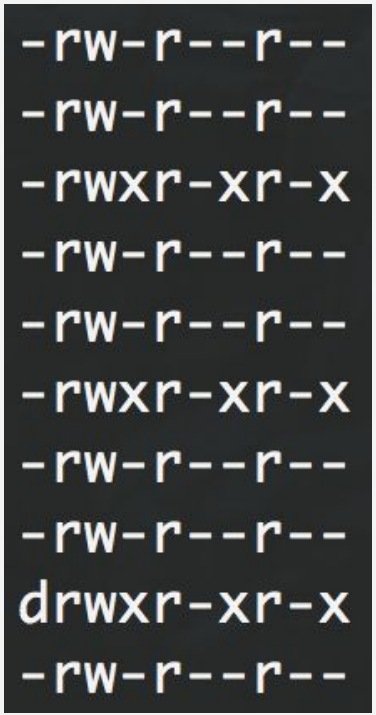
  - ◆ “r” - read
  - ◆ “w” - write
  - ◆ “x” - executable



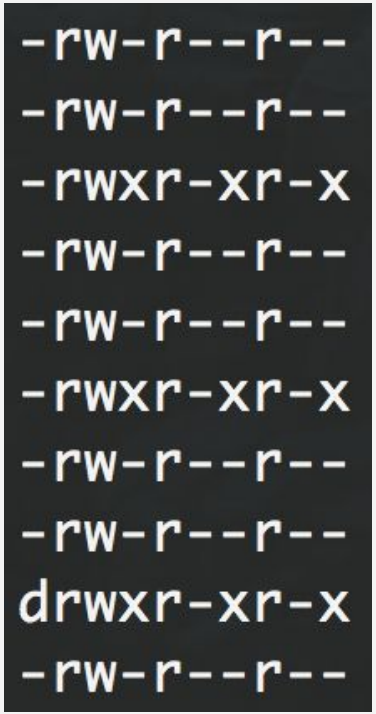
File Permissions

➔ Why are there three groups of three?



File Permissions

- Why are there three groups of three?
- There are permissions for 3 types of users
  - User
    - The owner of the file
  - Group
    - A group that the owner is in
  - Others
    - Anyone else
- In that order



Changing Permissions

- chmod
  - Change the mode of the file
- Can be used in multiple ways
- chmod [*ugoa*][+-=][*rwx*]
  - To individually apply one permission to a specific type of user
  - Eg. chmod u+x
- chmod [*0-7*][*0-7*][*0-7*]
  - To modify all of the permissions in one command
  - Eg. chmod 754

The “find” Command

- Useful for searching the tree for one or many files
- Some useful options
  - -type: type of file (like directory)
  - -perm: permission of file
  - -name: name of file
  - -user: the owner of the file
  - -prune: don’t descend into a directory
  - -maxdepth: descend into directories to a given depth

Linux Wildcards

When searching for files a few special characters can be very useful

- ?
  - Matches a single occurrence of any character
- *
  - Matches zero or more occurrences of any character
- [ ]
  - Matches any one of the characters between the brackets
  - A “-” can be used for a range of characters

Emacs

- Emacs is a text editor that can be used in a command line interface
  - Navigation and other tools in the editor are done using keyboard shortcuts
- For the majority of the class you can use whatever text editor you prefer (eg vim)
- However, for assignment #1 you should use Emacs

GNU Emacs Reference Card

(for version 26)

Starting Emacs

To enter GNU Emacs 26, just type its name: `emacs`

Leaving Emacs

suspend Emacs (or iconify it under X)	`C-z`
exit Emacs permanently	`C-x C-c`

Files

read a file into Emacs	`C-x C-f`
save a file back to disk	`C-x C-s`
save **all** files	`C-x s`
insert contents of another file into this buffer	`C-x i`
replace this file with the file you really want	`C-x C-v`
write buffer to a specified file	`C-x C-w`
toggle read-only status of buffer	`C-x C-q`

Getting Help

The help system is simple. Type `C-h` (or `F1`) and follow the directions. If you are a first-time user, type `C-h t` for a **tutorial**.

remove help window	`C-x 1`
scroll help window	`C-M-v`
apropos: show commands matching a string	`C-h a`
describe the function a key runs	`C-h k`
describe a function	`C-h f`
get mode-specific information	`C-h m`

Error Recovery

abort partially typed or executing command	`C-g`
recover files lost by a system crash	`M-x recover-session`
undo an unwanted change	`C-x u`, `C-_` or `C-/`
restore a buffer to its original contents	`M-x revert-buffer`
redraw garbaged screen	`C-l`

Incremental Search

search forward	`C-s`
search backward	`C-r`
regular expression search	`C-M-s`
reverse regular expression search	`C-M-r`
select previous search string	`M-p`
select next later search string	`M-n`
exit incremental search	`RET`
undo effect of last character	`DEL`
abort current search	`C-g`

Use `C-s` or `C-r` again to repeat the search in either direction. If Emacs is still searching, `C-g` cancels only the part not matched.

Motion

entity to move over	backward	forward
character	`C-b`	`C-f`
word	`M-b`	`M-f`
line	`C-p`	`C-n`
go to line beginning (or end)	`C-a`	`C-e`
sentence	`M-a`	`M-e`
paragraph	`M-{`	`M-}`
page	`C-x [`	`C-x ]`
sexp	`C-M-b`	`C-M-f`
function	`C-M-a`	`C-M-e`
go to buffer beginning (or end)	`M-<`	`M->`

scroll to next screen	`C-v`
scroll to previous screen	`M-v`
scroll left	`C-x <`
scroll right	`C-x >`
scroll current line to center, top, bottom	`C-l`
goto line	`M-g g`
goto char	`M-g c`
back to indentation	`M-m`

Killing and Deleting

entity to kill	backward	forward
character (delete, not kill)	`DEL`	`C-d`
word	`M-DEL`	`M-d`
line (to end of)	`M-0 C-k`	`C-k`
sentence	`C-x DEL`	`M-k`
sexp	`M-- C-M-k`	`C-M-k`

kill **region**	`C-w`
copy region to kill ring	`M-w`
kill through next occurrence of *char*	`M-z` *char*
yank back last thing killed	`C-y`
replace last yank with previous kill	`M-y`

Marking

set mark here	`C-@` or `C-SPC`
exchange point and mark	`C-x C-x`
set mark *arg* **words** away	`M-@`
mark **paragraph**	`M-h`
mark **page**	`C-x C-p`
mark **sexp**	`C-M-@`
mark **function**	`C-M-h`
mark entire **buffer**	`C-x h`

Query Replace

interactively replace a text string	`M-%`
using regular expressions	`M-x query-replace-regexp`

Valid responses in query-replace mode are

replace this one, go on to next	`SPC` or `y`
replace this one, don't move	`,`
skip to next without replacing	`DEL` or `n`
replace all remaining matches	`!`
back up to the previous match	`^`
exit query-replace	`RET`
enter recursive edit (`C-M-c` to exit)	`C-r`

Multiple Windows

When two commands are shown, the second is a similar command for a frame instead of a window.

delete all other windows	`C-x 1`	`C-x 5 1`
split window, above and below	`C-x 2`	`C-x 5 2`
delete this window	`C-x 0`	`C-x 5 0`
split window, side by side	`C-x 3`	
scroll other window	`C-M-v`	
switch cursor to another window	`C-x o`	`C-x 5 o`
select buffer in other window	`C-x 4 b`	`C-x 5 b`
display buffer in other window	`C-x 4 C-o`	`C-x 5 C-o`
find file in other window	`C-x 4 f`	`C-x 5 f`
find file read-only in other window	`C-x 4 r`	`C-x 5 r`
run Dired in other window	`C-x 4 d`	`C-x 5 d`
find tag in other window	`C-x 4 .`	`C-x 5 .`
grow window taller	`C-x ^`	
shrink window narrower	`C-x {`	
grow window wider	`C-x }`	

Formatting

indent current **line** (mode-dependent)	`TAB`
indent **region** (mode-dependent)	`C-M-\`
indent **sexp** (mode-dependent)	`C-M-q`
indent region rigidly *arg* columns	`C-x TAB`
indent for comment	`M-;`
insert newline after point	`C-o`
move rest of line vertically down	`C-M-o`
delete blank lines around point	`C-x C-o`
join line with previous (with arg, next)	`M-^`
delete all white space around point	`M-\`
put exactly one space at point	`M-SPC`
fill paragraph	`M-q`
set fill column to *arg*	`C-x f`
set prefix each line starts with	`C-x .`
set face	`M-o`

Case Change

uppercase word	`M-u`
lowercase word	`M-l`
capitalize word	`M-c`
uppercase region	`C-x C-u`
lowercase region	`C-x C-l`

The Minibuffer

The following keys are defined in the minibuffer.

complete as much as possible	`TAB`
complete up to one word	`SPC`
complete and execute	`RET`
show possible completions	`?`
fetch previous minibuffer input	`M-p`
fetch later minibuffer input or default	`M-n`
regexp search backward through history	`M-r`
regexp search forward through history	`M-s`
abort command	`C-g`

Type `C-x ESC ESC` to edit and repeat the last command that used the minibuffer. Type `F10` to activate menu bar items on text terminals.

GNU Emacs Reference Card

Buffers

select another buffer	`C-x b`
list all buffers	`C-x C-b`
kill a buffer	`C-x k`

Transposing

transpose **characters**	`C-t`
transpose **words**	`M-t`
transpose **lines**	`C-x C-t`
transpose **sexps**	`C-M-t`

Spelling Check

check spelling of current word	`M-$`
check spelling of all words in region	`M-x ispell-region`
check spelling of entire buffer	`M-x ispell-buffer`
toggle on-the-fly spell checking	`M-x flyspell-mode`

Tags

find a tag (a definition)	`M-.`
find next occurrence of tag	`C-u M-.`
specify a new tags file	`M-x visit-tags-table`
regexp search on all files in tags table	`M-x tags-search`
run query-replace on all the files	`M-x tags-query-replace`
continue last tags search or query-replace	`M-,`

Shells

execute a shell command	`M-!`
execute a shell command asynchronously	`M-&`
run a shell command on the region	`M-|`
filter region through a shell command	`C-u M-|`
start a shell in window `*shell*`	`M-x shell`

Rectangles

copy rectangle to register	`C-x r r`
kill rectangle	`C-x r k`
yank rectangle	`C-x r y`
open rectangle, shifting text right	`C-x r o`
blank out rectangle	`C-x r c`
prefix each line with a string	`C-x r t`

Abbrevs

add global abbrev	`C-x a g`
add mode-local abbrev	`C-x a l`
add global expansion for this abbrev	`C-x a i g`
add mode-local expansion for this abbrev	`C-x a i l`
explicitly expand abbrev	`C-x a e`
expand previous word dynamically	`M-/`

Miscellaneous

numeric argument	`C-u` *num*
negative argument	`M--`
quoted insert	`C-q` *char*

Regular Expressions

any single character except a newline	`.` (dot)
zero or more repeats	`*`
one or more repeats	`+`
zero or one repeat	`?`
quote special characters	`\`
quote regular expression special character *c*	`\`*c*
alternative ("or")	`|`
grouping	`\( ... \)`
shy grouping	`\(:? ... \)`
explicit numbered grouping	`\(:NUM ... \)`
same text as *n*th group	`\`*n*
at word break	`\b`
not at word break	`\B`

entity	**match start**	**match end**
line	`^`	`$`
word	`\<`	`\>`
symbol	`\_<`	`\_>`
buffer	`\‘`	`\’`
class of characters	**match these**	**match others**
explicit set	`[ ... ]`	`[^ ... ]`
word-syntax character	`\w`	`\W`
character with syntax *c*	`\s`*c*	`\S`*c*
character with category *c*	`\c`*c*	`\C`*c*

International Character Sets

specify principal language	`C-x RET l`
show all input methods	`M-x list-input-methods`
enable or disable input method	`C-\`
set coding system for next command	`C-x RET c`
show all coding systems	`M-x list-coding-systems`
choose preferred coding system	`M-x prefer-coding-system`

Info

enter the Info documentation reader	`C-h i`
find specified function or variable in Info	`C-h S`

Moving within a node:

scroll forward	`SPC`
scroll reverse	`DEL`
beginning of node	`b`

Moving between nodes:

next node	`n`
previous node	`p`
move **up**	`u`
select menu item by name	`m`
select *n*th menu item by number (1–9)	*n*
follow cross reference (return with `l`)	`f`
return to last node you saw	`l`
return to directory node	`d`
go to top node of Info file	`t`
go to any node by name	`g`

Other:

run Info **tutorial**	`h`
look up a subject in the indices	`i`
search nodes for regexp	`s`
quit Info	`q`

Registers

save region in register	`C-x r s`
insert register contents into buffer	`C-x r i`
save value of point in register	`C-x r SPC`
jump to point saved in register	`C-x r j`

Keyboard Macros

start defining a keyboard macro	`C-x (`
end keyboard macro definition	`C-x )`
execute last-defined keyboard macro	`C-x e`
append to last keyboard macro	`C-u C-x (`
name last keyboard macro	`M-x name-last-kbd-macro`
insert Lisp definition in buffer	`M-x insert-kbd-macro`

Commands Dealing with Emacs Lisp

eval **sexp** before point	`C-x C-e`
eval current **defun**	`C-M-x`
eval **region**	`M-x eval-region`
read and eval minibuffer	`M-:`
load a Lisp library from **load-path**	`M-x load-library`

Simple Customization

customize variables and faces	`M-x customize`

Making global key bindings in Emacs Lisp (example):

```
(global-set-key (kbd "C-c g") 'search-forward)
(global-set-key (kbd "M-#") 'query-replace-regexp)
```

Writing Commands

```
(defun command-name (args)
  "documentation" (interactive "template")
  body)
```

An example:

```
(defun this-line-to-top-of-window (line)
  "Reposition current line to top of window.
With prefix argument LINE, put point on LINE."
  (interactive "P")
  (recenter (if (null line)
                0
              (prefix-numeric-value line))))
```

The `interactive` spec says how to read arguments interactively. Type `C-h f interactive RET` for more details.

For GNU Emacs version 26
Designed by Stephen Gildea

For more Emacs documentation, and the TEX source for this card, see the Emacs distribution, or `https://www.gnu.org/software/emacs`

Assignment #1 Tips

- You will submit 2 files
  - ans1.txt should hold the answers to the laboratory section
  - key1.txt should hold the answers to the homework section
- Remember, if you need to know how a command works you can use the “man” command
- Try to use emacs shortcuts to complete things with the fewest keystrokes
  - Learning the shortcuts will be useful for future assignments