CS 35L- Software Construction Lab 3

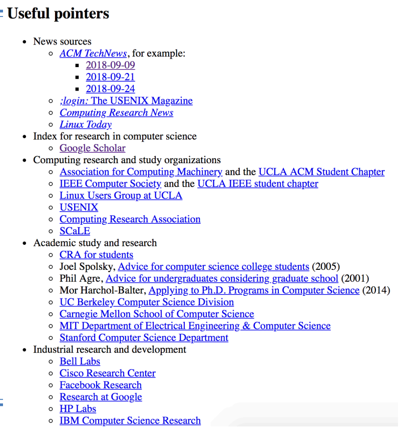
Fall 18
TA: Guangyu Zhou

Announcement

- PTE
  - Waitlist
  - Lab switch
- Switch of lab session:
  - Please proceed to contact the TA in other session for enrollment. Each session has it's own exam. You are welcomed to auditing.
- BeagleBones

Presentation

- Presentation
  - Topic on recent research in computer science
    - **Technical** content is required
  - Please think about topics from now on!
  - ~10 minutes talk in class
  - 1 or 2 people
  - Participation in Q&A
  - Sign-up sheet in week 3-4. (FCFS!)
  - Brief Research report (due in the last week)



Useful pointers

- News sources
  - *ACM TechNews*, for example:
    - 2018-09-09
    - 2018-09-21
    - 2018-09-24
  - *;login:* The USENIX Magazine
  - *Computing Research News*
  - *Linux Today*
- Index for research in computer science
  - Google Scholar
- Computing research and study organizations
  - Association for Computing Machinery and the UCLA ACM Student Chapter
  - IEEE Computer Society and the UCLA IEEE student chapter
  - Linux Users Group at UCLA
  - USENIX
  - Computing Research Association
  - SCaLE
- Academic study and research
  - CRA for students
  - Joel Spolsky, Advice for computer science college students (2005)
  - Phil Agre, Advice for undergraduates considering graduate school (2001)
  - Mor Harchol-Balter, Applying to Ph.D. Programs in Computer Science (2014)
  - UC Berkeley Computer Science Division
  - Carnegie Mellon School of Computer Science
  - MIT Department of Electrical Engineering & Computer Science
  - Stanford Computer Science Department
- Industrial research and development
  - Bell Labs
  - Cisco Research Center
  - Facebook Research
  - Research at Google
  - HP Labs
  - IBM Computer Science Research

Shell Scripting and Regular Expression

Week 2

Outline

- **Advanced Linux Commands**
- **Regular Expression**
- The Shell Scripting

Locale

- Set of parameters that define a user's cultural preference
  - Language
  - Country
  - Other area-specific things

`locale` command:
prints information about the current locale environment to standard output

Environmental Variables

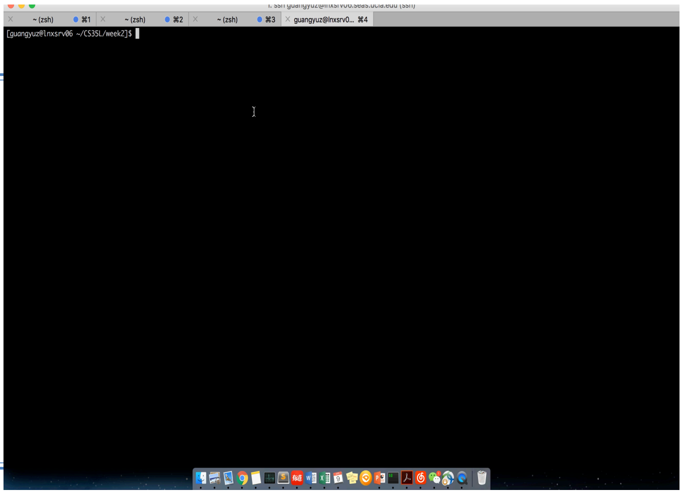
- Variables that can be accessed from any child process
- Common ones:
  - HOME: path to user's home directory
  - PATH: list of directories to search in for command to execute
- Change value:
  - **export** VARIABLE=…

LC_* Environment Variables

- locale gets its data from the LC_* environment variables
- Examples:
  - LC_TIME
    Date and time formats
  - LC_NUMERIC
    Non-monetary numeric formats
  - LC_COLLATE
    Order for comparing and sorting

Locale Settings Can Affect Program Behavior

- Default sort order for the sort command depends:
  - LC_COLLATE=‘C’: sorting is in ASCII order
  - LC_COLLATE=‘en_US’: sorting is case insensitive except when the two strings are otherwise equal and one has an uppercase letter earlier than the other.
- Other locales have other sort orders!



```
[guangyuz@lnxsrv06 ~/CS35L/week2]$
```

Text Processing Tools

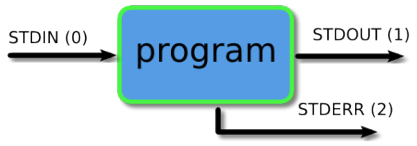
- sort: sorts text
- wc: outputs a one-line report of lines, words, and bytes
- head: extract top of files
- tail: extracts bottom of files

Sorting words

- Investigate the ‘sort’ command – man sort
  - Usage: sort [options] [filename]
  - -b: ignore leading blanks
  - -d: consider only blank and alphabets
  - -r: reverse the results of comparison
  - -u: unique, for duplicate records, output only the first one
- Sort all words in /usr/share/dict/words
- Save to your home folder

Basic I/O Redirection

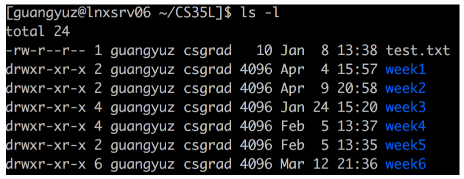
- I/O of most programs
  - read from standard input (stdin)
  - Write to standard output (stdout)
  - Send error messages to standard error (stderr)



Redirection and Pipelines

- Redirection
  - Use command < file to make program's standard input be file
  - Use command > file to make program's standard output be file
  - Use command >> file to append program's standard output to file
  - Use command 2> file to redirect STDERR to the file specified.
- Pipeline
  - Use command1 | command2 to make the standard output of program1 become the standard input of program2
  - Simple output: echo

Example



```
[guangyuz@lnxsrv06 ~/CS35L]$ ls -l
total 24
-rw-r--r-- 1 guangyuz csgrad   10 Jan  8 13:38 test.txt
drwxr-xr-x 2 guangyuz csgrad 4096 Apr  4 15:57 week1
drwxr-xr-x 2 guangyuz csgrad 4096 Apr  9 20:58 week2
drwxr-xr-x 4 guangyuz csgrad 4096 Jan 24 15:20 week3
drwxr-xr-x 4 guangyuz csgrad 4096 Feb  5 13:37 week4
drwxr-xr-x 2 guangyuz csgrad 4096 Feb  5 13:35 week5
drwxr-xr-x 6 guangyuz csgrad 4096 Mar 12 21:36 week6
```

What does ***ls | head -3*** return?
test.txt
week1
week2

How to list out week1 through week3?
• ***ls | head -4 | tail -3***

Search for Text

- grep
  - Use basic regular expression
  - Usage: grep [option] [pattern]
  - Can be integrated to other commands with |
- egrep
  - Extended grep that uses extended regular expressions
  - These are equal: grep –E   egrep   sed -r
- fgrep
  - Fast grep that matches fixed strings instead of regular expressions
  - These are equal: fgrep grep -F

Simple grep

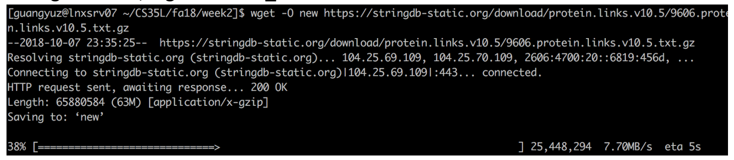
```
$ who                       Who is logged on
tolstoy tty1 Feb 26 10:53
tolstoy pts/0 Feb 29 10:59
tolstoy pts/1 Feb 29 10:59
tolstoy pts/2 Feb 29 11:00
tolstoy pts/3 Feb 29 11:00
tolstoy pts/4 Feb 29 11:00
austen pts/5 Feb 29 15:39 (mansfield-park.example.com)
austen pts/6 Feb 29 15:39 (mansfield-park.example.com)

$ who | grep -F austen      Where is austen logged on?
austen pts/5 Feb 29 15:39 (mansfield-park.example.com)
austen pts/6 Feb 29 15:39 (mansfield-park.example.com)
```

Compare difference between files

- diff
  - usage:
    diff *original_file new_file*
    diff –u original_file new_file
    diff –y original_file new_file *(output in two columns)*
  - function: compare files line by line
- comm
  - usage: comm [option] [file1] [file2]
  - function: compare **sorted files** line by line
- cmp
  - Compare two files byte by byte. When the files differ, by default, '**cmp**' outputs the byte offset and line number where the first difference occurs.

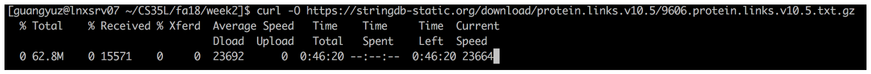
wget & curl

- A computer program that retrieves content from web servers
- Usage
  - wget <URL>, wget –O new_name <URL>



```
[guangyuz@lnxsrv07 ~/CS35L/fa18/week2]$ wget -O new https://stringdb-static.org/download/protein.links.v10.5/9606.prote
n.links.v10.5.txt.gz
--2018-10-07 23:35:25--  https://stringdb-static.org/download/protein.links.v10.5/9606.protein.links.v10.5.txt.gz
Resolving stringdb-static.org (stringdb-static.org)... 104.25.69.109, 104.25.70.109, 2606:4700:20::6819:456d, ...
Connecting to stringdb-static.org (stringdb-static.org)|104.25.69.109|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 65880584 (63M) [application/x-gzip]
Saving to: ‘new’

38% [============================>                                         ] 25,448,294  7.70MB/s  eta 5s
```

  - curl –O <URL>: Write output to <file> instead of stdout.



```
[guangyuz@lnxsrv07 ~/CS35L/fa18/week2]$ curl -O https://stringdb-static.org/download/protein.links.v10.5/9606.protein.links.v10.5.txt.gz
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0 62.8M    0 15571    0     0  23692      0  0:46:20 --:--:--  0:46:20 23664
```

tr: command for translate or transliterate

- Usage
  - tr [options] [set1] [set2]
  - Function: replace the elements in set1 with corresponding elements from set2
- Options:
  - -c: complement
  - -d: delete
  - -s: Replace each input sequence of a repeated character that is listed in set1 with a single occurrence of that character

Example: tr

tr [OPTION] … SET1 [SET2]

Example:

echo “abc” | tr [:lower:] [:upper:]

ABC

echo "password a1b2c3" | tr -d [:digit:]

password abc

echo "aaa123334" | tr -s a3

a1234

Without using |:

tr [:lower:] [:upper:]

abc

ABC

correction, it should be:
echo “abc” | tr [:lower:] [:upper:]
//make sure there’s a space between from and to translation

-s replaces sequence of repeated char that is listed in SET1 with single occurence of that char
-

sed: stream editor

- Modifies the input as specified by the command(s)

Usages:

- Printing specific lines or address ranges
  - sed –n '1p' file.txt — Prints out the first line
  - sed –n '1,5p' file.txt — prints out lines 1-5
  - sed –n '1~2p' file.txt — prints out odd num lines
- Deleting text
  - sed '1~2d' file.txt
- Substituting text - s/regex/replacement/flags
  - sed 's/cat/dog/' file.txt
  - sed 's/cat/dog/g' file.txt

first~step
match every steph’th line starting with first
i.e. 2~5 matches every fith line starting from 2nd

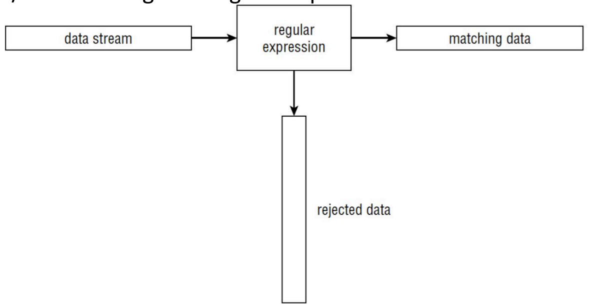
Regular Expression

- Notation that lets you search for text that fits a particular criterion, such as “starts with the letter a”
- Easy to learn, but difficult to handle

The programmer learns about regular expression, and try to use it in practical project.

Regular Expression ≈ Query

Match/Filter data against regular expression



Regular Expression

- Useful tools
  - Online test your regex expression
    http://regexpal.com
  - Simple regex tutorial
    https://www.icewarp.com/support/online_help/203030104.htm
  - References in Supplement materials

Regular Expression

- Different applications use different types of RE:
  - Programming languages (Python, Perl, Java)
  - Linux (sed, grep)
  - SQL
- Regular Expression Engine
  - Interprets regular patterns and use them to match texts
  - Two types:
    - BRE: Basic Regular expression
    - ERE: Extended Regular expression
  - BRE and ERE work together. ERE adds ?, +, and |, and it removes the need to escape the metacharacters ( ) and { }, which are *required* in BRE.

Special characters in Regular Expression

- Quantification (the number of previous occurrences)
  - ? (0 or 1)
  - * (0 or more)
  - + (1 or more)
  - {} (specified number)
- Alternation
  - [] (any character in the range)
  - | (one case or another)
- Anchors
  - ^ (beginning of a line)
  - $ (end of a line)
- Group
  - ()

"Go{0,6}gle" matches the word with less than 7 o's

"Go(oo)gle" matches any ver of word with even number of o's -because one or more instances of "oo"

Regular Expressions

Character	BRE / ERE	Meaning in a pattern
\	Both	Usually, turn off the special meaning of the following character. Occasionally, enable a special meaning for the following character, such as for \(...\) and \{...\}.
.	Both	Match any single character except NULL. Individual programs may also disallow matching newline.
*	Both	Match any number (or none) of the single character that immediately precedes it. For EREs, the preceding character can instead be a regular expression. For example, since . (dot) means any character, **.*** means "match any number of any character." For BREs, * is not special if it's the first character of a regular expression.
^	Both	Match the following regular expression at the beginning of the line or string. BRE: special only at the beginning of a regular expression. ERE: special everywhere.

Regular Expressions (cont'd)

\n	BRE	Replay the nth subpattern enclosed in \(and \) into the pattern at this point. n is a number from 1 to 9, with 1 starting on the left.
{*n*,*m*}	ERE	Just like the BRE \{*n*,*m*\} earlier, but without the backslashes in front of the braces.
+	ERE	Match one or more instances of the preceding regular expression.
?	ERE	Match zero or one instances of the preceding regular expression.
|	ERE	Match the regular expression specified before or after.
( )	ERE	Apply a match to the enclosed group of regular expressions.

Regular Expressions (cont'd)

$	Both	Match the preceding regular expression at the end of the line or string. BRE: special only at the end of a regular expression. ERE: special everywhere.
[...]	Both	Termed a bracket expression, this matches any one of the enclosed characters. A hyphen (-) indicates a range of consecutive characters. (Caution: ranges are locale-sensitive, and thus not portable.) A circumflex (^) as the first character in the brackets reverses the sense: it matches any one character not in the list. A hyphen or close bracket (]) as the first character is treated as a member of the list. All other metacharacters are treated as members of the list (i.e., literally). Bracket expressions may contain collating symbols, equivalence classes, and character classes (described shortly).
\{*n*,*m*\}	BRE	Termed an *interval expression*, this matches a range of occurrences of the single character that immediately precedes it. \{*n*\} matches exactly n occurrences, \{*n*,\} matches at least n occurrences, and \{*n*,*m*\} matches any number of occurrences between n and m. n and m must be between 0 and RE_DUP_MAX (minimum value: 255), inclusive.
\(\)	BRE	Save the pattern enclosed between \(and \) in a special *holding space*. Up to nine subpatterns can be saved on a single pattern. The text matched by the subpatterns can be reused later in the same pattern, by the escape sequences \1 to \9. For example, **\(ab\).*\1** matches two occurrences of ab, with any number of characters in between.

Examples

Expression	Matches
tolstoy	The seven letters tolstoy, anywhere on a line
^tolstoy	The seven letters tolstoy, at the beginning of a line
tolstoy$	The seven letters tolstoy, at the end of a line
^tolstoy$	A line containing exactly the seven letters tolstoy, and nothing else
[Tt]olstoy	Either the seven letters Tolstoy, or the seven letters tolstoy, anywhere on a line
tol.toy	The three letters tol, any character, and the three letters toy, anywhere on a line
tol.*toy	The three letters tol, any sequence of zero or more characters, and the three letters toy, anywhere on a line (e.g., toltoy, tolstoy, tolWHOtoy, and so on)

Example

"ab*c"	matches a string that has an a followed by zero or more b's ("ac", "abc", "abbc", etc.)
"ab+c"	same, but there's at least one b ("abc", "abbc", etc., but not "ac")
"ab?c"	there might be a single b or not ("ac", "abc" but not "abbc").
"a?b+$"	a possible 'a' followed by one or more 'b's at the end of the string: Matches any string ending with "ab", "abb", "abbb" etc. or "b", "bb" etc. but not "aab", "aabb" etc.

Example

"ab{2}"	matches a string that has an a followed by exactly two b's ("abb")
"ab{2,}"	there are at least two b's ("abb", "abbbb", etc.)
"ab{3,5}"	from three to five b's ("abbb", "abbbb", or "abbbbb")

POSIX Bracket Expressions

Class	Matching characters	Class	Matching characters
[:alnum:]	Alphanumeric characters	[:lower:]	Lowercase characters
[:alpha:]	Alphabetic characters	[:print:]	Printable characters
[:blank:]	Space and tab characters	[:punct:]	Punctuation characters
[:cntrl:]	Control characters	[:space:]	Whitespace characters
[:digit:]	Numeric characters	[:upper:]	Uppercase characters
[:graph:]	Nonspace characters	[:xdigit:]	Hexadecimal digits

Matching Multiple Characters with One Expression

*	Match zero or more of the preceding character
\{*n*\}	Exactly n occurrences of the preceding regular expression
\{*n*,\}	At least n occurrences of the preceding regular expression
\{*n*,*m*\}	Between n and m occurrences of the preceding regular expression

Operator Precedence (High to Low)

Operator	Meaning
[. .] [= =] [: :]	Bracket symbols for character collation
\metacharacter	Escaped metacharacters
[ ]	Bracket expressions
\(\) \\digit	Subexpressions and backreferences
* \{ \}	Repetition of the preceding single-character regular expression
no symbol	Concatenation
^ $	Anchors

Demo

- https://github.com/ziishaned/learn-regex

By def, regex does greedy matching — matches as long as possible

“/(.*at)/“ => The fat cat sat on the mat.
“/(.*?at)/“ => The fat cat sat on the mat.

Which regex would match “favorite” and “favourite”
favou?rite //for 0 or more instances of preceding regex

Which regex would match “Ggle”, “Gogle” and “Google”
Go*gle //* for any number of preceding regex
Which would match “Gogle”, “Google” and “Gooogle” but not “Ggle”
Go+gle //+ for one or more of preceding regex

Examples of tr command with regex

- Usage: as a part of pipeline
  - e.g. `cat assign2.html | tr -cs 'A-Za-z' '[\n*]' > pre`
- Eliminate everything except alphabet characters, also duplicate words
  - `tr -cs 'A-Za-z' '[\n*]'`
- Transform all upper cases characters to lower cases
  - `tr '[:upper:]' '[:lower:]'`
- Delete all left-over blanks
  - `tr -d '[:blank:]'`