CSE 390a
Lecture 7

Regular expressions,
egrep, and sed

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Lecture summary

- regular expression syntax

- commands that use regular expressions
  - `egrep` (extended grep) - search
  - `sed` (stream editor) - replace

- links
  - http://analyser.oli.tudelft.nl/regex/
  - http://www.panix.com/~elflord/unix/grep.html
  - http://www.robelle.com/smugbook/regexpr.html

What is a regular expression?

```
"[a-zA-Z_\-]+@(([a-zA-Z_\-])+\.)+[a-zA-Z]{2,4}"
```

- **regular expression** ("regex"): a description of a pattern of text
  - can test whether a string matches the expression's pattern
  - can use a regex to search/replace characters in a string
  - regular expressions are extremely powerful but tough to read
    - (the above regular expression matches basic email addresses)

- regular expressions occur in many places:
  - shell commands (`grep`)
  - many text editors (TextPad) allow regexes in search/replace
  - Java `Scanner`, `String split` (CSE 143 grammar solver)

egrep and regexes

command	description
egrep	extended grep; uses regexes in its search patterns; equivalent to grep -E

```
egrep "[0-9]{3}-[0-9]{3}-[0-9]{4}" faculty.html
```

- grep uses “basic” regular expressions instead of “extended”
  - extended has some minor differences and additional metacharacters
  - we’ll just use extended syntax. See online if you’re interested in the details.
- -i option before regex signifies a case-insensitive match
  - egrep -i "mart" matches "Marty S", "smartie", "WALMART", ...

Basic regexes

```
"abc"
```

- the simplest regexes simply match a particular substring
- this is really a pattern, not a string!
- the above regular expression matches any line containing "abc"
  - *YES* : `"abc", "abcdef", "defabc", ".=.abc.=.", …`
  - *NO* : `"fedcba", "ab c", "AbC", "Bash", …`

Wildcards and anchors

`.` (a dot) matches any character except `\n`

- `".oo.y"` matches `"Doocy"`, `"goofy"`, `"LooPy"`, ...
- use `\.` to literally match a dot `.` character

`^` matches the beginning of a line; `$` the end

- `"^fi$"` matches lines that consist entirely of `fi`

`\<` demands that pattern is the beginning of a *word*;
`\>` demands that pattern is the end of a word

- `"\<for\>"` matches lines that contain the word `"for"`

- *Exercise* : Find lines in `ideas.txt` that refer to the C language.
- *Exercise* : Find act/scene numbers in `hamlet.txt` .

Special characters

| means OR

- `"abc|def|g"` matches lines with "abc", "def", or "g"
- precedence of `^(Subject|Date):` vs. `^Subject|Date:`
- There's no AND symbol. Why not?

( ) are for grouping

- `"(Homer|Marge) Simpson"` matches lines containing `"Homer Simpson"` or `"Marge Simpson"`

\ starts an escape sequence

- many characters must be escaped to match them: `/ \ $ . [ ] ( ) ^ * + ?`
- `"\.\\n"` matches lines containing `".\n"`

Quantifiers: * + ?

`*` means 0 or more occurrences

- "`abc*`" matches "ab", "abc", "abcc", "abccc", ...
- "`a(bc)*`" matches "a", "abc", "abcbc", "abcbcbc", ...
- "`a.*a`" matches "aa", "aba", "a8qa", "a!?_a", ...

`+` means 1 or more occurrences

- "`a(bc)+`" matches "abc", "abcbc", "abcbcbc", ...
- "`Goo+gle`" matches "Google", "Gooogle", "Goooogle", ...

`?` means 0 or 1 occurrences

- "`Martina?`" matches lines with "Martin" or "Martina"
- "`Dan(iel)?`" matches lines with "Dan" or "Daniel"

- *Exercise* : Find all `^^` or `^_^` type smileys in `chat.txt` .

More quantifiers

`{`***`min`***`,`***`max`***`}` means between ***min*** and ***max*** occurrences

- `"a(bc){2,4}"` matches "abcbc", "abcbcbc", or "abcbcbcbc"

- ***min*** or ***max*** may be omitted to specify any number
  - `"{2,}"` means 2 or more
  - `"{,6}"` means up to 6
  - `"{3}"` means exactly 3

Character sets

`[ ]` group characters into a character set;
will match any single character from the set

- `"[bcd]art"` matches strings containing "bart", "cart", and "dart"
- equivalent to `"(b|c|d)art"` but shorter

- inside `[ ]`, most modifier keys act as normal characters
  - `"what[.!*?]*"` matches "what", "what.", "what!", "what?**!", ...

- *Exercise* : Match letter grades in 143.txt such as A, B+, or D- .

Character ranges

- inside a character set, specify a range of characters with -
  - `"[a-z]"` matches any lowercase letter
  - `"[a-zA-Z0-9]"` matches any lower- or uppercase letter or digit

- an initial ^ inside a character set negates it
  - `"[^abcd]"` matches any character other than a, b, c, or d

- inside a character set, - must be escaped to be matched
  - `"[+\-]?[0-9]+"` matches optional + or -, followed by ≥ one digit

- *Exercise* : Match phone #s in `faculty.html`, e.g. 206-685-2181 .

sed

command	description
`sed`	stream editor; performs regex-based replacements and alterations on input

- Usage:
  - `sed -r "s/`***`REGEX`***`/`***`TEXT`***`/g" `***`filename`***
    - substitutes (replaces) occurrence(s) of regex with the given text
    - if ***filename*** is omitted, reads from standard input (console)
    - sed has other uses, but most can be emulated with substitutions

- Example (replaces all occurrences of 143 with 390):
  - `sed -r "s/143/303/g" lecturenotes.txt`

more about sed

- `sed` is line-oriented; processes input a line at a time

- `-r` option makes regexes work better
  - recognizes `(  )` , `[  ]` , `*` , `+` the right way, etc.

- g flag after last / asks for a *global match* (replace all)

- special characters must be escaped to match them literally
  - `sed -r "s/http:\/\//https:\/\//g" urls.txt`

- sed can use other delimiters besides / ... whatever follows s
  - `find /usr | sed -r "s#/usr/bin#/home/billy#g"`

Back-references

- every span of text captured by ( ) is given an internal number
  - you can use `\number` to use the captured text in the replacement
  - `\0` is the overall pattern
  - `\1` is the first parenthetical capture
  - …
- Back-references can also be used in egrep pattern matching
  - Match "A" surrounded by the same character: "(.)A\1"

- Example: swap last names with first names
  - `sed -r "s/([^ ]*), ([^ ]*)/\2 \1/g" names.txt`

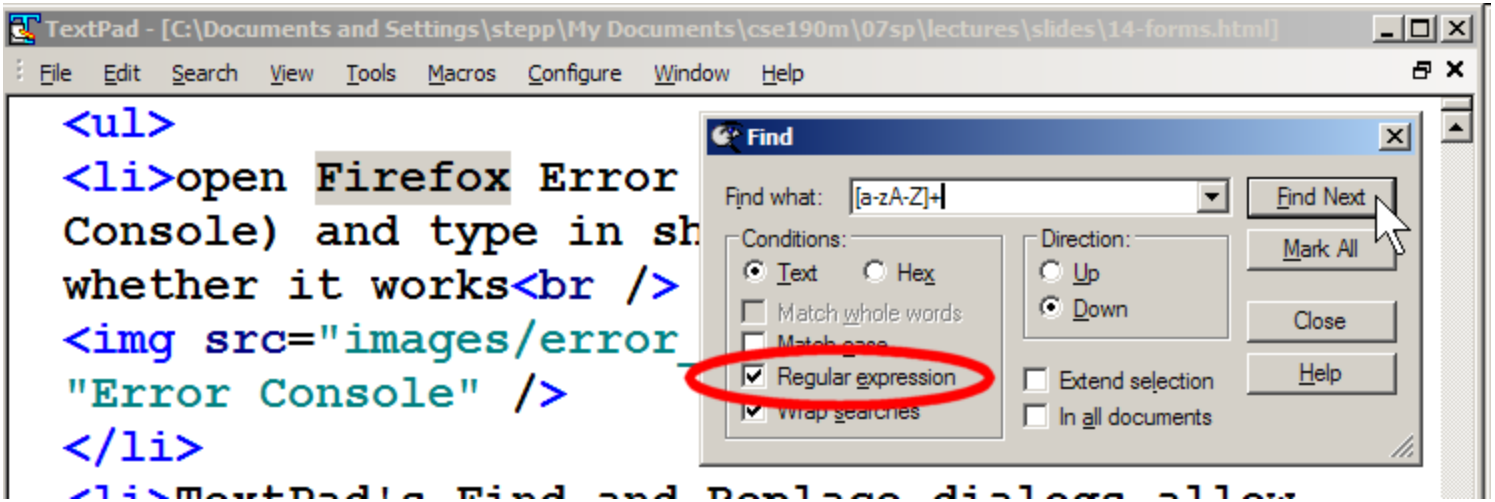
- *Exercise* : Reformat phone numbers from 206-685-2181 format to (206) 685.2181 format.

Other tools

- `find` supports regexes through its `-regex` argument

```
find . -regex ".*CSE 14[23].*"
```

- Many editors understand regexes in their Find/Replace feature



Exercise

- Write a shell script that reads a list of file names from `files.txt` and finds any occurrences of MM/DD dates and converts them into MM/DD/YYYY dates.
  - Example:

    ```
    Assignment due on 4/17
    ```

  - would be changed to:

    ```
    Assignment due on 4/17/2009
    ```