

Computer Systems and Architecture

Regular Expressions

Quinten Soetens

University of Antwerp

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Outline

What?

Tools

Anchors, character sets and modifiers

Advanced Regular expressions

Exercises

Regular Expressions

- ▶ A regular expression is a pattern that describes a set of strings
- ▶ Search and manipulate text based on patterns
- ▶ Flexible and powerful
- ▶ Three parts:
 - ▶ **Anchors** : specify the position of the pattern in relation to a line of text
 - ▶ **Character sets** : match one or more characters in a single position
 - ▶ **Modifiers** : specify how many times the previous character set is repeated

Tools

- ▶ Grep (`grep`)
 - ▶ Print lines matching a pattern
- ▶ Sed (`sed`)
 - ▶ Read and modify the input stream as specified by a pattern.
- ▶ Awk (`awk`)
 - ▶ More advanced string handling

Grep

- ▶ `grep 'class' /usr/share/dict/words`
 - ▶ Print all words that contain the string 'class'
- ▶ `grep '^class' /usr/share/dict/words`
 - ▶ Print all words that begin with the string 'class'
- ▶ `grep 'class$' /usr/share/dict/words`
 - ▶ Print all words that end with the string 'class'
- ▶ `grep '^c..ss$' /usr/share/dict/words`
 - ▶ Print all 5-letter words that begin with 'c' and end with 'ss'
- ▶ `grep '^c.*ss$' /usr/share/dict/words`
 - ▶ Print all words that begin with 'c' and end with 'ss'

Sed

- ▶ `sed 's/from/to/g'`
 - ▶ Replace all occurrences of regex *from* by *to*
- ▶ Substitute command:
 - ▶ `s` : Substitute command
 - ▶ `/.../.../` : Delimiter
 - ▶ `from` : Regular expression
 - ▶ `to` : Replacement string
 - ▶ `g` : Flags
- ▶ Usage:
 - ▶ `cat oldfile.txt | sed 's/from/to/'`
 - ▶ `sed 's/from/to/' < oldfile.txt`
 - ▶ `sed 's/from/to/' < oldfile.txt > newfile.txt`

Sed

- ▶ Other delimiters
 - ▶ `sed 's:/usr/local/bin:/home/bin:'`
 - ▶ `sed 's|/usr/local/bin|/home/bin|'`
- ▶ Using '&' as the matched string
 - ▶ `sed 's/[a-z]*/&/'` places parenthesis around a string
- ▶ Using '\1', '\2'... to keep part of the pattern

Sed Options

- ▶ `sed -e` : combine commands
 - ▶ `sed -e 's/a/A/' -e 's/b/B/'`
- ▶ `sed -f` : read commands from script file
- ▶ `sed -n` : silent mode

Sed Flags

- ▶ What to do when there is more than one occurrence of a pattern on a single line?
 - ▶ `/.../.../` : Only the first occurrence of *from* is replaced
 - ▶ `/.../.../g` : Global replacement
 - ▶ `/.../.../3` : Replace the third occurrence
 - ▶ `/.../.../2g` : Replace all but the first occurrence
 - ▶ `/.../.../p` : Print the modified lines
 - ▶ `sed -n 's/pattern/&/p'` duplicates the function of `grep`
 - ▶ `/.../.../w filename` : Write all modified lines to filename

Anchors

- ▶ `^` (beginning of line) and `$` (end of line)
- ▶ Examples:

`^A` “A” at the beginning of a line

`A$` “A” at the end of a line

`A^` “A^” anywhere on a line

`$A` “\$A” anywhere on a line

`^^` “^^” at the beginning of a line

`$$` “\$\$” at the end of a line

Character sets

- ▶ Simplest character set:
 - ▶ `abc` matches the character sequence `abc`
- ▶ `.` represents any single character
- ▶ Ranges
 - ▶ Between `[` and `]`: one of these characters/patterns
 - ▶ `[^` and `]`: NOT one of these characters/patterns
 - ▶ Use `-` between characters to denote a range between these characters
- ▶ Want to use literal characters with a special meaning?
 - ▶ “Escape” with backslash `\`
 - ▶ `\.` matches a `.`
 - ▶ `*` matches an asterix
 - ▶ `{`, `}`, `(`, `)`, `<`, `>` don't have a special meaning

Character sets

[A-Z]	Any capital letter
[A-Za-z]	Any letter
[]	The characters “[”
[0]	The character “0”
[0-9]	Any number
[^0-9]	Any character other than a number
[-0-9]	Any number or a “-”
[0-9-]	Any number or a “-”
[^[-0-9]	Any character except a number or a “-”
[]0-9]	Any number or a “[”
[0-9]]	Any number followed by a “[”

Modifiers

- ▶ Combining character sets:
 - ▶ `^T[a-z][aeiou]`
 - ▶ Matches a line that starts with T, followed by a letter and a vowel
- ▶ Use modifiers to repeat character sets
 - ▶ `[0-9]*` matches zero or more numbers
 - ▶ `[0-9][0-9]*` matches one or more numbers
 - ▶ `[0-9]\{5\}` matches five numbers
 - ▶ `[0-9]\{5,8\}` matches five to eight numbers
 - ▶ `[0-9]\{5,\}` matches five or more numbers
- ▶ Match only words: use `\<` and `\>`
 - ▶ Surrounding characters are anything but a letter, number, underscore, new line or end of line
 - ▶ `\<[tT]he\>` matches any line with the word the or The.

Backreferences

- ▶ Reuse patterns: remember what you found earlier
 - ▶ Mark pattern with `\(` and `\)`
 - ▶ Refer to previously marked patterns with `\1`, `\2`, `\3...`
- ▶ Examples
 - ▶ `\([a-z]\)\1` matches two identical letters.
 - ▶ `\<\([a-z]\)[a-z]*\1\>` matches every word that starts and ends with the same letter.
 - ▶ `\([a-z]\)\([a-z]\)[a-z]\2\1` matches every 5-letter palindrome.

Extended regular expressions

- ▶ Used by `egrep` and `awk`
- ▶ `?` matches 0 or 1 instances of the character set before
- ▶ `+` matches 1 or more instances of the character set before
- ▶ `\{`, `\}`, `\(`, `\)`, `\<`, `\>` no longer have a special meaning
- ▶ `^(Ruben|Pieter)` matches every line that starts with “Ruben” or “Pieter”

Exercises

- ▶ <http://msdl.cs.mcgill.ca/people/hv/teaching/ComputerSystemsArchitecture/#CS2>