

Ling 555 — Programming for Linguists

More unix basics & Regular Expressions

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Outline

unix basics

editors

regex/glob

Practice

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 - Calculator
 - Customizing your environment
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Network tools

unix basics

network tools

processes

archiving

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customization

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regex/glob

Practice

ssh secure remote login to another computer

sftp secure file transfer to another computer
(interactive)

scp secure file transfer to another computer
(non-interactive)

rsync extremely powerful and smart file transfer
(works both for local and remote
computers — non-interactive)

Process management

unix basics

network tools

processes

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line endings

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regex/glob

Practice

ps Display which processes are running
(non-interactive)

top Display which processes are running
(interactive)

kill Kill (abort) a process using the process ID

killall Kill (abort) a process using the process name

nice Set the cpu priority for a process

ionice Set the disk usage priority for a process

nohup Keep running after logging out

& Run process in the background

Example

Run a long process in the background and don't hog system resources

```
nohup ionice -c2 -n7 nice -n 19 prog --prog0pts &
```

Archiving and compressing

unix basics

network tools

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archiving

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customization

basic scripting

line endings

editors

regex/glob

Practice

`zip` Create a zip file

`unzip` Extract contents from a zip file

`gzip` Compress a file with GNU zip

`gunzip` Decompress a file with GNU zip

`bzip2` Compress a file with bzip compression (makes smaller files)

`bunzip2` Decompress a file with bzip

`tar` Create and extract tar archives

Common uses:

`create` `tar -czvf file.tar.gz directory`

`extract` `tar -xzvf file.tar.gz`

Calculator

unix basics

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processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

bc Basic interactive calculator. Usually should invoke with the `-l` option

dc Reverse polish style interactive calculator

Example

Add the first line of one file and the last of another

```
echo "`head -n1 numbers.txt` + `tail -n1  
numbers2.txt`" |bc -l
```

Example

Add the first 10 lines of a file (which contains one number per line)

```
echo "`head numbers.txt` + p" |dc
```

Environment variables

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Definition

Most UNIX programs pay attention to environment variables, such as the language, timezone, and PATH. To see all currently set variables, type:

```
export
```

Example

To change a variable, do:

```
export PATH="/home/robfelty/bin:${PATH}"
```

Custom variables and aliases

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Example

You can also create and use your own variables. If you frequently connect to the server `speech.psych.indiana.edu`, you can store that in a variable, e.g.

```
speech=speech.psych.indiana.edu  
ssh $speech
```

Example

If you always want to have color listings, you can create an alias

```
alias ls='ls --color'
```


.rc files

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Definition

Many UNIX programs, including the shell (we have been using the BASH shell), have files where one can store customizations between sessions.

Common .rc files

- .bashrc
- .vimrc
- .inputrc

Every time you open a new terminal, the .bashrc file is read.

Basic shell scripting

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Definition

A shell script uses the exact same syntax as the command line shell you use (we have been using BASH). In this way, you can group commands together, to reduce work.

Basic shell scripting

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Example

```
#!/bin/bash
# this script strips off any file extension from the
# argument, and runs the result through latex,
# bibtex, latex twice, dvips, ps2pdf, and then
# opens it with evince
SEED=`echo $1 | cut -f1 -d"."`
latex -interaction=batchmode $SEED && bibtex $SEED &&
    latex -interaction=batchmode $SEED && latex
    -interaction=batchmode $SEED && dvips -t letter
    -Ppdf $SEED.dvi -o $SEED.ps && ps2pdf $SEED.ps &&
    evince $SEED.pdf &
```

How might one improve this script?

```
1  #!/bin/bash
2  # this script syncs my school computer onto an external hard disk
   using rsync
3
4  # define a few constants
5  TARGET='/media/disk'
6  OPTIONS=' -avz --delete-after '
7  UMOUNT='FALSE'
8
9  echo "Executing incremental backup script"
10
11 # if /media/disk does not exist, create it, then mount the disk, and
   mark for unmounting
12 if [ ! -d /media/disk ]; then
13     echo "creating /media/disk and mounting"
14     UMOUNT='TRUE'
15     mkdir /media/disk
16     mount /dev/sdd1 /media/disk
17 fi
```

```
18 # first backup a few directories from the external disk to the local
    hard disk
19 ionice -c2 nice -n 19 rsync -avzu --exclude='.svn*'
    --exclude="*.swp"
    ${TARGET}/home/robfelty/{adam,RobDocs,pics,R,matlab}
    /home/robfelty
20 ionice -c2 nice -n 19 rsync -avzu --exclude='.svn*'
    --exclude="*.swp" ${TARGET}/var/celex /var
21
22 #next backup everything from the local disk to the external
23 ionice -c2 nice -n 19 rsync $OPTIONS /selinux /bin /etc /home /lib
    /lib64 /misc /opt /root /sbin /usr /var ${TARGET}/ >
    ~/fedibbletyBackupLog.txt
24
25 if [[ $UMOUNT = 'TRUE' ]]; then
26     echo "unmounting and removing /media/disk"
27     umount /media/disk
28     rmdir /media/disk
29 fi
```

Line Endings

unix basics

network tools

processes

archiving

calculator

customization

basic scripting

line endings

editors

regex/glob

Practice

Definition

Mac, UNIX, and DOS (Windows) use different line ending characters, which can cause lots of problems

`\r` Mac

`\n` UNIX

`\r\n` DOS

Converting between Mac, DOS, and UNIX

Most Linux distros ship with the programs *unix2dos* etc. Mac does not. Instead use the scripts provided in the `resources/utls` directory.

Common editors

unix basics

editors

regex/glob

Practice

nano (Open source version of pico).

Advantages:

- user-friendly. Lists commands at bottom of screen.
- small

Disadvantages:

- Not very powerful
- Not a default install on many UNIXes

vi Two-mode editor. This is my editor of choice.
advantages:

emacs Editor of choice for many programmers.
Swiss-army knife of editors.

Common editors

unix basics

editors

regex/glob

Practice

nano (Open source version of pico).

Advantages:

vi Two-mode editor. This is my editor of choice.

advantages:

- small (in size and memory usage)
- common (found on almost all UNIX systems by default)
- powerful (great regular expression support, and nice syntax highlighting)
- fast (your fingers never have to leave the home row. No mouse required)

Disadvantages:

- steep learning curve

emacs Editor of choice for many programmers.

Swiss-army knife of editors.

Common editors

unix basics

editors

regex/glob

Practice

nano (Open source version of pico).

Advantages:

vi Two-mode editor. This is my editor of choice.
advantages:

emacs Editor of choice for many programmers.

Swiss-army knife of editors. Advantages:

- Great syntax highlighting
- Single mode editor
- Includes all sorts of tools (news readers, e-mail readers, version control interfaces, friendfeed interface)

Disadvantages:

- Uses lots of memory
- Not a default install on many UNIXes

Globs (Wildcards)

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Definition

Globs (wildcards) can be used by BASH, and by other programs (Microsoft Word & Excel) as shortcuts to match multiple expressions

* Match zero or more characters.

? Match any single character

[...] Match any single character from the bracketed set. A range of characters can be specified with [-]

[!...] Match any single character NOT in the bracketed set.

{a,b,...} A list (set)

Globs (Wildcards)

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

N.B.

- An initial "." in a filename does not match a wildcard unless explicitly given in the pattern. In this sense filenames starting with "." are hidden. A "." elsewhere in the filename is not special.
- Pattern operators can be combined

Example

`chapter[1-5].*` could match *chapter1.tex*, *chapter4.tex*, *chapter5.tex.old*. It would not match *chapter10.tex* or *chapter1*

Using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Example

Delete all microsoft word documents in my home directory

```
rm -f ~/.doc
```

Example

Convert all microsoft word documents in my home directory to plain text

```
for file in ~/.doc; do antiword $file `basename  
$file .doc`.txt; done
```

Example

Create all files a-c with extensions txt,tmp,foo,bar

```
touch {a,b,c}.{txt,tmp,foo,bar}
```

Practice using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Download `l55practiceFiles.tar.gz` and untar it

- 1 Move all files ending in `.txt` to a new directory `txt`
- 2 Copy files `10-19` to a new directory `10-19`
- 3 list permissions for files ending in `.txt` which do not contain numbers
- 4 Separate files into different directories according to their extension

Practice using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Download `l55practiceFiles.tar.gz` and untar it

- 1 Move all files ending in `.txt` to a new directory `txt`
`mkdir txt; mv *.txt txt`
- 2 Copy files 10-19 to a new directory 10-19
- 3 list permissions for files ending in `.txt` which do not contain numbers
- 4 Separate files into different directories according to their extension

Practice using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Download `l55practiceFiles.tar.gz` and untar it

- 1 Move all files ending in `.txt` to a new directory `txt`
`mkdir txt; mv *.txt txt`
- 2 Copy files `10-19` to a new directory `10-19`
`mkdir 10-19; cp 1[0-9] 10-19`
- 3 list permissions for files ending in `.txt` which do not contain numbers
- 4 Separate files into different directories according to their extension

Practice using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Download l55practiceFiles.tar.gz and untar it

- 1 Move all files ending in .txt to a new directory txt
`mkdir txt; mv *.txt txt`
- 2 Copy files 10-19 to a new directory 10-19
`mkdir 10-19; cp 1[0-9] 10-19`
- 3 list permissions for files ending in .txt which do not contain numbers
`ls -l [a-zA-Z].txt`
OR
`ls -l [!0-9].txt`
- 4 Separate files into different directories according to their extension

Practice using globs in BASH

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Download `l55practiceFiles.tar.gz` and untar it

- 1 Move all files ending in `.txt` to a new directory `txt`

```
mkdir txt; mv *.txt txt
```

- 2 Copy files `10-19` to a new directory `10-19`

```
mkdir 10-19; cp 1[0-9] 10-19
```

- 3 list permissions for files ending in `.txt` which do not contain numbers

```
ls -l [a-zA-Z].txt
```

OR

```
ls -l [!0-9].txt
```

- 4 Separate files into different directories according to their extension

```
mkdir {tmp,foo,bar,txt}
```

```
for file in *. {tmp,txt,foo,bar}; do mv $file
```

```
`echo $file| cut -f 2 -d '.'` /$file; done
```

Regular expressions

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

- Finding the information you need from the databases will require the use of regular expressions
- Regular expressions are a feature in many programming languages that allow one to search for a given string in a body of text, including the use of some special characters
- Problem: I want to find all CVC words in the English CELEX database

Regular expressions

unix basics

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grep

sed

Practice

- Finding the information you need from the databases will require the use of regular expressions
- Regular expressions are a feature in many programming languages that allow one to search for a given string in a body of text, including the use of some special characters
- Problem: I want to find all CVC words in the English CELEX database
Solution: `grep -E '\\\\[CVC\\\\\\\\]' celex.cd`

Regular expressions

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

- Finding the information you need from the databases will require the use of regular expressions
- Regular expressions are a feature in many programming languages that allow one to search for a given string in a body of text, including the use of some special characters
- Problem: I want to find all CVC words in the English CELEX database
Solution: `grep -E '\\\\[CVC\\\\\\\\]' celex.cd`
- Problem: I want to know how many words that start and end with the letter *k*

Regular expressions

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

- Finding the information you need from the databases will require the use of regular expressions
- Regular expressions are a feature in many programming languages that allow one to search for a given string in a body of text, including the use of some special characters
- Problem: I want to find all CVC words in the English CELEX database
Solution: `grep -E '\\\\[CVC\\\\\\\\]' celex.cd`
- Problem: I want to know how many words that start and end with the letter *k*
Solution: `grep -iEc '\\k[a-z]*k\\\\' celex.cd`

character classes and anything

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Special characters: . ? + * [] {} () | ^ \$ \

. matches any character

[] matches any of the characters within the brackets e.g. [a0] matches both *a* and *0*

Several predefined shortcuts are also possible

[a-z] matches all lowercase letters

[A-Z] matches all uppercase letters

[a-zA-Z] matches all uppercase and lowercase letters

[0-9] matches all numbers

Quantifiers

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Special characters: . ? + * [] {} () | ^ \$ \

- ? matches 1 or 0 of the preceding character, e.g.
colou?r matches *color* and *colour*
- + matches 1 or more of the preceding character, e.g.
bug +off matches *bug off*, *bug off*, but not *bugoff*
- * matches any number of the preceding character, e.g.
colou*r matches *color*, *colour*, *colouur* and so on
- { } used to specify the number of times a character should be matched. Ranges are also possible.

Example

a{2} matches only *aa*

[a-z]{2} matches two lowercase letters, e.g. *ab*

[a-z]{2,4} matches 2–4 lowercase letters, e.g. *al* or *foo*

Greediness

Special characters: . ? + * [] {} () | ^ \$ \

Definition

By default, * and + are greedy, meaning that they match as much as possible. Often this is not the intended effect.

Example

I want to strip out html tags from a document. I use the following regular expression: `<.*>` This will match ``. But it will also match `some text I don't want to get rid of`

Solution: use negative character classes: `<[<>]*>`

In Perl and python, you can use `.*?` and `.+?`

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Grouping

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Special characters: . ? + * [] {} () | ^ \$ \

- () used to group sequences. Useful especially for backreferences (more on that later), and
- | used as an or operator, e.g. `x|y` matches either `x` or `y`

Example

`(m|M)(in|ax)imum` matches *minimum*, *maximum*, *Minimum* and *Maximum*

Backreferences

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Special characters:

. ? + * [] {} () | ^ \$ \

Definition

`\1` is a backreference. You can use multiple backreferences of the form `\n` where `n` is the `nth` pair of parentheses in the expression.

Example

Say I want to find common typos involving duplicate words (such as *a a* or *the the*). I could write an expression like so `(a|the) \1` which says “match either *a* or *the* followed by a space followed by whatever was matched in the parentheses”

The beginning, the end, and escaping

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Special characters: . ? + * [] {} () | ^ \$ \

- `^` matches the beginning of the string
Within brackets, negates the pattern, e.g. `[^xy]` matches everything but `x` or `y`
- `$` matches the end of the string
- `\` is the escape character. When you want to use one of the special characters as a normal character, it must be preceded by `\`

Grep specific information

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

- grep will search a file on a line by line basis, and return any lines which contain the regular expression
- In the case of CELEX, we will take advantage of the fact that fields are separated by\

Grep options

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Like many UNIX programs, grep has quite a few options available. For a complete list, type `man grep`

- -E extended regular expressions — allows us to use all the special characters
- -i ignore case
- -c simply print the number of matches
- -v invert match, i.e. return everything that does not match the expression

These can be used in conjunction with one another, e.g.

```
grep -icv 'dog' file
```

returns the number of lines that do not contain the word dog from the file 'file'.

Regular Expression practice

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
- all words that end in 'ing'
- word that begin with 'st' and ending with 'ing'
- all monosyllabic words
- all disyllabic words
- Find all words with a frequency of greater than 23

Regular Expression practice

unix basics

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regex/glob

globs

regular expressions

grep

sed

Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
\\st
- all words that end in 'ing'
- word that begin with 'st' and ending with 'ing'
- all monosyllabic words
- all disyllabic words
- Find all words with a frequency of greater than 23

Regular Expression practice

unix basics

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sed

Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
\\st
- all words that end in 'ing'
ing\\
- word that begin with 'st' and ending with 'ing'
- all monosyllabic words
- all disyllabic words
- Find all words with a frequency of greater than 23

Regular Expression practice

unix basics

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Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
`\\st`
- all words that end in 'ing'
`ing\\`
- word that begin with 'st' and ending with 'ing'
`\\st[a-z]*ing\\`
- all monosyllabic words
- all disyllabic words
- Find all words with a frequency of greater than 23

Regular Expression practice

unix basics

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Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
`\\st`
- all words that end in 'ing'
`ing\\`
- word that begin with 'st' and ending with 'ing'
`\\st[a-z]*ing\\`
- all monosyllabic words
`\\[[CV]+]\\`
- all disyllabic words
- Find all words with a frequency of greater than 23

Regular Expression practice

unix basics

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regular expressions

grep

sed

Practice

Practice writing some regular expressions that will find the following from CELEX:

- all words begin with 'st'
`\\st`
- all words that end in 'ing'
`ing\\`
- word that begin with 'st' and ending with 'ing'
`\\st[a-z]*ing\\`
- all monosyllabic words
`\\\[CV]+\]`
- all disyllabic words
`\\\[CV]+\][CV]+\]`
- Find all words with a frequency of greater than 23

Substitution

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Definition

Not only can you use regular expressions to match strings, but you can also replace matched strings with other strings. The easiest way to do this is with the program *sed*. **By default, sed prints out the entire input, replacing any patterns with the specified replacements** The basic form is like so:

```
sed 's/match/replace/flags' < infile > outfile
```

Example

Input: *The blue man sat next to the green man.*

```
echo 'The blue man sat next to the green man.' |  
sed 's/man/woman/'
```

Output: *The blue woman sat next to the green woman.*

Backreferences in replacements

unix basics

editors

regex/glob

globs

regular expressions

grep

sed

Practice

Definition

Backreferences can be used not only in patterns, but also in replacements. This allows one to use dynamic replacements.

Example

File replacement: I want to get rid of spaces in filenames, because they can cause problems with UNIX scripts. I can use sed.

```
mv "foo bar.txt" foo_bar.txt
```

```
for file in *; do mv "$file" `echo $file|sed -r 's/  
  /_/g'`; done
```

More transformations

unix basics

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grep

sed

Practice

- `\l` Makes the following character lower case
- `\u` Makes the following character upper case
- `\L` Makes all following characters lower case
- `\U` Makes all following characters upper case

Example

```
echo "Minimum" | sed -r 's/(in|ax)imum/\u\l/'
```

Practice (1)

unix basics

editors

regex/glob

Practice

- 1 Display the second column of courseBackground.txt
- 2 Create a new file with only the first and third columns of courseBackground.txt
- 3 Combine the courseBackground.txt with the new file you just created
- 4 Sort the courseBackground.txt file by nickname, ignoring case (HINT: use `-t $'\t'`)

Practice (1)

unix basics

editors

regex/glob

Practice

- 1 Display the second column of courseBackground.txt
`cut -f2 courseBackground.txt`
- 2 Create a new file with only the first and third columns of courseBackground.txt
- 3 Combine the courseBackground.txt with the new file you just created
- 4 Sort the courseBackground.txt file by nickname, ignoring case (HINT: use `-t $'\t'`)

Practice (1)

unix basics

editors

regex/glob

Practice

- 1 Display the second column of courseBackground.txt
`cut -f2 courseBackground.txt`
- 2 Create a new file with only the first and third columns of courseBackground.txt
`cut -f1,3 courseBackground.txt > courseBackground13.txt`
- 3 Combine the courseBackground.txt with the new file you just created
- 4 Sort the courseBackground.txt file by nickname, ignoring case (HINT: use `-t '$\t'`)

Practice (1)

unix basics

editors

regex/glob

Practice

- 1 Display the second column of courseBackground.txt
`cut -f2 courseBackground.txt`
- 2 Create a new file with only the first and third columns of courseBackground.txt
`cut -f1,3 courseBackground.txt > courseBackground13.txt`
- 3 Combine the courseBackground.txt with the new file you just created
`paste courseBackground.txt courseBackground13.txt > combinedFile.txt`
- 4 Sort the courseBackground.txt file by nickname, ignoring case (HINT: use `-t '$\t'`)
`sort -k 2,2f -t '$\t' courseBackground.txt`

Practice (2)

unix basics

editors

regex/glob

Practice

- 1 Count the number of entries in the Devil's Dictionary
- 2 Print out the all the entries in the Devil's dictionary (not the definition)
- 3 Count the number of occurrences of the word *the* in the Devil's Dictionary
- 4 Count the number of indefinite articles in the Devil's Dictionary

Practice (2)

unix basics

editors

regex/glob

Practice

- 1 Count the number of entries in the Devil's Dictionary
`grep -Ec '^[A-Z]{2,},' devilsDictionary.txt`
- 2 Print out all the entries in the Devil's dictionary (not the definition)
- 3 Count the number of occurrences of the word *the* in the Devil's Dictionary
- 4 Count the number of indefinite articles in the Devil's Dictionary

Practice (2)

unix basics

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regex/glob

Practice

- 1 Count the number of entries in the Devil's Dictionary

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt
```
- 2 Print out all the entries in the Devil's dictionary (not the definition)

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt | cut -f1 -d ','
```
- 3 Count the number of occurrences of the word *the* in the Devil's Dictionary
- 4 Count the number of indefinite articles in the Devil's Dictionary

Practice (2)

unix basics

editors

regex/glob

Practice

- 1 Count the number of entries in the Devil's Dictionary

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt
```
- 2 Print out all the entries in the Devil's dictionary (not the definition)

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt | cut -f1 -d ','
```
- 3 Count the number of occurrences of the word *the* in the Devil's Dictionary

```
grep -Eic '([^[a-z]|^)the([^[a-z]|$)'  
devilsDictionary.txt
```
- 4 Count the number of indefinite articles in the Devil's Dictionary

Practice (2)

unix basics

editors

regex/glob

Practice

- ① Count the number of entries in the Devil's Dictionary

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt
```
- ② Print out all the entries in the Devil's dictionary (not the definition)

```
grep -Ec '^[A-Z]{2,},' devilsDictionary.txt | cut -f1 -d ','
```
- ③ Count the number of occurrences of the word *the* in the Devil's Dictionary

```
grep -Eic '( |[^a-z]|^)the([a-z]|$)' devilsDictionary.txt
```
- ④ Count the number of indefinite articles in the Devil's Dictionary

```
grep -Eic '( |[^a-z]|^)(a|an)( |[^a-z]|$)' devilsDictionary.txt
```