DATA2901: Data Science, Big Data and Data Diversity (adv)

Introduction to Unix Tools

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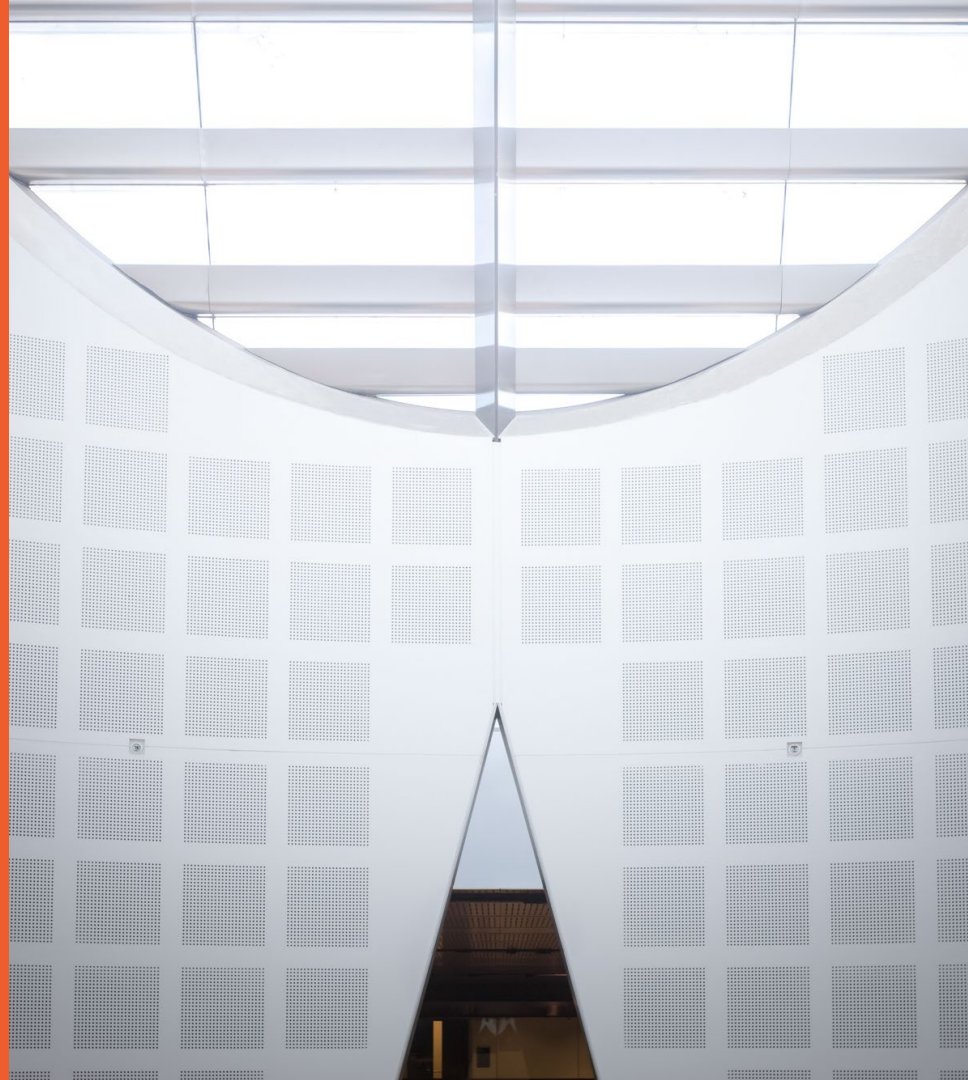
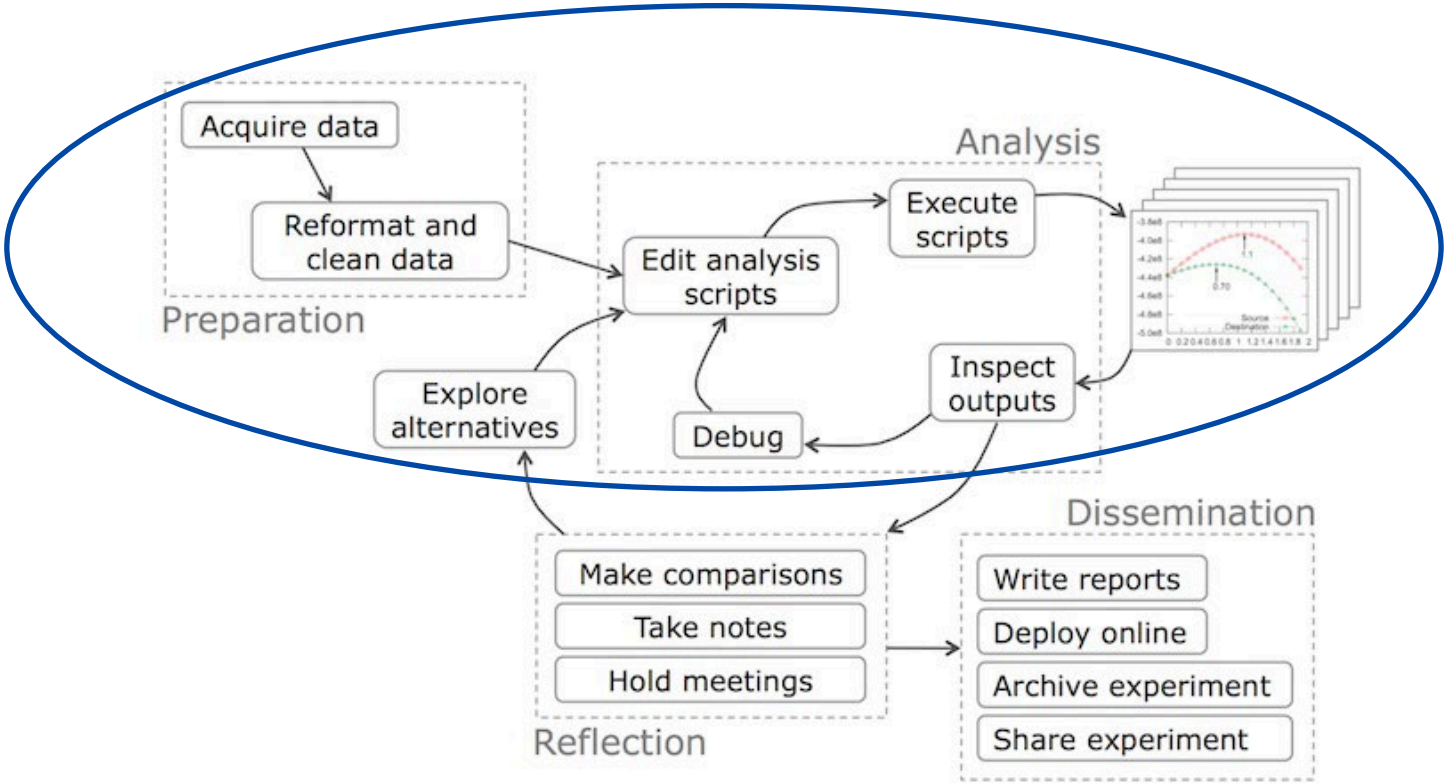


Exploratory Analysis Workflow



Exploratory Data Analysis with Unix

Unix…

- Unix is a family of multi-user, multi-tasking operating systems
  - Development started in the 1970s at Bell Labs
  - AT & T then licensed Unix to outside partners
  - Various commercialization attempts (some very successful)
    - Sun **Solaris**, IBM AIX, Microsoft Xenix, HP-UX
    - Berkeley **BSD Unix**
- **Linux** started 1991 as separate Unix-like project by Linus Torvalds
  - Free Software Foundation keeps referring to it as GNU/Linux
- Apple macOS is based on a Mach kernel with additional layers and tools derived from **BSD Unix**

Things to keep in mind

- Unix command line tools are **case sensitive**

- Unix commands are **keyboard-centric**; every character counts
  - ls instead of "list" or "dir"
  - chmod instead of "change_mode"

- Unix **seldomly asks** before executing something
  - be very careful when issuing modification or deletion commands!

Unix Filesystem

- Hierarchical file system with tree-like directory structure and access rights
  - "/" refers to the root of the Unix file system
  - Everything else is somewhere accessible under the root directory
  - Directory path delimiter: "/"
  - Classical path structure in Linux

    /bin /etc /sbin /usr /var /dev /home

- In Unix, everything is a file
  - e.g. /dev
- Cf. https://upload.wikimedia.org/wikipedia/commons/f/f3/Standard-unix-filesystem-hierarchy.svg

Commands to navigate the Filesystem

```
pwd
cd <name>
    cd
    cd -
    cd /
ls [<name>]
    ls -al
    ls -R
mkdir <name>
mv <old> <new>
cp <source> <destination>
```

- display working directory
- change directory
  - change to home directory
  - change to previous directory
  - change to root directory
- list (current) directory contents
  - list everything with all details
  - list directories recursively
- make new directory
- rename / move a file or directory
- copy a file

Finding files across directories: Find

find *startdir* **–name** *filename* **–print**

- Searches for files by name (or other characteristics) in directory sub-tree
- Displays matching files
- Note: case sensitive
- Many options!
  Can e.g. search by creation date or owner or file flags
  including negation and conjunctive conditions

Basic Unix Utility Commands

man *commandname*

- Read documentation ('man-page') of a given tool
- Also most unix commands support a '**-h**' or '**--help**' option for help

history

- List which commands have been executed before

!*num*

- Repeat command *num* from history

Looking at file content

- **cat** *filename*
  - output a file content in one go
- **more** *filename* or **less** *filename*
  - display (text-)content of a file page-by-page (less is the more powerful command)
- **head** *filename*
  - output the (by default: 10) first lines of a file
- **tail** *filename*
  - output the (by default: 10) last lines of a file
- **wc** *filename*
  - word count of file content; shows: *num_line* *num_words* *num_characters*
- **sort** *filename*
  - output content of file sorted; many options on how to sort

Looking at columns of a (CSV) file

cut –f *fields* **–d ,** *filename*

- output only the given fields of the file, as separated by the delimiter given with option –d (be default, it would assume the tab character)

Example:

```
cut -f 1,4,6-7 -d , programming_experience_survey_2018.csv
```

- Outputs columns 1, 4, 6 and 7 (as separated by comma in the file) from the CSV file programming_experience_survey_2018.csv

Attention: cut is very simplistic; e.g. does not parse quoted strings correctly which contain a delimiter sign…

Output Redirection

- Output of a Unix command is displayed by default on screen
- Can be re-directed into a file
- Those files can be read by the next command then
- Re-direct stdout:

  command > filename
- Re-direct stderr:

  command 2> filename
- Re-direct both to same file:

  command &> filename

Combining Unix Tools: Piping

- Remember: In unix everything is a file
  - In particular the output of a Unix command is a file 'stream'
  - => can hence be directly used as input for a subsequent command
- No need to materialize (store) the output of a command
  - Instead can be 'piped' into a subsequent Unix tool
- | sign

- Example:

  cat *filename* | sort | head -3

Finding data inside a file: grep or egrep

grep *pattern filename*

- Searches for patterns in file contents
- Displays matching lines
- Note: case sensitive

- Egrep variant supports extented regular expressions

Pattern Matching: Regular Expressions

- Sequence of characters that define a search pattern
  - Special characters for wildcards, options, repetitions, conjunctions

- Boolean or (Option): *vertical line* gray|grey
- Grouping with parenthesis: gr(a|e)y
- Wildcard: . matches any 1 char gr.y
- Quantification:
  - ? 0 or 1 (optional) colou?r
  - * 0 or more ab*c
  - + 1 or more ab+c
  - {n} n times
- Alternatives in [...] gr[ae]y
- Negation: ^ gr[^bcdf-z]y

Processing content of files: awk

- A programming language for the special purpose of text processing and data extraction – and its corresponding tool
  - AWK was created at Bell Labs in the 1970s,[3] and its name is derived from the surnames of its authors—Alfred Aho, Peter Weinberger, and Brian Kernighan
- Very powerful pattern matching language, where code blocks can be executed for each match, and data be extracted into variables or send to output
  - Special BEGIN and END 'patterns' to execute at start or end of a file
  - Field separators can be specified

AWK Example: Word Count

```
BEGIN {
      FS="[^a-zA-Z]+"
}
{
       for (i=1; i<=NF; i++)
            words[tolower($i)]++
}
END {
       for (i in words) print i, words[i]
}
```