Programming in shell 1

Filters
and
useful Unix commands.

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Filters

- Filter is a “simple” program that gets most of its data from its standard input (the main input stream) and writes its main results to its standard output (the main output stream).
- Examples: `head`, `tail`, `wc`, `cut`, `tr`, ...
- Filters are often used as elements of pipelines.
  - Which process allocates the most memory?

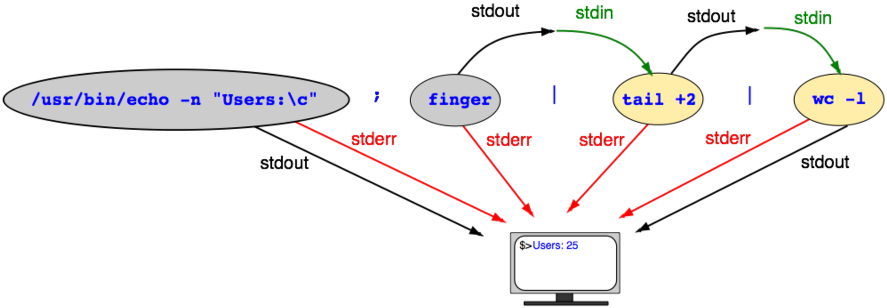
    ```
    ps -e -o rss,user,pid,comm | sort -k1,1n | tail -1
    ```

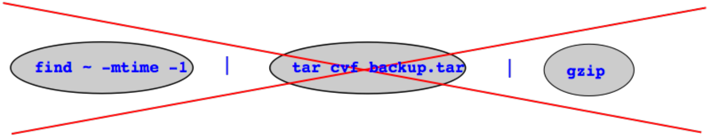
  - How to do get email addresses of all FIT students?

    ```
    getent passwd | cut -d: -f1 | \
       awk '{print $0 "@fit.cvut.cz"}' | tr '\n' ','
    ```

- Why use Unix filters and not my own C program?
  - It is not proprietary solution.
  - Anyone can simply modify the solution.
  - Platform portability.

Every application is not filter





tee

`tee [options] [files]`

- The filter reads lines from the standard input and writes them to the standard output and files.
- Options
  - `-a` ... appends the output to the files.
- Examples
  - How many users are logged on the server?

```
who | tr '\t'  ' ' | tr -s ' '  | cut -d' ' -f1,6 | \
   sort -u | tee list.txt | wc -l
```

nl

`nl [options] [files]`

- The filter numbers lines of the standard input/files and prints them to the standard output.
- Options
  - `-s'`*sep*`'` ... *sep* is the character(s) used in separating the line number.
  - `-bp'`*pattern*`'` ... only lines containing the *pattern* will be numbered.
- Examples
  - Default line numbering.

    ```
    ls -l /etc | nl
    ```

  - New separator between number and original line.

    ```
    ls -l /etc | nl -s') '
    ```

  - Only lines with patter will be numbered.

    ```
    ls -l /etc | nl -bp'^-'
    ```

wc

`wc [options] [files]`

- The filter prints a count of lines, words and characters of standard input/files to the standard output.
- Options
  - `-c` ... counts bytes.
  - `-w` ... counts words.
  - `-l` ... counts lines.
- Examples
  - How many files (items) are in the working directory?

```
ls -a | wc -w
ls -a | wc -l
```

  - How many user accounts are on the server `fray3.fit.cvut.cz`?

```
ssh trdlicka@fray3.fit.cvut.cz 'getent passwd | wc -l'
```

tr

`tr [options]` *set1* *set2*

- The filter copies the standard input to the standard output with substitution or deletion of selected characters.
- The *set*1 and *set*2 operands control translations that occur while copying characters.
- Options
  - `-c` ... use the complement of *set*1.
  - `-d` ... delete all occurrences of input characters that are specified by *set*1.
  - `-s` ... replace instances of repeated characters with a single character.
- Examples
  - Replace the following characters: a $\rightarrow$ X, b $\rightarrow$ Y, c $\rightarrow$ Z, in the output of the command `ls -l /`.

```
ls -l / | tr 'abc' 'XYZ'
```

tr

- Examples
  - Replace lower case by upper case in the output of `ls -l /`.

```
ls -l / | tr 'a-z'           'A-Z'             # GNU Linux
ls -l / | tr '[a-z]'         '[A-Z]'           # Solaris
```

```
ls -l / | tr '[:lower:]'   '[:upper:]' # locale independent
```

  - Replace all characters with a underscore character except characters *a* through *z* and newline in the output of the command `ls -l /`.

```
ls -l / | tr  -c '[:lower:]\n' '[_*]'
```

  - Modify the output of the command `ls -l /` so that adjacent columns are separated by just one space.

```
ls -l  | tr -s ' '
```

head

```
head [options] [files]
```

- The filter prints first 10 lines of standard input/files to the standard output.
- Options
  - *-k* … copies the first *k* lines from standard input to standard output.
- Examples
  - List the five largest files from the working directory.

    ```
    ls -S | head -5
    ```

  - List the three files from the working directory whose content has been last modified.

    ```
    ls -t | head -3
    ```

tail

`tail [options] [file]`

- The filter prints the last lines of the standard input/file to the standard output.
- Options
  - `-`*k* ... begins printing at *k*-th item from end of file.
  - `+`*k* ... begins printing at *k*-th item from beginning of file, `-n+`*k* ... GNU implementation.
  - `-f` ... dosn't quit at the end of file (use CTRL-C to quit).
- Examples
  - List the five smallest files from the working directory including details.

    ```
    ls -S | tail -5
    ```

  - List the five largest files from the working directory including details.

    ```
    ls -lS | tail -n+2 | head   # GNU Linux
    ls -lS | tail -n+2 | head   # Solaris
    ```

  - Execute the following commands in two different terminals.

    ```
    date > /tmp/f ; tail -f /tmp/f
    ```

    ```
    for (( i=0;i<5;i++)); do sleep 2; date >> /tmp/f ; done
    ```

cut

`cut [options] [files]`

- The filter cuts out selected fields of each line of the standard input/file and prints them to the standard output.
- Options
  - `-c` *list* ... specifies characters (e.g. 2-10,15,45-).
  - `-d` *delim* ... defines the field delimiter (-f option only).
  - `-f` *list* ... specifies fields separated in the file by a delimiter character.
- Examples
  - For each file in your working directory, list its access rights and name

```
ls -l | cut -c2-10,54-    # Attribute dependent solution
```

```
ls -l | tr -s ' ' | cut -d' ' -f1,9 | cut -c2-
```

  - For each user account on the server `fray3.fit.cvut.cz`, print the account name (the first item) and user information (the fifth item).

```
ssh trdlicka@fray3.fit.cvut.cz \
   'getent passwd | cut -d":" -f1,5'
```

paste

`paste [options] files`

- The utility merges corresponding or subsequent lines of files and print them to the standard output.
- Options
    - `-d`*list* ... each character in list is an element specifying a delimiter character.
- Examples
    - Save the name, uid and shell of users who have an account on this server to the files `/tmp/name`, `/tmp/uid` and `/tmp/shell`, respectively.

```
getent passwd | cut -d":" -f1 > /tmp/name.txt
getent passwd | cut -d":" -f3 > /tmp/uid.txt
getent passwd | cut -d":" -f7 > /tmp/shell.txt
```

    - Merge the previous files so that each row contains: `uid+shell*name`.

```
paste -d"+*" /tmp/uid.txt /tmp/shell.txt /tmp/name.txt
```

split

split [options] file [*prefix*]

- The utility splits a file into pieces of given size with given names: *prefix*aa, *prefix*ab, *prefix*ac, ...
- Options
  - -b *n* ... splits a file into pieces *n* bytes in size.
  - -l *n* ... splits a file into pieces *n* lines in size.
  - -a *n* ... *n* is length of name suffix.
- Examples
  - Split file /bin/date into 10kB pieces (files).

    ```
    split -b10k /usr/bin/date date
    ```

  - Merge the previous pieces to file mydate .

    ```
    cat date?? > mydate
    ```

  - Split file /etc/passwd into 5 line pieces (files).

    ```
    split -l 5 -a 3 /etc/passwd passwd
    ```

  - Merge the previous pieces to file mypasswd.

    ```
    cat passwd??? > mypasswd
    ```

sort

`sort [options] [files]`

- The filter sorts lines of all the named files together and writes the result on the standard output.
- Options
  - `-f` ... folds lower-case letters into upper case.
  - `-n` ... sorts in arithmetic order.
  - `-M` ... compares as months.
  - `-r` ... reverses the sense of comparisons.
  - `-u` ... identical lines in input file appear only one (uniq).
  - `-t`*char* ... uses *char* as the field separator character.
  - `-k`*start_field*`[.`*start_char*`][,`*end_field*`[.`*end_char*`]]` ... restricted sort key field definition.

sort

- Examples
  - Sort the output of `ls -l /` alphabetically.

    ```
    ls -l / | sort
    ```

  - Sort the output of `ls -l /` alphabetically by the sixth column.

    ```
    ls -l / | sort -k6,6
    ```

  - Sort the output of `ls -l /` by the sixth column as month.

    ```
    ls -l / | sort -k6,6M
    ```

  - Sort the output of `ls -l /` by the fifth column as number.

    ```
    ls -l / | sort -k5,5n
    ```

  - Sort the output of `ls -l /` by the date and after by size.

    ```
    ls -l / | sort -k6,6M -k7,7n -k5,5n
    ```

  - Sort the output of `ls -l /` by the time.

    ```
    ls -l / | sort  -k8.2,8.3n -k8.5,8.6n
    ```

uniq

`uniq [options] [file]`

- The filter reports or filters out repeated lines in a file and print them to the standard output.
- Options
  - `-c` ... precedes each output line with a count of the number of times.
- Examples
  - Which users have an application running on this server?

```
ps -eo user | tail -n+2 | sort | uniq
```

```
ps -eo user | tail -n+2 | sort -u        # better solution
```

  - How many processes have each user running?
    (Frequency table: users x number of processes)

```
ps -eo user | tail -n+2 | sort | uniq -c
```

cmp

`cmp [options] file1 file2`

- The utility compare two files byte by byte.
- Options
  - `-s` ... writes nothing for differing files and returns only exit status.
- Examples
  - Create two files by the following commands.

```
printf "%s\n" a b c d e f > f1.txt
printf "%s\n" a c "new line" d "e modified line" f > f2.txt
```

  - Compare the previous files.

```
cmp f1.txt f1.txt
cmp f1.txt f2.txt
```

  - Compare the previous files and print only string "Same", if they are identical.

```
cmp -s f1.txt f1.txt && echo "Same"
cmp -s f1.txt f2.txt && echo "Same"
```

comm

`comm [options] file1 file2`

- The utility reads `file1` and `file2`, which must be ordered in the current collating sequence, and produces three text columns as output.
  1. lines only in `file1`,
  2. lines only in `file2`,
  3. and lines in both files.
- Options
  - `-1` ... suppress column 1 (lines unique to `file1`).
  - `-2` ... suppress column 2 (lines unique to `file2`).
  - `-3` ... suppress column 3 (lines that appear in both files).
- Examples
  - Compare previous files.

```
comm f1.txt f2.txt
```

  - List rows that are the same in both files.

```
sort f1.txt > f1.sort
sort f2.txt > f2.sort
comm -12 f1.sort f2.sort
```

diff

```
diff [options] file1 file2
```

- The utility compares two files.
- Options
  - `-u` ... produces a listing of differences with lines of context.
    - `+` ... lines added or changed in `file2`.
    - `-` ... removed and changed lines in `file1`.
- Examples
  - Compare previous files.

```
diff -u f1.txt f2.txt
```

xargs

`xargs [options] [command]`

- The utility build and execute command lines from standard input.
- Options
  - `-I` *replstr* ... utility taking the entire line as a single argument, inserting it in argument for each occurrence of *replstr*.
- Examples
  - Create the following files and directory.

    ```
    touch {a,b,c}.{png,c,tar,gz,txt,jpg} ; mkdir pictures
    ```

  - Move all files with suffix `.png` or `.jpg` to the directory `pictures`

    ```
    printf "%s\n" *.png *.jpg | xargs -I FILE mv FILE pictures
    ```