# Part Three

## Substitution with sed

# Sample Data

Move into **section-3/**, find the following:

- m.tab - similar to unsorted.tab in Part 2
- ids.txt - a file of info on imaginary people
- s.fa - a protein sequence file

# The power of sed

```
$ sed 's/This/That/g' yourfile.txt   # text replacement
```

- search and replace (with style)
- extract specific patterns from files
- delete specific lines or ranges of lines

# sed will not hurt your data

sed reads your data and writes to output.

The output will pour into your terminal unless redirected to a pipe or file.

Your original file is perfectly safe

# sed won’t, but YOU can

**NEVER REDIRECT TO ORIGIN**

**--- Pipelines should not be circular ---**

The following will destroy z.txt:

```
prog1 z.txt | prog2 > z.txt    # BAD!!!
```

# Test drive sed…

```
$ sed ‘ ’ m.tab                    # prints everything
$ sed -n ‘ ’ m.tab                 # prints nothing

$ sed -n ‘/Fred/p’ m.tab           # same as “grep ‘Fred’ m.txt”
$ sed ‘/Fred/p’ m.tab              # duplicate ‘Fred’ lines

$ sed ‘s/Fred/George/’ m.tab       # 1st time text replacement
$ sed ‘s/Fred/George/g’ m.tab      # global text replacement
```

# sed syntax

sed **[OPTIONS]** **<command>**

sed **[OPTIONS]** **‘[LINE_ADDRESS] PROCEDURE’**

# sed workflow

**for each** line of input
    remove trailing newline character
    **if** line matches the **address**
        perform user's **procedure**
    **if -n** option is NOT set
        append newline and print

# Addresses - by number

| | |
|---|---|
| **1** | Matches line number 1 |
| **12** | Matches line number 12 |
| **2,5** | Matches lines 2 to 5 |
| **5,$** | Matches lines 5 and on |

```
$ sed -n '1p' m.tab          # prints 1st line
$ sed -n '5,$p' m.tab        # prints lines 5 and on
```

# Addresses - by expression

| | |
|---|---|
| **/ham/** | Matches lines with pattern ‘ham’ |
| **/a/,/b/** | Matches from lines matching a to b |
| **1,/ham/** | Matches lines 1 to matching ‘ham’ |
| **/ham/,$** | Matches from ‘ham’ to the end |

```
$ sed -n ‘/ham/p’ m.tab          # prints lines matching ham
$ sed -n ’/start/,/stop/p’ m.tab # print between two patterns
```

# Procedure: deletion (d)

When the line matches the address, sed does not print, rather it moves onto the next line

# Examples 3.1: deletion (d)

The address can be a number or a regular expression:

```
$ sed 'd' m.tab                  # delete everything
$ sed '1d' m.tab                 # delete 1st line
$ sed '/Fred/d' m.tab            # delete lines containing 'Fred'
$ sed '5,10d' m.tab              # delete lines 5 to 10
$ sed '10,$d' m.tab              # delete lines from 10 on
$ sed '/R/,/T/d' m.tab           # delete lines between R and T
$ sed '/Fred/,/Duffy/d' m.tab
```

# ! operator, invert selection

Addresses can be negated with **!**

| | |
|---|---|
| **1!** | Matches lines NOT equal to 1 |
| **2,5!** | Matches lines NOT between 2 and 5 |

```
$ sed -n '1!p' m.tab          # prints all except 1st line
$ sed -n '2,5!p' m.tab        # prints all except lines 5 and on
$ sed -n '/Bob/!p' m.tab      # prints all except Bob lines
```

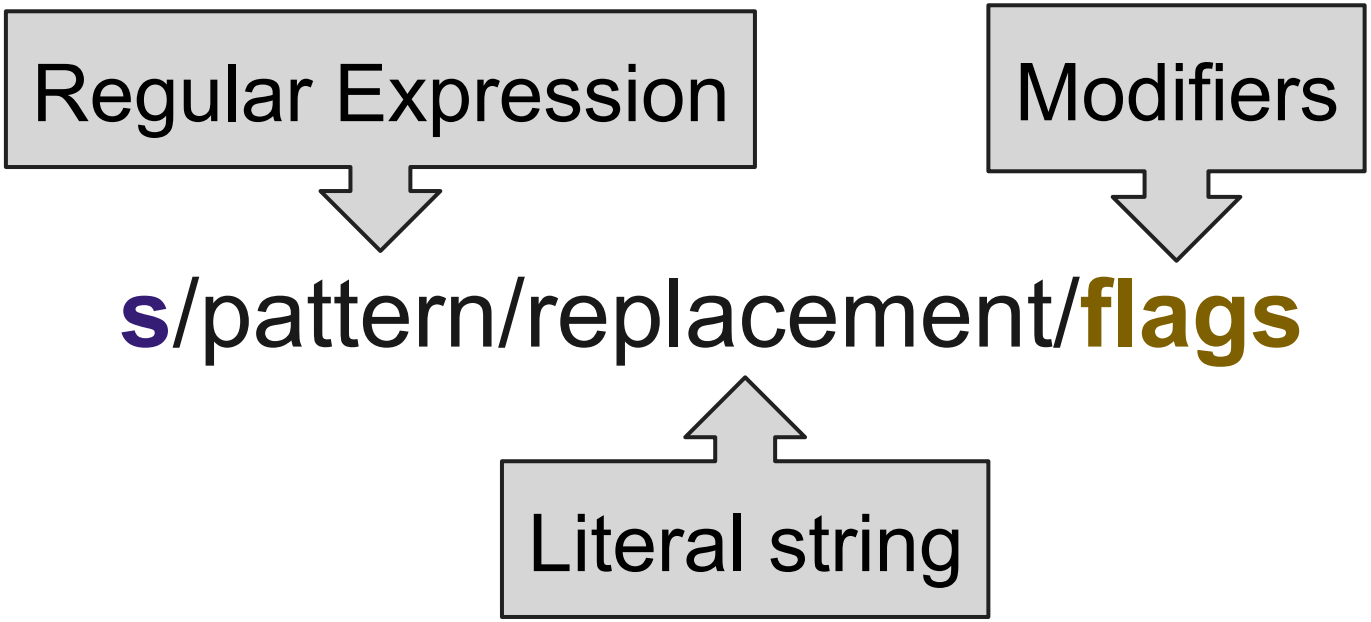
# Regular Expressions (1)

| | |
|---|---|
| . | matches any character except a newline |
| * | matches 0 or more of the previous char |
| [...] | matches any of the enclosed |
| [^...] | matches everything EXCEPT the enclosed |
| ^ | anchors match at the BEGINNING of the line |
| $ | anchors match at the END of the line |
| \ | escapes the following special character |

# Examples 3.2: regex

```
$ sed '/[TA]$/d' m.txt          # Remove if ends in T or A
$ sed '/[^TA]$/d' m.txt         # Remove if not ends in T or A
$ sed '/^Scene/d' h1.txt        # Remove if starts with 'Scene'
$ sed '/^\[/d' h1.txt           # Remove if starts '['
```

# substitution (s)



# Examples

```
# replace each line's 1st 'this' with 'that'
cat "this this this" | sed 's/this/that/'

# replace EVERY 'this' with 'that' (global flag)
cat "this this this" | sed 's/this/that/g'
```

# Examples 3.3

```
$ sed ‘s/Fred/Franz/’ m.tab
$ sed ‘/Feb/,/Sep/ s/Bob/Larry/’ m.tab
$ sed ‘s/[1-5]/*/g’ m.tab
$ sed ‘s/\[.*\]//’ h*.txt
```

# Exercise 1.1 (ids.txt)

1. cat  ids.txt, check format (anything weird?)
2. delete ONLY those who are absent
3. delete ONLY those who are present
4. delete all entries after Mark
5. delete entries with an ‘*’ after the name

# Extended Expressions (2)

| | |
|---|---|
| (...) | captures the enclosed sequence |
| *n* | recalls *n*th captured sequence |
| + | matches 1 or more of the previous characters |
| \| | OR |

All of these require the **-r** argument (**-E** on mac)

# Examples 3.4

```
# [A-Z] matches letters A to Z, similar for [a-z] and [0-9]
$ sed -r '/^[A-Z][a-z]+\.$/d' h1.txt
$ sed -r '/Bob|Fred/d' m.tab
```

# Exercise 1.2

*s.fa* is formatted as so:

>gi|**<gi>**|ref|**<ref>**| **<description>** [**<species>**]
<sequence line 1>
...
<sequence line N>

1. Extract the 4 header regions individually
2. Write the gi and ref to a comma-delimited file

# Print only if substituted

**Problem:**

$ sed -r ‘s/^>gi\|([0-9]+).*/\1/’ s.fa

You want a list of integers, but all the lines in the input still print

**Solution:**

$ sed -r**n** ‘s/^>gi\|([0-9]+).*/\1/**p**’ s.fa

# Extraction strategy

To one of more words from a line:

- ➢Start with the term to be extracted

**sed** -rn ‘s/**.*([0-9]+).***/**\1**/p’

- ➢Make pattern unambiguous by adding context

**sed** -r ‘s/.***id=([0-9]+)**.*/**\1**/’

- ➢If no context is necessary, just use grep -o

**grep** -oE ‘[0-9]+’