

ULI101: INTRODUCTION TO UNIX / LINUX AND THE INTERNET

WEEK 8 LESSON I

REGULAR EXPRESSIONS VS FILENAME EXPANSION / SIMPLE AND COMPLEX REGULAR EXPRESSIONS

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LESSON I TOPICS

Regular Expressions

- Definition / Purpose
- *Regular Expressions vs. Filename Expansion*

Simple and Complex Regular Expressions

- *Simple (Literal)* Regular expressions using **grep**
- *Complex* Regular Expressions using **grep**
- Demonstration

Perform Week 8 Tutorial

- Investigation I
- Review Questions (**Simple** and **Complex** Regular Expressions Parts **A** and **B**)

Complete Assignment #2 (Due Week 9)

REGULAR EXPRESSIONS

Definition

A **regular expression** ... is a sequence of characters that define a **search pattern**. Usually, such patterns are used by string searching algorithms for "**find**" or "**find and replace**" operations on strings, or for **input validation**.

Reference: https://en.wikipedia.org/wiki/Regular_expression



REGULAR EXPRESSIONS



Regular Expressions vs Filename Expansion

In a previous lesson, you learned **filename expansion** symbols that allow the Linux shell to **expand** filenames as **arguments** (referred to as “*globbing*”).

This is used for command **file management** and **file manipulation commands** including:

`ls`, `rm`, `mv`, `cp`, `cat`, `less`, `more`, `head`,
`tail`, `sort`, `uniq`, `grep`, `tr`, `cut` and `wc`

```
ls ?.txt
```

Files in current directory

```
a.txt b.txt c.txt webpage.html 1.txt 2.txt 3.txt abc.txt picture.png work.txt
```

```
ls a.txt b.txt c.txt 1.txt 2.txt 3.txt
```

The diagram illustrates the process of filename expansion. It shows a terminal command `ls ?.txt` being executed. A blue arrow points from the text "Files in current directory" to the output of the command, which lists all files in the current directory: `a.txt b.txt c.txt webpage.html 1.txt 2.txt 3.txt abc.txt picture.png work.txt`. Another blue arrow points from the output to the expanded command: `ls a.txt b.txt c.txt 1.txt 2.txt 3.txt`, demonstrating how the shell expands the `?.txt` pattern into the actual filenames.

REGULAR EXPRESSIONS



Regular Expressions vs Filename Expansion

Regular expressions are used to **search, edit** and **manipulate text**.

This can represent text contained in a **file** or within a **pipeline command**.

Regular expressions are used with commands that match patterns contained in text such as: **grep** , **egrep** , **man** , **more** , **less** , **vi** , **sed** and **awk**

REGULAR EXPRESSIONS

Simple (literal) Regular Expressions With Linux Commands



A simple regular expression is a collection of **characters** (for example words or phases).

Although we will later discuss several Linux commands that use regular expressions, the **grep** Linux command is useful to **learn** to display lines of text that **match** a regular expression.

Example:

```
grep Linux document.txt
```

```
cat document.txt
I like Linux
It is different than Windows
I find Linux useful

grep Linux document.txt
I like Linux
I find Linux useful
```

REGULAR EXPRESSIONS

Regular Expressions With Linux Pipeline Commands

Regular expressions can also be used to manipulate text within **Linux Pipeline Commands**.



The **grep** command can act as a **filter** to match text patterns. In turn, the **stdout** from that filter can be further processed by other *filters* throughout the *Linux pipeline command*.

Examples:

```
ls | grep txt  
who | grep khan | head -20
```

command1 | command2

stdout from command1 →  → stdin for command2

```
ls  
1.txt  3.bash  a.doc  a.txt  b.docx  b.txt  
  
ls | grep txt  
1.txt  
a.txt  
b.txt
```


REGULAR EXPRESSIONS

Instructor Demonstration

Your instructor will demonstrate examples of using **simple regular expressions** with the **grep** command.



REGULAR EXPRESSIONS

More Precise Pattern Matching

The problem with using simple (literal) regular expressions is that only **simple** or **general** patterns are matched.

For example, the **pattern:** `the` would match larger words such as `there`, `they`, `either`, `them`, `their`, in addition to the word `the`.

There are also other types of patterns you may want to search such as **location** of pattern at the beginning or ending of a string, **number** of characters (or character classes) or the **number of occurrences** of a *character* or *pattern*.

We can use **complex** and **extended** regular expressions for more precise matches. We will discuss **complex** regular expressions in this lesson.



REGULAR EXPRESSIONS

Complex Regular Expressions Symbols

Complex Regular Expressions use **symbols** to help match text for more **precise** or **complex** patterns.

The most common **complex regular expression symbols** are displayed below:

Anchors ^ , \$

Characters .

Character Class [] , [^]

Zero or More Occurrence *



REGULAR EXPRESSIONS

Complex Regular Expressions Symbols

Anchors: ^ , \$

Anchors are used to “anchor” the match at a **specific** position (at beginning or ending of a string of text).

The ^ symbol anchors the pattern at the **beginning** of the string.
The \$ symbol anchors the pattern at the **end** of the string.

Examples:

```
grep "^Beginning" data.txt
grep "end$" data.txt
```

```
cat data.txt
Beginning of the line
This is not at the beginning
This is at the end
Beginning of line and the end
Not at beginning and end not so

grep "^Beginning" data.txt
Beginning of the line
Beginning of line and the end

grep "end$" data.txt
This is at the end
Beginning of line and the end
```

REGULAR EXPRESSIONS

Complex Regular Expressions Symbols

Single Character: .

The period symbol “.” is used to represent a **single character** which could represent **any** character.

This symbol (or sequence of period symbols) are effective when used with **anchors**.

Examples:

```
grep "^.$" data.txt
```

```
grep "^.....$" data.txt
```

```
cat data.txt
```

```
Hello  
Therefore  
Hi  
I  
isn't
```

```
grep "^.$" data.txt
```

```
I
```

```
grep "^.....$" data.txt
```

```
Hello  
isn't
```

REGULAR EXPRESSIONS

Complex Regular Expressions Symbols

Character Class: [], [^]

Works like the *Single Character* symbol, but with **restrictions**.

The **^** symbol with the character class means **opposite** of the contents within the character class.

This symbol (or sequence of these symbols) are effective when used with **anchors**.

Examples:

```
grep "[a-z][a-z][a-z]" data.txt
```

```
grep "[^a-zA-Z]$" data.txt
```

```
cat data.txt
abc123
12abcdef
abc.
XYZ
123abc+

grep "[a-z][a-z][a-z]" data.txt
abc123
abc.

grep "[^a-zA-Z]$" data.txt
abc123
abc.
123abc+
```

REGULAR EXPRESSIONS

Complex Regular Expressions Symbols

Zero or More Occurrence(s) *

This symbol means **zero or more occurrences** of the **previous** character.

People learning about regular expressions get **confused** with this symbol thinking that it means zero or any character, but that would require the use of two symbols: `.*`

Examples:

```
grep "Linux i*" data.txt
grep "I*s an" data.txt
grep "^[0-9].*[0-9]$" myfile.txt
```

data.txt

```
Linux is an OS
Linux iis and OS
Linux is a choice
is true
iis true
iis true
true
```

grep "Linux i*" data.txt

```
Linux is an OS
Linux iis and OS
Linux is a choice
```

grep "i*s an" data.txt

```
Linux is an OS
Linux iis and OS
```

REGULAR EXPRESSIONS

Instructor Demonstration

Your instructor will demonstrate examples of using **complex regular expressions** with the **grep** command.



REGULAR EXPRESSIONS

Tip: Creating a Reference Sheet

It is a good idea to keep symbols for Filename Expansion and Regular Expressions **separate** since there is some overlapping similar symbols that have different purposes.

It is recommended to write-out these separate set of symbols on a **sheet of paper** for reference.

FILENAME EXPANSION SYMBOLS

- ? - single character (any character)
- [], [!] - single character
(with restrictions)
- * - zero of more characters
(any character)

REGULAR EXPRESSION SYMBOLS

- ^ - anchor at beginning
- \$ - anchor at ending
- . - single character (any character)
- [] , [^] - single character
(restrictions)
- * - zero or more occurrences of
preceding character
- . * - zero or any number of characters
(any character)

REGULAR EXPRESSIONS

Getting Practice

To get practice to help perform **assignment #3**, perform **Week 8 Tutorial**:

- [INVESTIGATION 1: SIMPLE & COMPLEX REGULAR EXPRESSIONS](#)
- [LINUX PRACTICE QUESTIONS](#)

Review Questions (**Simple** and **Complex Regular** Expressions Parts **A** and **B**)

Complete Assignment #2 (due Week 9)