

# ULI101: INTRODUCTION TO UNIX / LINUX AND THE INTERNET

## WEEK 9 LESSON 1

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### 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 9 Tutorial

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

# 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](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  
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
```

Files in current directory

A diagram illustrating filename expansion. It shows a terminal session where the command 'ls ?.txt' is entered. The output 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'. A blue arrow points from the text 'Files in current directory' to this list. A second blue arrow points from the list of files to the expanded command output: 'ls a.txt b.txt c.txt 1.txt 2.txt 3.txt'.

# 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 phrases).

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
```

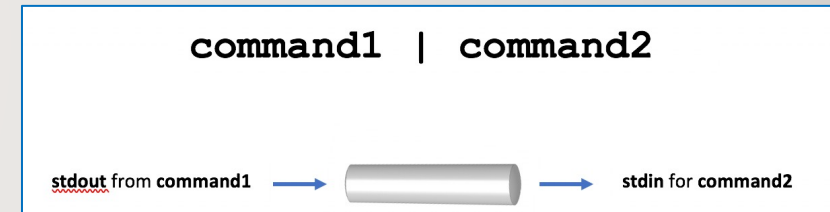
# REGULAR EXPRESSIONS

## 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
```

```
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 or more characters  
(any character)

### REGULAR EXPRESSION SYMBOLS

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



# HOMEWORK

## Getting Practice

Perform **Week 9 Tutorial**:

(**Due: Friday Week 10 @ midnight for a 2% grade**):

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

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