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UNIX sed & awk

Education & Research

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Course Objectives

- To introduce regular expressions
- To introduce sed tool
- To introduce awk programming language

Session Plan – Day 1

- To introduce wildcards and regular expressions
- To introduce sed
- Addressing mechanism in sed
- To explain basic sed commands for stream manipulation –insert, delete, append, substitute, print , quit and transform
- To explain input/output processing in sed

Session Plan – Day 2

- Recap of sed
- Pattern space and sed
- To explain branching commands and multiline processing
- Advantage and disadvantages of sed
- To explain awk features
- To introduce basic structure of awk, running awk scripts
- To explain how to read input from files/records
- To explain print statement, output separators and formatted output with printf statement
- To explain awk expressions – Arithmetic Expressions, string operators, Boolean expressions, conditional expressions

Session Plan – Day 3

- To introduce Built-in variables & dynamic/user defined variables
- To introduce control statements – if, for and while
- To introduce arrays
- To explain how to work with associative arrays, multidimensional arrays
- To introduce built-in functions in awk
- To explain user-defined functions
- Case study discussion

Day 1

- Regular Expressions
- sed features
- sed commands for string manipulation
- Input/out processing
- Branching commands and multiline processing

Regular Expressions

- What is it?
  - String of ordinary and meta characters which can be used to match more than one type of pattern
  - Used in grep, egrep, awk, vi, sed etc.
  - Some examples of metacharacters are
    - [ ], ^, $, { }, ., etc

- Regular expression is collection of Atom and Operator
  - Atom specifies the nature and position of search
  - Operator provides robust constructs for using atoms in a more advanced way

Regular Expressions (Contd…)

- Atoms
  - Character
    - This may contain any printable character (alpha-numeric or special)
  - . (dot)
    - represents any single character except newline
  - Range/Class
    - matches any one character from the set [ ]
  - Anchor
  - Back Reference

Regular Expressions (Contd…)

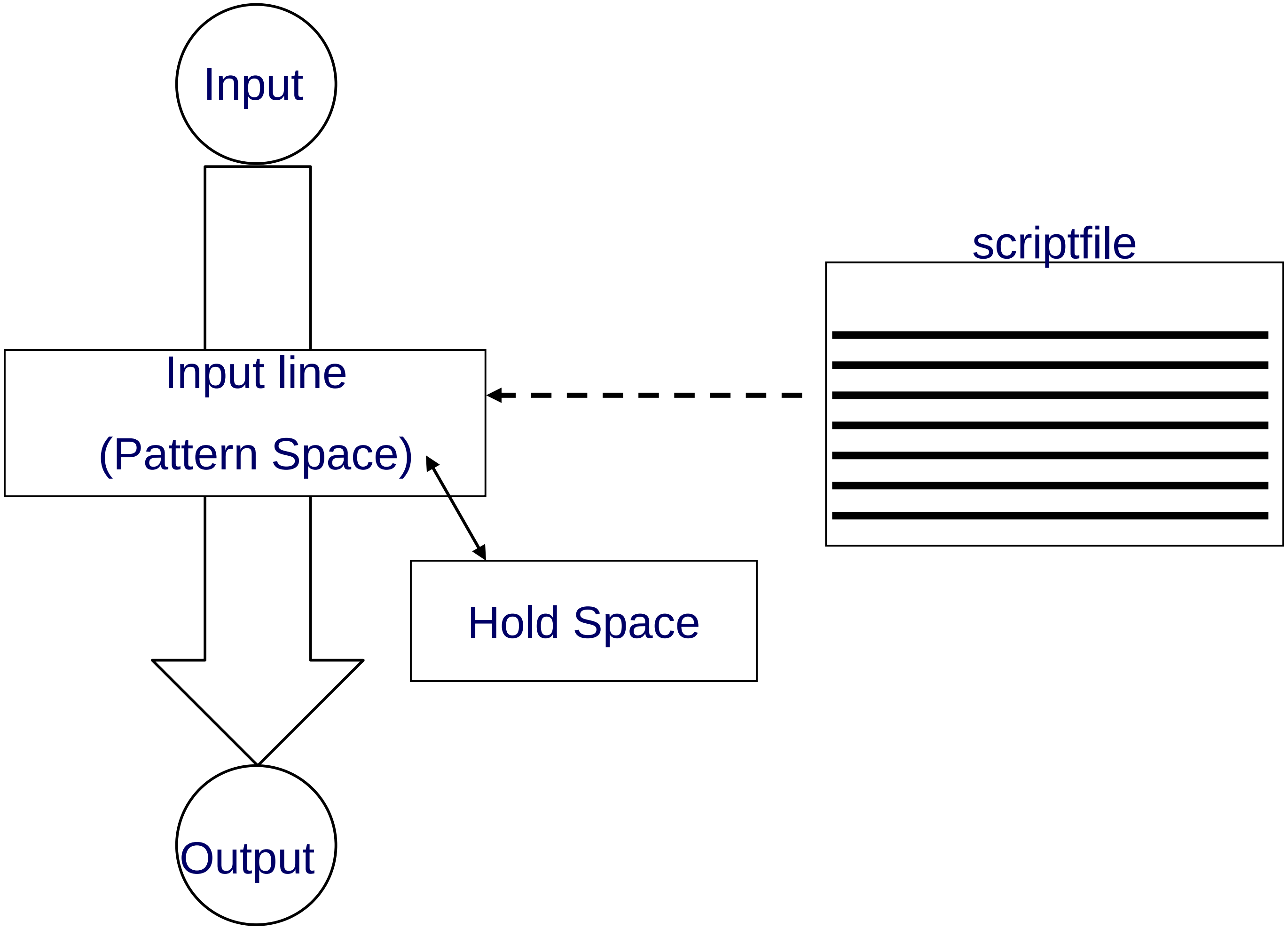
- Operators
  - Alternation |
  - Repetition \{m,n\}
  - Grouping ( )
  - Shorthand * + ?

  - * zero or more matches
  - + one or more matches
  - ? Zero or one match

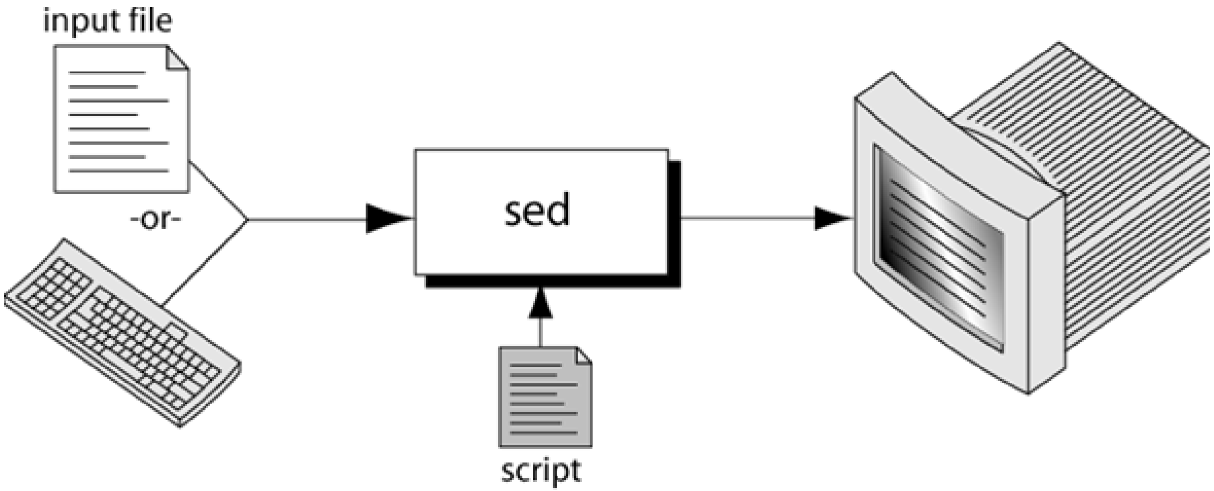
Introduction to sed

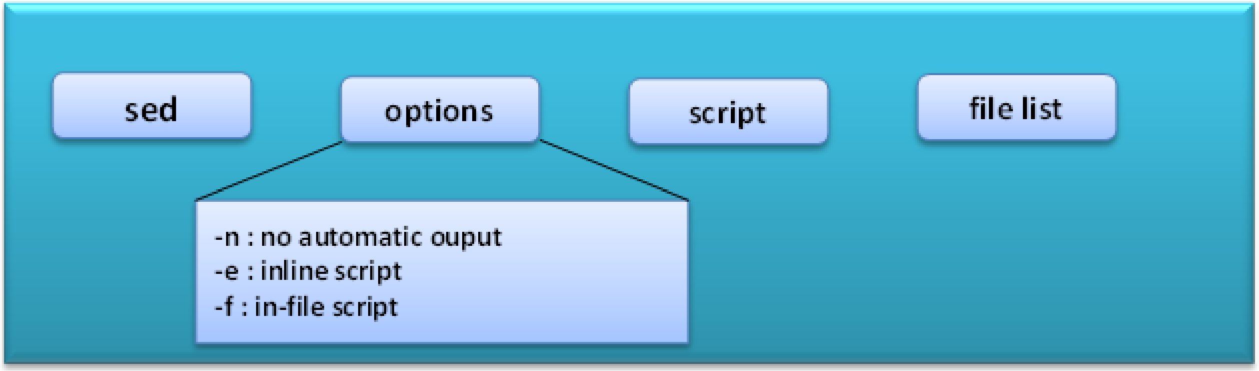
- sed stands for **s**tream **ed**itor
- A non-interactive, command-line editor
- Can be one-liner sed command or a script with multiple commands
- Supports all regular text editing operations
- Used to perform series of edit operations on same file(s)
- Automates text editing of multiple large files

Sed Architecture



Sed Architecture



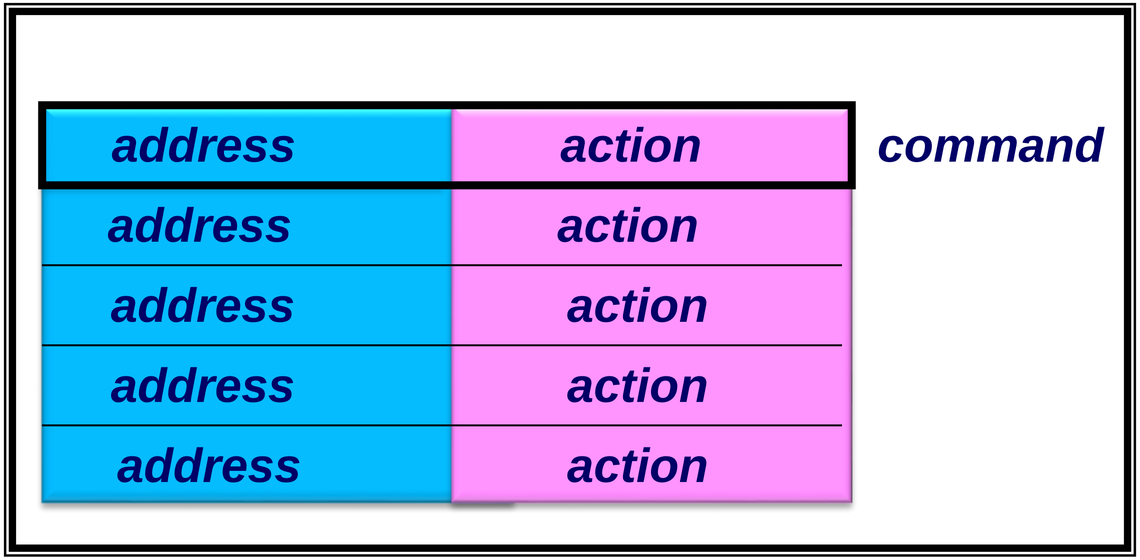


sed options script file list

-n : no automatic ouput
-e : inline script
-f : in-file script

Scripts

- A script is nothing more than a file of commands
- Each command consists of up to two *addresses* and an *action*, where the *address* can be a regular expression or line number.



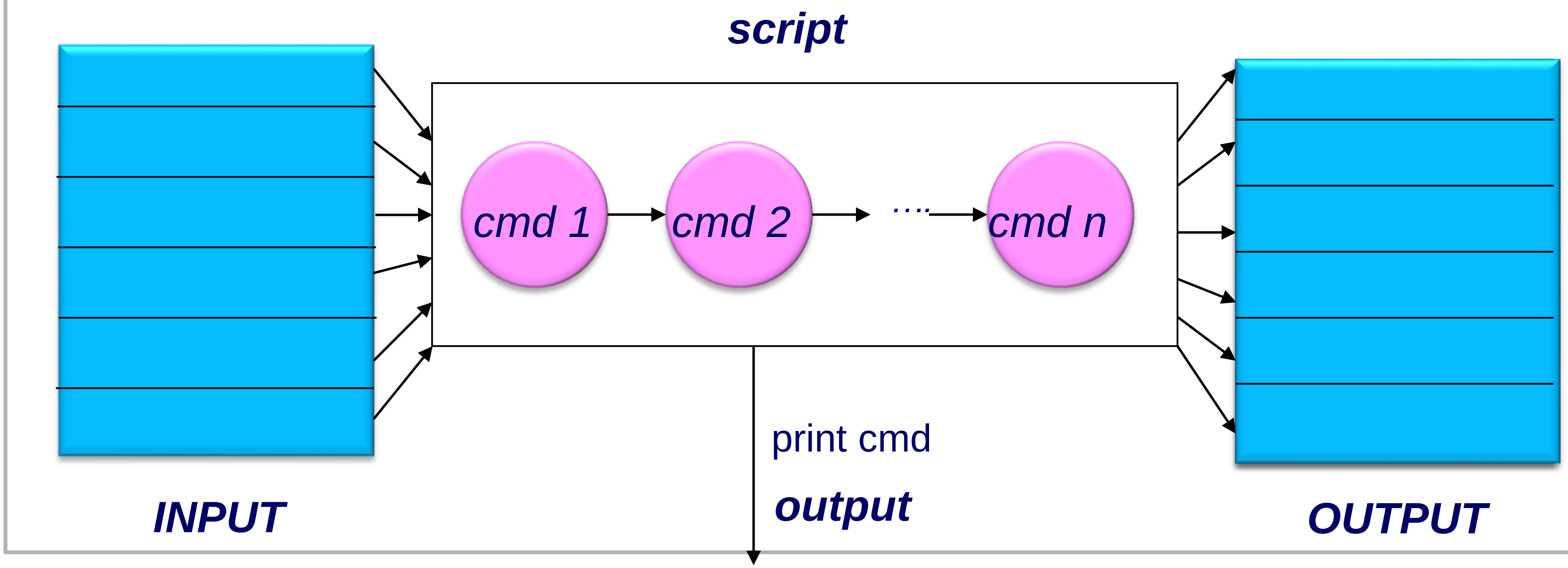
address	*action*
address	*action*
address	*action*
address	*action*
address	*action*

command

•script

Sed Flow of Control

- *sed* then reads the next line in the input file and restarts from the beginning of the script file
- All commands in the script file are compared to, and potentially act on, all lines in the input file



Addressing

- An address can be either a line number, a pattern enclosed in slashes (***Ipatternl***), or a "**$**" symbol (which refers the last line).
- A pattern is described using *regular expressions.*
  - If no sed address is specified, the command will be applied to all lines of the input file
  - If there is only one sed address, the command will be applied to any line which matches the address.
  - If two comma separated addresses are given, then the command operates on a range of lines between the first and second address, inclusively
  - The ! operator can be used to negate an address, ie; *address!command* causes command to be applied to all lines that do not match address

Syntax for sed addressing

- sed commands have the general form

[address[, address]][!]command [arguments]

- where,
  - address : either a line number, a pattern, or a “**$**”
  - ! : negate an address
  - command : can be valid sed command such as options s, a, i, c, d, p, y, q, etc.,
  - arguments : arguments such as input file

Example for sed addressing

- If no sed address is specified,
  - sed –n p file.txt
    - This will print all the lines from the file “file.txt”
- If there is only one sed address,
  - sed -n 2p file.txt
    - This will print only the second line from the from “file.txt”
- If two comma separated addresses are given,
  - sed -n 2,4p file.txt
    - This will print the lines from 2 to 5 from the file “file.txt”
- If ! operator is used,
  - sed -n '2!p' file.txt
    - This will print all the lines except second line from the file “file.txt”

How does sed works?

- *sed* copies each input line into a *pattern space*
  - If the address of the command matches the line in the *pattern space*, the command is applied to that line
  - If the command has no address, it is applied to each line as it enters *pattern space*
  - If a command changes the line in *pattern space*, subsequent commands operate on the modified line
- When all commands have been read, the line in *pattern space* is written to standard output and a new line is read into *pattern space*

Sed Commands

- Although sed contains many editing commands, we are only going to cover the following subset:

- ***`s` - substitute***
- ***`a` - append***
- ***`i` - insert***
- ***`c` - change***
- ***`d` - delete***
- ***`p` - print***
- ***`y` - transform***
- ***`q` - quit***

substitute command

- s/// is substitution command
- Used to replace strings matching the pattern specified.
- Syntax

[address]s/pattern/string/flags

- Address preceding the command is used to specify the range of input lines
  - ex-1: sed ‘2,4s/bat/xyz/’ input.txt
  - Replaces first occurrence of bat from line number 2 to 4(inclusive).
  - ex-2: sed ‘4s/bat/xyz/’ input.txt
  - Replaces first occurrence of bat from in line number 4.
- Address can be line numbers, keywords(patterns) or both

Example

- sed example
  - sed -e 's/sed/SED/i' input.txt(given in notes page)
    - This sample command will manipulate all occurrences of string sed in input.txt by SED.
    - s/// is a substitution command
  - sed -e ‘1,3s/sed/SED/i' input.txt(given in notes page)
    - Same as above but the command is operated only on range of line numbers specified
  - sed -e 's/old/new/' -e 's/fast/slow/' <in.txt >out.txt
    - It combines multiple commands

substitute command…

- Flags are used to modify the default behavior
  - /g for global replacement (all multiple occurrences)
  - /n for nth occurrence (by default substitution is done for first occurrence)
  - /p – prints the modified lines
    - Useful with sed's –n option to only print modified lines
  - /w to save to file
    - sed 's/bat/cat/w change.log' input.txt
    - Replaces all occurrences of 'bat' with 'cat' and writes the modified output into change.log

Example

- sed example
  - sed -e 's/sed/SED/i' input.txt(given in notes page)
    - This sample command will manipulate all occurrences of string sed in input.txt by SED.
    - s/// is a substitution command
  - sed -e ‘1,3s/sed/SED/i' input.txt(given in notes page)
    - Same as above but the command is operated only on range of line numbers specified
  - sed -e 's/old/new/' -e 's/fast/slow/' <in.txt >out.txt
    - It combines multiple commands

sed is not recursive

- Sed’s actions will be performed only on the incoming input(data) which has been read and pattern is matched.
- Generates modified output on that data and continues to read the rest of input lines.
- Here it will not scan the newly created output.
- The following will not cause any indefinite loop.
  - **sed 's/India/India defeats Pakistan in World cup final/g' in.txt**

append command

- append command used to add lines after the matched lines
- Syntax:

sed '[address] a new-line text' filename

- Examples
  - sed '1,10 a THIS IS NEW LINE' input.txt
    - Adds the new line after every line of first 10 lines
  - sed '/bat/ a THIS IS NEW LINE' input.txt
    - Adds the new line after every line that contains pattern ‘bat’
  - sed '$ a HEADING' input.txt
    - Adds text after last line

insert command

- insert command used to replace whole matching line
- Syntax:

sed '[address] i new-line text' filename

- Examples
  - sed '1,10 i THIS IS NEW LINE' input.txt
    - Adds the new line before every line of first 10 lines
  - sed '/bat/ i THIS IS NEW LINE' input.txt
    - Adds the new line before every line which has ‘bat’ pattern
  - sed '1 i HEADING' input.txt
    - Adds text before first line

change command

- Change Command is used to replace a line with new line
- Syntax:

sed '[address] c new-line text' filename

- Examples
  - sed '1,10 c THIS IS NEW LINE' input.txt
    - Suppress all lines from 1 to 10 and replaces with one new line
  - sed '/bat/ c\THIS IS NEW LINE' input.txt
    - Replaces every line containing 'bat' with new line

delete command

- Delete command deletes lines matching the pattern specified
- Complete line is deleted
- Use s/// command to delete part of line that matches
- Syntax

```
[address1[,address2]]d
```

  - Delete the addressed line(s) from the pattern space; line(s) not passed to standard output.
  - A new line of input is read and editing resumes with the first command of the script.

delete command…

- Examples
  - sed '1,10 d' input.txt
    - Deletes lines 1 to 10 and displays all other lines
  - sed '/bat/ d' input.txt
    - Deletes all lines containing 'bat' and displays all other lines
  - sed –e '1,10 !d' input.txt (! Operator is used to negate)
    - Negates the deletion and deletes all lines starting from line 11

print command

- The Print command (**p**) can be used to force the pattern space to be output, useful if the ***-n*** option has been specified
- Syntax:

[address1[,address2]]p

- Note: if the ***-n*** or ***#n*** option has not been specified, **p** will cause the line to be output twice!
- Examples:

  1,5p will display lines 1 through 5

  /^$/,$p will display the lines from the first blank line through the last line of the file

print command…

- Examples
  - sed –n '1,10 p' input.txt
    - Prints first 10 lines (similar to head command in unix)
  - sed -n '/bat/ p' input.txt
    - prints all lines containing 'bat'
  - sed –n '2 !p' input.txt (! Operator is used to negate)
    - Prints all lines except line 2

transform command

- transform command is used for character by character translation
- Syntax:

```
sed '[address] y/char-list/new-char-list/' filename
```

- Examples
  - sed '1,10 y/abc/xyz/' input.txt
    - Replaces all occurrences of 'a' , 'b' and 'c' with 'x' , 'y' and 'z' respectively.
  - sed '/bat/ y/abc/xyz/' input.txt
    - Replaces all occurrences of 'a', 'b' and 'c' with 'x' , 'y' and 'z' respectively in only those lines containing 'bat'.

quit command

- Quit causes **sed** to stop reading new input lines and stop sending them to standard output
- It takes at most a single line address
  - Once a line matching the address is reached, the script will be terminated
  - This can be used to save time when you only want to process some portion of the beginning of a file
- Syntax

[address1[,address2]]q

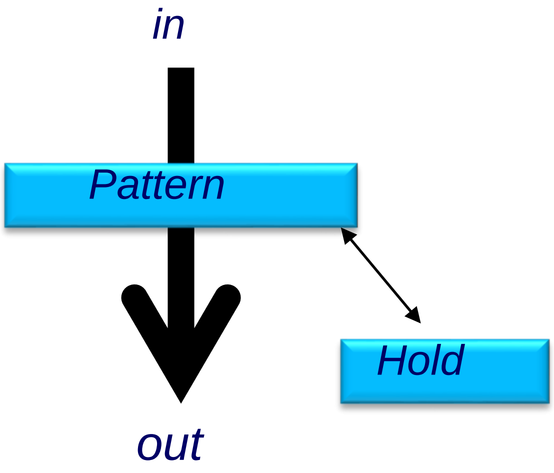
quit command

- Examples
  - to print the first 100 lines of a file (like *head*) use:
    - **`sed '100q' filename`**
      - sed will, by default, send the first 100 lines of *filename* to standard output and then quit processing

Pattern and Hold spaces

- **Pattern space**: Workspace or temporary buffer where a single line of input is held while the editing commands are applied
- **Hold space**: Secondary temporary buffer for temporary storage only

`h, H, g, G, x`



Pattern space

- sed reads each line into pattern space and performs operation on the current pattern space
- Ex:
  - sed '1,10 s/bat/cat/' input.txt
    - Each line from 1 to 10 are read into pattern space and substitution operation is performed
  - sed '1,10 {s/bat/cat/; s/bat/mat/} input.txt
    - Each line read into pattern space. Then the 2 s/// commands are performed on pattern space
    - In the above example, each line from 1 to 10 are read
    - first occurrence of 'bat' is replaced by 'cat'
    - Again the second s/// is operated on updated pattern space. So second occurrence is replaced by mat

Working with pattern space…

- n(next command) updates the current pattern space with content of next line.
- Ex:
  - sed -n '/bat/{n;p}' input.txt
    - prints next line after a line containing 'bat'
  - sed '/bat/ {n; y/aeiou/AEIOU/}' input.txt
    - Each line containing 'bat' is read into pattern space.
    - n(next) command replaces the current pattern space with next line
    - y(transform) command then transforms the new pattern space
    - In other words, transform command in this example is performed on line after a line containing 'bat'

Working with pattern space…

- N command appends the current pattern space with content of next line.
- While appending '\n' is added in between the lines
- Ex:
  - sed -n '/bat/{N;p}' input.txt
    - Searches for line with 'bat' and appends current line in pattern space with next line and prints the pattern space.
  - sed '/bat/ {N; y/aeiou/AEIOU/}' input.txt
    - Each line containing 'bat' is read into pattern space.
    - N command appends the current pattern space with next line
    - y(transform) command then transforms the updated pattern space
    - y command is applied on both lines appended in current pattern space

pattern space..holding & exchanging

- h command copies the current pattern space to the hold space(hold buffer)
- H command appends the current pattern space to the hold space(hold buffer)
- g command copies the current hold space to the pattern space
- G command appends the current hold space to the pattern space(hold buffer)
- x command swaps pattern space with hold space
- Ex:
  - sed -n '/me/{h;s/me/he/g;H;x;s/\n/:/;p}' input2.txt
  - Changes all occurrences of 'me' to 'he' and prints both original and changed line separated by colon

Advantages and Disadvantages

- Advantages
  - Regular expressions
  - Fast
  - Concise
- Disadvantages
  - Hard to remember text from one line to another
  - Not possible to go backward in the file
  - No facilities to manipulate numbers
  - Cumbersome syntax

Day 2

Introduction to AWK

Introduction to awk

- A data filtering tool and reporting generation tool
- Initially developed by A. Aho, B. W. Kernighan and P. Weinberger.
- It is data driven, hence convenient than procedural languages to operate easily on specific data.
- **awk** processes ***fields*** while **sed** only processes ***lines***
- An interpreter based language with extensive string handling functions

Advantages of awk over sed

- Convenient numeric processing
- Variables and control flow in the actions
- Convenient way of accessing fields within lines
- Flexible printing
- Built-in arithmetic and string functions
- C-like syntax

awk - Syntax

- The genral form is

awk option pattern { action } file(s)

  - awk '/sales/{print}' emp.dat

- Awk program/script contains a series of statements specifying the action to be take when a particular pattern is matched
  - Syntax

pattern { action }

AWK Program structure

- An **awk** program consists of:
  - An optional BEGIN segment
    - Executes prior to reading input
  - pattern - action pairs
    - Processing for input data
    - For each pattern matched, the corresponding action is taken
  - An optional END segment
    - Processing after end of input data

```
BEGIN {action}
pattern {action}
pattern {action}
  .
  .
  .
pattern { action}
END {action}
```

Running AWK Program

- There are several ways to run an Awk program

- Method1:

```
awk 'program' input_file(s)
```

  - program and input files are provided as command-line arguments

- Method2:

```
awk 'program'
```

  - program is a command-line argument; input is taken from standard input (yes, awk is a filter!)

- Method 3

```
awk -f program_file input_files
```

  - program is read from a file

How does awk works?

- Search a set of files for *patterns.*
- Perform specified *actions* upon lines or fields that contain instances of patterns.
- Does not alter input files.
- Process one input line at a time
- This is similar to **sed**

What is Pattern?

- Selector that determines whether *action* is to be executed *pattern* can be:
  - the special token **BEGIN** or **END**
  - regular expression (enclosed with //)
  - relational or string match expression
  - ! negates the match
  - arbitrary combination of the above using **&& ||**
  - Examples
    - ***/mysore/*** matches if the string “mysore” is in the record
    - **N > 0** matches if the condition is true
    - ***/mysore/ && (name == “Anderson")***
    - awk 'BEGIN { print “Marks"} $1==“Suresh“ {print“$2"} END{print“That’s all Suresh marks"}' std.dat

Actions

- *action* may include a list of one or more C like statements, as well as arithmetic and string expressions and assignments and multiple output streams.
- *action* is performed on every line that matches *pattern*.
  - If *pattern* is not provided, *action* is performed on every input line
  - If *action* is not provided, all matching lines are sent to standard output.
- Since *patterns* and *actions* are optional, *actions* must be enclosed in braces to distinguish them from *pattern*.

awk variables

- User Defined variables
  - Variables can be defined to hold values
  - No declaration is required
  - Can hold number or a string
- Positional variables
  - $(field operator) sign is used, refers to field in the input
  - For ex: $1 contains field 1, $2 contains field 2…..
  - When '$' is used with user defined variables, variable's value is treated as field number.
  - default field separator is single space character

Awk built-in variables

- Apart from user defined variables and positional variables, awk has some special built-in variables

Variable	Description
NF	***number of fields in current record***
NR	***number of records***
FS	***input field separator***
RS	***input record separator***
OFS	***output field separator***
ORS	***output record separator***

NF

- **NF** - Number of fields in record
  - Gives number of fields in record being processed

- Examples
  - $awk '{print NF}' emp.dat
    - This prints the number of fields in the current line

  - $awk '{print $NF}' emp.dat
    - This allows you to print the last field of any column

NR

- **NR -** Number of records
  - the variable whose value is the number of the current record or number of records processed

- Examples
  - awk '{print NR}' emp.dat
    - This prints no. of fields in the current line
  - awk -F"|" 'NR == 2, NR == 10 { print NR, $0 }' emp.dat
    - This prints records from 2 to 10 along with record numbers.

FS

- **FS** - Input field separator
  - The default value is " ". A character/regular expression can be assigned
  - awk –**Fc** option sets FS to the character c
  - Can also be changed in BEGIN
  - $0 is the entire line
  - $1 is the first field, $2 is the second field and so on…

- Examples
  - $ awk -F '|' '{print $1}' emp.dat
    - This has taken the field separator as “|” and prints the first field from the file emp.dat
  - $ awk 'BEGIN { FS="|" } /anil/ {print $1 " " $4}' emp.dat
    - This has taken the field separator as “|” and prints the fields 1 and 4 which matches the lines contains pattern anil.

RS

- **RS -** record separator
  - The default record separator is **newline**
  - By default, **awk** processes its input a line at a time.
  - Can be changed in **BEGIN** action

- Examples
  - awk 'BEGIN { RS = "|" } ; { print $0 }' emp.dat
    - This will print all the fields separated by “|” in a new line as a separate record.

OFS

- **OFS** - Output Field separator
  - used to separate field output when print is used. The default value is " “

- Examples

  - $ awk 'BEGIN { FS="|" ;OFS = ";" }{ print $1, $2 }' emp.dat
    - This will print the fields a,b,c and d separated by “:”

ORS

- **ORS**: Output record separator
  - The default output record separator is a newline
  - This is used to separate record output when print is used

- Examples
  - $ awk 'BEGIN { ORS = "\n\n" }{ print $1, $2 }' emp.dat
    - This prints the first two fields of all the records and prints the blank line after each record

Reading Input files

- **FIELDWIDTHS** variable is used to read fixed length data
- Used to read data files with fixed field sizes

- Example:
  - $ awk 'BEGIN{FIELDWIDTHS="3 2 5"};{print $1,":",$2}' field.txt
    - FIELDWIDTHS is set to string with each field sizes

Computing with awk

- **awk** variables take on numeric (floating point) or string values according to context.
- User-defined variables are *unadorned* (they need not be declared).
- By default, user-defined variables are initialized to the null string which has numerical value 0.
- Counting is easy to do with Awk

```
        $3 > 15 { emp = emp + 1}
        END { print emp, “employees worked more than 15
hrs” }
```

Selection in Awk

- Awk patterns are good for selecting specific lines from the input for further processing
  - Selection by Comparison
    - `$2 >= 5 { print }`
  - Selection by Computation

    `$2 * $3 > 50 { printf(“%6.2f for %s\n”,$2 * $3, $1) }`
  - Selection by Text Content
    - `$1 == "NYU”    or $2 ~ /NYU/`
  - Combinations of Patterns
    - `$2 >= 4 || $3 >= 20`
  - Selection by Line Number
    - `NR >= 10 && NR <= 20`

awk operators

- Arithmetic operators
- String concatenation
- Assignment & Increment operators
- Comparison operators
- Boolean operators
- Conditional expressions

awk operators

- Arithmetic operators
  - Unary plus [+] Ex: var1="1e2"; var2= var1; print var1
    - converts var1 to numeric and assigns to var2
  - Negation [-] Ex: var1="1e2"; var2= -var1; print var1
    - converts var1 to negative numeric and assigns to var2
  - var1 ^ var2 or var1 ** var2
    - var1 raised to power of var2
  - var1= var2 + var3 * var4 / var5;
- String concatenation
  - No specific operator to concatenate, string expressions are concatenated by writing together separated by space
  - var1="abc" ;var2="xyz";var3 = (var1 var2); print var3
  - Prints abcxyz

awk operators

- Assignment operator
  - var1="new"; var2="this is " var1 " value"; print var2
    - prints this is new value
- Increment/decrement operators
  - concatenation
  - No specific operator to concatenate
  - var1= "abc"; var2=var1"xyz";print var2
  - Prints abcxyz

awk operators

- Comparison Operators
  - <, <=, >, >=, ==, !=, ~, !~
  - Both operands should be numbers for numeric comparison, else string comparison is done.
  - x=25;y=100{print x < y }
    - Numeric comparison returns true. Output is 1
  - x="25";y=100{ print x < y }
    - string comparison, returns false. Output is 0
  - x="25";y="100"{print x < y }
    - string comparison, returns false as ascii value of 2 is not less then 1. Output is 0
  - x="25A";y="25a"{print x < y }
    - string comparison, returns true as ascii value of A is less than a. Output is 1

awk operators

- Boolean expressions
  - &&, || , !
- Conditional expression
  - Syntax: [condition ? true-block : false-block;]
  - var2=var1>0 ? var1 : -var1
  - If var1 is greater than zero, assigns var1 else assigns –var1
- Field Operator ($)
  - var1=1; print var1
    - Prints value of var1. output is 1
  - var1=1; print $var1 [$ is used]
    - Prints value of field 1.
    - $var1 is same as $1, if var1 is 1

Control statements

- If Statement.

```
if{
        statements;
}
else{
        statements;
}
```

Ifexample.awk

```
{
    pass_per = $3 / $2 * 100;
    if ( pass_per >= 50 )
    {
        print $1;
     }
}
```

```
{    pass_per = $3 / $2 * 100;
      if ( pass_per >= 50 ){
        pass++;
      }
      else{
       fail++;
      }
}
END { print "total no. of classes with
pass % >= 50:", pass;
          print "total no. of classes with
pass% < 50:",fail}
```

Control statements

- do-while

```
do
{
    block of statements
}while (condition)
```

- while

```
while (condition)
{
    block of statements
}
```

•while

```
# interest1 - compute compound interest
#   input: amount, rate, years
#   output: compound value at end of
each year
{     i = 1
      while (i <= $3) {
        printf("\t%.2f\n", $1 * (1 + $2) ^ i)
        i = i + 1
      }
}
```

For loop

- The syntax of for loop is similar to the one like C language
- Example

```
{
for (i = 1; i <= $3; i = i + 1)
     printf("\t%.2f\n", $1 * (1 + $2) ^ i)
}
```

Control statements

- break - breaks out of current innermost loop
- continue - skips current iteration and starts next iteration
- exit - stops processing immediately
  - If a END rule is specified it is executed

- Example:

  -
    ```
    NF != 3 { printf("Record %d do not contain req. no. of fields", FNR)
               next
             }
    ```

Arrays

- Set of related elements and can contain either number or strings
- Arrays are associative in nature, each value is associated with an index
- indices can be numbers or strings.
- Array declaration is not needed and size of array is not fixed
  - array[subscript] = value
    - array[1]=10
    - array[4]= 100
    - array["one"]=20

Arrays –if and for

- Scanning array element

```
if(4 in array)   # checks if index 4 exists in array
{
        print array[4]
}
```

- Scanning whole array

```
for(i in array)   # prints value for each index in the array
{
        print array[i]
}
```

Arrays –split, delete

- **split** function is used to split string into multiple array elements
- Syntax
  - size = split(string, array-name, separator);
  - s=split(var1, array1, " ")
  - splits var1 with space as delimiter and stores into array
  - returns last index or size. Indices are numeric and starts from 1
- **delete** function deletes one index-value pair from the array
  - delete array[2];
  - deletes element with index 2

awk Examples

- END { print NR }
  - Prints the number of records processed.
- NR == 10
- { print $NF }
- { field = $NF }

  END { print field }
- NF > 4
- $NF > 4
- { nf = nf + NF }

  END { print nf }

Functions

- Awk provide huge set of built-in functions – arithmetic functions, string functions, date functions so on
- string manipulation functions
  - index(in, find)
  - length([string])
  - match(string, regexp)
  - split(string, array [, fieldsep])
  - sub(regexp, replacement [, target])
  - gsub(regexp, replacement [, target])
  - substr(string, start [, length])
  - tolower(string)
  - toupper(string)

String functions

- **index(mainstring, findstring)**
  - Returns the position of first occurrence of 'findstring' in 'mainstring'
  - $ awk 'BEGIN { print index("abcdefgh", "cd") }'
  - prints 3
- **length([string])**
  - Returns length of the string
  - If string is not passed returns length of $0
  - awk 'BEGIN { print length(" abcdefgh ") }' , prints 8

String functions

- **sub(regexp, replacement [, target])**
  - Searches for longest match from start and replaces complete matched string with replacement string
  - Replaces only first match
  - awk ' BEGIN { var1="aabasdtxtzz";sub("b.*t","XYZ",var1); print var1 }'
  - prints aaXYZzz
  - The target should be a variable/array to store the modified value. If target is omitted, default target is $0
- **gsub(regexp, replacement [, target])**
  - Same as sub() with global replacement
  - All longest matches will be replaced

String functions

- **substr(string, start [, length])**
  - Extracts substring starting from **start** till end
  - If length is specified, extracts number of characters equal to length

String functions

- **match(source string, regular expression)**
  - This is used to match/find the regular expression within the source string
  - If it finds the match it sets two special variable which in turn indicate begin and end of regular expression.
  - RSTART:- indicates where the pattern starts
  - RLENGTH:- indicates the length of the pattern

User defined functions

- Function definitions can appear in between the awk rules
- Section of the script that performs a specific task
- Values can be passed to function so that it performs the task on these values
- Values passed to the functions are called arguments
- Return value is send back by the function
- Syntax

```
function name(parameter-list)
    {
        body-of-function
    }
```

User defined functions

Func_example.awk

```
function add(x)
{
        total= total + x ;
}
{
add($2);
}
END {print total}
```

- This script adds $2 of each record and prints after end of input

Summary

- Regular Expression
- Sed Tool
- Awk Programming

Education
and
Research
We enable you to leverage knowledge
anytime, anywhere!

Thank You