Week Two, Lecture 2

Agenda

1. Shell Scripting
2. RegEx
3. sed, awk

Video on Shell Scripting

https://www.youtube.com/watch?v=eiBVlxxu3so

Regex Utility

https://regex101.com/

RegEx

- RegEx: A **regular expression** is a special text string for describing a search pattern.

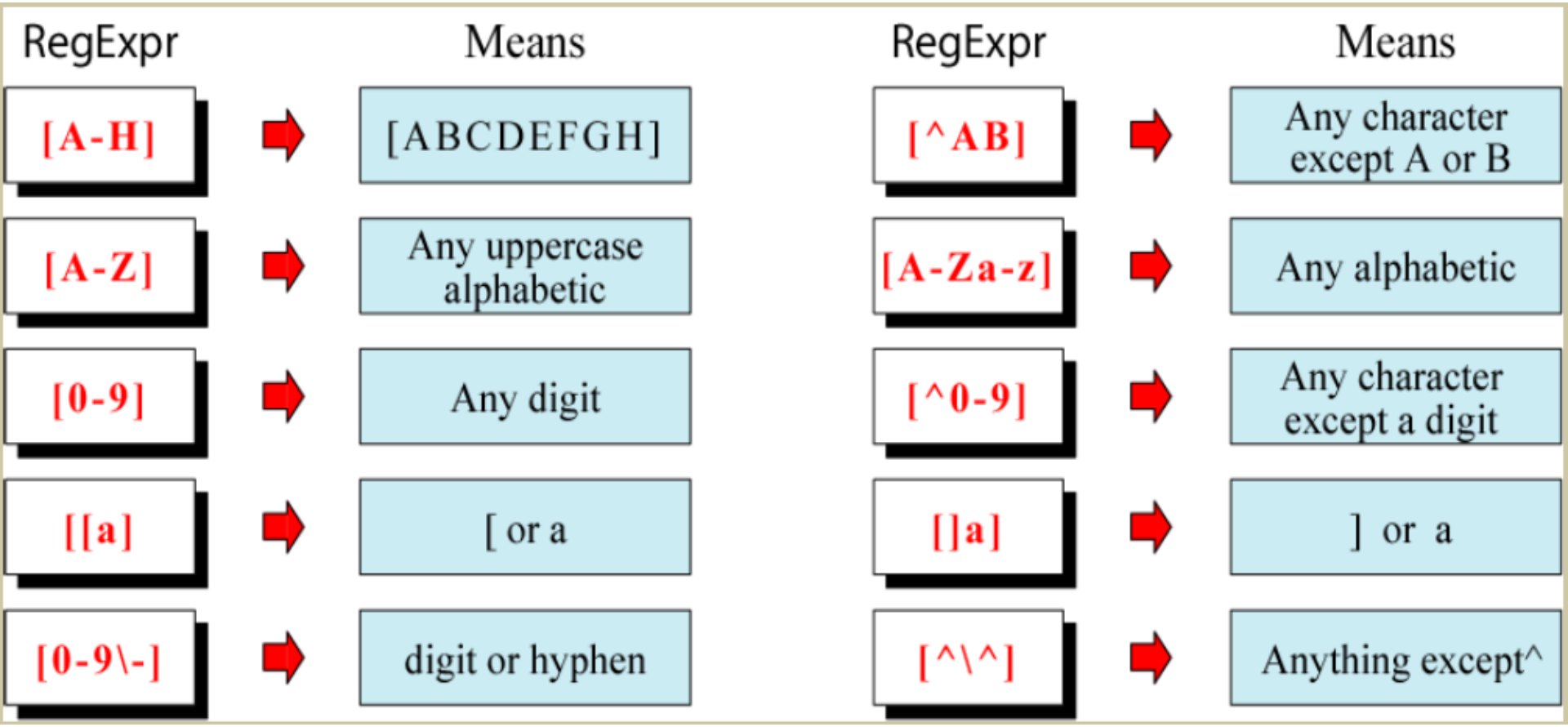
- In Windows, a wildcard notation such as *.txt finds all text files in a directory.
- The regex equivalent is ^.*\.txt$.

- Why?
  - Programatically matching data in records to a pattern
  - Validating user data input

Meta Characters

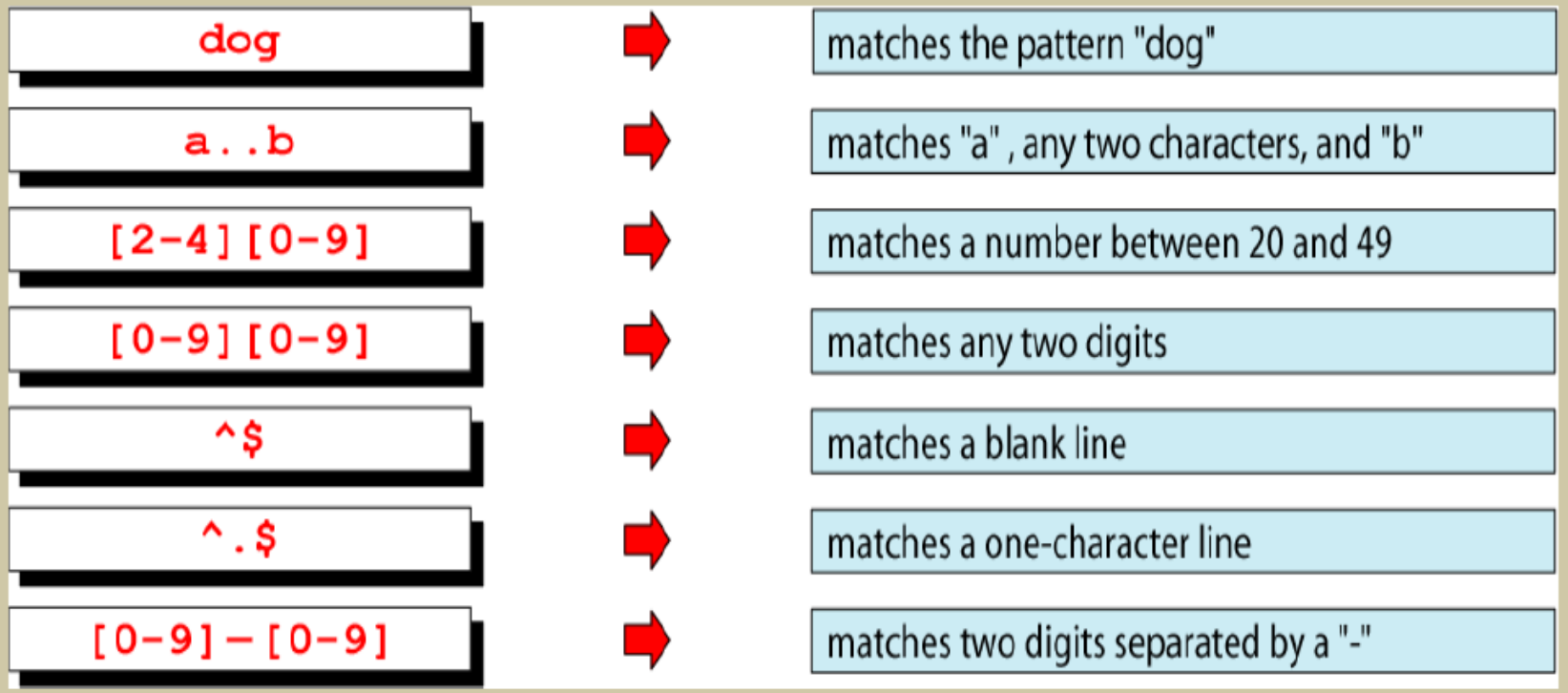
MetaCharacter	Usage
.	Any one character
[ ]	Any enclosed character
*	Zero or more of the preceding character
?	Zero or one of the preceding character
+	One or more of the preceding character
^	Anchor - The beginning of the string
$	Anchor - The end of the string
\	Escape character (treat what follows as a literal, NOT a regex command character)
|	"or"
{m,n}	The preceding character occurs from m to n times
\b	Anchor – beginning of a word
[[:blank:]]	Space or Tab

RegEx


RegExpr
Means
RegExpr
Means
[A-H]
[ABCDEFGH]
[^AB]
Any character except A or B
[A-Z]
Any uppercase alphabetic
[A-Za-z]
Any alphabetic
[0-9]
Any digit
[^0-9]
Any character except a digit
[[a]
[or a
[]a]
] or a
[0-9\-]
digit or hyphen
[^\^]
Anything except^

Sequence Operator

In a sequence operator, if a series of atoms are shown in a regular expression, there is no operator between them.



Examples

\"\(8

5{2}

[J,j]a

[J,j]a.{1,10}

[J,j]a[^"]*"\(

\b[M|m]|\b[F|f]

b[A-Z|a-z]+@[A-Z|a-z]+\.[A-Z|a-z]+

[[:blank:]]

Short Form Repetition Operators: * + ?

Formats

`*`	➡	special case: matches previous atom zero or more times
`+`	➡	special case: matches previous atom one or more times
`?`	➡	special case: matches previous atom 0 or one time only

Examples

`BA*`	➡	B, BA, BAA, BAAA, BAAAA, . . .
`B.*`	➡	B, BA . . . BZ, BAA . . . BZZ, BAAA . . . BZZZ, . . .
`.*`	➡	zero or more characters
`.+`	➡	one or more characters
`[0-9]?`	➡	zero or one digit

Examples

"^The"	matches any string that starts with "The".
"of despair$"	matches a string that ends in with "of despair".
"^abc$"	a string that starts and ends with "abc" - effectively an exact match comparison.
"notice"	a string that has the text "notice" in it.
"ab*"	matches a string that has an a followed by zero or more b's ("ac", "abc", "abbc", etc.)
"ab+"	same, but there's at least one b ("abc", "abbc", etc., but not "ac")
"ab?"	there might be a single b or not ("ac", "abc" but not "abbc").
"a?b+$"	a possible 'a' followed by one or more 'b's at the end of the string: Matches any string ending with "ab", "abb", "abbb" etc. or "b", "bb" etc. but not "aab", "aabb" etc.

Examples

"ab{2}"	matches a string that has an a followed by exactly two b's ("abb")
"ab{2,}"	a followed by at least two b's ("abb", "abbbb", etc.)
"ab{3,5}"	a followed by from three to five b's ("abbb", "abbbb", or "abbbbb")
"a(bc)*"	matches a string that has an a followed by zero or more copies of the sequence "bc"
"a(bc){1,5}"	a followed by one through five copies of "bc"
"hi|hello"	matches a string that has either "hi" or "hello" in it
"(b|cd)ef"	a string that has either "bef" or "cdef"
"(a|b)*c"	a string that has a sequence of alternating a's and b's ending in a c
"a.[0-9]"	matches a string that has an a followed by one character and a digit
"^.{3}$"	a string with exactly 3 characters
"[ab]"	matches a string that has either an a or a b (that's the same as "a|b")
"[a-d]"	a string that has lowercase letters 'a' through 'd' (that's equal to "a|b|c|d" and even "[abcd]")
"^[a-zA-Z]"	a string that starts with a letter
"[0-9]%"	a string that has a single digit before a percent sign
",[a-zA-Z0- 9]$"	a string that ends in a comma followed by an alphanumeric character

Further Reading:

https://regex101.com/

http://regexone.com/

http://www.zytrax.com/tech/web/regex.htm

http://docs.python.org/2/howto/regex.html

AWK

- a programming language designed for text processing
- Used for processing regular expressions in a script
- Used when the text is in file / delimited field format
- typically used as a data extraction and reporting tool
- a powerful standard feature of most Unix-like operating systems.

Awk

awk operations:

- scans a file line by line
- splits each input line into fields
- compares input line/fields to pattern
- performs action(s) on matched lines

Useful for:

- transforming data files
- Producing formatted reports

Programming constructs:

- format output lines for reports
- arithmetic and string operations
- conditionals and loops

Basic awk Script

- consists of patterns & actions:

```
pattern {action}
```

  - if pattern is missing, action is applied to all lines
  - if action is missing, the matched line is printed
  - must have either pattern or action

Example:

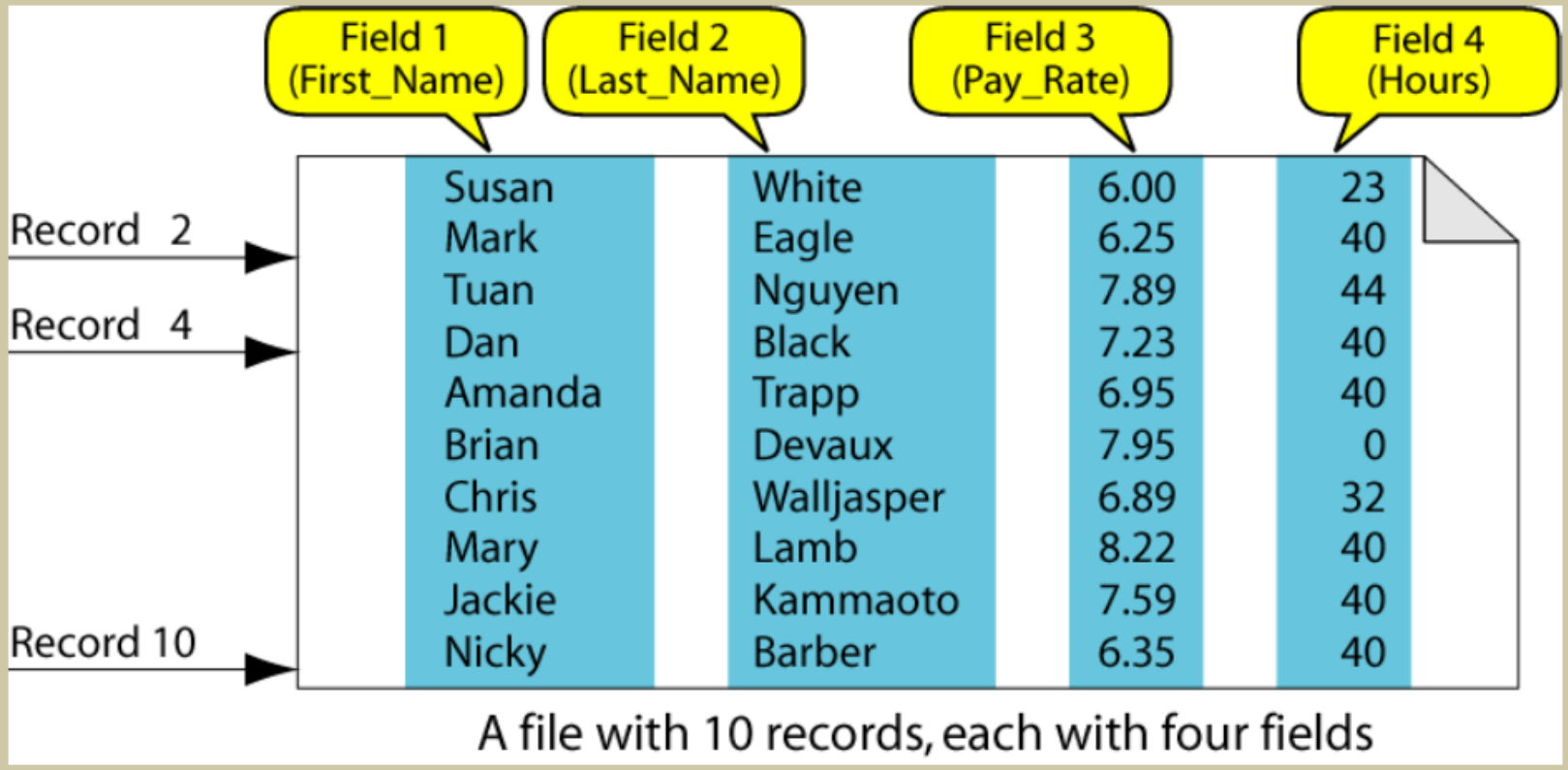
```
awk '/for/' testfile
```

  - prints all lines containing string “for” in testfile

Basic Terminology: input file

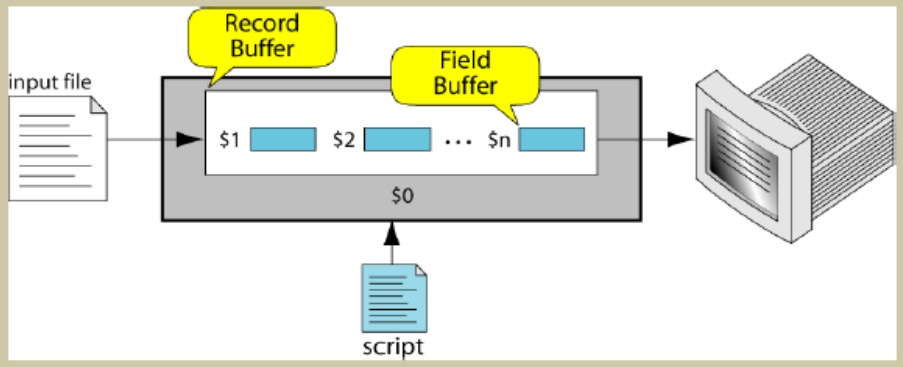
- A field is a unit of data in a line
- Each field is separated from the other fields by the field separator
  - default field separator is whitespace
- A record is the collection of fields in a line
- A data file is made up of records

Example Input File



A file with 10 records, each with four fields

Buffers



- awk supports two types of buffers: record and field
- field buffer:
  - one for each fields in the current record.
  - names: $1, $2, …
- record buffer :
  - $0 holds the entire record

Some System Variables

FS	Field separator (default=whitespace)
RS	Record separator (default=\n)
NF	Number of fields in current record
NR	Number of the current record
OFS	Output field separator (default=space)
ORS	Output record separator (default=\n)
FILENAME	Current filename

Example: Records and Fields

```
% cat emps
Tom Jones          4424    5/12/66 543354
Mary Adams         5346    11/4/63 28765
Sally Chang        1654    7/22/54 650000
Billy Black        1683    9/23/44 336500

% awk '{print NR, $0}' emps
1 Tom Jones        4424    5/12/66 543354
2 Mary Adams       5346    11/4/63 28765
3 Sally Chang      1654    7/22/54 650000
4 Billy Black      1683    9/23/44 336500
```

Example: Colon as Field Separator

```
% cat em2
Tom Jones:4424:5/12/66:543354
Mary Adams:5346:11/4/63:28765
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500

% awk -F: '/Jones/{print $1, $2}' em2
Tom Jones 4424
```

Pattern types

- match
  - entire input record
    regular expression enclosed by '/' s
  - explicit pattern-matching expressions
    ~ (match), !~ (not match)

- expression operators
  - arithmetic
  - relational
  - logical

Example: match input record

```
% cat employees2
Tom Jones:4424:5/12/66:543354
Mary Adams:5346:11/4/63:28765
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500

% awk -F: '/00$/' employees2
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500
```

- Further Reading:

www.hcs.harvard.edu/~dholland/computers/awk.html

https://www.digitalocean.com/community/tutorials/how-to-use-the-awk-language-to-manipulate-text-in-linux

sed

- a programming language designed for text processing
- Used for processing regular expressions in a script
- Used when the text is in a stream (no delimited field structure)
- typically used as a stream editor (thus the name)
- a powerful standard feature of most Unix-like operating systems

sed

sed operations:

- Loops through a file line by line
- Looks for text patterns
- Executes commands on a match
  - Substitute, delete, insert a new line, etc.

Useful for:

- Transforming data files
- Finding text strings and changing them

Programming constructs:

- A rather primitive language

- Further Reading:

http://www.wikiwand.com/en/Sed

https://www.tutorialspoint.com/sed/sed_overview.htm