# UNIX

Lesson 07 : AWK Programming

# Lesson Objectives

- At the end of the session you is able to understand:
  - How to write simple *awk* scripts.

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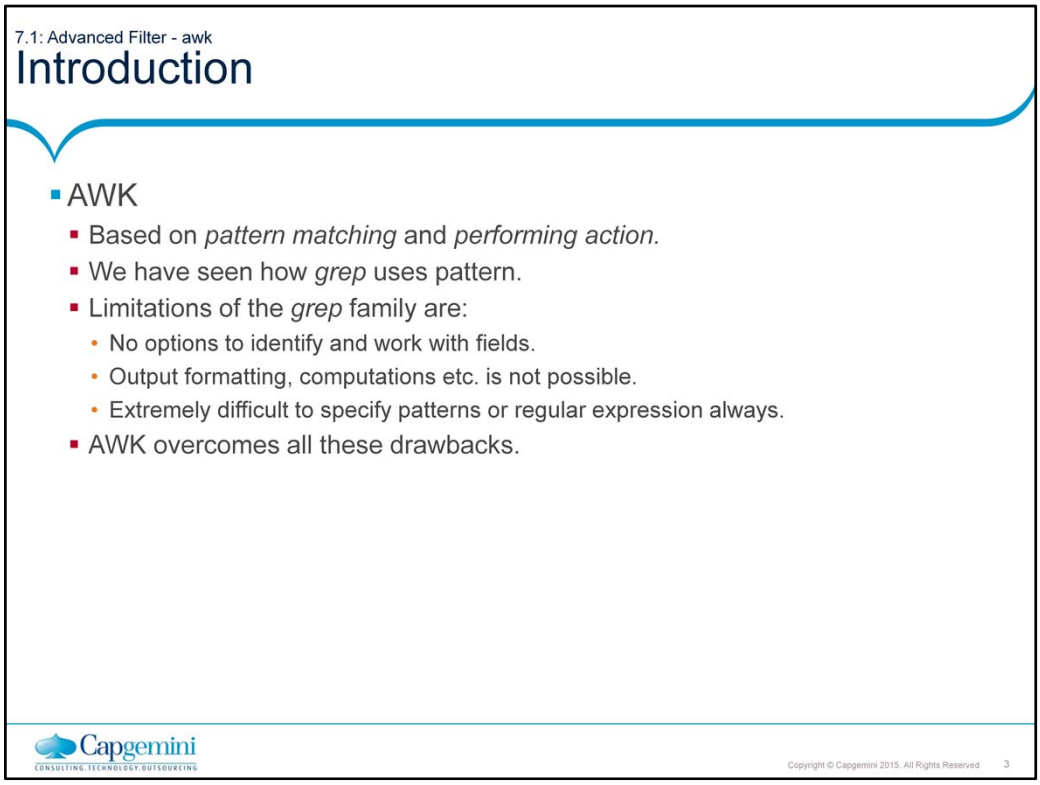
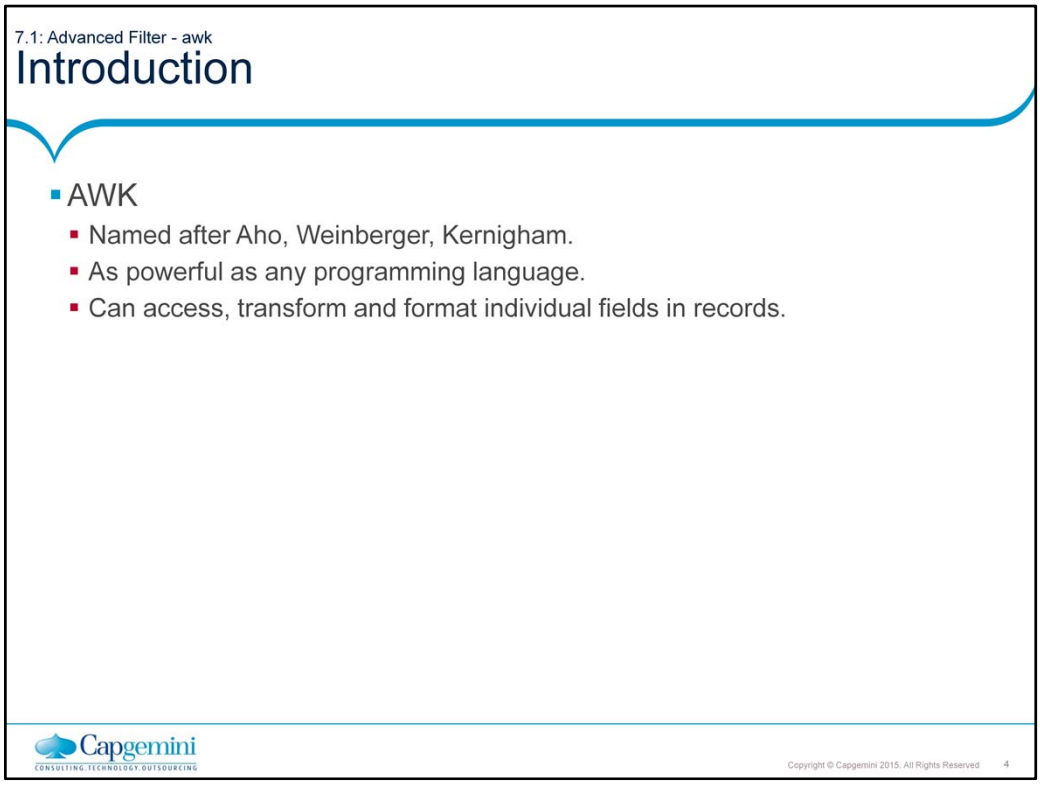
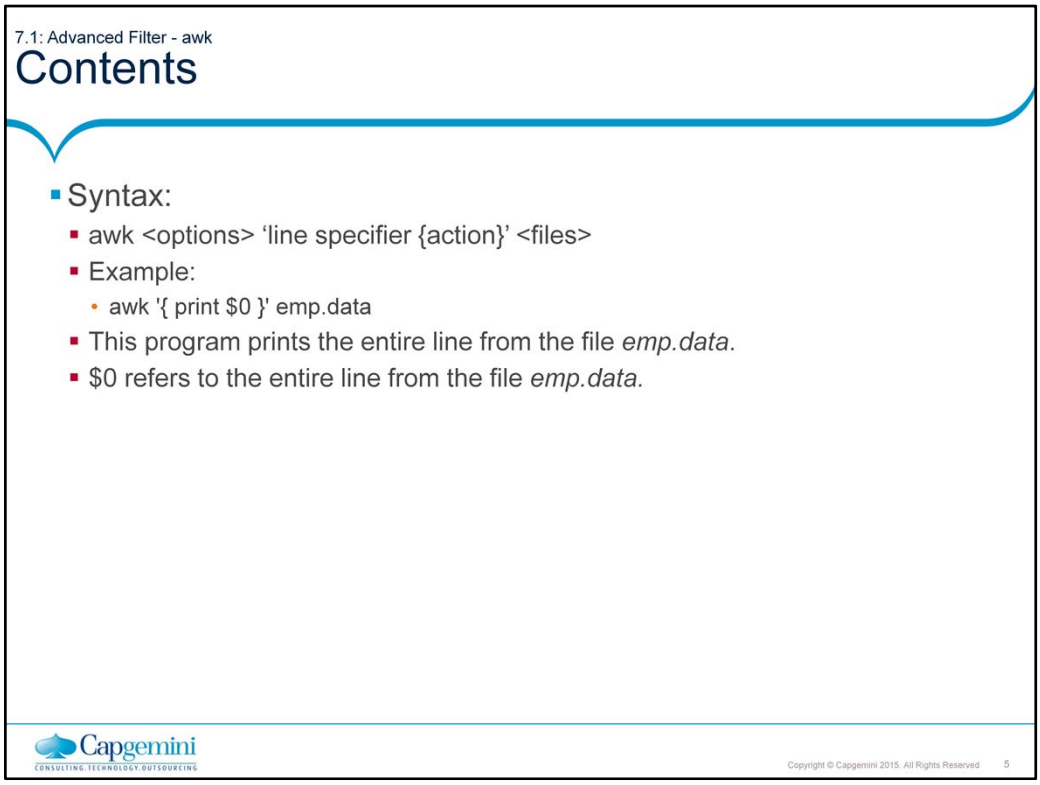
 2




The *awk* command, named after its authors Aho, Weinberger and Kernighan, is one of the most powerful utilities for text manipulation. It combines features of many other filters. It can access, transform and format individual fields in a record – it is also called as a report writer. It can accept regular expressions for pattern matching, has "C" type programming constructs, variables and in-built functions. In fact, awk is nearly as powerful as any other programming language. However, awk programs are generally slow, if any alternative commands are available to do the same use them rather than using AWK.




Filters accept some data as input, perform some manipulation on it and produce some output. Some simple filters have been discussed in the previous chapters. This chapter discusses advanced filter –*awk*.




**Advanced Filter awk.**

The general syntax of the awk command is:

awk <options> 'line specifier {action}' <file(s)>

**Simple awk Filtering**

Following is an example of a simple awk command:

It prints all lines from file *books.lst* in which pattern 'Computer' is found.

**$ awk '/Computer/ {print}' books.lst**

**Output:**

```
1001|Learning Unix              |Computers    |01/01/1998| 575
1003|XML Unleashed              |Computers    |20/02/2000| 398
1004|Unix Device Drivers         |Computers    |09/08/1995| 650
1007|Unix Shell Programming     |Computers    |03/02/1993| 536
```

7.1: Advanced Filter - awk

## AWK variables

- Variable List:
  - **$0:** Contains contents of the full current record.
  - **$1..$n:** Holds contents of individual fields in the current record.
  - **NF:** Contains number of fields in the input record.
  - **NR:** Contains number of record processed so far.
  - **FS:** Holds the field separator. Default is *space* or *tab.*
  - **OFS:** Holds the output field separator.
  - **RS:** Holds the input record separator. Default is a new line.
  - **FILENAME:** Holds the input file name.
  - **ARGC:** Holds the number of Arguments on Command line
  - **ARGV:** The list of arguments

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 6

7.1: Advanced Filter - awk

# Example

- awk '{ print $1 $2 $3 }' emp.data
  - This prints the *first, second* and *third* column from file *emp.data.*
- awk '{ print }' emp.data
  - Prints all lines (all the fields) from file *emp.data.*

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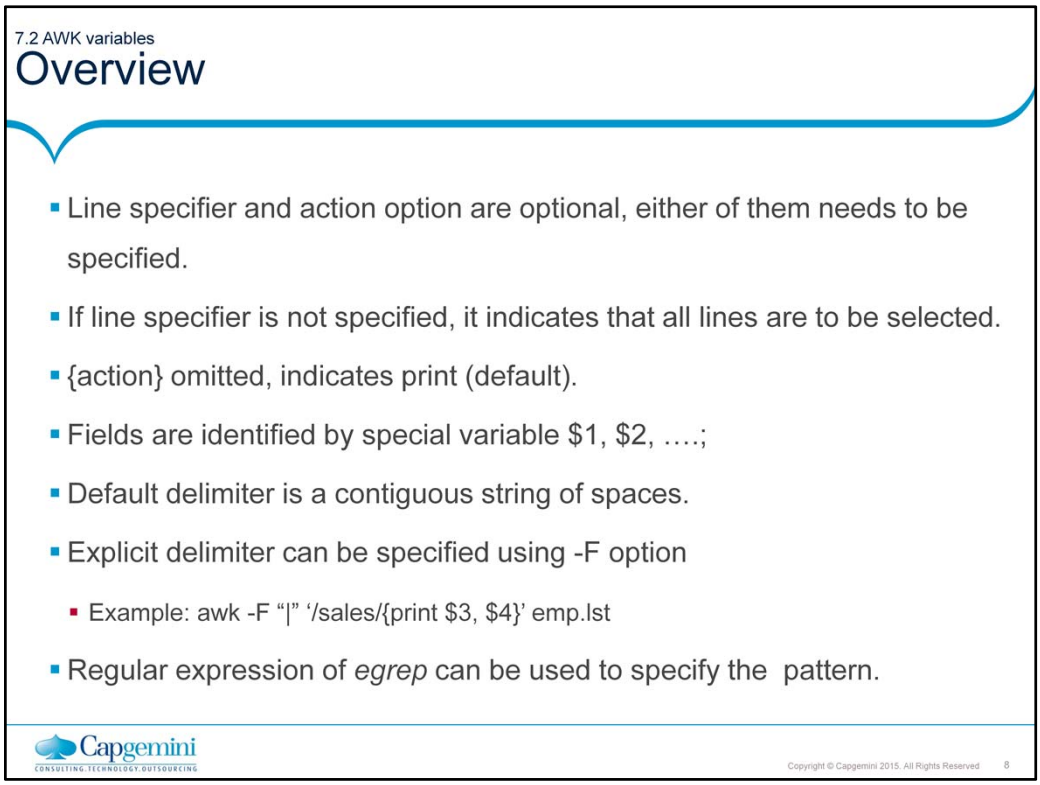
 7




The line specifier uses a context address to specify the lines that need to be taken up for processing in the action section. If the line specifier is missing, then the action is applicable to all lines of the file.

In the action part, statement {print} indicates that selected lines are to be printed. The statement {print} is equivalent to {print $0} - $0 being the variable for the entire line. The awk command is also capable of breaking each line into fields – each field is identified as $1, $2 etc.

For the purpose of identification of fields, awk uses a contiguous string of spaces as field delimiter. However, it is possible to use a different delimiter. This is specified using the –F option in awk.

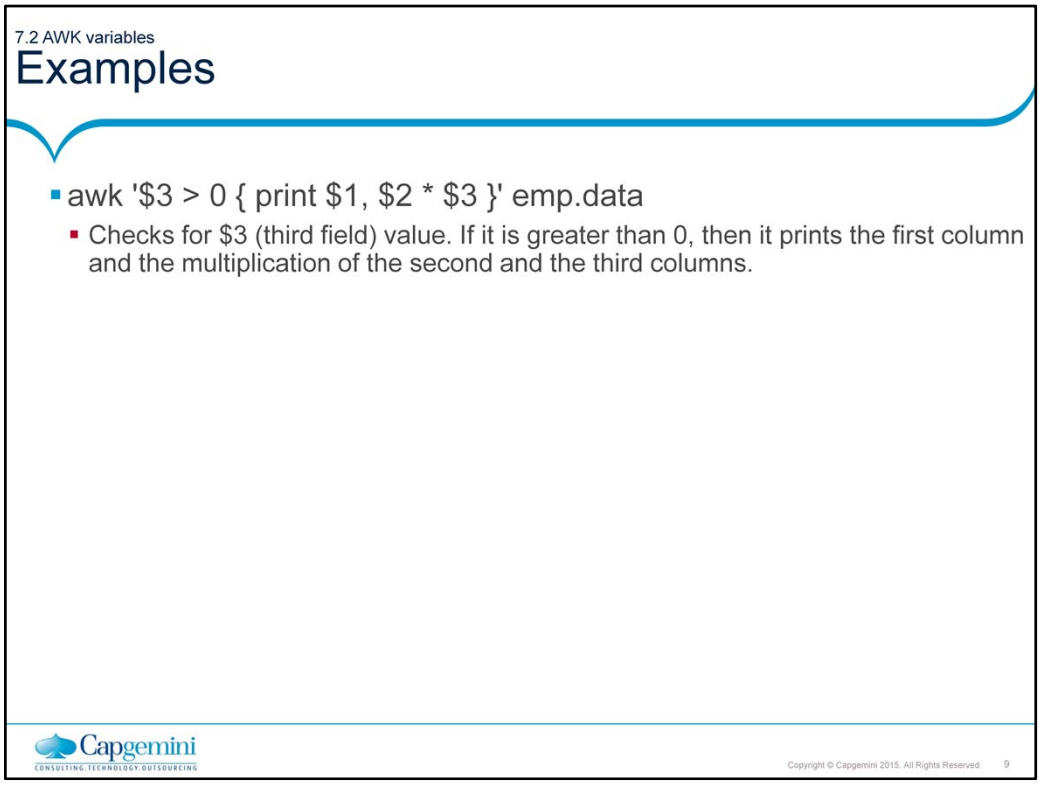
**$ awk -F"|" '/Computer/ {print $2,$5}' books.lst**
**Output:**
Learning Unix 575
XML Unleashed 398
Unix Device Drivers 650
Unix Shell Programming 536

For pattern matching, awk uses regular expressions of *egrep* variety.
**$ awk -F"|" '/XML|Unix/ {print $2, $5}' books.lst**
**Output:**
Learning Unix 575
XML Unleashed 398
Unix Device Drivers 650
XML Applications 630
Unix Shell Programming 536

It is possible to specify line numbers in file using the inbuilt NR variable. Also, awk can use the C-like *printf* statement to format the output.

**$ awk -F"|" '$1=="1002" {printf "%2d,%-20s",NR,$2}' books.lst**
**Output:**
2,Moby Dick

The –f option of awk is useful if you wish to store the line specifier or action in a separate file.

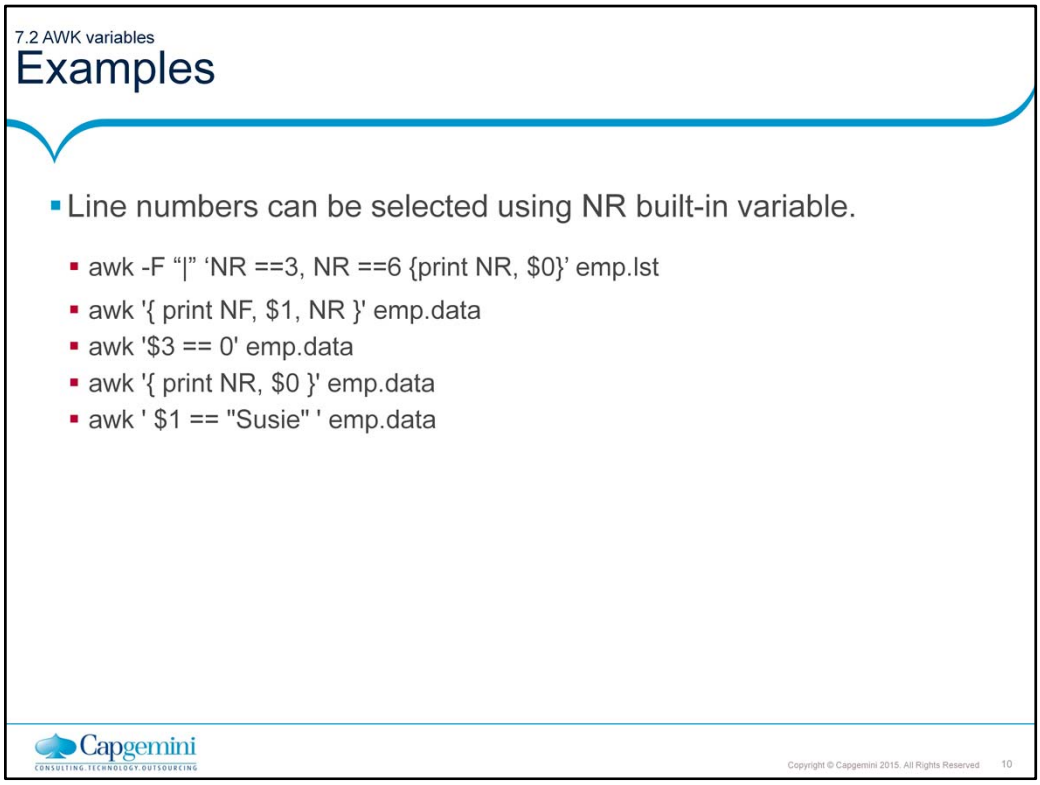



The logical operators || (or) and && (and) are used by the awk command to combine conditions in the line specifier. A relational operator can be used in the line specifier, also in the action component.

The operators == (equal) and != (not equal) can handle only fixed length strings and not regular expressions. To match regular expressions, ~ (match) and !~ (negate) are used. The characters ^ and $ can be used for looking for a pattern in the beginning and end of field.

To work with numbers, operators like < (less than), > (greater than), <= (less than or equal), >= (greater than or equal), == (equal) and != (not equal) can be used.
It is possible to perform computations on numbers using C like arithmetic operators (+, -, *, /, %, ++, --, += etc).
**$ awk -F"|" '/Unix/ && $5 < 600 {printf "%s,%d\n",$2,$5}' books.lst**
**Output:**

```
Learning Unix                ,575
Unix Shell Programming   ,536
$ awk -F"|" '$2=="Learning Unix"' books.lst
$ awk -F"|" '$2~/Learning Unix/' books.lst
1001|Learning Unix           |Computers     |01/01/1998| 575
$ awk -F"|" '$5<500 {
> cnt=cnt+1
> printf "%d %s\n",cnt,$2}' books.lst
1 Moby Dick
2 XML Unleashed
```



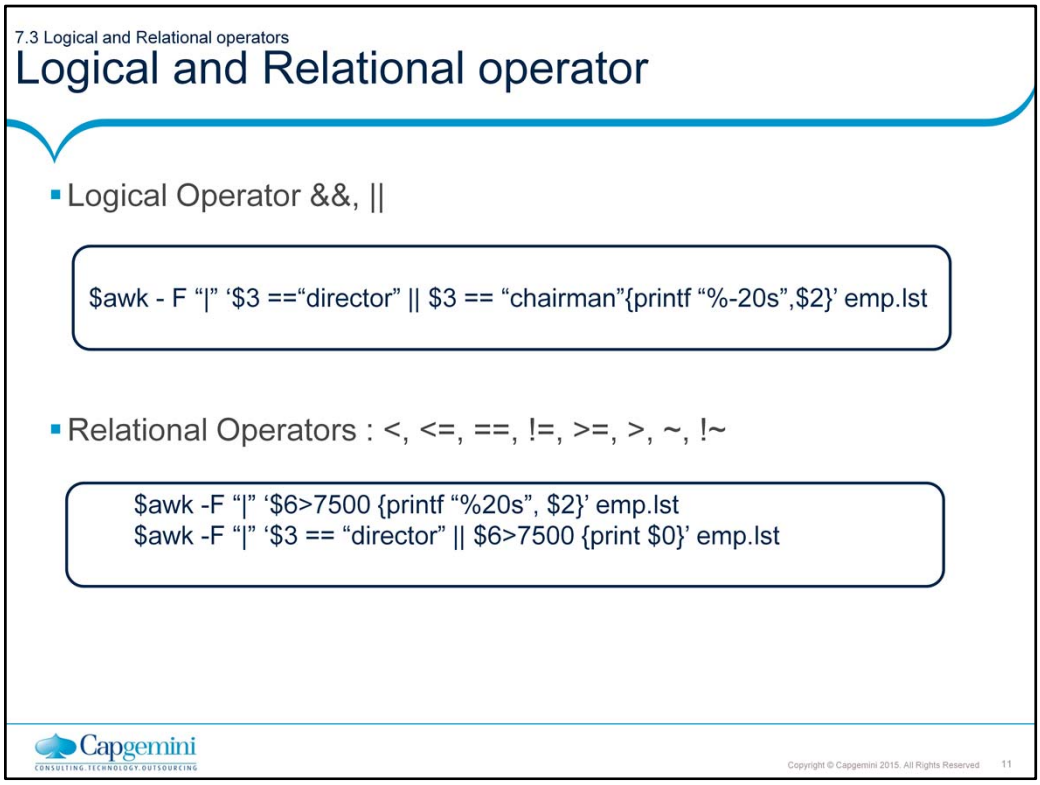

**awk -F "|" 'NR ==3, NR ==6 {print NR, $0}' emp.lst**
In this example, NR represents record number. It prints records from *third record* to *sixth* record.
-F is use to specify field separator.

**awk '{ print NF, $1, NR }' emp.data**
This prints number of fields, contents of field 1 and record number for all records.

**awk '$3 == 0' emp.data**
It prints all lines in which the value in the third field is 0.

**awk '{ print NR, $0 }' emp.data**
It will print record number and record for all records

**awk ' $1 == "Susie" ' emp.data**
It prints all lines in which the value in the first field is Susie.

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For working with numbers, operators like < (less than), > (greater than), <= (less than or equal), >= (greater than or equal), == (equal) and != (not equal) can be used.

It is possible to perform computations on numbers using C like arithmetic operators (+, -, *, /, %, ++, --, += etc).

Print all lines with Unix pattern in the line and value of 5 th field should be < 600:

**$ awk -F"|" '/Unix/ && $5 < 600 {printf "%s,%d\n",$2,$5}' books.lst**

**Output**

```
Learning Unix                ,575
Unix Shell Programming   ,536
$ awk -F"|" '$2=="Learning Unix"' books.lst
$ awk -F"|" '$2~/Learning Unix/' books.lst
1001|Learning Unix           |Computers     |01/01/1998| 575
$ awk -F"|" '$5<500 {
> cnt=cnt+1
> printf "%d %s\n",cnt,$2}' books.lst
1 Moby Dick
2 XML Unleashed
```

Example of awk command using relational, logical expressions and computations.

7.3 Logical and Relational operators

## Logical and Relational operators

- == tries to find perfect match.
  - String may have trailing spaces.
  - To overcome this you can use "~" and "!~" (match and negate of match) with the regular expression.
  - Example:

```
$awk -F "|" '$2~/director/||$2~/g.m/{printf $0}' emp.lst
    $3 ~/^g.m/    # Beginning with g.m
```

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 12

7.4 Arithmetic operators

## Arithmetic operators

- Computation on numbers is done:
  - +, -, *, /, % operator available.
  - No type-declaration for variables.
  - Variables are initialized to zero.

```
$awk -F "|" '$3 == "director" || $6>7500 {
>kount = kount+1
>printf "%3d%-20s\n", kount,$2}' emp.lst
```

- Can also use C constructs like kount++, Kount+=sum etc.

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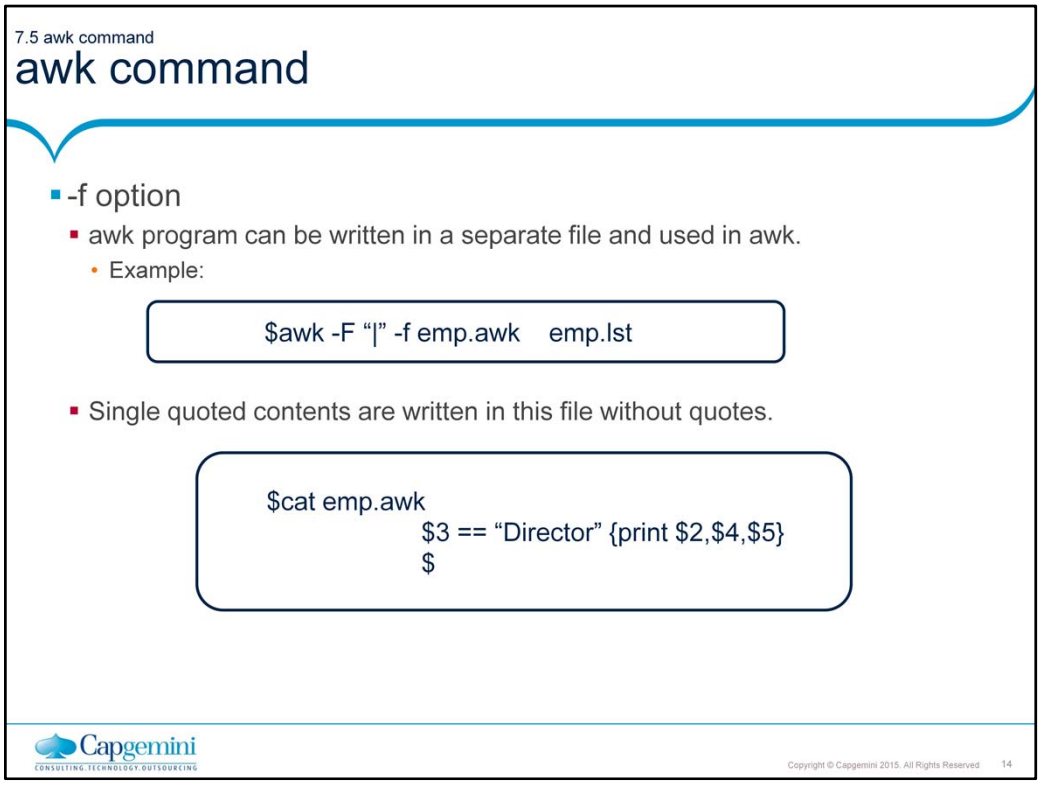
 13


7.5 awk command
awk command
-f option
awk program can be written in a separate file and used in awk.
Example:
$awk -F "|" -f emp.awk emp.lst
Single quoted contents are written in this file without quotes.
$cat emp.awk
$3 == "Director" {print $2,$4,$5}
$
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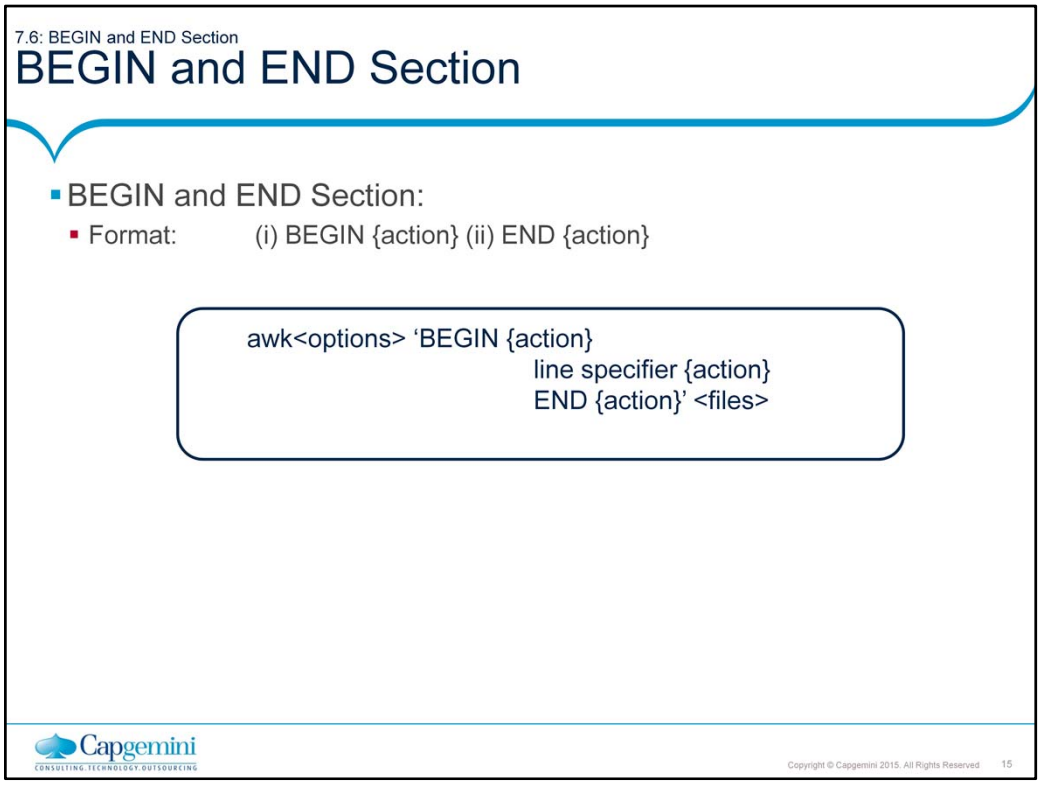
14



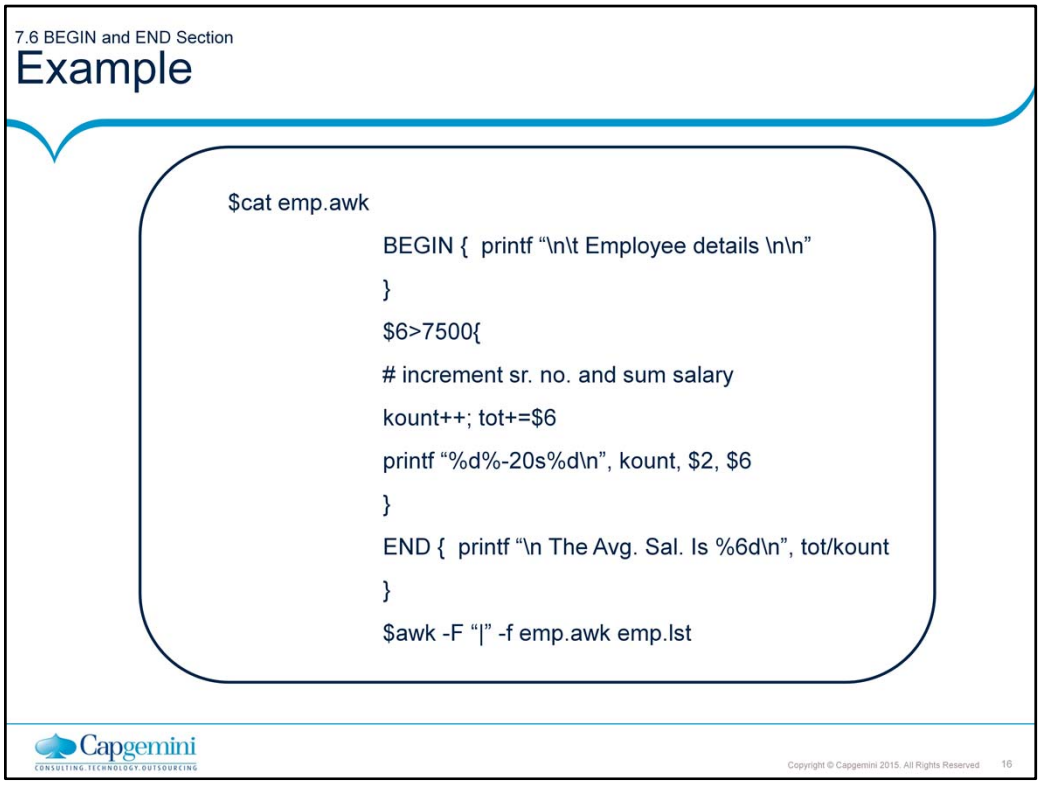

**BEGIN and END Sections**

In case, something is to be printed before processing the first line begins, BEGIN section can be used. Similarly, to print at the end of processing, END section can be used.

These sections are optional. When present, they are delimited by the body of the awk program.

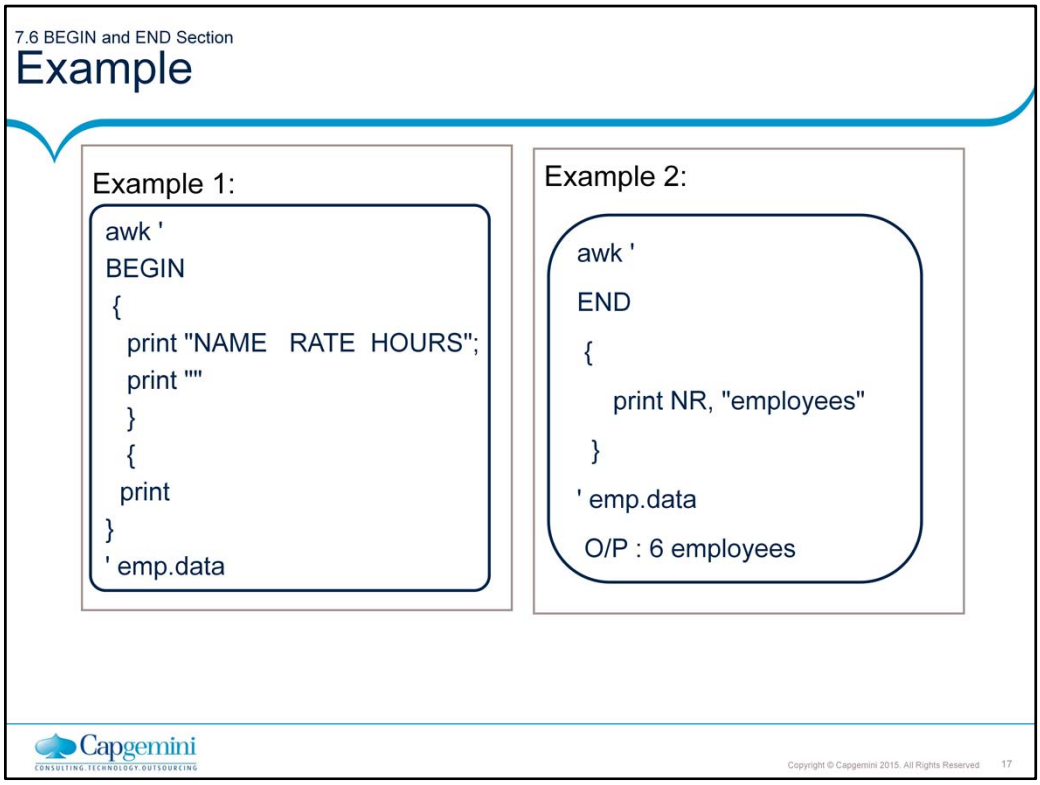
Normally if you want to print any header lines or want to set field separator then use BEGIN section

And If you want to display total or any summarized information at the end of the report then use END section



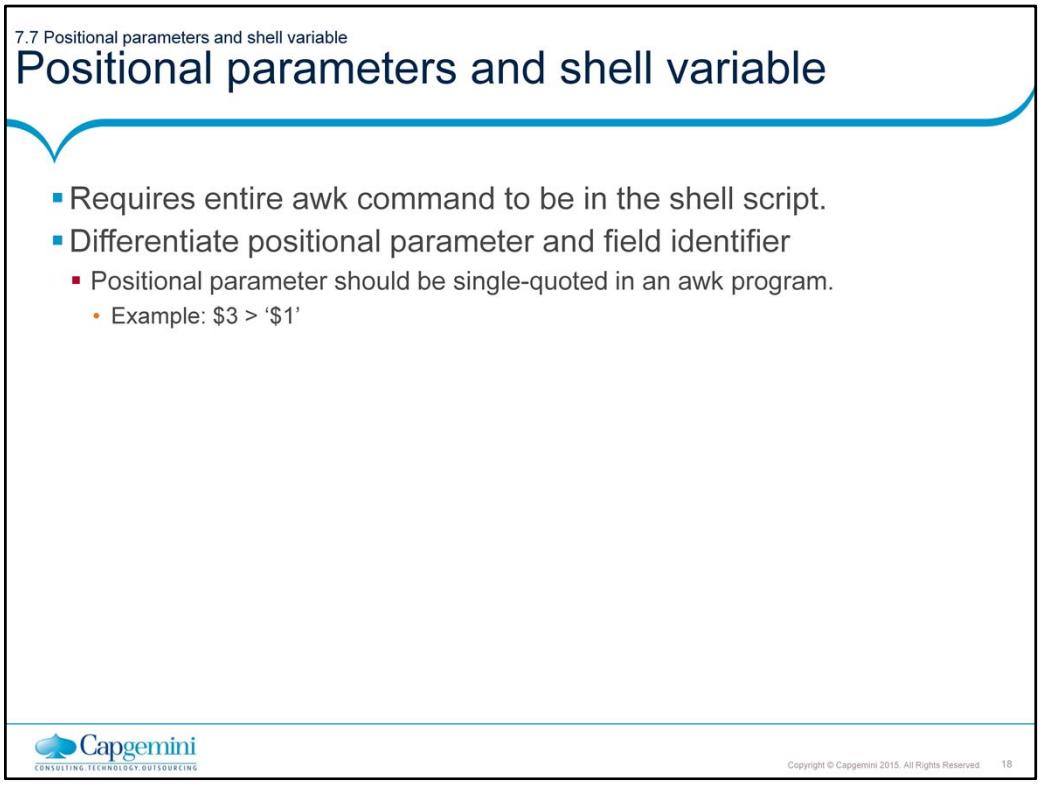

**$ cat awk1.awk**
**BEGIN {**
**printf "\n\t Unix Book Details \n\n"**
**}**
**$2~/Unix/ {**
**cnt++; tot+=$5**
**printf "%d %-15s\n",cnt,$2**
**}**
**END {**
**printf "\n Total Cost is %d\n",tot**
**}**
**$ awk -F"|" -f awk1.awk books.lst**
**Output:**

Unix Book Details
1 Learning Unix
2 Unix Device Drivers
3 Unix Shell Programming
Total Cost is 1761




**Example 1:**
In this example It will perform action enclosed in BEGIN section (It prints headings) and then it will perform print action on all lines in the file emp.dat (because no line specifier is mentioned)

**Example 2 :**
In this example BEGIN section is not given. The main action part is also empty hence no action is performed on all the records and then it will execute End section which prints last record number which will give you total number of records.




**Positional Parameters and Shell Variables**

It is possible to store an entire awk command into a file as a shell script, and pass parameters as arguments to the shell script. The shell will identify these arguments as $1, $2 etc based on the order of their occurrence on the command line.

Within awk, since $1, $2 etc. indicate fields of data file, it is necessary to distinguish between the positional parameters and field identifiers. This is done by using single quotes for the positional parameters used by awk.

```
$ cat awk2.awk
awk -F"|" '$5>'$1' {
cnt++
printf "%d %s %d\n",cnt,$2,$5 }
END {
printf "\n No. of books costing more than specified amount is:%d\n",cnt
}' books.lst
$ awk2.awk 600
```

**Output:**

```
1 Unix Device Drivers       650
2 Complete Works:Sherlock H 1290
3 XML Applications          630
No. of books costing more than specified amount is:3
$ awk2.awk 1000
1 Complete Works:Sherlock H 1290
No. of books costing more than specified amount is:1
```

(Example of awk command using positional parameter.)

7.8 Built in functions

## Numeric Functions

- int(x)
  - Returns integer value of x.
- sqrt(x)
  - Returns square root of x.
- index(s1,s2)
  - Returns the position of string s2 in s1.
- length()
  - Returns length of the argument.

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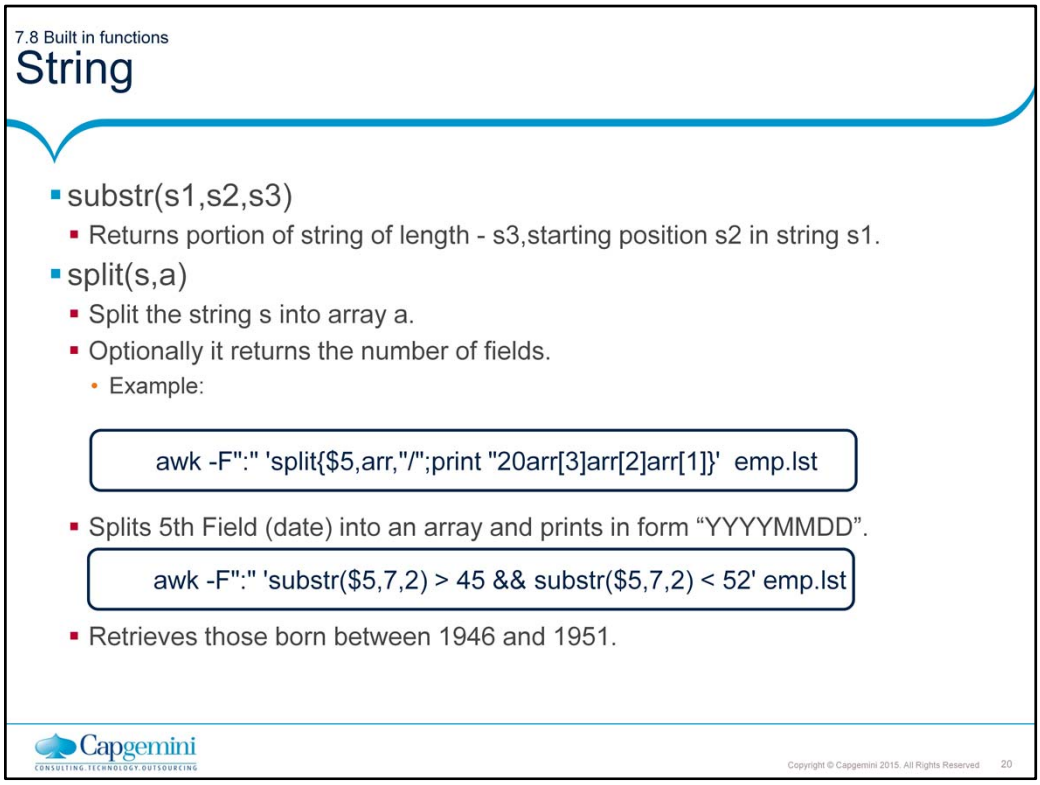
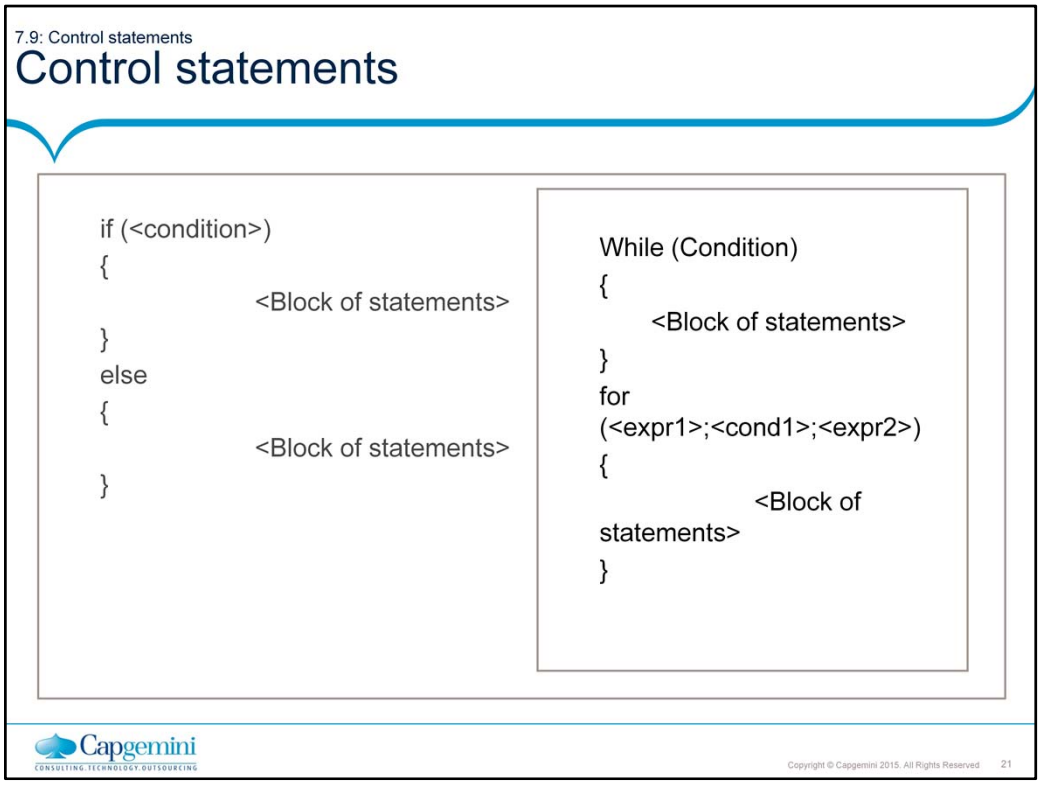



**awk -F":" 'length > 1024' emp.lst**
Retrieves all lines > 1024.
**awk -F":" 'length($2) > 11' emp.lst**
Retrieves all lines whose characters in 2nd col < 11.

**awk -F":" 'substr($5,7,2) > 45 && substr($5,7,2) < 52' emp.lst**
Retrieves those born between 1946 and 1951.


7.9: Control statements
Control statements
if (<condition>)
{
<Block of statements>
}
else
{
<Block of statements>
}
While (Condition)
{
<Block of statements>
}
for
(<expr1>;<cond1>;<expr2>)
{
<Block of
statements>
}
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21

7.9: Control statements

## Example

```
awk '
{
   if (NF != 3)  {
      print $0, "number of fields is not equal to 3“
   if ($2 < 3.35)  {
      print $0, "rate is below minimum wage"   }
   if ($2 > 10)  {
      print $0, "rate exceeds $ 10 per hour"   }
   if ($3 < 0)  {
      print $0, "negative hours worked"   }
   if ($3 > 60)  {
      print $0, "too many hours worked"   }
}
' emp.data
```

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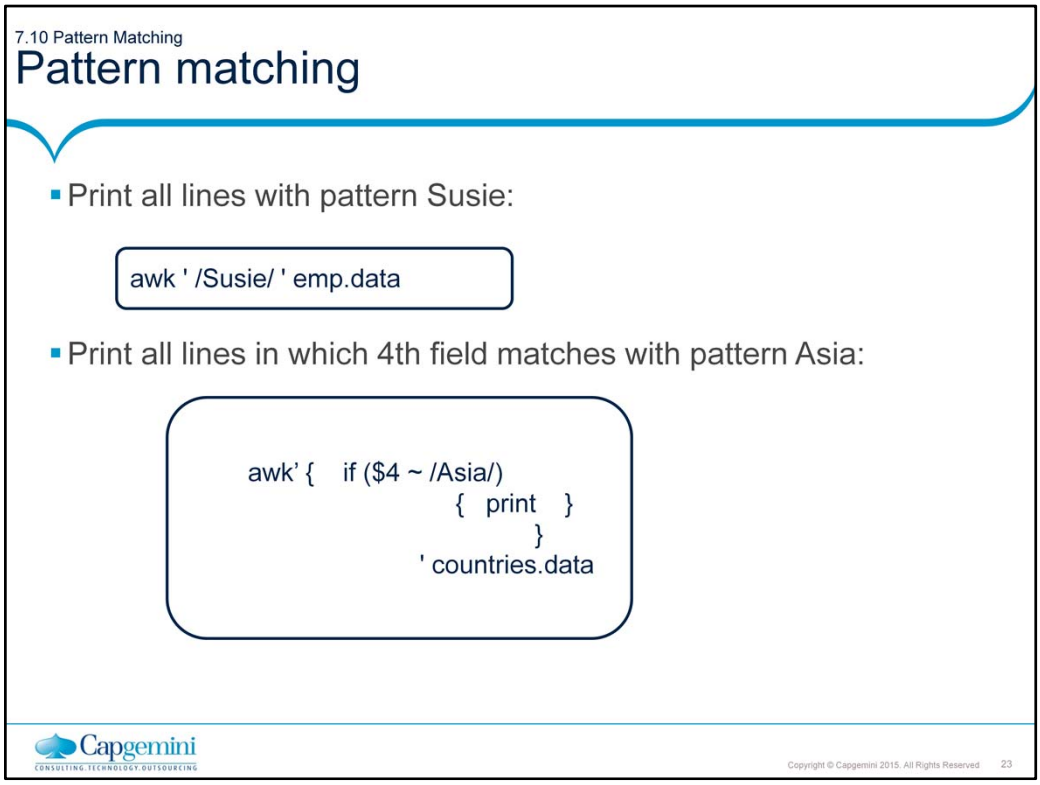
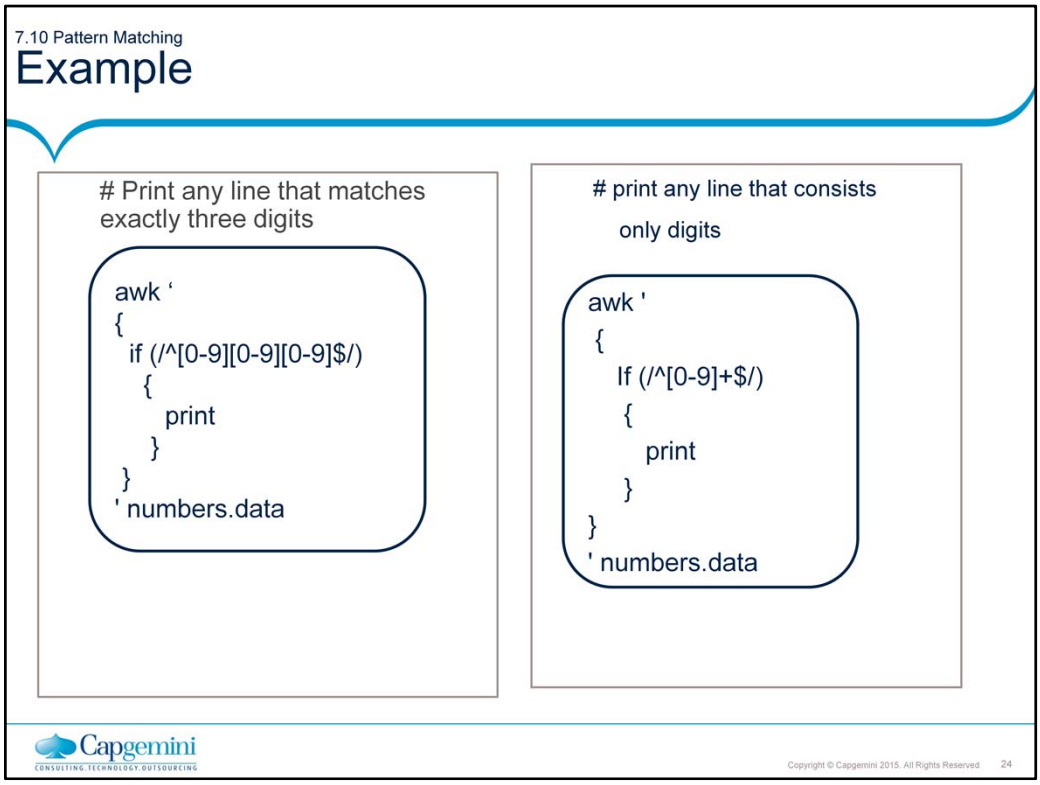
 22




To print all lines in which 4 th field does not matches with pattern Asia:

```
awk '
{
   if ($4 !~ /Asia/)
   {
       print
   }
}
' countries.data
```


7.10 Pattern Matching
Example
# Print any line that matches exactly three digits
awk '
{
if (/^[0-9][0-9][0-9]$/)
{
print
}
}
' numbers.data
# print any line that consists only digits
awk '
{
If (/^[0-9]+$/)
{
print
}
}
' numbers.data
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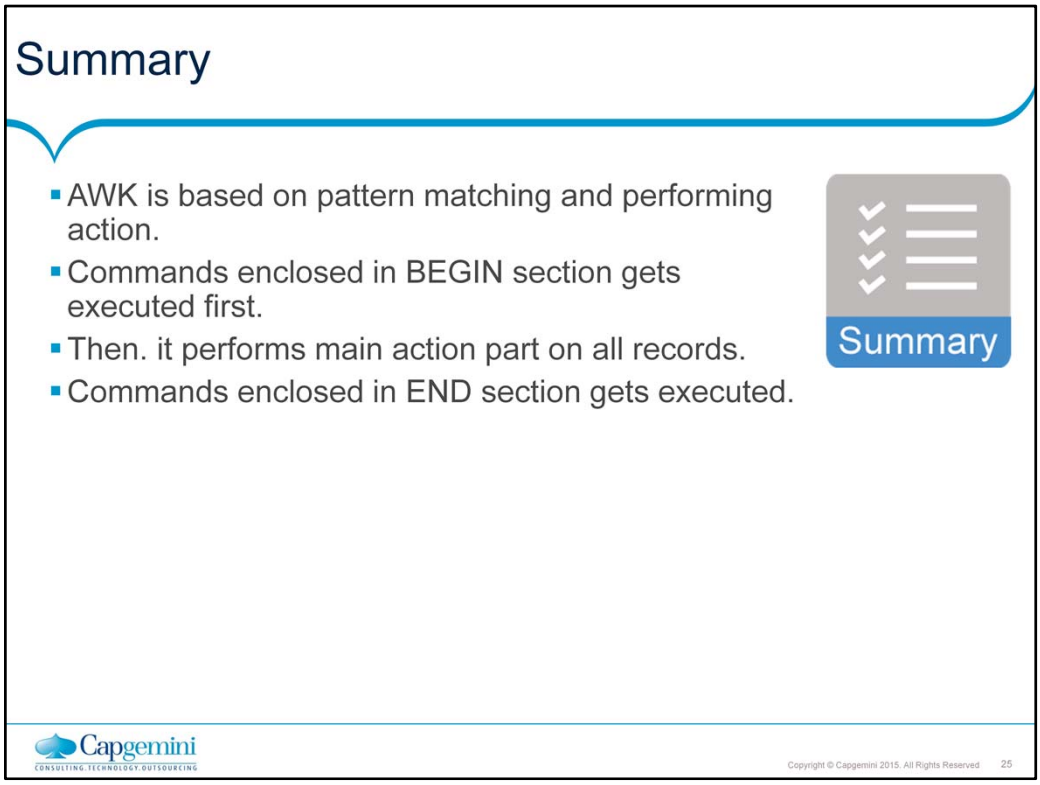
24

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## Review Questions

- In ------ section report header can be printed
- ------ section helps to print totals
- Print $0 prints whole record
  - TRUE
  - FALSE

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