

UNIX

Shell Programming

Lesson Objectives

- At the end of the session you will be able to understand:
 - Shell variable
 - Environment variables
 - Shell script commands
 - Command substitution
 - Command line argument
 - Conditional statements
 - Iterative statements



8.1: Shell Variables

Introduction

- System Variables
 - Set during:
 - Boot
 - Login
- .profile:
 - Script executed at login.
 - Alters operating environment of a user.
- \$set
 - Displays a list of system variables.



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System Variables

There are several variables set by the system - some during booting and some after logging in. These are called the system variables, and they determine the environment one is working in. The user can also alter their values. The set statement can be used to display list of system variables.

```
$ set
HOME=/usr1/deshpavn
HUSHLOGIN=FALSE
HZ=100
IFS=
LOGNAME=deshpavn
MAIL=/usr/spool/mail/deshpavn
MAILCHECK=600
MF_ADM=adm.cat@Unix
MSG_MAIL=1
MS_PROFILE=1
OPTIND=1
PATH=/bin:/usr/bin:/usr1/deshpavn/bin:.
PS1=$
PS2=>
SHELL=/bin/sh
TERM=ansi
TZ=IST-5:30
```

8.2: Environmental Variables

Standard shell variables

■ Shell Variables

- PATH : Contains the search path string.
- HOME : Specifies full path names for user login directory.
- TERM : Holds terminal specification information
- LOGNAME : Holds the user login name.
- PS1 : Stores the primary prompt string.
- PS2 : Specifies the secondary prompt string.



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Output of set command

Significance of some of these variables is explained below:

PATH Variable: Determines the list of directories (in order of precedence) that need to be scanned while you look for an executable command.

Path can be modified as:

```
$ PATH=$PATH:/usr/user1/progs
```

This causes the /usr/user1/progs path to get added to the existing PATH list.

HOME Variable: This controls the login or Home directory for the user.

IFS Variable: It contains a string of characters that can be used as separators on command line.

PS1 and PS2 Variables: These determine the primary and secondary prompt.

8.2: Environmental Variables

Scripts executed automatically

- **.profile script**
 - shell script that gets executed by the shell when the user logs on
 - Used by Bourne shell
- **.cshrc ,.login**
 - Used by C Shell users
 - *.login* and is read when the user logs in.
 - *.cshrc* and is read whenever a new C shell is created
- **.logout script**
 - *.logout* file can also be created for commands to be executed when you log out.



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.profile script

The *.profile* script is a shell script that gets executed by the shell when the user logs on. It contains settings for the operating environment of the user, and it remains in effect throughout the login session. Using this file, it is possible to customize operating environment.

.cshrc ,.login and .logout script

For the Bourne shell, the system reads the *.profile* file and executes the commands found there. C Shell users, however, have two files to read and execute. One is called *.login* and is read when the user logs in. The second is called *.cshrc* and is read whenever a new C shell is created, including the login shell. A *.logout* file can also be created for commands to be executed when you log out.

8.3: Shell script Commands

Example

- Simple Shell Script: Accept Name & Display Message

hello.sh

```
echo "Good Morning!"  
echo "Enter your name?"  
read name  
echo "HELLO $name How are you?"
```

- To execute the shell script
\$sh hello.sh
- To debug the shell script use -x option
\$sh -x hello.sh



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In above program, the `read` command accepts input from the user and stores it in name variable.

To display the variable value, you need to precede the variable name with a `$` sign:

```
echo "HELLO $name How are you?"
```

8.4: Arithmetic Operations

Details

```
echo "Enter first Number"
read no1
echo "Enter second Number"
read no2
res=`expr $no1 + $no2`
echo "The result is $res"
```

- In the above example, instead of *expr* we can use *let*.
 - Syntax:
 - *let expressions* or *((expressions))*
 - In above script *res=`expr \$no1 + \$no2`* can be replaced by
`let res=no1+n02`



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The above program accepts two numbers and displays their sum as a result. Instead of the *expr* command, we can use the *let* command.

Example:

Add one to variable *i*. Using *expr* statement:

```
i=`expr $i + 1`
```

Add one to variable *i*. Using *let* statement:

```
let i=i+1      If no spaces in expression
let "i = i + 1"  enclose expression in "... " if expression includes spaces
(( i = i + 1 ))
```

Expr is generally used but *let* is more user-friendly. It is used in Bash and Korn shell

8.5: Command Substitution

Details

- Command is enclosed in backquotes (`).
- Shell executes the command first.
 - Enclosed command text is replaced by the command output.
- Display output of the date command using echo:

```
$echo The date today is `date`  
The date today is Fri 27 00:12:55 EST 1990
```

- Issue echo and date commands sequentially:

```
$echo The date today is; date
```



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```
$echo The date today is `date`
```

In this command date is a command which is enclosed in backquotes and hence will get replaced by its output and then echo command will display message

```
$echo The date today is; date
```

In above command echo and date commands are separated by ; hence will get executed sequentially.

8.5: Command Substitution

Example

- Following instructions print pwd as a string:

```
➤ var=pwd
echo $var
Output: pwd
```

- Following instructions execute PWD shell command and display the present working directory:

```
var=`pwd`
echo $var
Output: /usr/deshpavan
```



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In the first example pwd is a string which is assigned to var variable. Hence o/p of echo \$var will be pwd

But in second example 'pwd' string is assigned to var variable
Hence echo \$var command will is
echo`pwd`

Since pwd is enclosed in backquotes it will get replaced by present working directory. echo will display name of current working directory.

8.6: Command Line Arguments

Details

- Specify arguments along with the name of the shell program on the command line called as command line argument.
- Arguments are assigned to special variables \$1, \$2 etc called as positional parameters.
- *special parameters*
 - \$0 – Gives the name of the executed command
 - \$* - Gives the complete set of positional parameters
 - \$# - Gives the number of arguments
 - \$\$ - Gives the PID of the current shell
 - \$! – Gives the PID of the last background job
 - \$? – Gives the exit status of the last command
 - @\$ - Similar to \$*, but generally used with strings in looping constructs



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You can pass values to shell programs while you execute shell scripts. These values entered through command line are called as command line arguments.

Parameters Related to Command Line Arguments

When you specify argument along with the name of the shell procedure, they are assigned into parameters \$1, \$2 etc. They are called as positional parameters.

There are also some other special parameters you can use. Some of them are:

- \$0 – Gives the name of the executed command
- \$* - Gives the complete set of positional parameters
- # - Gives the number of arguments
- \$ - Gives the PID of the current shell
- \$! – Gives the PID of the last background job
- \$? – Gives the exit status of the last command
- \$@ - Similar to \$*, but generally used with strings in looping constructs

8.6: Command Line Arguments

Details

- Arguments are assigned to special variables (positional parameters).

- \$1 - First parameter , \$2 - Second parameter,....

- Example:

```
echo Program: $0
echo Number of arguments are $#
echo arguments are $*
grep "$1" $2
echo "\n End of Script"
```

```
$ scr1.sh "Unix" books.lst      --$1 is UNIX , $2 -books.lst
```

- Run script:



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In above example

\$ scr1.sh "Unix" books.lst - The output only has lines with UNIX as substring from book.lst file .

Program: scr1.sh

Number of arguments are 2.

Arguments are Unix books.lst.

1001|Learning Unix |Computers |01/01/1998| 575

1004|Unix Device Drivers |Computers |09/08/1995| 650

1007|Unix Shell Programming |Computers |03/02/1993| 536

End of Script.

8.7: Conditional Execution

Details

- Logical Operators `&&` and `||`:

- `&&` operator delimits two commands. Second command is executed only if the first *succeeds*.
- `||` operator delimits two commands. Second command is executed only if the first *fails*.
- Example:

```
$grep `director` emp.lst && echo "pattern found"
$grep `manager` emp.lst || echo "pattern not found"
```



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Conditional Execution using `&&` and `||`

The shell provides `&&` and `||` operators to control the execution of a command depending on the success or failure of previous command. In case of `&&`, the second command executes only if the first has succeeded. Similarly, `||` will ensure that the second command is executed only if the first has failed.

The following command displays "Found!" only if the XML pattern is found in the books.lst file at least once.

```
$ grep "XML" books.lst && echo "Found!"
1003|XML Unleashed      |Computers  |20/02/2000| 398
1006|XML Applications   |Fiction    |09/08/2000| 630
Found!
```

The following command displays "Not Found ...". If grep does not find the "WAP" pattern in the books.lst file.

```
$ grep "WAP" books.lst || echo "Not Found..."
"Not Found..."
```

8.8: if Statement Format


Details

■ Syntax

(i) if <condition is true>
then
 <execute commands>
else
 <execute commands>
fi
(ii) if <condition is true>
then
 <execute commands>
fi

■ Example

```
if grep "^$1" /etc/passwd 2>/dev/null
then
    echo "pattern found"
else
    echo "pattern not found"
fi
```

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In UNIX /dev/null or the null device is a special file that discards all data written to it.

The null device is typically used to dispose the unwanted output stream of a process.

In given example, if grep returns any error and you wish to discard error messages, use /dev/null device.

8.9: if Statement Format


if Statement

■ Syntax:

(iii) if <condition is true>
then
 <execute commands>
elif <condition is true>
then
 <execute commands>
 <...>
else
 <execute commands>
fi

■ Example

```
if test $# -eq 0; then  
    echo "wrong usage " > /dev/tty  
elif test $# -eq 2 ; then  
    grep "$1" $2 || echo "$1 not  
                        found in $2" > /dev/tty  
else  
    echo "you didn't enter 2  
                arguments"  
fi
```

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In the example, test command is use to specify condition
The shell scripts checks for two command line arguments. If the number of arguments is zero, then the output is:
Wrong Usage

If it is two, then the first argument is used as a pattern and the second one is used as the file name to search in the grep command.

If the pattern is found, then the output of the grep command is displayed.
Otherwise, the output of the echo command is displayed.

If the number of arguments are not two, then the output is as follows:
"you didn't enter 2 arguments".

8.9: test Statement

Relational Operator for numbers

- Specify condition either using *test* or *[condition]*
 - Example: `test $1 -eq $2` same as `[$1 -eq $2]`
- Relational Operator for Numbers:
 - `eq`: Equal to
 - `ne`: Not equal to
 - `gt`: Greater than
 - `ge`: Greater than or equal to
 - `lt`: Less than
 - `le`: Less than or equal to

8.9: test Statement

Relational Operator for strings and logical operators

■ String operators used by *test*:

- `-n str` True, if `str` not a null string
- `-z str` True, if `str` is a null string
- `S1 = S2` True, if `S1 = S2`
- `S1 != S2` True, if `S1 ≠ S2`
- `str` True, if `str` is assigned and not null

■ Logical Operators

- `-a` .AND.
- `-o` .OR.
- `!` Not

9.9: test Statement

File related operators

- File related operators used by test command

- `-f <file>` True, if file exists and it is regular file
- `-d <file>` True, if file exist and it is directory file
- `-r <file>` True, if file exist and it is readable file
- `-w <file>` True, if file exist and it is writable file
- `-x <file>` True, if file exist and it is executable file
- `-s <file>` True, if file exist and it's size > 0
- `-e <file>` True, if file exist

8.9: test Statement

Example

- Check whether user has entered a filename or not:
 - Example:

```
echo "Enter File Name:\c "  
read fn  
if [ -z "$fn" ]  
then  
    echo "You have not entered file name"  
fi
```



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In the given example `-z` checks whether `$fn` is empty or not. If users do not enter the file name, then the output is as follows:

"You have not entered file name".

8.9: test Statement

Example

- Example:

```
if test $x -eq $y
≡ if [ $x -eq $y ]
```

- Example:

```
If [ ! -f fname ]
    then
        echo "file does not exists"
    fi
```



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```
if test $x -eq $y
≡ if [ $x -eq $y ]
```

In above command both the conditions are the same. You can use the “[” bracket to check the condition in place of the test command.

test \$x -eq \$y returns true if the values of variables x and y are equal. You can write the same condition as [\$x -eq \$y]. Here, instead of test command we use “[” (square bracket).

```
If [ ! -f fname ]
```

You can also write this condition as:
test !-f fname

8.9: test Statement

Example

```
echo "Enter the source file name : \c"
read source
#check for the existence of the source file
if test -s "$source" #file exists & size is > 0
then
    if test ! -r "$source"
    then
        echo "Source file is not readable"
        exit
    fi
else
    echo "Source file not present"
    exit
fi
```

The above example checks whether a given source file exists and displays appropriate messages.

8.10: Case Statement

Case command

Syntax:

```
case <expression> in
  <pattern 1> ) <execute
  commands> ;;
  <pattern 2> ) <execute
  commands> ;;
  <...>
  <...>
esac
```

Example:

```
echo "\n Enter Option : \c"
read choice
case $choice in
  1) ls -l ;;
  2) ps -f ;;
  3) date ;;
  4) who ;;
  5) exit ;;
esac
```



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In a case statement you can also use commands enclosed in backquotes. The given example executes command ``date | cut -d " " -f1`` which returns only the day part. The output is used to execute the appropriate case.

Example:

```
case `date | cut -d " " -f1` in
  Mon ) <commands> ;;
  Tue ) <commands> ;;
  :
esac
```

Example:

#display the options to the user

```
echo "1. Date and time          2. Directory listing"
echo "3. Users information      4. Current directory"
echo "Enter choice (1,2,3,4) :\c"
```

```
read choice
case $choice in
  1) date;;
  2) ls -l;;
  3) who;;
  4) pwd;;
  *) echo wrong choice;;
esac
#end of script
```

8.10: Case Statement

Example

```
echo "do you wish to continue?"
read ans
  Case "$ans" in
    [yY] [eE] [sS]) ;;
    [nN] [oO]) exit ;;
    *) "invalid option" ;;
  esac
```

In the above example, the first case matches with “yes” or “YES”. Similarly, the second case matches with “no” or “NO”.

8.11: While loop Statement

Syntax and Example

■ Syntax:

```
while <condition is true>
do
    <execute statements>
done
```

e.g.

```
while [ $x -gt 3 ]
do
    ps -a
    sleep 5
done
```

```
while true
do
    ps -a
    sleep 5
done
```



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Example: Script to edit, compile and execute a program.

```
while true
Do
    cc $1
case $? In
o) echo "Compilation Successful"
    echo "Executing a.out"
    a.out ; exit ;;
*) echo "Compilation Error"
    echo "Press <Enter> to edit"
    read pause
    vi $1 ;;
Esac
done
```

8.11: Examples

Example : While

```
#using while loop
num=1
while [ $num -le 10 ]
do
    echo $num
    num=`expr $num + 1`
done
#end of script
```

In the above example, the loop executes till the condition is true. This is till the value of the variable num is < 10.

8.12: Break & Continue Statement

break and continue statement

- Continue:
 - Suspends statement execution following it.
 - Switches control to the top of loop for the next iteration.
- Break:
 - Causes control to break out of the loop.

8.12: Break & Continue Statement

Example

```
while echo "designation : \c"
do
    read desig
    case "$desig" in
        [0-9]) if grep "^$desig" emp.lst >/dev/null
                then
```



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In above example, the while loop is an unending loop as echo " designation : \c " statement (which is put as a condition in the while loop) always returns an exit status of success (condition becomes true).

Hence, it is more efficient if you write the following as a single statement:

```
while true
    echo "designation : \c"
```

In the above program if you enter a designation as a two digit number, it matches with case [0-9][0-9]. If the designation found in the file break statement is executed, control comes out of the loop and the program halts.

Otherwise, the default case is executed. Continue statement transfers the control at the beginning of the loop.

8.13: until loop

Syntax

- Complement of while statement.
- Loop body executes repeatedly as long as the condition remains false.
- Example:

```
until false
do
    ps -a
    sleep 5
done
```



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The syntax is as follows:

```
until condition
do
    commands
Done
```

This loop is a complement of the while loop. In the while loop statements are repeated till the condition is true. But in an until loop, statements inside loop are repeated till the condition is false. As soon as the condition becomes true, the iteration stops.

In the above example given until loop is infinite loop.

8.14: For Statement

for statement

▪ Syntax:

```

for variable in list
do
    <execute commands>
done

```

▪ Eg:

```

for x in 1 2 3
do
    echo "The value of x is $x"
done

```

```


for var in $PATH $HOME $MAIL
do
    echo "$var"
done

```

```

for file in *.c
do
    cc $file
done

```

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Example 1:

In this example, for loop executes three times because three numbers are there in the list. In every iteration x is assigned 1, 2 and 3 respectively.

Example 2:

In this example also, for loop executes 3 times. In each iteration, var takes values from system variables in the list \$PATH, \$HOME and \$MAIL respectively.

Example 3:

In this example, the for loop iterates equal to the number of files with extension c in the current working directory. This is because *.c is replaced with a list of all files with extension c in the current working directory.

Some more examples are:

```

for i in 1 2 3 4 5 6 7 8 9 0
do
    echo $i
done

```

Example : for

```
for file in chap20 chap21 chap22  
chap23; do  
  cp $file ${file}.bak  
  echo $file copied to $file.bak  
done
```

```
for file in 'cat list'.....
```

```
for file in *.htm *.html;  
do  
  # do something  
done
```

```
for pattern in "$@"; do  
  grep "$pattern" emp.lst || echo "$pattern not found"  
done
```

8.14 For Statement

Details


▪ Syntax:

```
for (( expr1; expr2; expr3 ))
do
..... .. repeat all
statements between do
and done until expr2 is
TRUE

done
```

▪ e.g.

```
for (( i = 0 ; i <= 5; i++ ))
do
  echo "Welcome $i times"
done
```

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In above example, syntax before the first iteration, `expr1` is evaluated. This is usually used to initialize variables for the loop. All statements between `do` and `done` are executed repeatedly until the value of `expr2` is true.

After each iteration of the loop, `expr3` is evaluated. This is usually used to increment a loop counter.

The output of the given example is:

```
Welcome 0 times
Welcome 1 times
Welcome 2 times
Welcome 3 times
Welcome 4 times
Welcome 5 times
```

8.15: Examples

Example : Until

```
#script to create a employee file
ans="y"
until [ $ans = "N" -o $ans = "n" ]
do
    echo "Enter the name : \c"
    read name
    echo "Enter the grade : \c"
    read grade
    echo "Enter the basic : \c"
    read basic
    echo $name: $grade : $basic >>emp
    echo "Want to continue (Y/N) : \c"
    read ans
done
#end of script
```



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In above example the loop executes till the condition is false. This is as soon as the user enters "N" or "n" for ans, the condition is true and the loop stops iteration.

Some more examples of shell script are:

Script to accept five numbers and display their sum:

```
echo the parameters passed are : $1, $2, $3, $4, $5
echo the name of script is      : $0
echo the number of parameters passed are : $#
#calculate the sum
sum=`expr $1 + $2 + $3 + $4 + $5`
echo the sum is $sum
```

#end of script

Invoke this script as follows:

```
$sh disp_sum 10 12 13 14 15
```

The above command is to be followed by 5 different number as shown.

8.16: Shell functions

Functions in Shell Script

- Use shell functions to modularize the script.
- These are also called as script module
- Normally defined at the beginning of the script.
- Syntax (Function Definition):

```
functionname(){  
    commands  
}
```

- Example: Function to create a directory and change directories:
- Use `mkcd mydir` to call the function. `mydir` is used as `$1` in the function.

```
mkcd()  
{  
    mkdir $1    --$1 is the argument we pass while calling function  
    cd $1  
}
```



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You can also call the shell function script module as it makes a whole script section available under a single name. Normally, shell functions are defined at the beginning of the script. Or several functions can be stored in a file and read whenever they are needed. Files are stored in the `bin` directory. Function name can be any combination from the regular character string.

8.16 : Shell functions

Using return statement

- Used to come out of a function from within.
 - If called *without* an argument, function return value is the same as *exit* status of the last command executed within the function
 - If called *with* an argument it returns the argument specified.
- Example:

```
functret()  
{  
  command1  
  if .....  
  then  
    return 1  
  else  
    return 0  
  fi  
  Command2  
}
```

8.16 : Shell functions

Using return statement

```
Myfunction(){  
  echo "$*"  
  echo "The number should be between 1 and 20"  
  read num  
  if [ $num -le 1 ] -a [ $num -ge 20 ]  
    then  
    return 1;  
  else  
    return 0;  
  fi  
  echo "You will never reach to this line"}  
  
echo "Calling the function Myfunction"  
if Myfunction "Enter the number"  
then  
  echo "The number is within range"  
else  
  echo "The number is out of range"
```



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In the above example, Myfunction is called in the if statement with message "enter the number". This message is passed as three arguments.

In Myfunction, the first line is echo \$*.

Hence, it display message "Enter the number".

Read num accepts the number.

If the number is between 1 and 20, the function returns 1, otherwise it returns 0.

If Myfunction returns 1, then the output is:

The number is within range.

Otherwise the output should be as follows:

The number is out of range.

8.16 : Arrays

Using arrays

- Contains a collection of values accessible by individuals or groups
 - Subscript of array element indicates their position in the array.
 - `arrayname[subscript]`
- First element is stored at subscript 0.
 - Assign a value in *flowers* array at the first position.
 - `Flowers[0]=Rose`
- Assign values in an array with a single command:
 - `$ set -A Flowers Rose Lotus`
- Access individual array elements
 - `${arrayname[subscript]}`

8.16 : Arrays

Using arrays

- To print values from array we can use while loop

```
flowers[0]=Rose
flowers[1]=Lotus
flowers[2]=Mogra
i=0
while [ $i -lt 3 ]
do
echo ${flowers[$i]}
i=`expr $i + 1`
done
```

- Access all elements:

```
${array_name[*]}
${array_name[@]}
```



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You can display all elements from the array using * or @ symbol:

```
Num[0]="Zero"
Num[1]="One"
Num[2]="Two"
Num[3]="Three"
echo "First Method: ${NAME[*]}"
echo "Second Method: ${NAME[@]}"
```

Summary

- .profile:
 - Script executed during login time.
- *Command enclosed in backquotes (`)*:
 - Shell executes the command first
 - Enclosed command text is replaced by the command the output.
- Test:
 - Command used to check the condition in an if statement.
- Different loop statements in Unix are:
 - For
 - While
 - Until



Review Questions

- Complete The Following

- ----- command can be replaced by test command.
- ----- condition checks whether two strings are equal or not.
- ----- loop terminates as soon as condition becomes true.

- TRUE OR FALSE

- PS1 stores primary cursor string:

