UNIX Programming (JNTUK-R16)

Unit-1 Syllabus: Introduction to UNIX

- What is UNIX
- UNIX Components
- Using UNIX
- Commands in UNIX
- Some Basic Commands
- Command Substitution
- Giving Multiple Commands.
- Brief History

Text Books:

1. The UNIX programming Environment by Brain W. Kernighan & Rob Pike, Pearson.
2. Introduction to UNIX Shell Programming by M.G.Venkateshmurthy, Pearson.

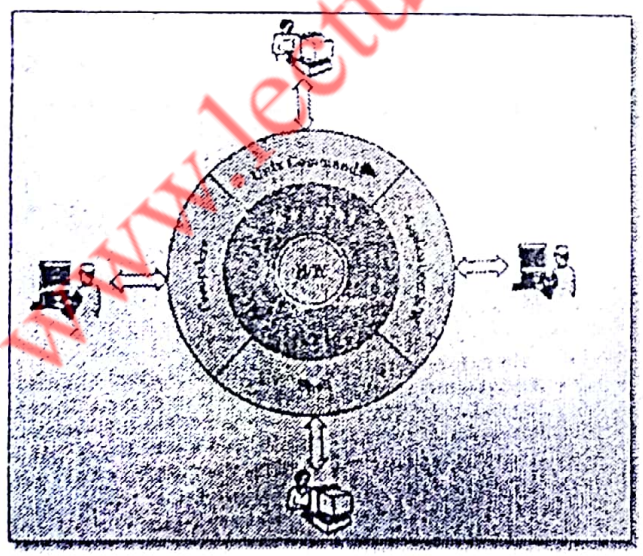
1. WHAT IS UNIX?

- UNIX is

- An Operating System
- A Multi-tasking Operating System
- A Multi-user Operating System
- Highly Portable
- Provides Security at various levels
- Treats Everything including memory and I/O devices
- Uses Text-based Terminal

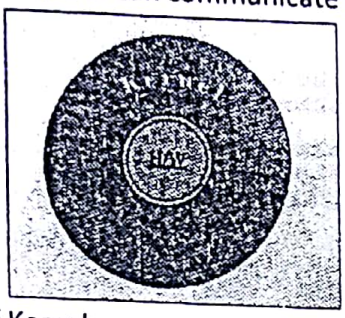
2. UNIX COMPONENTS:

- It has 3 major Components
  - i) The Kernel
  - ii) The Shell
  - iii) The File System



i) The Kernel:

- Kernel is the Heart of any Unix Operating System.
- Every UNIX has just one Kernel.
- It is a small piece of code that is embedded on the Computer Hardware.
- It is a collection of programs that are mostly written in C.
- It is the only component that can communicate directly with the Hardware.



- There are 2 types of Kernels
  - Monolithic Kernels
  - Micro kernels

ii) The Shell:

- A Shell is a Command Interpreter or a Processor.
- It acts as an agent or interface between the Users and the Kernel (Hardware).
- Every UNIX has at least one shell.
- It is similar to command.com in the MS-DOS environment.
- Shell has certain programming capability of its own, called Shell Programs or Shell Scripts.

Types of Shells:

- The Shells are 4 types
  a) The Bourne Shell (sh)
  b) The C Shell (csh)
  c) The Korn Shell (ksh)
  d) The Bourne-Again Shell (bash)

a) The Bourne Shell (sh):

- This is the most common shell available on Unix Systems.
- The first major shell developed by Stephen Bourne at AT&T Bell labs.
- This shell is widely used.
- This shell is distributed as the standard shell on almost all Unix Systems.

b) The C Shell (csh):

- It is developed by Bill Joy at UCB as part of the BSD release.
- Its syntax and usage is very similar to the C programming language.
- This shell is not available on all machines.
- Shell scripts written in the C shell are not compatible with the Bourne Shell.
- A version of it called tcsh is available free of cost under Linux.

c) The Korn Shell (ksh):

- This shell was developed by David Korn at AT&T Bell labs.
- Basically it is built on the Bourne Shell.
- It also incorporates certain features of the C shell.
- At present it is one of the widely used shells.
- It can run Bourne shell scripts without any modification.
- One of its versions, the Public Domain Korn Shell (pdksh), comes with Linux free of cost.

d) The Bourne-Again Shell:

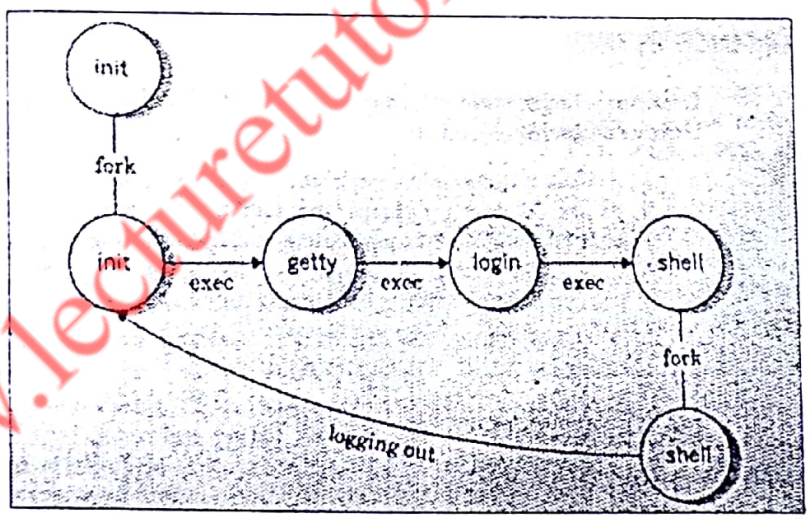
- It was developed by B Fox and C Ramey at Free Software Foundation.
- Certain Linux operating system variants come with this shell as its default shell.
- This is clearly a free ware shell.

iii) The File System:

- Another major component of UNIX system.
- UNIX treats everything including hardware devices – as a file.
- Files in UNIX are organized in an inverted tree-like hierarchical structure.
- All files are stored in a File System as in the form of a tree-like hierarchical structure.

3. USING UNIX:

- To use UNIX, one has to get into the UNIX environment.
- The process of getting into the UNIX environment is known as Logging into the System.
- The Login process is depicted as,



The Sequence of events in a Complete Login process is given as,

- As soon as the system is booted, a daemon called **init** gets started along with some other daemons.
- Daemons are background processes that get started at the boot time and continue to run as long as the system is up.
- This **init** daemon spawns a process called **getty** for every terminal.
- The user enters a login name at the getty's login prompt on the terminal.
- getty executes the login program with the login name as the argument.

- login requests for a password and validates it against /etc/passwd.
- A file called passwd file under /etc directory contains a line for every user containing the user's login name, numerical user id, encrypted password, home directory, and other such information.
- login sets up the TERM environment variable and runs a shell.
- The shell executes the appropriate startup files like .profile.
- The shell then prints a prompt, usually a $ or a % symbol and waits for further input.
- This indicates successful entry made into a UNIX environment with a proper shell.
- When the user completes the session with the system, he comes out of the UNIX environment.
- The process of coming out of the UNIX environment is known as Logging out.
- As soon as the user logs out, the control return to init daemon, which in turn spawns a new getty on the corresponding terminal.
- This facilitates a new user to login to the system.

The shell prompt:

- Successful login into a UNIX system is indicated by the appearance of a prompt called the shell prompt or system prompt on the terminal.
- The character that appears as a prompt depends on the shell used.
- The list of default prompts given in a table as,

Prompt	Shell
$ (dollar)	Bourne and Korn Shells (sh, bash, ksh)
% (percent)	C Shells (csh, tcsh)
# (hash)	Any shell as root

4. COMMANDS IN UNIX:

- UNIX has a Large number of commands.
- A UNIX command is a program written to perform certain specific action.
- All UNIX commands are written using Lower-case letters.
- Almost all UNIX commands are Cryptic.
- UNIX commands can have zero, one or more number of arguments associated with them.
- UNIX commands can also have Format Specifiers (indicated by +) as well as Options (indicated by -) associated with them.
- A current UNIX command can be killed by using either <delete> or <ctrl+u> command.
- There are two types of UNIX Commands available.
    i) External Commands
    ii) Internal Commands

i) External Commands:

- A Command with an independent existence in the form of a separate file is called an External Command.
- For example, programs for commands such as **cat** and **ls**, exist independently in a directory called the **/bin**directory.
- When such commands are given, the shell reaches these command files with the help of a system variable called the PATH variable and executes them.
- Most of the UNIX commands are External Commands.

ii) Internal Commands:

- A Command that does not have an independent existence is called an Internal Command.
- These commands also called as Built-in Commands.
- The routine for internal commands will be a part of another program or routine.
- For example, the echo command is an internal command as its routine will be a part of the shell's routine, sh.
- cd and mkdir are also examples of internal commands.

5. SOME BASIC COMMANDS:

a) echo
b) tput
c) tty
d) who
e) uname
f) date
g) cal
h) calendar
i) passwd
j) lock
k) banner
l) cat
m) bc
n) spell and ispell

a) The echo command:

- This command is used to display messages.
- It takes zero, one or more arguments.
- Arguments may be given either as a series of individual symbols or as a string within a pair of double quotes (" ").

Examples:

i) $echo
#A Blank line is displayed
$

ii) $echo Hello World
Hello World
$

iii) $echo Hello World
Hello World
$

- The echo command

iv) $echo "Hello World"
Hello World
$

v) $echo "Hello World"
Hello World
$

b) The tput command:

- It is used to control the movement of the cursor on the screen.
- Along with clear argument clears screen.

Example:

I) $tput clear

- Along with cup argument and certain coordinate values is used to position the cursor.

Example:

```
$tput  cup 10 20
```

- To find the number of rows and columns on the current terminal we use lines and cols arguments along with tput command.

Example:

```
$tput lines
  45
$tput cols
 120
$
```

c) The tty command:

- In UNIX, every terminal is associated with a device file.
- All the device files will be present in the /dev directory.
- A user can know the name of his device file on which he is working by using the tty command.

Examples:

- In UNIX, the tty command gives the result as,

```
$tty
  /dev/tty01
$
```

- In UNIX, the tty command gives the result as,

```
$tty
 /dev/pts/0
$
```

d) The who command:

- The *user can know login details of all the current users* by using the who command.
- It has three column format.

Example:

```
$who
 root  console  july 2  10:30
 aaa   tty01    july 2  10:40
 bbb   tty02    july 2  10:55
$
```

- Some *options like -H, -u* can be used with this command
  -H option provides *headers for columns.*
  -u option provides *more details like idle time, PID and comments.*

Example:

```
$who –Hu
  NAME  LINE   TIME          IDLE  PID   COMMENTS
   root    console  july 2  10:30   0:05    22
   aaa     tty01    july 2  10:40   0:10    23
   bbb     tty02    july 2  10:55   0:15    24
$
```

The who am I command:

- The *self-login details of a user* can be obtained as a single line output using am and i arguments along with the who command.

Example:

```
$who am i
 aaa   tty01  july 2  10:40
$
```

e) The uname command:

- It gives the name of the UNIX system being used by the user.
- It uses certain options like r,v,m,a.

Examples:

```
i) $uname
    Linux
   $

ii) $uname -r
    2.4.18 - 3          #release details
   $

iii) $uname -m
    i686                #machine details
   $
```

f) The date command:

- Using this command, the user can display the current date along with the time nearest to the second

Example:

```
$date
 Sat  Jan 10  11:58:00  IST  2004
$
```

- It allows the use of format specifiers
- Each format specifier is preceded by a + symbol followed by the % operator
- +m is used to display the month in the numeric form

Example:

```
$date  +%m
09
$
```

- +h is used to display the name of the month

Example:

```
$date  +%h
Sep
$
```

g) The cal command:

This command is used to print the calendar of a specific month or a specific year

Example:

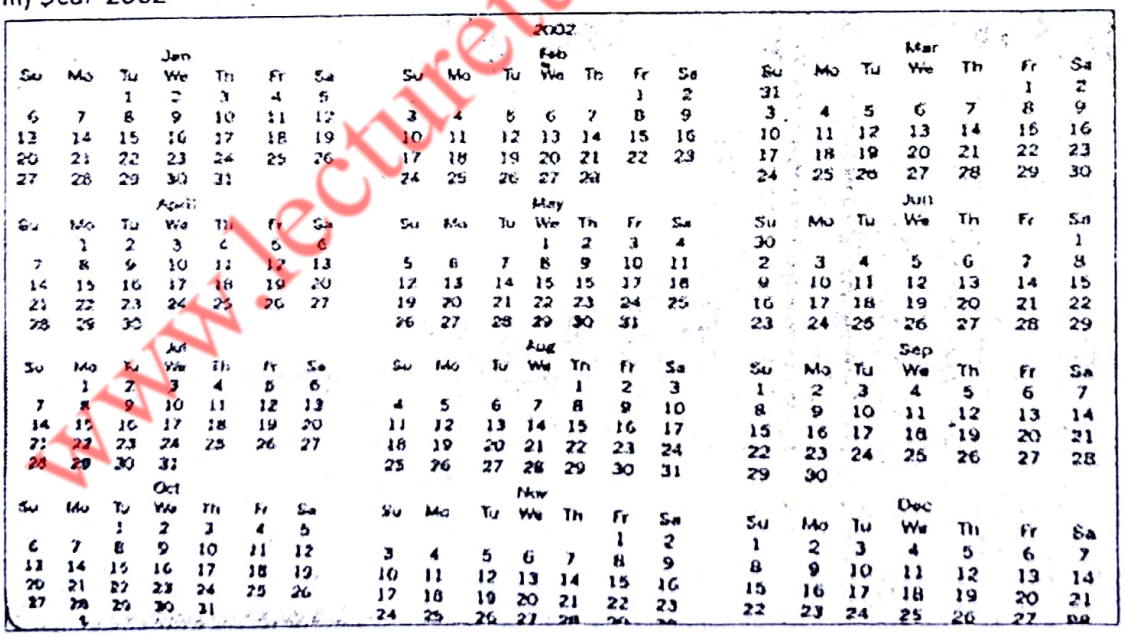
i) $cal

```
      MARCH 2018
Su    Mo    Tu    We    Th    Fr    Sa
                  1     2     3
4     5     6     7     8     9     10
11    12    13    14    15    16    17
18    19    20    21    22    23    24
25    26    27    28    29    30    31
$
```

ii)$cal 09 1949

```
      September 1949
Su    Mo    Tu    We    Th    Fr    Sa
                        1     2     3
4     5     6     7     8     9     10
11    12    13    14    15    16    17
18    19    20    21    22    23    24
25    26    27    28    29    30
$
```

iii) $cal 2002



h) The calendar command:

- It is like an engagement dairy that contains text information and offers a remainder service based on a file.
- The file must be in the present working directory/ home directory.
- This file is created and managed by the user with the help of an editor(like vi) on the system.
- This command works on today and tomorrow dates concept

Example:

```
$calendar
Jun 11, 2018 college opening day
$
```

I) The passwd command

- UNIX is a multi-user OS in which there is always a security threat.
- The security of an individual user can be given using password.
- During the addition of new users, the system administrator permits or authorizes the new user by assigning a unique password to him or her.
- A user can change his or her password using the passwd command.

Example:

```
$passwd
  old password: ********
  new password: ********
  new password: ********
$
```

j) The lock command:

- It is used for locking a session for any required amount of time.

Example:

```
password:********
re-enter password:********
terminal locked by 501 0 min ago
```

- One can lock a terminal for a maximum period of 60 minutes.
- A numeric option may be used to lock the terminal for any period ranging between 1 and 60 minutes

Example:

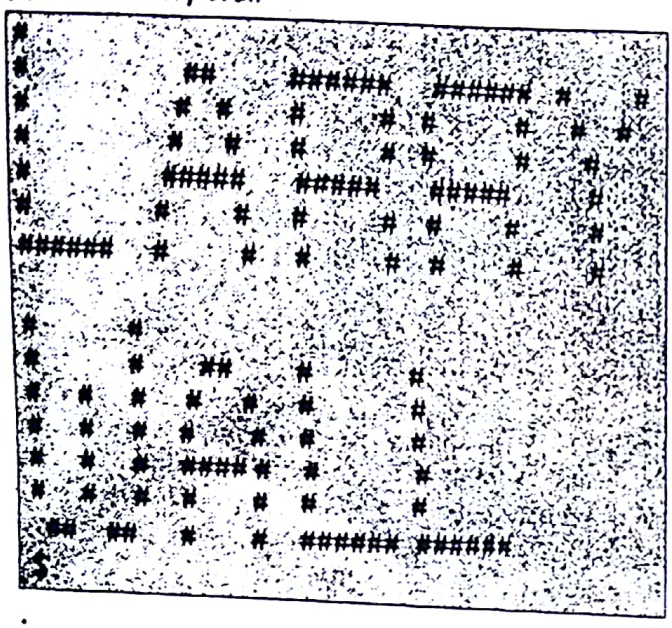
```
$lock -45                    #locks for 45 minutes
```

k) The banner Command

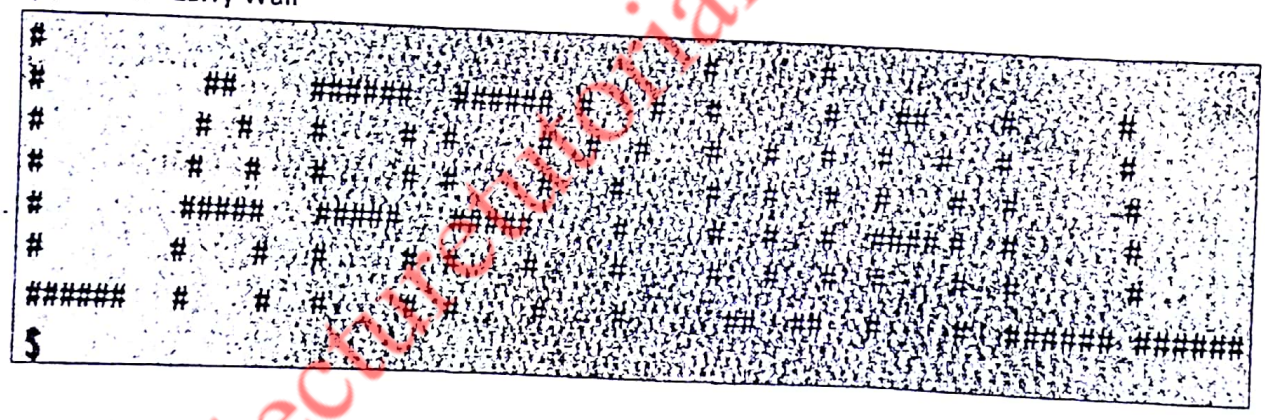
- It is available on SCO UNIX (But not in Linux).
- It is used to display banners and posters.

Example:

i) $banner Larry Wall



ii) $banner "Larry Wall"



l) The cat command:

- It is used for creating small UNIX files

Example:

```
$cat > newfile
 Hi
 Hell
 Welcome
$
```

- The input operation is terminated by using <ctrl+d> command

m) The bc command:

- The bc command is both a calculator and a small language for writing numerical programs
- Math functions in bc command are

Function	Acronym
Cosine	c(n)
Sine	s(n)
Tan	t(n)
Arctan	a(n)
natural log	l(n)
exponential function	e(n)
square root	sqrt(n)
exponent	^

- The bc command is used as a calculator

Example:

1.
```
$bc
sqrt 55
7
quit
$
```

2.
```
$bc
scale = 4
sqrt 55
7.4161
quit
$
```

Example: control construct

```
$bc
for (i=1; i<=4; i=i+1) i^2
1
4
9
16
quit
$
```

n) The spell and ispell commands:

- The spell command displays a list of misspelled words in the document used as argument.

Example:

$ cat > sample

```
$cat spell.ux
This is an exmple
I am testing the spel command.
Als I am testing the ispell comand.
$
```

- By using spell command, we can get the misspelled words

$ spell sample.

```
$spell spell.ux
Als
comand
exmple
spel
$
```

- The ispell command is an interactive spell-check program

Example:

$ ispell sample

```
This is an exmple.
I am testing the spel command.
Als I am testing the ispell comand.
```

2

```
1) mine                    5) examples
2) example                 6) expol
3) exempler                7) ampule
4) exampled                8) example's

i) Ignore                  I) Ignore all
r) Replace                 R) Replace all
a) Add                     X) Exit
```

6. COMMAND SUBSTITUTION:

- In UNIX, it is possible to run a command within a command.
- The date command can be run within the echo command by writing a command line.

Example:

$echo Today the date is 'date'
Today the date is Fri jul 6 9:40:00 IST 2018

- It shows the command (date) is executed within another command (echo).
- The command is given here between single quotes (' ').

- In Korn shell, the command substitution is accomplished by using a $ sign followed by the command within a pair of parenthesis.

Example:

$echo Today the date is $(date)
Today the date is Fri jul 6 9:40:00 IST 2018

7. GIVING MULTIPLE COMMANDS:

- Normally a single command is given to the shell at its prompt.
- There are many situations when more than one command is given in a single command line.
- One of the ways of giving multiple commands is to use a semicolon (;) between successive commands.

Example:

$echo "Giving multiple commands"; date; who

- Commands given in this way does not mutually interact with each other in any manner.
- They are executed independently one after the other, from left to right as they appear in the command line.

IMPORTANT QUESTIONS:

1. What is UNIX? What are UNIX Components? Explain with a neat diagram how to enter into UNIX environment
2. What is a UNIX command? What are rules to write UNIX commands? Write its types. And explain the following commands
   a) echo b) who c) passwd d) cat e) bc f) spell and ispell