

EECS2301

Lab 1 Winter 2016

Lab Objectives

In this lab, you will be introduced to the Linux operating system. The basic commands will be presented in this lab. By the end of you lab, you will be asked to perform simple operations and submit a script of the terminal session.

What is a shell?

A shell is the interface between you and the computer. It accepts commands typed by the user and then uses the operating system in order to execute these commands. For example the command could be `ls` followed by enter

```
sh-3.00$ ls
emp.data  f2   file1  one_liners.log one_liners.pdf p1   p3
f1        f3   ile2   one_liners.odt one_liners.ps  p2
sh-3.00$
```

Before you enter `ls` the shell displayed the prompt (in this case `sh-3.00$`) and sits patiently waiting for your input. After typing `ls` and pressing enter, it takes the command (`ls` – listing all the files in the current directory) and runs it (using the OS) producing the shown output.

Where the shell can find the program `ls` to run? There is a variable called `PATH` (We will discuss how to set `PATH` variable later). This variable lets the shell looks for any command that you type in specific places, if the command is not in one of the places defined by `PATH`, then the shell displays a message on the form (The exact form depends on what shell you are running on your system)

```
sh-3.00$ Command not found
```

`ls` is one of many basic commands that you can use to manipulate your files. The best way to know how to use a command is to use the `man` command (short for manual). For example type `man ls` at your shell prompt and you get a description of the `ls` command and the options you can use with it.

Do `ls -l`, `ls -s`, `ls -a`, and `ls -las` what do you get?

Then do `man ls` and check what are the flags `-l`, `-s`, `-a` and `-las` means

What are the different kinds of shells?

There are many shells that you can use on any Unix/Linux system. We will briefly introduce these shells and compare between them. There is a shell that is started when you login, that is the default shell and is set by your system administrator. You can start other shells, or you can change your default shell later.

The Bourne Shell

Designed by Stephen Bourne of AT&T Bell Laboratories and released in 1977. The Bourne shell, or sh as it is widely known is considered to be the original shell (although it was actually a replacement for Thompson Shell. It is considered to be a standard on any UNIX system. The Bourne shell is considered the least common denominator for shells. For truly portable scripts, use the Bourne Shell and it will run on many shells.

The C Shell

Designed by Bill Joy at the University of California at Berkeley for the BSD Unix. Its syntax resembles that of C, hence the name. It introduced new features to the shell like the history substitution (!! to repeat the last command) and the ~ expansion for home directory lookup. There are some syntax difference between csh and sh, for example in sh we set a variable as "a=b" while in csh "set a=b"

The Korn Shell

Developed by David Korn of AT&T Bell Laboratories for its System V Unix as a response to the csh. It has many of the features of csh but is backward compatible with sh. The Korn shell has been standardized as a part of POSIX

The Bourne Again Shell – Bash

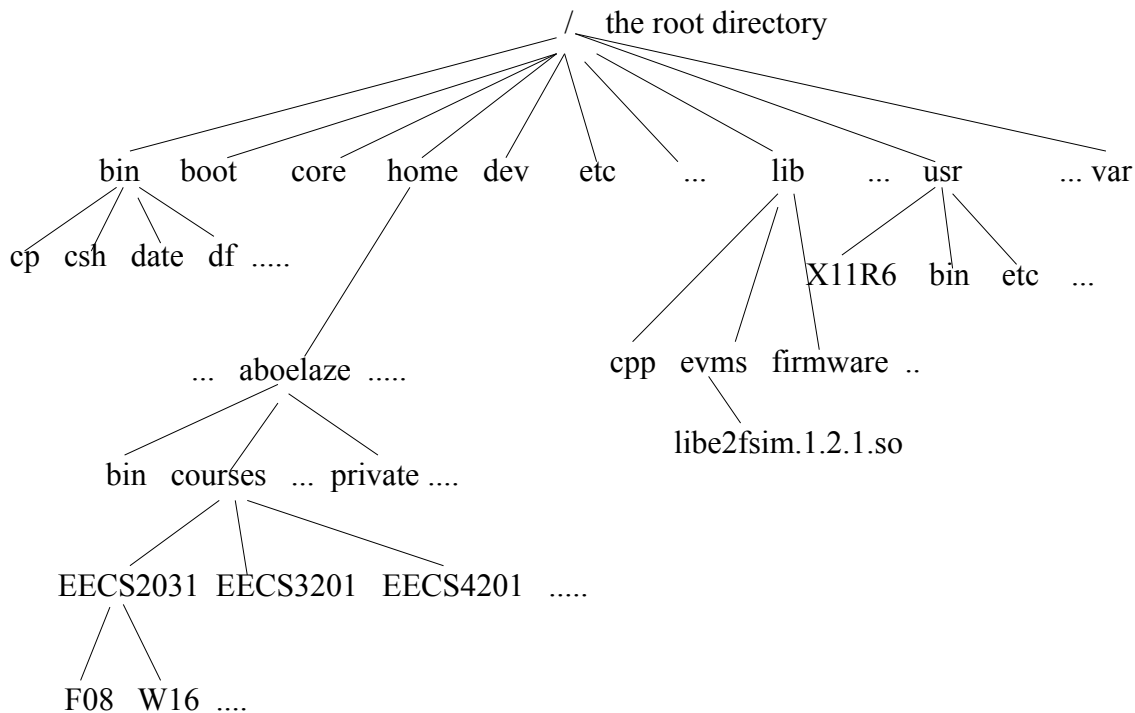
The Bourne Again Shell or bash has been developed for the GNU project and is mainly a response to the Korn shell. It has many features in the Korn shell, but is backward compatible with the original Bourne Shell.

The Extended C shell tcsh

The tcsh extends the original c shell by adding file name completion and command line editing. It is also backward compatible with csh.

Unix File System

The Unix/Linux file system is organized on the form of a tree. The root directory is defined as "/" without the quotation marks. You can define files or directories relative to the directory you are in, or as an absolute starting from the / root directory. An example of a Unix directory tree is shown below.



For example when I refer to the directory "courses" I can refer to it as ~/courses (~ means home directory) or the full path /home/aboelaze/courses. The command pwd (print working directory) displays the name of the directory you are currently in.

File Protection

In Unix/Linux each file has an access rights that are determined by the access bits. For example when you type `ls -ls filename`

```
tigger 127 % ls -ls abs.txt
-rwx----- 1 aboelaze faculty 1066 Nov 15 2005 abs.txt*
tigger 128 %
```

The access bits in this case is - rwx-----

The first dash states that the file is a regular file and not a directory (it would be d if it is a directory). The following 9 characters are divided into three groups with

3 character per group. The groups determine the access right for user (owner), group and others. In each group the right2 are `rwX` (for read, write, and execute). For the above example, the owner has the right to read, write (modify), or execute the file. The group and other do not have access rights at all to the file. Access bits on the form `rwXr-Xr--` means the owner have the right to read, write, and execute the file. People in the same group as the owner have the right to read and execute the file (no write) stated as `r-X`, while others have the right to read the file but not write it or execute it.

The command **mkdir** makes a new sub-directory in the current directory. To change to the directory you just created (or to any other directory) use he command **cd** for change directory followed by the directory name you want to go to.

cd without any arguments takes you to you **home directory**

cd .. (two dots) takes you one directory up in the directory tree.

Basic Unix Commands

Login and open an xterm. First to know your login shell, echo the login shell variable

```
tigger 207 % echo $SHELL
/cs/local/bin/tcsh
tigger 208 %
```

That means that I am using a tcsh shell. To explain what the commands mean, echo echoes what follows it verbatim if you say echo bla bla bla, then "bla bla bla" will be displayed on the screen. However the dollar sign before SHELL tells the shell do not just echo the phrase SHELL but the variable named SHELL which is a shell variable holds the name of the login shell.

Unix/Linux commands are on the form

commands arguments

or

commands options arguments

For example when we did ls commands before, that is an example of a command without any arguments. We can do

`ls file` lists the named file if it exists

or

`ls directory` lists the contents of the directory if exists

there are a lot of options that could be used with ls (`-a -s -l -f`) do man ls to check all the options.

Some other commands

rm removes (deletes) a file or a directory
mv moves a file or director
cp copies a file
ps lists the running processes
kill kills a process (kill -9 for maximum effects)

for example try to man uname (another Linux command), here is part of the man pages for uname.

After you man uname, try it for different options as given below.

```
tigger 119 % man uname
```

```
UNAME(1)                    User Commands                    UNAME(1)
```

NAME

```
uname - print system information
```

SYNOPSIS

```
uname [OPTION]...
```

DESCRIPTION

```
Print certain system information. With no OPTION, same as -s.
```

```
-a, --all
```

```
print all information, in the following order:
```

```
-s, --kernel-name
```

```
print the kernel name
```

```
-n, --nodename
```

```
print the network node hostname
```

```
-r, --kernel-release
```

```
print the kernel release
```

```
-v, --kernel-version
```

```
print the kernel version
```

```
-m, --machine
```

```
print the machine hardware name
```

```
-p, --processor
```

```
print the processor type
```

```
-i, --hardware-platform  
    print the hardware platform
```

The command `grep`

`grep`, checks for a specific pattern from a file and display the lines containing that line (by default). It has many options check `man grep` for complete list of options.

```
grep book file1
```

display all the lines in `file1` that include the string `book`.

Another useful command is `wc` (short for word count). `Wc` counts the number of characters, words, and lines in a file.

```
tigger 157 % wc temp  
 3  32 169 temp  
tigger 158 %
```

That means the file `temp` has three lines, 32 words, and 169 characters.

Redirection and Pipes

By default, Unix/Linux uses three input/output channels

- ◆ `0=stdin` (standard input, by default the keyboard)
- ◆ `1=stdout` (standard output, by default the monitor)
- ◆ `2=stderr` (standard error, by default the monitor)

For example when I type `cat filename` the file is displayed on the monitor. If there is an error of any type (for example the file does not exist, the error message is displayed on the monitor too.

```
sh-3.00$ cat hgfhgfhf  
cat: hgfhgfhf: No such file or directory  
sh-3.00$
```

by directing the standard error to `cat.err`

```
sh-3.00$ cat jhdsjhghgfhg 2>cat.err  
sh-3.00$ more cat.err  
cat: jhdsjhghgfhg: No such file or directory  
sh-3.00$
```

cat displays the contents of a file on the monitor. If the file is 1000 lines, the whole file will be displayed and you will see only the last 20-25 lines depends on the size of the monitor (or terminal).

The command **more** also displays the contents of the file on the monitor, but it does that only in chunks according to the size of the screen. If the screen is big enough for 20 lines, then the first 20 lines are displayed. Each time you hit the space bar, the next 20 lines are displayed and so on. The command **less** is similar to more but it can go back and display previous lines instead of only going forward in the file.

we can redirect inputs (<) and outputs (>) for example

```
cat filename 1>out.txt 2>err.txt
```

cat reads the file filename and stores it in a file called out.txt, if there is any error message it will be stored in a file err.txt instead of being displayed on the monitor. >> means to append the output to the file (> deletes the contents of the file before sending the output to it).

<< string means the string is considered to be the end of input and on a line by itself (default CTRL-D)

```
tigger 113 % cat <<XX
? first line
? second line
? last line XX
? XX
first line
second line
last line XX
tigger 114 %
```

Pipes are used to send the output of a program to the input of another program. For example the command

```
ls |less
```

ls by itself displays the directory on the monitor. The "|" pipe the output of the ls to the input of another program called less (less displays its input on the screen). So what is the difference between the above command and simple ls. One thing about less is that it displays the contents a screen by screen, so a screen-full of file names will be shown, then it waits for any input character

Finally the command **script**. Script makes a copy of your terminal session (do man script for more details).

The way script works is as follows. When you type script, a file is created that will store every command you type and everything that is displayed on the screen. So for example if you type ls, then the ls command together with the displayed results will be stored in the script file. You can specify the name of the file with

the script command. If you did not specify the file, the default file is `typescript`. Do not forget to exit the scripting session using `exit` command. An example is shown below.

```
tigger 106 % script myscriptfile
Script started, file is myscriptfile
tigger 101 % date
Fri Aug 14 14:55:34 EDT 2009
tigger 102 % exit
exit
Script done, file is myscriptfile
tigger 107 % cat myscriptfile
Script started on Fri Aug 14 14:55:26 2009
tigger 101 % date
Fri Aug 14 14:55:34 EDT 2009
tigger 102 % exit
exit
```

Starting the script, then you executed the date command, the result is shown on the screen

Exit to end the scripting session

Now, we are out of the scripting session, the contents is stored in a file called myscriptfile. Cat this file to see the contents of the session

```
Script done on Fri Aug 14 14:55:39 2009
tigger 108 %
```

Compiling and running a program

Write the C program using the editor of your choice and store it with extension `.c`. Then you have to compile it, we will use `gcc` or `cc` (they are actually the same program on our system). The way to compile your program (assume it is called `prog1.c`) is as follows

```
gcc prog1.c
```

If your program contains `math.h` (later on we will discuss it) which is basically a math library that will allow you to use functions like `sin` or `cos` and many other math functions, then you have to tell the compiler to use the math library, you should type.

```
gcc prog1.c -lm
```

where `lm` stands for math library.

The result of the compilation is a file called `a.out`. `a.out` is the executable file you can run by typing `a.out` then hit return.

If it says **a.out command not found** that means the current directory is not in

your path, in this case you should use

`./a.out`

basically you are saying run a.out in the current directory.

If you compile another program, the result is another a.out file and the previous a.out is gone (over-written). However, you can instruct the compiler to name it with another name. In order to do this, you can use the -o (o for output)

```
gcc -o prog1 prog1.c
```

compile prog1.c file and put the executable code in a file named prog1.

Deliverables:

1. Start a script session to a file called myscrip0. Type and execute a Linux command to do the following. **Remember, use man command if you need to know more about any Unix command.**
 - Display a list of the files in your directory sorted by modification time.
 - Count the number of files in your current directory that includes the phrase "HW"
 - Repeat the previous command but consider both capital and small letters (i.e. the files that contains HW, Hw, hW, and hw).
 - A command to count the number of lines, that you input from the standard input, that contains the string book. The number should be displayed after you finish entering text.
 - Submit your script file to L1a
2. Write a C program named squares.c The program reads a sequence of positive numbers (**integers**) and display the sum of their squares. It stops after the first negative number (the negative number is not added), and print the result. The result should be printed in 10 spaces left justified followed by a newline character. Only the result as stated should be displayed, not "the result is" or "please enter the numbers". Any things that is displayed and was not required to be displayed (even if it is a single space) you will fail the test cases. Submit your script file to L1.

do man submit for instructions on submissions