Chapter 1: Using the Shell

Objectives: students should be able to interact with shells and commands using the command line. The objective assumes the Bash shell.

Key Knowledge Areas: Use single shell commands and one line command sequences to perform basic tasks on the command line.

Key Terms:

Quoting
Enclosing special characters in quotes will prevent the shell from interpreting special characters. Double quotes will prevent the shell from interpreting some of these special characters; single quotes prevent the shell from interpreting any special characters.

echo
Echo the STRING(s) to standard output. Useful with scripts.

man
An interface to the on-line reference manuals.

pwd
Print the name of the current working directory.

uname
Print certain system information such as kernel name, network node hostname, kernel release, kernel version, machine hardware name, processor type, hardware platform, and operating system, depending on options provided.

And many more

1. Theory:

1.1 Introduction

The definition of the word *Linux* depends on the context in which it is used. Technically speaking, Linux is the *kernel* of the system, which is the central controller of everything that happens on the computer. People that say their computer "runs Linux" are usually referring to the kernel and suite of tools that come with it (called a *distribution*). If someone says they have Linux experience, it might refer to configuring systems, running web servers, or any number of other services and programs that operate on top of Linux. Over time, Linux administration has evolved to encompass just about every task that a modern business, educational, or government institution might use in their daily operations.

What about *UNIX*? UNIX was originally an operating system developed at AT&T Bell Labs in the 1970s. It has been modified and *forked* (that is, people modified it, and those modifications served as the basis for other systems) such that now there are many different variants of UNIX. However, UNIX is now both a trademark and a specification, owned by an industry consortium called the Open Group. Only software that has been certified by the Open Group may call itself UNIX. Despite adopting most if not all of the requirements of the UNIX specification, Linux has not been certified, so Linux really isn't UNIX! It's just… UNIX-like.

Note
Much of the early material in this chapter is very similar to what can be found in **LPI.org**. If you have already taken that course, you can use this as an opportunity to refresh your knowledge or feel free to skip ahead a few pages.

1.1.1 Role of the Kernel

The three main components of an operating system are the kernel, shell, and filesystem. The kernel of the operating system is like an air traffic controller at an airport. The kernel dictates which program gets which

pieces of memory, it starts and kills programs, it interprets instructions given to it by the user, and it handles more common and simple tasks such as displaying text on a monitor. When an application needs to write to disk, it must ask the kernel to complete the write operation.

The kernel also handles the switching of applications. A computer will have one or more CPUs and a finite amount of memory. The kernel takes care of unloading tasks and loading new tasks, and can manage multiple tasks across multiple CPUs. When the current task has run a sufficient amount of time, the CPU pauses the task so that another may run. This is called *preemptive multitasking*. Multitasking means that the computer is doing several tasks at once, and preemptive means that the kernel is deciding when to switch focus between tasks. With the tasks so rapidly switching, it appears that the computer is doing many things at once.

Each application may think it has a large block of memory on the system, but it is the kernel that maintains this illusion; remapping smaller blocks of memory, sharing blocks of memory with other applications, or even swapping out blocks that haven't been used in a while to the disk.

When the computer starts up, it loads a small piece of code called a *bootloader*. The bootloader's job is to give you a choice (if configured) of options to load one or more versions of Linux, or even other operating systems, and then to load the kernel of the chosen option and get it started. If you are more familiar with operating systems such as Microsoft Windows or Apple's OS X, you probably never see the bootloader, but in the UNIX world, it's usually visible so that you can adjust the way your computer boots.

The bootloader loads the Linux kernel and then transfers control. Linux then continues with running the programs necessary to make the computer useful, such as connecting to the network or starting a web server.

1.1.2 Applications

Like an air traffic controller, the kernel is not useful without something to control. If the kernel is the tower, the applications are the airplanes. Applications make requests to the kernel and receive resources, such as memory, CPU, and disk, in return. The kernel also abstracts the complicated details away from the application. The application doesn't know if the block of a disk is on a solid-state drive from manufacturer A, a spinning metal hard drive from manufacturer B, or even a network file share. Applications just follow the kernel's *Application Programming Interface (API)* and in return don't have to worry about the implementation details

When we, as users, think of applications, we tend to think of word processors, web browsers, and email clients. The kernel doesn't care if it is running something that's user-facing, a network service that talks to a remote computer, or an internal task. So, from this, we get an abstraction called a *process*. A process is just one task that is loaded and tracked by the kernel. An application may even need multiple processes to function, so the kernel takes care of running the processes, starting and stopping them as requested, and handing out system resources.

1.1.3 Role of Open Source

Software projects take the form of *source code*, which is a human-readable set of computer instructions. The source code may be written in any of hundreds of different programming languages. The Linux kernel is mostly written in C, which is a language that shares history with the original UNIX.

Source code is not understood directly by the computer, so it must be compiled into machine instructions by a *compiler*. The compiler gathers all of the source files and generates something that can be run on the computer, such as the Linux kernel.

Historically, most software has been issued under a *closed-source license*, meaning that you get the right to use the machine code, but cannot see the source code. Often the license specifically says that you will not attempt to reverse engineer the machine code back to source code to figure out what it does!

Open source takes a source-centric view of software. The open source philosophy is that you have a right to obtain the software and to modify it for your own use. Linux adopted this philosophy to great success.

In 1991, Linux started out as a hobby project by Linus Torvalds. He made the source freely available, allowing others to join in and shape this fledgling operating system. It was not the first system to be developed by a volunteer group, but since it was built from scratch, early adopters could influence the project's direction. People took the source, made changes, and shared them back with the rest of the group, greatly accelerating the pace of development, and ensuring mistakes from other operating systems were not repeated.

The Linux kernel is licensed under the GNU Public License (GPL) which requires you to make changes available. This guarantees that those who use the code will also contribute to the greater good by making those changes available to anyone.

Alongside this, was the *GNU project* (GNU's, not UNIX). While GNU (pronounced "guh-noo") was building their own operating system, they were far more successful at building the tools that go along with a UNIX operating system, such as the compilers and user interfaces. The source was all freely available, so Linux was able to target their tools and provide a complete system. As such, most of the tools that are part of the Linux system come from these GNU tools.

There are many different variants on open source. However, all agree that you should have access to the source code, but they differ in how you can, or in some cases, must, redistribute changes.

1.1.4 Linux Distributions

Take the Linux kernel and the GNU tools, add some more user-facing applications like an email client, word processors and other programs and you have a full Linux system. People started bundling all this software into a *distribution* almost as soon as Linux became usable. The distribution takes care of setting up the storage, installing the kernel, and installing the rest of the software. The full-featured distributions also include tools to manage the system and a *package manager* to help you add and remove software after the installation is complete.

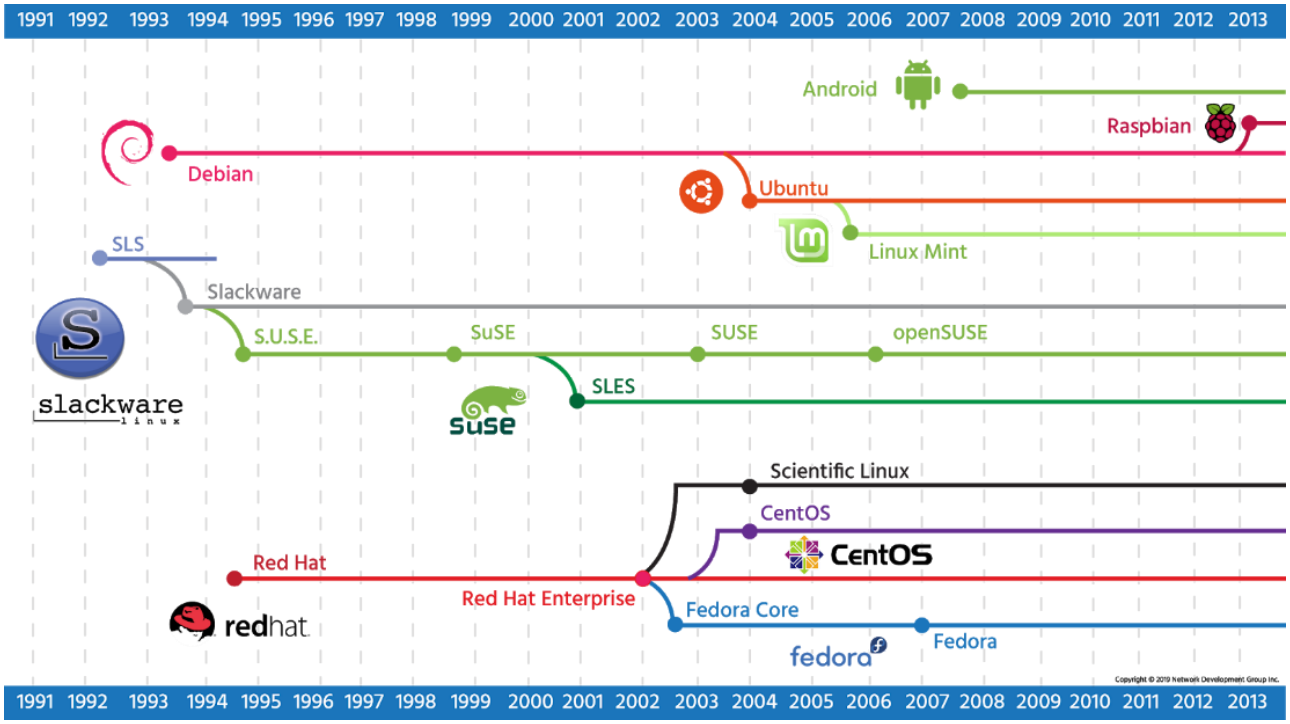
Like UNIX, there are many different flavors of distributions. These days, there are distributions that focus on running servers, desktops, or even industry-specific tools like electronics design or statistical computing. The major players in the market can be traced back to either **Red Hat** or **Debian**. The most visible difference is the software package manager, though you will find other differences on everything from file locations to political philosophies.

Red Hat started out as a simple distribution that introduced the Red Hat Package Manager (RPM) based on the `.rpm` file format. The developer eventually formed a company around it, which tried to commercialize a Linux desktop for business. Over time, Red Hat started to focus more on the server applications such as web and file serving and released Red Hat Enterprise Linux, which was a paid service on a long *release cycle*. The release cycle dictates how often software is upgraded. A business may value stability and want long release cycles, a hobbyist or a startup may want the latest software and opt for a shorter release cycle. To satisfy the latter group, Red Hat sponsors the **Fedora Project** which makes a personal desktop comprising the latest software but still built on the same foundations as the enterprise version.

Because everything in Red Hat Enterprise Linux is open source, a project called **CentOS** came to be, that recompiled all the RHEL packages and gave them away for free. CentOS and others like it (such as **Scientific Linux**) are largely compatible with RHEL and integrate some newer software, but do not offer the paid support that Red Hat does.

Debian is more of a community effort, and as such, also promotes the use of open source software and adherence to standards. Debian came up with its own package management system based on the `.deb` file format. While Red Hat leaves non-Intel and AMD platform support to derivative projects, Debian supports many of these platforms directly.

Ubuntu is the most popular Debian derived distribution. It is the creation of **Canonical**, a company that was made to further the growth of Ubuntu and makes money by providing support.



1.2 Hardware Platforms

Linux started out as something that would only run on a computer like Linus': a 386 with a specific hard drive controller. The range of support grew, as support for other hardware was built. Eventually, Linux started supporting other chipsets, including hardware that was made to run competitive operating systems!

The types of hardware grew from the humble Intel chip up to supercomputers. Smaller sized Linux-supported chips were eventually developed to fit in consumer devices (called embedded devices). The support for Linux became ubiquitous such that it is often easier to build hardware to support Linux and then use Linux as a springboard for your custom software than it is to build the custom hardware and software from scratch.

Eventually, cellular phones and tablets adopted Linux. A company, later bought by Google, came up with the Android platform which is a bundle of Linux and the software necessary to run a phone or tablet. This means that the effort to get a phone to market is significantly less. Instead of long development on a new operating system, companies can spend their time innovating on the user-facing software. Android is now one of the market leaders in the phone and tablet space.

Aside from phones and tablets, Linux can be found in many consumer devices. Wireless routers often run Linux because it has a rich set of network features. The TiVo is a consumer digital video recorder built on Linux. Even though these devices have Linux at the core, the end users don't have to know. The custom software interacts with the user and Linux provides the stable platform.

1.3 Shell

An operating system provides at least one *shell* that allows the user to communicate with the operating system. A shell is sometimes called an *interpreter* because it takes the commands that a user issues and interprets them into a form that the *kernel* can then execute on the hardware of the computer. The two most common types of shells are the Graphical User Interface (GUI) and Command Line Interface (CLI).

Microsoft Windows™ typically uses a GUI shell, primarily using the mouse to indicate what you want to accomplish. While using an operating system in this way might be considered easy, there are many advantages to using a CLI, including:

- **Command Repetition**: In a GUI shell, there is no easy way to repeat a previous command. In a CLI there is an easy way to repeat (and also modify) a previous command.
- **Command Flexibility**: The GUI shell provides limited flexibility in the way the command executes. In a CLI, *options* are specified with commands to provide a more flexible and powerful interface.
- **Resources**: A GUI shell typically uses a relatively large amount of resources (RAM, CPU, etc.). This is because a great deal of processing power and memory is needed to display graphics. By contrast, a CLI uses very little system resources, allowing more of these resources to be available to other programs.

- **Scripting**: In a GUI shell, completing multiple tasks often requires multiple mouse clicks. With a CLI, a *script* can be created to execute many complex operations by just typing the name of the script. A script is a series of commands placed into a single file. When executed, the script runs all of the commands in the file.
- **Remote Access**: While it is possible to execute commands in a GUI shell remotely, this feature isn't typically set up by default. With a CLI shell, gaining access to a remote machine is easy and typically available by default.
- **Development**: Normally a GUI-based program takes more time for the developers to create when compared to CLI-based programs. As a result, there are typically thousands of CLI programs on a typical Linux OS while only a couple hundred programs in a primarily GUI-based OS like Microsoft Windows. More programs mean more power and flexibility.

The Microsoft Windows operating system was designed to primarily use the GUI interface because of its simplicity, although there are several CLI interfaces available, too. For simple commands, there is the Run dialog box, where you can type or browse to the commands that you want to execute. If you want to type multiple commands or if you want to see the output of the command, you can use the Command Prompt, also called the DOS shell. Recently, Microsoft realized how important it is to have a powerful command line environment and introduced Powershell.

Like Windows, Linux also has both a CLI and GUI. Unlike Windows, Linux lets you easily change the GUI shell (also called the desktop environment) that you want to use. The two most common desktop environments for Linux are GNOME and KDE; however, there are many other GUI shells available.

To access the CLI from within the GUI on a Linux operating system, the user can open a software program called a *terminal*. Linux can also be configured only to run the CLI without the GUI; this is typically done on servers that don't require a GUI, primarily to free up system resources.

1.3.1 Bash Shell

Not only does the Linux operating system provide multiple GUI shells, but also multiple CLI shells are available. Normally, these shells are derived from one of two older UNIX shells: The Bourne Shell and the C Shell. In fact, the Bash shell, a default CLI shell used in modern Linux operating systems, derives its name from the Bourne Shell: **B**ourne **A**gain **SH**ell. In this course, you will focus upon learning how to use the CLI for Linux with the Bash shell, arguably the most popular CLI in Linux.

Users interact with a system by executing *commands* which are interpreted by the shell and transformed into actions by the kernel. These actions may or may not return information to the command line depending on the command issued and its result. For example, when the `ls` command is typed into the console, it will return the contents of whichever directory the user is currently in.

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
```

A command can be followed by options that modify how the command is executed, and arguments, that are typically the files to be operated on:

```
command [options] [arguments]
```

Note

Some commands require options and arguments while others, like `ls`, can be used alone.
Commands entered are considered standard input, (stdin) whether they are typed by an operator, entered by a script, or as the result of another command. Text returned to the console can be either standard output (stdout), or standard error (stderr).

This deceptively simple method of communicating with the Linux kernel is the basis for almost every interaction a Linux administrator has with their systems. It can be confusing at first for users who have only experienced GUI interfaces, but ultimately it gives the experienced operator far more power than any graphical interface can.

The Bash shell has numerous built-in commands and features that you will learn including:

- **Aliases**: Give a command a different or shorter name to make working with the shell more efficient.

- **Re-Executing Commands**: To save retyping long command lines.
- **Wildcard Matching**: Uses special characters like `?`, `*`, and `[]` to select one or more files as a group for processing.
- **Input/Output Redirection**: Uses special characters for redirecting input, < or <<, and output, >.
- **Pipes**: Used to connect one or more simple commands to perform more complex operations.
- **Background Processing**: Enables programs and commands to run in the background while the user continues to interact with the shell to complete other tasks.

The shell that your user account uses by default is set at the time your user account was created. By default, many Linux distributions use Bash for a new user's shell. Typically, a user learns one shell and sticks with that shell; however, after you have learned the basics of Linux, you may want to explore the features of other shells.

Consider This Homework:

An administrator can use the `usermod` command to specify a different default shell after the account has been created.

As a user, you can use the `chsh` command to change your default shell. Most of the time the default shell a system offers will be adequate for basic tasks. Occasionally, an administrator will want to change the shell to have access to more advanced features, or simply because they are more familiar with a different shell and the features it offers. On systems that are near capacity, it may be advisable not to change shells as it could require additional resources and slow processing for all users.

The location where the system stores the default shell for user accounts is the `/etc/passwd` file.

1.3.2 Accessing the Shell

How you access the command line shell depends on whether your system provides a GUI login or CLI login:

- GUI-based systems: If the system is configured to present a GUI, then you will need to find a software application called a *Terminal*. In the GNOME desktop environment, the Terminal application can be started by clicking the Applications menu, then the System Tools menu and Terminal icon.
- CLI-based systems: Many Linux systems, especially servers, are not configured to provide a GUI by default, so they present a CLI instead. If the system is configured to present a CLI, then the system runs a terminal application automatically after you log in.

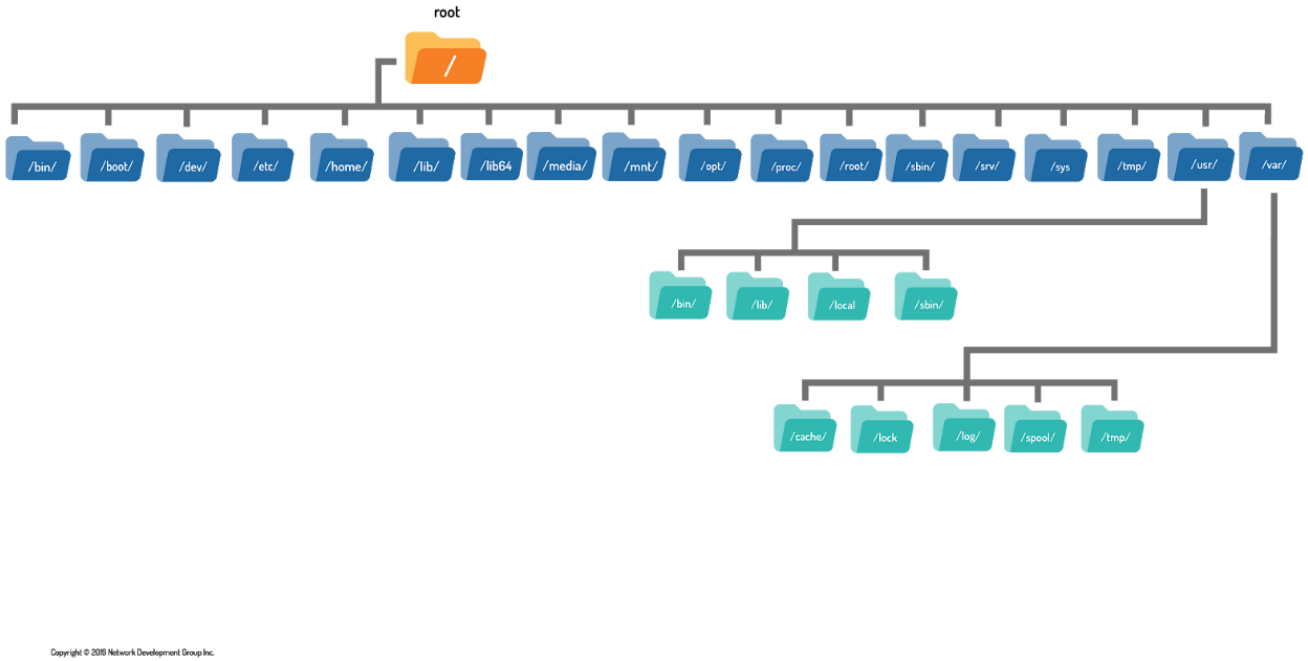
In the early days of computing, terminal devices were large machines that allowed users to provide input through a keyboard and displayed output by printing on paper. Over time, terminals evolved and their size shrank down into something that looked similar to a desktop computer with a video display monitor for output and a keyboard for input.

Ultimately, with the introduction of personal computers, terminals became *software emulators* of the actual hardware. Whatever you type in the terminal is interpreted by your shell and translated into a form that can then be executed by the kernel of the operating system.

If you are in a remote location, then *pseudo-terminal* connections can also be made across the network using several techniques. Insecure connections could be made using protocols such as `telnet` and programs such as `rlogin`, while secure connections can be established using programs like `putty` and protocols such as `ssh`.

1.4 Filesystems

In addition to the kernel and the shell, the other major component of any operating system is the filesystem. To the user, a filesystem is a hierarchy of directories and files with the root `/` directory at the top of the directory tree. To the operating system, a filesystem is a structure created on a disk partition consisting of tables defining the locations of directories and files.



2.1 Command Line Interface (CLI)

Most consumer operating systems are designed to shield the user from the “ins and outs” of the CLI. The Linux community is different in that it positively celebrates the CLI for its power, speed, and ability to accomplish a vast array of tasks with a single command line instruction.

When a user first encounters the CLI, they can find it challenging because it requires memorizing a dizzying amount of commands and their options. However, once a user has learned the structure of how commands are used, where the necessary files and directories are located, and how to navigate the hierarchy of a file system, they can be immensely productive. This capability provides more precise control, greater speed, and the ability to automate tasks more easily through scripting.

Furthermore, by learning the CLI, a user can easily be productive almost instantly on ANY flavor or distribution of Linux, reducing the amount of time needed to familiarize themselves with a system because of variations in a GUI.

2.2 Commands

What is a command? The simplest answer is that a command is a software program that when executed on the command line, performs an action on the computer.

When you consider a command using this definition, you are really considering what happens when you execute a command. When you type in a command, a process is run by the operating system that can read input, manipulate data, and produce output. From this perspective, a command runs a process on the operating system, which then causes the computer to perform a *job*.

However, there is another way of looking at what a command is: look at its *source*. The source is where the command "comes from" and there are several different sources of commands within the shell of your CLI:

- **Internal Commands**: Also called *built-in commands*, these commands are built-in to the shell itself. A good example is the `cd` (change directory) command as it is part of the Bash shell. When a user types the cd command, the Bash shell is already executing and knows how to interpret that command, requiring no additional programs to be started.
- **External Commands**: These commands are stored in files that are searched by the shell. If you type the `ls` command, then the shell searches through a predetermined list of directories to try to find a file

named `ls` that it can execute. These commands can also be executed by typing the complete path to the command.

- **Aliases**: An alias can override a built-in command, function, or a command that is found in a file. Aliases can be useful for creating new commands built from existing functions and commands.
- **Functions**: Functions can also be built using existing commands to either create new commands, override commands built-in to the shell or commands stored in files. Aliases and functions are normally loaded from the initialization files when the shell first starts, discussed later in this section.

2.2.1 External Commands

Commands that are stored in files can be in several forms that you should be aware of. Most commands are written in the C programming language, which is initially stored in a human-readable text file. These text source files are then *compiled* into computer-readable binary files, which are then distributed as the command files.

Users who are interested in seeing the source code of compiled, GPL licensed software can find it through the sites where it originated. GPL licensed code also compels distributors of the compiled binaries, such as RedHat and Debian, to make the source code available. Often it is found in the distributors' repositories.

Note

It is possible to view available software packages, binary programs that can be installed directly at the command line. Type the following command into the terminal to view the available source packages (source code that can be modified before it's compiled into binary programs) for the GNU Compiler Collection:

```
1033_clim_antonio@sop.ase.ro:~$ apt-cache search gcc | grep source
gcc-4.8-source - Source of the GNU Compiler Collection
gcc-5-source - Source of the GNU Compiler Collection
gcc-6-source - Source of the GNU Compiler Collection
gcc-7-source - Source of the GNU Compiler Collection
gcc-8-source - Source of the GNU Compiler Collection
gcc-arm-none-eabi-source - GCC cross compiler for ARM Cortex-A/R/M processors (source)
```

The `apt-cache` command allows us to display information from the APT database cache. It is commonly used to find information about programs you wish to install and the components required to make them work.

Although there are a tremendous number of free and open source programs available, quite often the binary code you will need as a Linux administrator won't exist for the particular distribution you are running. Since open source licensing gives you access to the code for these programs, one of your tasks will be compiling, and sometimes modifying that code into executable programs that can be installed on the systems you manage. The Free Software Foundation (FSF) distributes the GNU Compiler Collection (GCC) to make this process easier. The GCC provides a compiler system (the special programs used to convert source code into usable binary programs) with front ends for many different programming languages. In fact, the FSF doesn't limit these tools to just Linux. There are versions of the GCC that run on Unix, Windows, MacOS, and many other systems including specific microcontroller environments.

Linux package management will be covered in greater detail later in the course.

Note

Command files can also contain human-readable text in the form of *script files*. A script file is a collection of commands that is typically executed at the command line.

The ability to create your own script files is a very powerful feature of the CLI. If you have a series of commands that you regularly find yourself typing in order to accomplish some task, then you can easily create a Bash shell script to perform these multiple commands by typing just one command: the name of your script file. You simply need to place these commands into a file and make the file *executable*.

2.2.2 Aliases

An *alias* can be used to map longer commands to shorter key sequences. When the shell sees an alias being executed, it substitutes the longer sequence before proceeding to interpret commands.

For example, the command `ls -l` is commonly aliased to `l` or `ll`. Because these smaller commands are easier to type, it becomes faster to run the `ls -l` command line.

To determine what aliases are set on the current shell use the `alias` command:

```
1033_clim_antonio@sop.ase.ro:~$ alias
alias egrep='egrep --color=auto'
alias fgrep='fgrep --color=auto'
alias grep='grep --color=auto'
alias l='ls -CF'
alias la='ls -A'
alias ll='ls -alF'
alias ls='ls --color=auto'
```

The aliases from the previous examples were created by initialization files. These files are designed to make the process of creating aliases automatic.

New aliases can be created using the following format, where *name* is the name to be given the alias and *command* is the command to be executed when the alias is run.

```
alias name=command
```

For example, the `cal 2030` command displays the calendar for the year 2030. Suppose you end up running this command often. Instead of executing the full command each time, you can create an alias called `mycal` and run the alias, as demonstrated in the following graphic:

```
1033_clim_antonio@sop.ase.ro:~$ alias mycal="cal 2019"
1033_clim_antonio@sop.ase.ro:~$ mycal
                              2019

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


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

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

Aliases created this way only persist while the shell is open. Once the shell is closed, the new aliases are lost. Additionally, each shell has its own aliases, so, aliases created in one shell won't be available in a new shell that's opened.

2.3 Basic Command Syntax

To execute a command, the first step is to type the name of the command. Click in the terminal on the right. Type `ls` and hit **Enter**. The result should resemble the example below:

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
```

Note

By itself, the `ls` command lists files and directories contained in the current working directory. At this point, you shouldn't worry too much about the output of the command, but instead, focus on understanding how to format and execute commands.

The `ls` command will be covered in greater detail later in the course.

Many commands can be used by themselves with no further input. Some commands require additional input to run correctly. This additional input comes in two forms: *options* and *arguments*. Commands typically follow a simple pattern of syntax:

```
command [options…] [arguments…]
```

When typing a command that is to be executed, the first step is to type the name of the command. The name of the command is often based on what the command does or what the developer who created the command thinks will best describe the command's function.

For example, the `ls` command displays a *listing* of information about files. Associating the name of the command with something mnemonic for what it does may help you to remember commands more easily.

Keep in mind that every part of the command is normally case-sensitive, so `LS` is incorrect and will fail, but `ls` is correct and will succeed.

2.3.1 Specifying Arguments

```
command [options] [arguments]
```

An *argument* can be used to specify something for the command to act upon. Following a command, any desired arguments are allowed or are required depending on the command. For example, the `touch` command is used to create empty files or update the timestamp of existing files. It requires at least one argument to specify the file name to act upon.

```
touch FILE...
```

```
1033_clim_antonio@sop.ase.ro:~$ touch newfile
```

The `ls` command, on the other hand, allows for a path and/or file name to be specified as an argument, but it's not required.

```
ls [FILE]...
```

An example of a scenario where an argument is allowed but not required is the use of the `ls` command. If the `ls` command is used without an argument, it will list the contents of the current directory:

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
```

If the `ls` command is given the name of a directory as an argument, it will list the contents of that directory. In the following example, the `/etc/ppp` directory is used as an argument; the resulting output is a list of files contained in the `/etc/ppp` directory:

```
1033_clim_antonio@sop.ase.ro:~$ ls /etc/ppp
ip-down.d  ip-up.d
```

The `ls` command also accepts multiple arguments. To list the contents of both the `/etc/ppp` and `/etc/ssh` directories, pass them both as arguments:

```
1033_clim_antonio@sop.ase.ro:~$ ls /etc/ppp /etc/ssh
/etc/ppp:
ip-down.d  ip-up.d


/etc/ssh:
moduli                  ssh_host_ecdsa_key        ssh_host_rsa_key
ssh_config              ssh_host_ecdsa_key.pub    ssh_host_rsa_key.pub
ssh_host_dsa_key        ssh_host_ed25519_key      ssh_import_id
ssh_host_dsa_key.pub    ssh_host_ed25519_key.pub  sshd_config
```

Some commands, like the `cp` command (*copy* file) and the `mv` command (*move* file), always require at least two arguments: a source file and a destination file.

```
cp SOURCE... DESTINATION
```

In the example below, we will copy the public ssh rsa key called `ssh_host_rsa_key.pub` which resides in the `/etc/ssh` directory, to the `/home/sysadmin/Documents` directory and verify that it is there:

```
1033_clim_antonio@sop.ase.ro:~$ cp /etc/ssh/ssh_host_rsa_key.pub /home/sysadmin/Documen
ts
1033_clim_antonio@sop.ase.ro:~$ ls ~/Documents
School            alpha.txt    linux.txt     profile.txt
Work              animals.txt  longfile.txt  red.txt
adjectives.txt    food.txt     newhome.txt   spelling.txt
alpha-first.txt   hello.sh     numbers.txt   ssh_host_rsa_key.pub
alpha-second.txt  hidden.txt   os.csv        words
alpha-third.txt   letters.txt  people.csv
```

Consider This Homework:

An *ssh rsa key* is a file that contains an authentication credential (similar to a password) used to verify the identity of a machine that is being logged into using the `ssh` command. The `ssh` command allows users on a system to connect to another machine across a network, log in, and then perform tasks on the remote machine.

The `ssh` command is covered in greater detail on the internet sources.

2.3.1.1 Quoting

Arguments that contain unusual characters like spaces or non-alphanumeric characters will usually need to be *quoted*, either by enclosing them within double quotes or single quotes. *Double quotes* will prevent the shell from interpreting *some* of these special characters; *single quotes* prevent the shell from interpreting *any* special characters.

In most cases, single quotes are considered safer and should probably be used whenever you have an argument that contains characters that aren't alphanumeric.

To understand the importance of quotes, consider the `echo` command. The `echo` command displays text to the terminal and is used extensively in shell scripting.

```
echo [STRING]...
```

Consider the following scenario in which you want to list the contents of the current directory using the `ls` command and then use the `echo` command to display the string `hello world!!` on the screen.

You might first try the `echo` command without any quotes, unfortunately without success:

```
1033_clim_antonio@sop.ase.ro:~$ ls
1033_clim_antonio@sop.ase.ro:~$ echo hello world!!
echo hello worldls
hello worldls
```

Using no quotes failed because the shell interprets the `!!` characters as special shell characters; in this case, they mean "replace the `!!` with the last command that was executed". In this case, the last command was the `ls` command, so `ls` replaced `!!` and then the `echo` command displayed `hello worldls` to the screen.

You may want to try the double quote `"` characters to see if they will block the interpretation (or expansion) of the exclamation `!!` characters. The double quotes block the expansion of some special characters, but not all of them. Unfortunately, double quotes do not block the expansion of the exclamation `!!` characters:

```
1033_clim_antonio@sop.ase.ro:~$ ls
1033_clim_antonio@sop.ase.ro:~$ echo "hello world!!"
echo "hello worldls"
hello worldls
```

Using double quotes preserves the literal value of all characters that they enclose except metacharacters such as the `$` dollar sign character, the `` ` `` backquote character, the `\` backslash character and the `!` exclamation point character. These characters, called *wild cards*, are symbol characters that have special meaning to the shell. Wild card characters are used for *globbing* and are interpreted by the shell itself before it attempts to run any command. Glob characters are useful because they allow you to specify patterns that make it easier to match file names in the command line. For example, the command `ls e??` would list all files in that directory that start with an `e` and have any two characters after it. However, because glob characters are interpreted differently by the shell, they need to be enclosed appropriately to be interpreted literally.

Note

Globbing will be covered in greater detail later in the course.

If you enclose text within the `'` single quote characters, then all characters have their literal meaning:

```
1033_clim_antonio@sop.ase.ro:~$ ls
1033_clim_antonio@sop.ase.ro:~$ echo 'hello world!!'
hello world!!
```

2.3.2 Options

```
command [options] [arguments]
```

Options can be used with commands to expand or modify the way a command behaves. If it is necessary to add options, they can be specified after the command name. *Short options* are specified with a hyphen - followed by a single character. Short options are how options were traditionally specified.

In the following example, the `-l` option is provided to the `ls` command, which results in a *long display* output:

```
1033_clim_antonio@sop.ase.ro:~$ ls -l
total 0
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Desktop
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Documents
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Downloads
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Music
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Pictures
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Public
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Templates
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Videos
```

Often the character is chosen to be mnemonic for its purpose, like choosing the letter *l for long* or *r for reverse*. By default, the `ls` command prints the results in alphabetical order, so adding the `-r` option prints the results in reverse alphabetical order.

```
1033_clim_antonio@sop.ase.ro:~$ ls -r
Videos  Templates  Public  Pictures  Music  Downloads  Documents  Desktop
```

In most cases, options can be used in conjunction with other options. They can be given as separate options like `-l -r` or combined like `-lr`. The combination of these two options would result in a long listing output in reverse alphabetical order:

```
1033_clim_antonio@sop.ase.ro:~$ ls -l -r
total 0
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Videos
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Templates
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Public
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Pictures
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Music
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Downloads
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Documents
drwxr-xr-x 1 sysadmin sysadmin   0 Sep 18 22:25 Desktop
```

Multiple single options can be either given as separate options like `-a -l -r` or combined like `-alr`. The output of all of these examples would be the same:

```
ls -l -a -r
ls -rla
ls -a -lr
```

Generally, short options can be combined with other short options in any order. The exception to this is when an option requires an argument.

For example, the `-w` option to the `ls` command specifies the *width* of the output desired and therefore requires an argument. If combined with other options, the `-w` option can be specified last, followed by its argument and still be valid, as in `ls -rtw 40`, which specifies an output width of 40 characters. Otherwise, the `-w` option cannot be combined with other options and must be given separately.

```
1033_clim_antonio@sop.ase.ro:~$ ls -lr -w 40
total 32
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Videos
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Templates
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Public
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Pictures
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Music
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Downloads
drwxr-xr-x 4 sysadmin sysadmin 4096 Feb 22 16:32 Documents
drwxr-xr-x 2 sysadmin sysadmin 4096 Feb 22 16:32 Desktop
```

If you are using multiple options that require arguments, don't combine them. For example, the `-T` option, which specifies *tab size*, also requires an argument. In order to accommodate both arguments, each option is given separately:

```
1033_clim_antonio@sop.ase.ro:~$ ls -w 40 -T 12
Desktop Music   Templates
Documents  Pictures  Videos
Downloads  Public
```

Some commands support additional options that are longer than a single character. *Long options* for commands are preceded by a double hyphen `--` and the meaning of the option is typically the name of the option, like the `--all` option, which lists all files, including hidden ones. For example:

```
1033_clim_antonio@sop.ase.ro:~$ ls --all
.              .bashrc   .selected_editor  Downloads  Public
..             .cache  Desktop         Music   Templates
.bash_logout  .profile  Documents      Pictures   Videos
```

For commands that support both long and short options, execute the command using the long and short options concurrently:

```
1033_clim_antonio@sop.ase.ro:~$ ls --all --reverse -t
.profile       Templates  Music       Desktop        ..
```

```
.bash_logout   Public    Downloads   .selected_editor   .cache
Videos          Pictures    Documents   .bashrc          .
```

Commands that support long options will often also support arguments that may be specified with or without an equal symbol (the output of both commands is the same):

```
ls --sort time
ls --sort=time
```

```
1033_clim_antonio@sop.ase.ro:~$ ls --sort=time
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
```

A special option exists, the *lone double hyphen* `--` option, which can be used to indicate the end of all options for the command. This can be useful in some circumstances where it is unclear whether some text that follows the options should be interpreted as an additional option or as an argument to the command.

For example, if the `touch` command tries to create a file called `--badname`:

```
1033_clim_antonio@sop.ase.ro:~$ touch --badname
touch: unrecognized option '--badname'
Try 'touch --help' for more information.
```

The command tries to interpret `--badname` as an option instead of an argument. However, if the lone double hyphen `--` option is placed before the file name, indicating that there are no more options, then the file name can successfully be interpreted as an argument:

```
1033_clim_antonio@sop.ase.ro:~$ touch -- --badname
1033_clim_antonio@sop.ase.ro:~$ ls
--badname  Documents  Music    Public  Videos
Desktop Downloads  Pictures  Templates
```

Consider This Homework:

The file name in the previous example is considered to be bad because putting hyphens in the beginning of file names, while allowed, can cause problems when trying to access the file. For example, using the `ls` command without any options to list the path of the `--badname` file above, will result in an error:

```
1033_clim_antonio@sop.ase.ro:~$ ls --badname
ls: unrecognized option '--badname'
Try 'ls --help' for more information.
```

To remove the `--badname` file from the home directory, use the `rm` *remove* command:

```
1033_clim_antonio@sop.ase.ro:~$ rm -- --badname
```

The `rm` command will be covered in greater detail later in the course.

A third type of option exists for a select few commands. While the options used in the **AT&T** version of UNIX used a single hyphen and the GNU port of those commands used two hyphens, the **Berkeley Software Distribution (BSD)** version of UNIX used options with no hyphen at all.

This no hyphen syntax is fairly rare in most Linux distributions. A couple of notable commands that support the BSD UNIX style options are the `ps` and `tar` commands; both of these commands also support the single and double hyphen style of options.

In the terminal below, there are two similar commands, the first command is executed with a traditional UNIX style option (with single hyphens) and the second command is executed with a BSD style option (no hyphens).

```
1033_clim_antonio@sop.ase.ro:~$ ps -u sysadmin
  PID TTY          TIME CMD
   79 ?        00:00:00 bash
  122 ?        00:00:00 ps
1033_clim_antonio@sop.ase.ro:~$ ps u
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
sysadmin    79  0.0  0.0  18176  3428 ?        S    20:23   0:00 -bash
sysadmin   120  0.0  0.0  15568  2040 ?        R+   21:26   0:00 ps u
```

2.4 Scripts

One exception to the basic command syntax used is the `exec` command, which takes another command to execute as an argument. What is special about the commands that are executed with `exec` is that they replace the currently running shell.

A common use of the `exec` command is in what is known as *wrapper scripts*. If the purpose of a script is to simply configure and launch another program, then it is known as a wrapper script.

A wrapper script often uses the following as the last line of the script to execute another program.

```
exec program
```

A script written this way avoids having a shell continue to run while the program that it launched is running, the result is that this technique saves resources (like RAM).

Although redirection of input and output to a script are discussed in another section, it should also be mentioned that the `exec` command can be used to cause redirection for one or more statements in a script.

2.5 Displaying System Information

The `uname` command displays system information. This command will output `Linux` by default when it is executed without any options.

```
1033_clim_antonio@sop.ase.ro:~$ uname
Linux
```

The `uname` command is useful for several reasons, including when you need to determine the name of the computer as well as the current version of the kernel that is being used.

To display additional information about the system, you can use one of the many options available for the `uname` command. For example, to display *all* the information about the system, use the `-a` option with the `uname` command:

```
1033_clim_antonio@sop.ase.ro:~$ uname -a
Linux localhost 4.4.0-72-generic #93~14.04.1-Ubuntu SMP Fri Mar 31 15:05:15 UTC
2017 x86_64 x86_64 x86_64 GNU/Linux
```

To display information about what kernel version the system is running, use the `-r` option:

```
1033_clim_antonio@sop.ase.ro:~$ uname -r
```

```
4.4.0-72-generic
```

The options for the `uname` command (for example) are summarized below:

Short Option	Long Option	Prints
`-a`	`--all`	All information
`-s`	`--kernel-name`	Kernel name
`-n`	`--node-name`	Network node name
`-r`	`--kernel-release`	Kernel release
`-v`	`--kernel-version`	Kernel version
`-m`	`--machine`	Machine hardware name
`-p`	`--processor`	Processor type or unknown
`-i`	`--hardware-platform`	Hardware platform or unknown
`-o`	`--operating-system`	Operating system
	`--help`	Help information
	`--version`	Version information

2.6 Current Directory

One of the simplest commands available is the `pwd` command, which is an acronym for *print working directory*. When executed without any options, the `pwd` command will display the name of the directory where the user is currently located in the file system. When a user logs into a system, they are normally placed in their *home directory* where files they create and control reside. As you navigate around the file system it is often helpful to know what directory you're in.

```
1033_clim_antonio@sop.ase.ro:~$ pwd
/home/sysadmin
```

Notice our virtual machines employ a prompt that displays the current working directory, emphasized with the color blue. In the first prompt above, the blue tilde `~` character is equivalent to `/home/sysadmin`, representing the user's home directory:

```
1033_clim_antonio@sop.ase.ro:~$
```

After changing directories, the new location can also be confirmed in the new prompt by using the `pwd` command, and is again shown in blue:

```
1033_clim_antonio@sop.ase.ro:~$ cd Documents/
1033_clim_antonio@sop.ase.ro:~/Documents$ pwd
/home/sysadmin/Documents
```

To get back to the home directory after changing to a new location, use the `cd` *change directory* command without any arguments:

```
1033_clim_antonio@sop.ase.ro:~/Documents$ cd
1033_clim_antonio@sop.ase.ro:~$
```

2.7 Command Information

The `type` command displays information about a command type. For example, if you entered `type ls` at the command prompt, it will return that the `ls` command is actually an alias for the `ls --color=auto` command:

```
1033_clim_antonio@sop.ase.ro:~$ type ls
ls is aliased to `ls --color=auto'
```

Using the `-a` option with the `type` command will return all locations of the files that contain a command; also called an *executable* file:

```
1033_clim_antonio@sop.ase.ro:~$ type -a ls
ls is aliased to `ls --color=auto'
ls is /bin/ls
```

In the output above, the `/bin/ls` file path is the file location of the `ls` command.

This command is helpful for getting information about commands and where they reside on the system. For internal commands, like the `pwd` command, the `type` command will identify them as shell builtins:

```
1033_clim_antonio@sop.ase.ro:~$ type pwd
pwd is a shell builtin
```

For external commands like the `ip` command, the `type` command will return the location of the command, in this case, the `/sbin` directory:

```
1033_clim_antonio@sop.ase.ro:~$ type ip
ip is /sbin/ip
```

Consider This Homework:

The `/bin` directory contains executable programs needed for booting a system, commonly used commands, and other programs needed for basic system functionality.

The `/sbin` directory also contains executable programs; mainly commands and tools designed for system administration.

If a command does not behave as expected or if a command is not accessible, that should be, it can be beneficial to know where the shell is finding the command.

The `which` command searches for the location of a command in the system by searching the `PATH` variable.

```
1033_clim_antonio@sop.ase.ro:~$ which ls
/bin/ls
```

Note

The `PATH` variable contains a list of directories that are used to search for commands entered by the user.

The `PATH` variable will be covered in greater detail later in the course.

2.8 Command Completion

A useful tool of the Bash shell is the ability to complete commands and their arguments automatically. Like many command line shells, Bash offers command line completion, where you type a few characters of a command (or its file name argument) and then press the **Tab** key. The Bash shell will complete the command (or its file name argument) automatically for you. For example, if you type `ech` and press **Tab**, then the shell will automatically complete the command `echo` for you.

There will be times when you type a character or two and press the **Tab** key, only to discover that Bash does not automatically complete the command. This will happen when you haven't typed enough characters to match only one command. However, pressing the **Tab** key a second time in this situation will display the possible completions (possible commands) available.

A good example of this would be if you typed `ca` and pressed **Tab**; then nothing would be displayed. If you pressed **Tab** a second time, then the possible ways to complete a command starting with `ca` would be shown:

```
1033_clim_antonio@sop.ase.ro:~$ ca
cal                 capsh               cat                 cautious-launcher
calendar            captoinfo           catchsegv
caller              case                catman
1033_clim_antonio@sop.ase.ro:~$ ca
```

Another possibility may occur when you have typed too little to match a single command name uniquely. If there are more possible matches to what you've typed than can easily be displayed, then the system will use a *pager* to display the output, which will allow you to scroll through the possible matches.

For example, if you just type `c` and press the **Tab** key twice, the system will provide you with many matches that you can scroll through:

```
c_rehash                cksum
cal                     clear
calendar                clear_console
caller                  cmp
capsh                   codepage
captoinfo               col
case                    colcrt
cat                     colrm
catchsegv               column
catman                  comm
cautious-launcher       command
cd                      compgen
cfdisk                  complete
chage                   compopt
chardet3                compose
chardetect3             continue
chattr                  coproc
chcon                   corelist
chcpu                   cp
chfn                    cpan
chgpasswd               cpan5.26-x86_64-linux-gnu
```

```
chgrp                       cpgr
chmem                       cpio
--More--
```

You may not wish to scroll through all these options; in that case, press **Q** to exit the pager. In a situation like this, you should probably continue to type more characters to achieve a more refined match.

A common mistake when typing commands is to misspell the command name. Not only will you type commands faster, but you will type more accurately if you use command completion. Using the **Tab** key to complete the command automatically helps to ensure that the command is typed correctly.

Note that completion also works for arguments to commands when the arguments are file or directory names.

2.9 Getting Help

As previously mentioned, UNIX was the operating system from which the foundation of Linux was built. The developers of UNIX created help documents called ***man*** pages (short for *manual* page).

Referring to the man page for a command will provide you with the basic idea behind the purpose of the command, as well as details regarding the options of the command and a description of its features.

2.9.1 Viewing Man Pages

To view a `man` page for a command, execute the man command in a terminal window.

```
man command
```

For example, the following graphic shows the partial man page for the `cal` command:

```
1033_clim_antonio@sop.ase.ro:~$ man cal
CAL(1)                    BSD General Commands Manual                    CAL(1)


NAME
     cal, ncal -- displays a calendar and the date of Easter


SYNOPSIS
     cal [-3hjy] [-A number] [-B number] [[month] year]
     cal [-3hj] [-A number] [-B number] -m month [year]
     ncal [-3bhjJpwySM] [-A number] [-B number] [-s country_code] [[month]
         year]
     ncal [-3bhJeoSM] [-A number] [-B number] [year]
     ncal [-CN] [-H yyyy-mm-dd] [-d yyyy-mm]


DESCRIPTION
     The cal utility displays a simple calendar in traditional format and ncal
     offers an alternative layout, more options and the date of Easter.  The
     new format is a little cramped but it makes a year fit on a 25x80 termi-
     nal.  If arguments are not specified, the current month is displayed.
```

```
    The options are as follows:

    -h      Turns off highlighting of today.
```

Consider This Homework:

It is possible to print man pages from the command line. If you wanted to send a man page to a default printer from a local machine, you would execute the following command:

```
man -t command | lp
```

The command above maybe will not function in our virtual environment.

2.9.2 Controlling the Man Page Display

The `man` command uses a pager to display documents. Typically, this pager is the `less` command, but on some distributions, it may be the `more` command. Both are very similar in how they perform and will be discussed in more detail in a later chapter.

To view the various movement commands that are available, use the **H** key or **Shift+H** while viewing a man page. This will display a help page.

Note

If you are working on a Linux distribution that uses the `more` command as a pager, your output will be different from the partial example shown here.

Pagers will be covered in greater detail later in the course.

```
                  SUMMARY OF LESS COMMANDS


      Commands marked with * may be preceded by a number, N.
      Notes in parentheses indicate the behavior if N is given.
      A key preceded by a caret indicates the Ctrl key; thus ^K is ctrl-K.


  h  H                 Display this help.
  q  :q  Q  :Q  ZZ     Exit.
 ---------------------------------------------------------------------------


                           MOVING


  e  ^E  j  ^N  CR  *  Forward  one line   (or N lines).
  y  ^Y  k  ^K  ^P  *  Backward one line   (or N lines).
  f  ^F  ^V  SPACE  *  Forward  one window (or N lines).
  b  ^B  ESC-v      *  Backward one window (or N lines).
  z                 *  Forward  one window (and set window to N).
  w                 *  Backward one window (and set window to N).
  ESC-SPACE         *  Forward  one window, but don't stop at end-of-file.
  d  ^D             *  Forward  one half-window (and set half-window to N).
  u  ^U             *  Backward one half-window (and set half-window to N).
```

```
  ESC-)  RightArrow *  Left  one half screen width (or N positions).
  ESC-(  LeftArrow  *  Right one half screen width (or N positions).
  F                    Forward forever; like "tail -f".
  r  ^R  ^L            Repaint screen.
  R                    Repaint screen, discarding buffered input.
        ---------------------------------------------------
        Default "window" is the screen height.
        Default "half-window" is half of the screen height.
 ---------------------------------------------------------------------------
```

To exit the `SUMMARY OF LESS COMMANDS`, type **Q**.

If your distribution uses the `less` command, you might be a bit overwhelmed with the large number of "commands" that are available. The following table provides a summary of the more useful commands:

Command	Function
Return (or **Enter**)	Go down one line
Space	Go down one page
/term	Search for *term*
n	Find next search item
1G	Go to the beginning of the page
G	Go to the end of the page
h	Display help
q	Quit man page

2.9.3 Sections Within Man Pages

Each man page is broken into sections. Each section is designed to provide specific information about a command. While there are common sections that you will see in most man pages, some developers also create sections that you will only see in a specific man page.

The following table describes some of the more common sections that you will find in man pages:

NAME

Provides the name of the command and a very brief description.

```
NAME
       ls - list directory contents
```

SYNOPSIS

A brief summary of the command or function's interface. A summary of how the command line syntax of the program looks.

```
SYNOPSIS
```

```
       ls [OPTION]... [FILE]...
```

DESCRIPTION

Provides a more detailed description of the command.

```
DESCRIPTION
       List  information  about  the FILEs (the current directory by default).
       Sort entries alphabetically if none of -cftuvSUX nor --sort  is  speci-
       fied.
```

OPTIONS

Lists the options for the command as well as a description of how they are used. Often this information is found in the DESCRIPTION section and not in a separate OPTIONS section.

```
-a, --all
              do not ignore entries starting with .


       -A, --almost-all
              do not list implied . and ..


       --author
              with -l, print the author of each file


       -b, --escape
              print C-style escapes for nongraphic characters


       --block-size=SIZE
              scale sizes by SIZE before printing them; e.g., '--block-size=M'
              prints sizes in units of 1,048,576 bytes; see SIZE format below
```

FILES

Lists the files that are associated with the command as well as a description of how they are used. These files may be used to configure the command's more advanced features. Often this information is found in the DESCRIPTION section and not in a separate FILES section.

AUTHOR

Provides the name of the person who created the man page and (sometimes) how to contact the person.

```
AUTHOR
       Written by Richard M. Stallman and David MacKenzie.
```

REPORTING BUGS

Provides details on how to report problems with the command.

```
REPORTING BUGS
       GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
```

```
       Report ls translation bugs to <http://translationproject.org/team/>
```

COPYRIGHT

Provides basic copyright information.

```
COPYRIGHT
       Copyright (C) 2017 Free Software Foundation, Inc.  License GPLv3+:  GNU
       GPL version 3 or later <http://gnu.org/licenses/gpl.html>.
       This  is  free  software:  you  are free to change and redistribute it.
       There is NO WARRANTY, to the extent permitted by law.
```

SEE ALSO

Provides you with an idea of where you can find additional information. This often includes other commands that are related to this command.

```
SEE ALSO
       Full documentation at: <http://www.gnu.org/software/coreutils/ls>
       or available locally via: info '(coreutils) ls invocation'
```

2.9.4 Man Pages Synopsis

The `SYNOPSIS` section of a man page can be difficult to understand, but it is a valuable resource since it provides a concise example of how to use the command. For example, consider an example `SYNOPSIS` for the cal command:

```
SYNOPSIS
     cal [-3hjy] [-A number] [-B number] [[month] year]
```

The square brackets `[ ]` are used to indicate that this feature is not required to run the command. For example, `[-3hjy]` means you can use the options `-3`, `-h`, `-j`, `-y`, but none of these options are required for the cal command to function properly.

The second set of square brackets `[-A number]` allows you to specify the number of months to be added to the end of the display.

The third set of square brackets in the `[-B number]` allows you to specify the number of months to be added to the beginning of the display.

The fourth set of square brackets in the `[[month] year]` demonstrates another feature; it means that you can specify a year by itself, but if you specify a month you must also specify a year.

Another component of the `SYNOPSIS` that might cause some confusion can be seen in the `SYNOPSIS` of the `date` command:

```
SYNOPSIS
       date [OPTION]... [+FORMAT]
       date [-u|--utc|--universal] [MMDDhhmm[[CC]YY][.ss]]
```

In this `SYNOPSIS` there are two syntaxes for the `date` command. The first one is used to display the date on the system while the second is used to set the date.

The ellipses `...` following `[OPTION]`, indicate that `[OPTION]` may be repeated.

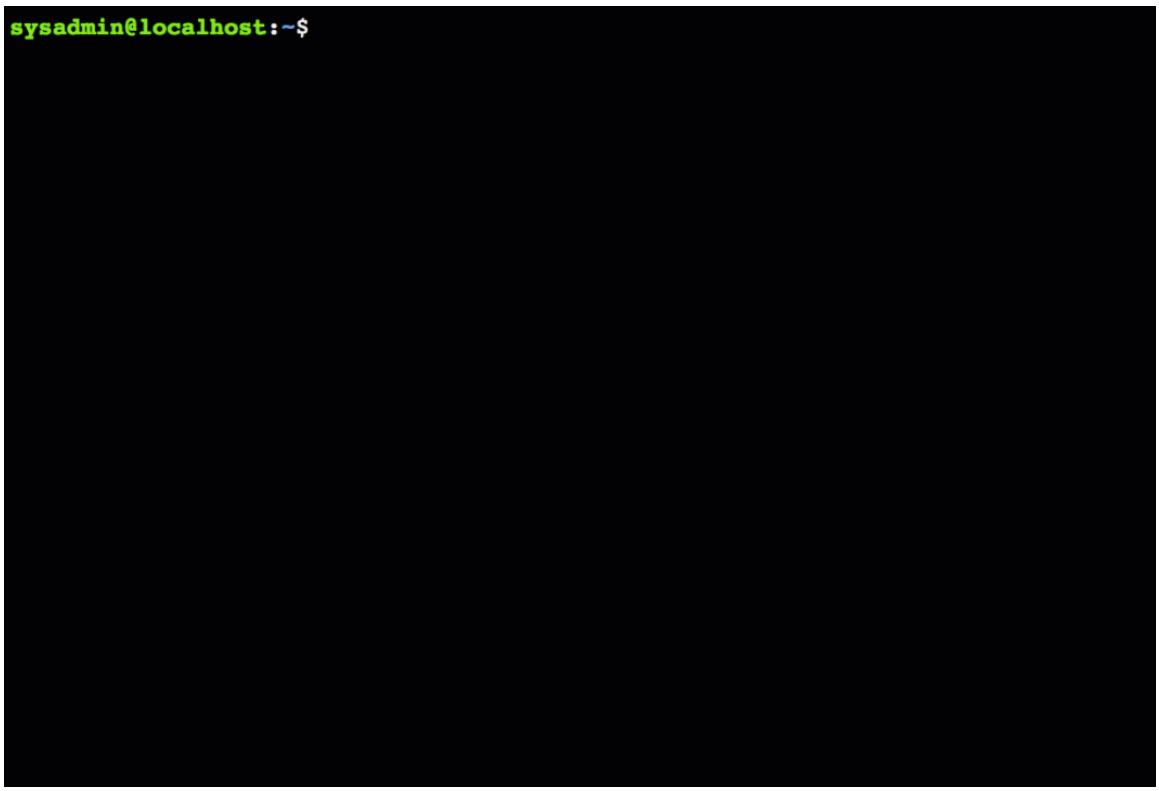
Additionally, the `[-u|--utc|--universal]` notation means that you can either use the `-u` option or the `--utc` option, or the `--universal` option. Typically, this means that all three options really do the same thing, but sometimes this format (use of the `|` character) is used to indicate that the options can't be used in combination, like a logical *or*.

2.9.5 Searching Within a Man Page

In order to search a man page for a term, type the `/` character followed by the term and hit the **Enter** key. The program will search from the current location down towards the bottom of the page to try to locate and highlight the term.

If the term is not found, or you have reached the end of the matches, then the program will report Pattern not found (press Return). If a match is found and you want to move to the next match of the term, press **N**. To return to a previous match of the term, press **Shift+N**.

Press ▷ *in the center of the next black windows.*



Note

If you haven't already, notice here that pager commands are viewed on the final line of the screen.

2.9.6 Man Page Sections

Until now, we have been displaying man pages for commands. However, sometimes configuration files also have man pages. Configuration files (sometimes called system files) contain information that is used to store information about the operating system or services.

Additionally, there are several different types of commands (user commands, system commands, and administration commands) as well as other features that require documentation, such as libraries and kernel components.

As a result, there are thousands of man pages on a typical Linux distribution. To organize all of these man pages, the pages are categorized by sections, much like each individual man page is broken into sections.

By default, there are nine sections of man pages:

- Executable programs or shell commands
- System calls (functions provided by the kernel)
- Library calls (functions within program libraries)

- Special files (usually found in `/dev`)
- File formats and conventions, e.g. `/etc/passwd`
- Games
- Miscellaneous (including macro packages and conventions), e.g. `man(7)`, `groff(7)`
- System administration commands (usually only for root)
- Kernel routines [non-standard]

When you use the `man` command, it searches each of these sections in order until it finds the first match. For example, if you execute the command `man cal`, the first section (Executable programs or shell commands) is searched for a man page called `cal`. If not found, then the second section is searched. If no man page is found after searching all sections, you will receive an error message:

```
1033_clim_antonio@sop.ase.ro:~$ man zed
No manual entry for zed
```

Consider This Homework:

Typically, there are many more sections than the standard nine. Custom software designers make man pages, using non-standard section names, for example "3p".

2.9.6.1 Determining Which Section

To determine which section a specific man page belongs to, look at the numeric value on the first line of the output of the man page. For example, if you execute the command `man cal`, you will see that the `cal` command belongs to the first section of man pages:

```
1033_clim_antonio@sop.ase.ro:~$ man cal
```

```
CAL(1)                  BSD General Commands Manual                  CAL(1)
```

2.9.6.2 Specifying a Section

In some cases, you will need to specify the section in order to display the correct man page. This is necessary because sometimes there will be man pages with the same name in different sections.

For example, there is a command called `passwd` that allows you to change your password. There is also a file called `passwd` that stores account information. Both the command and the file have a man page.

The `passwd` command is a user command, so the following command will display the man page for the `passwd` command, located in the first section, by default:

```
1033_clim_antonio@sop.ase.ro:~$ man passwd
PASSWD(1)                       User Commands                       PASSWD(1)


NAME
       passwd - change user password
```

To specify a different section, provide the number of the section as the first argument of the `man` command. For example, the command `man 5 passwd` will look for the `passwd` man page in section 5 only:

```
PASSWD(5)               File Formats and Conversions               PASSWD(5)


NAME
```

```
       passwd - the password file
```

2.9.6.3 Searching by Name

Sometimes it isn't clear which section a man page is stored in. In cases like this, you can search for a man page by name.

The `-f` option to the `man` command will display man pages that match, or partially match, a specific name and provide a brief description of each man page:

```
1033_clim_antonio@sop.ase.ro:~$ man -f passwd
passwd (1ssl)         - compute password hashes
passwd (1)            - change user password
passwd (5)            - the password file
```

Note that on most Linux distributions, the `whatis` command does the same thing as `man -f`. On those distributions, both will produce the same output.

```
1033_clim_antonio@sop.ase.ro:~$ whatis passwd
passwd (1ssl)         - compute password hashes
passwd (1)            - change user password
passwd (5)            - the password file
```

2.9.6.4 Searching by Keyword

Unfortunately, you won't always remember the exact name of the man page that you want to view. In these cases, you can search for man pages that match a keyword by using the `-k` option to the `man` command.

For example, what if you knew you wanted a man page that displays how to change your password, but you didn't remember the exact name? You could run the command `man -k password`:

```
1033_clim_antonio@sop.ase.ro:~$ man -k password
chage (1)             - change user password expiry information
chgpasswd (8)         - update group passwords in batch mode
chpasswd (8)          - update passwords in batch mode
cpgr (8)              - copy with locking the given file to the password or gr...
cppw (8)              - copy with locking the given file to the password or gr...
```

Warning

When you use this option, you may end up with a large amount of output. The preceding command, for example, provided over 60 results.

Recall that there are thousands of man pages, so when you search for a keyword, be as specific as possible. Using a generic word, such as "the" could result in hundreds or even thousands of results.

Note that on most Linux distributions, the `apropos` command does the same thing as `man -k`. On those distributions, both will produce the same output.

Consider This Homework:

Want to learn more about man pages? Execute the following command:

```
1033_clim_antonio@sop.ase.ro:~$ man man
```

1. Labs (steps from 1 to 33):

2.1 Introduction

In this lab, you will interact with the shell and gain an understanding of how basic commands are executed. You will also learn how to seek help on various commands and topics.

Most Linux commands follow a simple pattern of syntax:

```
command [options…] [arguments…]
```

We will begin with simple commands and then go on to execute commands with *options* and *arguments*.

Step 1

You will begin by running three commands: `pwd`, `ls`, and `uname`. These commands, in their simplest forms, are executed without any options or arguments.

At the shell prompt, type the `pwd` command and press the **Enter** key. The `pwd` command displays the directory where the user is currently located in the file system:

```
1033_clim_antonio@sop.ase.ro:~$ pwd
/home/sysadmin
1033_clim_antonio@sop.ase.ro:~$
```

The *working directory* is the directory that your terminal window or shell is currently "in". This is also called the *current directory*. This is an important consideration when you are running commands, since they may behave differently based on the directory you are currently in.

The output of the `pwd` command (`/home/sysadmin` in this example) is called a *path*. The first slash represents the *root directory*, the top level of the directory structure; `home` is a directory under the root directory, and `sysadmin` is a directory under the `home` directory.

Step 2

Execute the `ls` command at the prompt and press **Enter**; this command will list the files and directories that are in the current directory:

```
ls
```

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  Documents  Music  Public  Videos
1033_clim_antonio@sop.ase.ro:~$
```

Warning: Linux commands are case sensitive. Running the `ls` command is not the same as `LS` or `Ls`. Try executing `LS` at the prompt and notice that it will report an error:

```
LS
```

```
1033_clim_antonio@sop.ase.ro:~$ LS
Command 'LS' not found, but can be installed with:
sudo apt install sl
1033_clim_antonio@sop.ase.ro:~$
```

Step 3

The `uname` command displays information about the current system. Execute the following `uname` command and review the output:

```
uname
```

```
1033_clim_antonio@sop.ase.ro:~$ uname
Linux
1033_clim_antonio@sop.ase.ro:~$
```

Step 4

There are two types of options for Linux commands:

a. *Short options* are specified with a hyphen - followed by a single character.

b. *Long options* for commands are preceded by a double hyphen -- and the option is typically a "full name".

The `ls` command can be executed using various options. Execute the following `ls` command with the `-a` option. You will notice that with the `-a` option specified, the result now includes hidden files that begin with a dot `.` character:

```
ls -a
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -a
.             .bashrc    .selected_editor  Downloads  Public
..            .cache     Desktop           Music      Templates
.bash_logout  .profile   Documents         Pictures   Videos
1033_clim_antonio@sop.ase.ro:~$
```

File names displayed in different colors denote different file types. For example, blue denotes directories and white denotes plain files.

Step 5

The same effect can be achieved by using a long option `--all` with the `ls` command. Execute the following:

```
ls --all
```

```
1033_clim_antonio@sop.ase.ro:~$ ls --all
.             .bashrc    .selected_editor  Downloads  Public
..            .cache     Desktop           Music      Templates
.bash_logout  .profile   Documents         Pictures   Videos
1033_clim_antonio@sop.ase.ro:~$
```

Warning: If you don't include two hyphens and instead use the option `-all`, your output will be different because you will really be executing the `ls -a -l` command.

Step 6

Execute the `ls` command with the `-l` option; this will show the listing in long format:

```
ls -l
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -l
total 32
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Desktop
drwxr-xr-x 4 sysadmin sysadmin 4096 Mar 29 17:36 Documents
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Downloads
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Music
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Pictures
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Public
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Templates
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Videos
1033_clim_antonio@sop.ase.ro:~$
```

Step 7

The `-r` option for the `ls` command produces the listing in reverse sorting order. Compare it with the output from the `ls` command executed earlier.

```
ls -r
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -r
Videos  Templates  Public  Pictures  Music  Downloads  Documents  Desktop
1033_clim_antonio@sop.ase.ro:~$
```

Step 8

It is typically possible to combine more than one option in any order. Execute the following `ls` command with all three options you have previously used:

```
ls -alr
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -alr
total 60
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Videos
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Templates
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Public
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Pictures
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Music
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Downloads
drwxr-xr-x 4 sysadmin sysadmin 4096 Mar 29 17:36 Documents
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Desktop
-rw-r--r-- 1 sysadmin sysadmin   74 Mar 29 17:36 .selected_editor
-rw-r--r-- 1 sysadmin sysadmin  807 Apr  4  2018 .profile
drwx------ 2 sysadmin sysadmin 4096 Apr  2 15:27 .cache
```

```
-rw-r--r-- 1 sysadmin sysadmin 3768 Mar 29 17:36 .bashrc
-rw-r--r-- 1 sysadmin sysadmin  220 Apr  4  2018 .bash_logout
drwxr-xr-x 1 root     root     4096 Mar 29 17:36 ..
drwxr-xr-x 1 sysadmin sysadmin 4096 Apr  2 15:27 .
1033_clim_antonio@sop.ase.ro:~$
```

This `ls` command output has the combined effect of all the options specified:

- The `-a` option includes files starting with a period `.` character.
- The `-l` option provides the long listing format.
- The `-r` option sorts the result in reverse order.

Warning: Not all options can be combined. Some options are conflicting; for example, an option to the `ls` command that sorts files by name would conflict with an option that sorts files by size. Later in this lab, you will see how to consult documentation to determine which options will conflict.

Step 9

Just to confirm that it has the same combined effect, specify all of the options separately. You will note that it produces the same result:

```
ls -a -l -r
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -a -l -r
total 60
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Videos
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Templates
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Public
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Pictures
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Music
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Downloads
drwxr-xr-x 4 sysadmin sysadmin 4096 Mar 29 17:36 Documents
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Desktop
-rw-r--r-- 1 sysadmin sysadmin   74 Mar 29 17:36 .selected_editor
-rw-r--r-- 1 sysadmin sysadmin  807 Apr  4  2018 .profile
drwx------ 2 sysadmin sysadmin 4096 Apr  2 15:27 .cache
-rw-r--r-- 1 sysadmin sysadmin 3768 Mar 29 17:36 .bashrc
-rw-r--r-- 1 sysadmin sysadmin  220 Apr  4  2018 .bash_logout
drwxr-xr-x 1 root     root     4096 Mar 29 17:36 ..
drwxr-xr-x 1 sysadmin sysadmin 4096 Apr  2 15:27 .
1033_clim_antonio@sop.ase.ro:~$
```

Step 10

Earlier, without any options specified, the `uname` command had produced the output `Linux`. Now, execute the `uname` command with various options and notice the additional information it can display:

```
uname -a
uname -s
uname -n
uname -m
uname -p
uname -i
uname -o
```

```
1033_clim_antonio@sop.ase.ro:~$ uname -a
Linux localhost 4.4.0-141-generic #167~14.04.1-Ubuntu SMP Mon Dec 10 13:20:24 UTC 2018 x86_64 x86_64 x86_64 GNU/Linux
1033_clim_antonio@sop.ase.ro:~$ uname -s
Linux
1033_clim_antonio@sop.ase.ro:~$ uname -n
localhost
1033_clim_antonio@sop.ase.ro:~$ uname -m
x86_64
1033_clim_antonio@sop.ase.ro:~$ uname -p
x86_64
1033_clim_antonio@sop.ase.ro:~$ uname -i
x86_64
1033_clim_antonio@sop.ase.ro:~$ uname -o
GNU/Linux
1033_clim_antonio@sop.ase.ro:~$
```

Note that the `uname` command provides various system information, including system name (`-n`) and processor type (`-p`).

Step 11

After the command and its options, many commands will accept one or more arguments. Commands that use arguments may require multiple values. The `-w` option, when specified with the `ls` command, can be used to specify the width of the screen (normally this is determined by the actual terminal window size):

```
ls -rw 40
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -rw 40
Videos      Picture     Documents
Templates   Music       Desktop
Public      Downloads
1033_clim_antonio@sop.ase.ro:~$
```

Step 12

Since the `-w` option requires an argument, it must be specified at the end of the options. Combining options where the `-w` option is not at the end will not work. Execute the following command and notice the error that is reported:

```
ls -wr 40
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -wr 40
ls: invalid line width: 'r'
1033_clim_antonio@sop.ase.ro:~$
```

Step 13

It is not possible to combine multiple options that require arguments. In such a case, they have to appear separately. Execute the following to see a demonstration:

```
ls -w 40 -I "T*"
```

```
1033_clim_antonio@sop.ase.ro:~$ ls -w 40 -I "T*"
Desktop    Downloads  Pictures  Videos
Documents  Music      Public
1033_clim_antonio@sop.ase.ro:~$
```

The *ignore* `-I` option will cause the `ls` command to not display specific files that match a pattern. The pattern `"T*"` means *any file or directory that begins with a capital T*. In this case, the `Templates` directory was not displayed.

Step 14

It is possible to use both short and long options in the same command line. Execute the `ls` command using both long and short options as shown below:

```
ls --all -rl
```

```
1033_clim_antonio@sop.ase.ro:~$ ls --all -rl
total 60
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Videos
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Templates
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Public
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Pictures
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Music
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Downloads
drwxr-xr-x 4 sysadmin sysadmin 4096 Mar 29 17:36 Documents
drwxr-xr-x 2 sysadmin sysadmin 4096 Mar 29 17:36 Desktop
-rw-r--r-- 1 sysadmin sysadmin   74 Mar 29 17:36 .selected_editor
-rw-r--r-- 1 sysadmin sysadmin  807 Apr  4  2018 .profile
drwx------ 2 sysadmin sysadmin 4096 Apr  2 15:27 .cache
-rw-r--r-- 1 sysadmin sysadmin 3768 Mar 29 17:36 .bashrc
-rw-r--r-- 1 sysadmin sysadmin  220 Apr  4  2018 .bash_logout
drwxr-xr-x 1 root     root     4096 Mar 29 17:36 ..
```

```
drwxr-xr-x 1 sysadmin sysadmin 4096 Apr  2 15:27 .
1033_clim_antonio@sop.ase.ro:~$
```

Step 15

Similarly, it is possible to run commands with long options and with arguments. For example, execute the following to display files with the `ls` command without having the file names color-coded by file type:

```
ls --color=never
```

```
1033_clim_antonio@sop.ase.ro:~$ ls --color=never
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
1033_clim_antonio@sop.ase.ro:~$
```

Step 16

A lone double hyphen indicates the end of all the options for the command. Without this double hyphen, the following sequence of commands would not work since `--badname` would be considered an option to these commands rather than a file name:

```
touch -d "1970-01-01 12:00:00" -- --badname
ls --full-time -- --badname
rm -- --badname
```

```
1033_clim_antonio@sop.ase.ro:~$ touch -d "1970-01-01 12:00:00" -- --badname
1033_clim_antonio@sop.ase.ro:~$ ls --full-time -- --badname
-rw-rw-r-- 1 sysadmin sysadmin 0 1970-01-01 12:00:00.000000000 +0000 --badname
1033_clim_antonio@sop.ase.ro:~$ rm -- --badname
1033_clim_antonio@sop.ase.ro:~$
```

The `touch` command creates a file with a specific timestamp. The `ls` command displays this file with its timestamp. The `rm` command deletes the file. Without the `--` characters before the `--badname` file name, these commands would consider `--badname` to be an option to the commands.

Step 17

Some commands make use of arguments that don't require any options. For example, execute the following `touch` command with a file name. This will create a file. Then execute the `ls` command immediately after to confirm that it has created the file:

```
touch lpicfile.txt
ls
```

```
1033_clim_antonio@sop.ase.ro:~$ touch lpicfile.txt
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  lpicfile.txt
Documents  Music      Public    Videos
1033_clim_antonio@sop.ase.ro:~$
```

Step 18

Similarly, you can execute the following `rm` command with the same file name as an argument to remove that file:

```
rm lpicfile.txt
ls
```

```
1033_clim_antonio@sop.ase.ro:~$ rm lpicfile.txt
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
1033_clim_antonio@sop.ase.ro:~$$
```

Step 19

Some commands, like the `cp` command, require at least two arguments. The `cp` command requires the *source file* to copy and the *destination file* (where to copy the file to). For example, execute the following to copy the `hosts` file from the `/etc` directory into the current directory with a new name of `myhosts`:

```
cp /etc/hosts myhosts
ls
```

```
1033_clim_antonio@sop.ase.ro:~$ cp /etc/hosts myhosts
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  myhosts
Documents  Music      Public    Videos
1033_clim_antonio@sop.ase.ro:~$
```

Step 20

Arguments that contain spaces or non-alphanumeric characters need to be enclosed within single quotes `'` or double quotes `"`. The use of single quotes is safer because it prevents the shell from interpreting any special characters. For example, without quotes, the shell will interpret a double exclamation point `!!` as *repeat the last command executed*.

Note: Special characters such as the exclamation point `!` character, the question mark `?` character, the asterisk `*` character, and more will be covered in greater detail later in the course.
Use the `echo` command to illustrate the effects of different quotes on special characters:

```
ls
echo something new!!
```

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  myhosts
Documents  Music      Public    Videos
1033_clim_antonio@sop.ase.ro:~$ echo something new!!
echo something newls
```

```
something newls
```

The shell interprets the double exclamation point `!!` as the previously executed `ls` command and then the `echo` command returns the string something `newls`. This time, try executing the `echo` command with double quotes `"` :

```
ls
echo "something new!!"
```

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  myhosts
Documents  Music      Public    Videos
1033_clim_antonio@sop.ase.ro:~$ echo "something new!!"
something newls
```

Slightly better, but the `ls` command is still appended to the end of the string something new. Now use single quotes `'` to let the shell know that everything inside should be interpreted literally:

```
ls
echo 'something new!!'
```

```
1033_clim_antonio@sop.ase.ro:~$ ls
Desktop    Downloads  Pictures  Templates  myhosts
Documents  Music      Public    Videos
1033_clim_antonio@sop.ase.ro:~$ echo 'something new!!'
something new!!
```

This time the `echo` command worked properly, displaying only the data contained within single quotes.

Step 21

Aliases serve as a nickname for another command or series of commands. As you can see by the commands that you have executed so far, commands in the Linux command shell require a fair amount of memorizing and typing. Aliases can help save such repetitive effort. New aliases can be created using the following format, where *`name`* is the name to be given the alias and *`command`* is the command to be executed when the alias is run.

```
alias name=command
```

Instead of typing the command `ls -alr` each time, you can create an alias called `l` as shown below. Single quotes `'` are used to ensure that all the characters retain their literal meaning:

```
alias l='ls -ar'
ls -ar
l
```

```
1033_clim_antonio@sop.ase.ro:~$ alias l='ls -ar'
1033_clim_antonio@sop.ase.ro:~$ ls -ar
myhosts    Public     Downloads .selected_editor  .bashrc        .
Videos     Pictures   Documents  .profile          .bash_logout
Templates  Music      Desktop    .cache            ..
```

```
1033_clim_antonio@sop.ase.ro:~$ l
myhosts     Public     Downloads .selected_editor   .bashrc        .
Videos      Pictures   Documents  .profile           .bash_logout
Templates   Music      Desktop    .cache             ..
1033_clim_antonio@sop.ase.ro:~$
```

Consider This

Later, you can remove entries from your list of aliases by using the `unalias` command:

```
unalias l
l
```

```
1033_clim_antonio@sop.ase.ro:~$ unalias l
1033_clim_antonio@sop.ase.ro:~$ l
l: command not found
1033_clim_antonio@sop.ase.ro:~$
```

Step 22

The Bash shell provides a feature designed to avoid typing mistakes and save typing effort; this feature is called command completion. Command completion allows you to type a few characters of a command (or its file name argument) and then press the **Tab** key. The Bash shell will complete the command (or its file name argument) automatically for you.

For example, first type `ec`:

```
ec
```

```
1033_clim_antonio@sop.ase.ro:~$ ec
```

Next, press the **Tab** key, and the shell will automatically complete the command `echo` for you (it even places a space after the command so you can immediately start typing the option or argument):

```
1033_clim_antonio@sop.ase.ro:~$ echo
```

Step 23

When the characters that are typed are insufficient to match a single command, all the possible choices are displayed if you press the **Tab** key twice:

```
ca
```

```
1033_clim_antonio@sop.ase.ro:~$  ca
cal                capsh              cat                cautious-launcher
calendar           captoinfo          catchsegv
caller             case               catman
1033_clim_antonio@sop.ase.ro:~$  ca
```

Finish this command by pressing the letter `l`, followed by the **Enter** key:

```
l
```

```
1033_clim_antonio@sop.ase.ro:~$ cal
     April 2020
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

1033_clim_antonio@sop.ase.ro:~$
```

Step 24

The `type` command is used to determine what a file is and/or where it is located. Use the `type` command to get information about the `pwd` command.

```
type pwd
```

```
1033_clim_antonio@sop.ase.ro:~$ type pwd
pwd is a shell builtin
```

The `pwd` command is identified as a shell builtin; a command that is part of the shell rather than a separate program. Let's find out more about the `man` command that's used for viewing manual pages.

```
type man
```

```
1033_clim_antonio@sop.ase.ro:~$ type man
man is /usr/bin/man
```

The `man` command is identified as a program located in `/usr/bin`.

Step 25

Getting Help: *Manual pages are one of the best resources to get help on a Linux system. Referring to the man page for a command will provide you with the basic idea behind the purpose of the command, as well as details regarding the options of the command and a description of its features.*

To access man pages of the `ls` command, execute the following command:

```
man ls
```

```
1033_clim_antonio@sop.ase.ro:~$ man ls
LS(1)                          User Commands                          LS(1)


NAME
```

```
       ls - list directory contents
SYNOPSIS
       ls [OPTION]... [FILE]...
DESCRIPTION
       List information  about  the FILEs (the current directory by default).
       Sort entries alphabetically if none of -cftuvSUX nor --sort is speci
       -fied.
       Mandatory  arguments  to  long  options are mandatory for short
       options too.

       -a, --all
             do not ignore entries starting with .

       -A, --almost-all
              do not list implied . and ..

       --author
Manual page ls(1) line 1 (press h for help or q to quit)
```

Step 26

To view the various movement commands that are available, type the **H** key or **Shift+h** while viewing a man page:

```
h
                  SUMMARY OF LESS COMMANDS


      Commands marked with * may be preceded by a number, N.
      Notes in parentheses indicate the behavior if N is given.
      A key preceded by a caret indicates the Ctrl key; thus ^K is ctrl-K.


  h  H                 Display this help.
  q  :q  Q  :Q  ZZ     Exit.
 ---------------------------------------------------------------------------


                           MOVING


  e  ^E  j  ^N  CR  *  Forward  one line   (or N lines).
  y  ^Y  k  ^K  ^P  *  Backward one line   (or N lines).
  f  ^F  ^V  SPACE  *  Forward  one window (or N lines).
```

```
  b  ^B  ESC-v      *  Backward one window (or N lines).
  z                 *  Forward  one window (and set window to N).
  w                 *  Backward one window (and set window to N).
  ESC-SPACE         *  Forward  one window, but don't stop at end-of-file.
  d  ^D             *  Forward  one half-window (and set half-window to N).
  u  ^U             *  Backward one half-window (and set half-window to N).
  ESC-)  RightArrow *  Right one half screen width (or N positions).
HELP -- Press RETURN for more, or q when done
```

Step 27

Press the **Spacebar** to read through the help section. When you are ready to go back to the man page for the `ls` command, press the **Q** key:

```
q
LS(1)                          User Commands                          LS(1)


NAME
       ls - list directory contents
SYNOPSIS
       ls [OPTION]... [FILE]...
DESCRIPTION
       List information  about  the FILEs (the current directory by default).
       Sort entries alphabetically if none of -cftuvSUX nor --sort is speci
       -fied.
       Mandatory  arguments  to  long  options are mandatory for short
       options too.

       -a, --all
             do not ignore entries starting with .

       -A, --almost-all
              do not list implied . and ..

       --author
Manual page ls(1) line 1 (press h for help or q to quit)
```

Step 28

Take a few moments to explore a few of the movement commands that are available when displaying a man page:

Command	Function
Return (or **Enter**)	Go down one line
Space	Go down one page
/term	Search for term
n	Find next search item
1G	Go to the beginning
G	Go to the end
h	Display help
q	Quit man page

Step 29

When you are finished exploring the man page, exit the `ls` man page by typing the **Q** key:

```
q
```

```
1033_clim_antonio@sop.ase.ro:~$ man ls
1033_clim_antonio@sop.ase.ro:~$
```

Step 30

A command may be included in more than one section of man pages. To display a specific section for the `passwd` command, execute the following:

```
man 5 passwd
```

```
1033_clim_antonio@sop.ase.ro:~$ man 5 passwd
PASSWD(5)                File Formats and Conversions                PASSWD(5)


NAME
       passwd - the password file


DESCRIPTION
       /etc/passwd contains one line for each user account, with seven fields
       delimited by colons (":"). These fields are:

       o   login name
       o   optional encrypted password
```

```
        o   numerical user ID

        o   numerical group ID

        o   user name or comment field

        o   user home directory

        o   optional user command interpreter

 Manual page passwd(5) line 1 (press h for help or q to quit)
```

Consider This

By default, there are nine sections of man pages:

1. Executable programs or shell commands
2. System calls (functions provided by the kernel)
3. Library calls (functions within program libraries)
4. Special files (usually found in `/dev`)
5. File formats and conventions, e.g., `/etc/passwd`
6. Games
7. Miscellaneous (including macro packages and conventions), e.g., `man(7)`, `groff(7)`
8. System administration commands (usually only for root)
9. Kernel routines [non-standard]

Step 31

When you are finished exploring the man page, exit the man page by typing the **Q** key:

```
q
```

Step 32

If you do not know the exact man page you are looking for, you can search for man pages that match a keyword by using the `-k` option to the `man` command. For example, execute the following:

```
man -k passwd
```

```
1033_clim_antonio@sop.ase.ro:~$ man -k passwd
chgpasswd (8)         - update group passwords in batch mode
chpasswd (8)          - update passwords in batch mode
gpasswd (1)           - administer /etc/group and /etc/gshadow
openssl-passwd (1ssl) - compute password hashes
pam_localuser (8)     - require users to be listed in /etc/passwd
passwd (1)            - change user password
passwd (1ssl)         - compute password hashes
passwd (5)            - the password file
update-passwd (8)     - safely update /etc/passwd, /etc/shadow and /etc/group
1033_clim_antonio@sop.ase.ro:~$
```

Note: When you use the `-k` option, both the man page names and descriptions are searched.

Step 33

To search only for the man page name, use the `-f` option:

```
man -f passwd
```

```
1033_clim_antonio@sop.ase.ro:~$ man -f passwd
passwd (1ssl)         - compute password hashes
passwd (1)            - change user password
passwd (5)            - the password file
1033_clim_antonio@sop.ase.ro:~$
```

Step 34

Alternatively, you can try the `whatis` command, which produces the same result as the `man -f` command:

```
whatis passwd
```

```
1033_clim_antonio@sop.ase.ro:~$ whatis passwd
passwd (1ssl)         - compute password hashes
passwd (1)            - change user password
passwd (5)            - the password file
1033_clim_antonio@sop.ase.ro:~$
```

Consider This

Want to learn more about man pages? Execute the command `man man`:

```
1033_clim_antonio@sop.ase.ro:~$ man man
```

Now: ONLINE TEST from this material