

Type	Owner permissions	Group permissions	Other user permissions
File	rwxrwxrwx	rwxrwxrwx	rwxrwxrwx
Directory	drwxrwxrwx	drwxrwxrwx	drwxrwxrwx
Link	lrwxrwxrwx	lrwxrwxrwx	lrwxrwxrwx
Symbolic Link	lcrwxrwxrwx	lcrwxrwxrwx	lcrwxrwxrwx

Linux Nitty Gritty:

Working at the Ubuntu Command-Line Prompt

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A brief introduction

The fact you're reading this book might mean you already know about Ubuntu, but one or two readers might have bought the book on a whim to see what the fuss is all about. These people might lack specifics, and remain unconvinced of the benefits of Ubuntu. So, I'm going to burn through some precious pages of this slim volume to evangelize and explain just a little.

What is Ubuntu?

Ubuntu is a version of the Linux operating system. An operating system is the software that “runs your computer”. Microsoft Windows is the world’s most popular operating system, at least for desktop computers, but Linux is a completely separate endeavor.

The ball started rolling back in the 1980s, when a hugely talented computer scientist called Richard Stallman decided to create a clone of a venerable operating system called Unix. At the time, Unix ran many of the world's industrial and academic computer systems.

Stallman did this because Unix was becoming increasingly *proprietary*—it was no longer permitted to share its source code (the listings created by programmers), as had happened since the inception of Unix in 1969.

This was anathema to Stallman, who believed sharing software was natural and healthy. He decided his version of Unix would always be freely available, and invented the legal and ethical concept of *Free Software* to ensure this happened. Put simply, Free Software says users should always have the freedom to share software, without restrictions. On a technical level, Free Software guarantees the right to view and also modify source code, or even use it as a basis to make a new program. However, any additions or changes must be released as Free Software too, so others can continue to benefit.

NOTE *The Free Software ideal is enshrined in a software license applied to all Free Software projects. It's called the GNU Public License, or GPL. This is like Microsoft's End User License Agreement that comes with Windows (and you see whenever you install Windows from scratch), except whereas the Microsoft EULA prohibits sharing Windows under any circumstances, the GPL says exactly the opposite—that you can always share the software!*

Stallman called his version of Unix “GNU” (pronounced *G-noo*). This is a recursive acronym, standing for *GNU's Not Unix*. In other words, the acronym refers to itself—a joke of a type favored by programmers.

The Linux kernel

GNU grew into a major project with many contributors. However, good as it was, it lacked a *kernel*. A kernel is the program at the heart of any operating system that takes care of fundamental stuff, like letting hardware communicate with software.

Almost by accident, a chap called Linus Torvalds provided a solution. In 1991 he started a personal project to create a kernel. Due to a naming error when his kernel was uploaded to the Internet, it got named after him and became known as *Linux*—a hybrid of “Linus” and “Unix”.

Crucially, Torvalds chose to release his kernel as Free Software, and invited any interested party to give him a hand. They did. Thousands of people around the world got involved. As the years went by, the project became more and more important, and grander in its design and outlook. Today, the Linux kernel receives sponsorship from many major corporations, including IBM.

NOTE Torvalds continues to oversee and contribute to the Linux kernel project to this day. He humorously describes his role as a “benign dictator”.

Because the kernel is such an important aspect of an operating system, people began to refer to the combination of GNU and Linux simply as *Linux*. This upset Stallman, who asked that the name GNU/Linux be used instead. But it was too late. The name stuck.

NOTE Whether to refer to the operating system as *GNU/Linux* or simply *Linux* is a debate that continues to this day.

Software from other sources is typically included in the Linux operating system too, alongside GNU and the Linux kernel. Virtually all the software in Linux is Free Software, even though much of it has no direct ties with GNU or Richard Stallman. Arguably, Stallman’s greatest gift to the world was not the GNU software, but the concept of Free Software. Much of Stallman’s activity nowadays involves evangelizing around the world about Free Software.

NOTE Often the term open source is used instead of Free Software. It has a similar meaning—see www.opensource.org.

Linux distros

There isn't just one version of Linux. There are hundreds. Versions are known as *distributions* of Linux, or *distros* for short. Examples of other distros include Red Hat (www.redhat.com) and SUSE (www.suse.com), but there are many others, and new ones appear all the time.

This variety is possible because of the freedom allowed by Free Software—anybody can take the source code and make their own version.

Some distros are commercially sponsored, while others arose from the massive community of Linux users around the world. Ubuntu is a little of both: it is sponsored by Canonical, a company founded by the entrepreneur Mark Shuttleworth in 2004, but also benefits from massive community support, and is based on Debian (www.debian.org), a community-generated distro.

What makes Ubuntu special

Three things make Ubuntu stand out from the crowd:

1. Its focus on desktop users;
2. The Ubuntu philosophy and community;
3. Ease of use.

Let's take a closer look at each.

Focus on desktop users

Although it comes in versions for all kinds of computers, at its core Ubuntu is a distribution of Linux aimed primarily at desktop users.

Most Linux distros are equally at home on desktop or server computers (the powerful computers that run the Internet), but lack polish when it comes to the desktop experience. Indeed, in many cases the needs of desktop users are something of an afterthought.

In contrast, the desktop experience is something to which the Ubuntu developers pay very close attention.

When Ubuntu was created back in 2004, Mark Shuttleworth recorded the very first bug in the online database. However, it wasn't about software. Instead, it was a revolutionary call to arms. It read as follows: "Microsoft has a majority market share in new desktop PC marketplace. This is a bug, which Ubuntu is designed to fix".

Philosophy and community

As you might have realized, Linux is as much a philosophy as it is an operating system. Ubuntu is no different.

African values

Ubuntu gets its title from the African concept of the same name that translates roughly as “humanity to others”. The term gained popularity in post-apartheid South Africa, where it stressed the importance of individuals recognizing their role within communities, and being generous of spirit because of this.

When Mark Shuttleworth founded the Ubuntu Linux project in 2004, he drew-up a philosophical statement, based on this concept, and on the principles of Free Software.

In a nutshell, the Ubuntu project is driven by the idea that software should be inclusive. It should be possible for anybody, anywhere to use, share, or modify Ubuntu. This means the software should be available in a particular user's language too. If they have a disability, the software should be accessible to them.

Ubuntu is free of charge, like nearly all versions of Linux. Updates are also free-of-charge for a set period after release (usually 18 months).

NOTE You can read more about the Ubuntu philosophy at www.ubuntu.com/community/ubuntu-story/philosophy, and read more about the Free Software Foundation's principles at www.gnu.org/philosophy/free-sw.html.

What Ubuntu represents is *freedom*—freedom to use and share the software, to do what you want with it, and to learn.

The community

The Ubuntu community arose directly out of the Ubuntu philosophy. Put simply, people respect the principled stand Ubuntu takes. They also like the fact that Ubuntu focuses on the desktop experience.

There have been many versions of Linux that, like Ubuntu, were aimed specifically at desktop users. Virtually all failed. This was because they compromised on some component of Free Software principles. Maybe their version of Linux included a proprietary installation program that couldn't be freely shared or modified. Sometimes they attempted to limit redistribution of their version of Linux.

Ubuntu doesn't do any of this. Its reward is a truly massive community of users around the world—arguably the biggest user-base of any version of Linux. It's certainly one of the friendliest Linux communities.

Shuttleworth takes a back seat and, apart from occasionally issuing edicts, the community runs the show. Decisions about new features are made democratically, and many of its users help develop Ubuntu (provided they have the skills, of course).

For a humble end-user of Ubuntu, the benefit of the Ubuntu community is found in the magnificent technical support offered at www.ubuntuforums.org, the community forums site where Ubuntu users hang-out and help each other.

NOTE It isn't 100% accurate that Ubuntu doesn't include proprietary software. A small amount of proprietary hardware firmware is provided to support wireless and graphics devices presently not fully supported by Free Software. This is seen as a stopgap measure, however, until more acceptable alternatives become available.

Ease of use

Alongside strong principles and financial sponsorship, Shuttleworth brought something else to the Linux party: He wanted to make a “Linux for human beings”. Indeed, this is Ubuntu’s tag line.

How it used to be

To understand why this is important, let me recount an experience I had with Linux in 2002, before Ubuntu hit the scene. I wanted the wireless card in my notebook to connect to my network, but I couldn’t get it working under Linux. So, I asked for help on a popular forum. I received something similar to the following in reply:

“*Getting the card to work is simple! Just grab the source code for the module and compile it against the kernel. `insmod` it and then use `iwconfig` to configure a WEP password—*”

Are you still reading? As you can tell, that’s a complex answer. It involves working at the command-line, and requires knowledge of how Linux works on a very technical level. I knew what the poster was talking about, although inwardly I sighed at the amount of work involved. However, a newcomer would be baffled.

That’s how it was back then. Linux was “for techies only”. It was considered an industrial-strength operating system, and brought with it a steep learning curve that drove many away.

How it is now

Ubuntu changed everything. It focuses on the desktop user experience and, to this end, features graphical configuration software. It includes a wide variety of hardware drivers so that nearly all standard hardware “just works”. Ubuntu comes with an installer program that doesn’t feature mind-boggling terminology, and updating the system takes just a few clicks of the mouse.

NOTE To be fair, it can be argued Ubuntu was part of a broader revolution in desktop Linux, and several other versions of Linux were heading in the same direction. Ubuntu was the first to get there, and continues to lead the charge with each new release.

While the command-line is still around, there’s no longer an obligatory requirement to use it. It’s often quicker and more efficient to use it, as you’ll find out later in this book, but you don’t have to. Ubuntu makes Linux truly accessible to all.

Don’t think Ubuntu is somehow “less Linux” than other versions. Scratch under the surface and you’ll find Ubuntu is based on Debian, a widely-respected community-generated version of Linux that many consider definitive. See www.debian.org.

What Ubuntu offers

Ubuntu is a thoroughly modern operating system that provides everything you might find in Windows or Macintosh OS X, but without the drawbacks. It keeps things simple, yet offers sophisticated features.

Hardware support is excellent, with virtually every item of day-to-day hardware supported, including graphics/sound cards, printers, wireless, USB memory sticks, cameras, iPods, and so-on. There's no need to fumble around with driver CDs—practically everything will be up and running straight after installation, although as with any operating system you may have to configure the system to your own tastes and needs.

Users and the filesystem

The purpose of this chapter is to get you to speed with the Ubuntu filesystem. You'll learn about:

- * How Ubuntu compares to Windows when it comes to files;
- * Where things can be found in the Ubuntu filesystem;
- * The basics of the users and permissions system that lies at the heart of Ubuntu.

How Ubuntu handles files

Some comparison between Windows and Ubuntu is inevitable when discussing the filesystem. Although fundamentally similar, as a variant of Linux, Ubuntu differs from Windows in the following ways.

Paths

There are no drive letters under Ubuntu. Instead, the root of the filesystem, known as C:\ under Windows, is identified simply by a forward slash (/).

Additionally, whereas Windows uses a backslash (\) to indicate the root of the filesystem, and to separate folders in a path listing, Ubuntu uses a forward slash.

So, whereas a path like **C:\Documents and Settings\Owner\My Documents** is common under Windows, you will see something like **/home/frank/Documents** in Ubuntu. This difference can be jarring at first, but you'll be surprised at how quickly you used to it.

Mounting

If there are no drive letters then how are other storage devices accessed, such as CD/DVD drives, or USB memory sticks?

The answer is that they're *mounted*—effectively, the filesystem of the storage device is magically plumbed through to a particular folder within the Ubuntu filesystem. Insert a CD/DVD, for example, and its contents will be visible when you browse to `/media/cdrom` folder.

It's important to note that the files aren't literally copied to the folder. They're made available in a virtual way. You can manipulate the files and folders like any other files and folders, and although it might appear as if they're contained in that particular folder, they aren't.

Anything that might have already been in the folder used as the *mount point* will temporarily disappear. However, the contents are still there, and if the storage device is *unmounted*, the contents will reappear.

Mounting might sound complicated, but don't worry—it's nearly always done automatically, either at boot-up for devices permanently attached to your PC, or when you attach a removable storage device to the computer, such as a USB stick. You probably won't be aware of it taking place, in fact; all the user sees after inserting a USB memory stick is a new icon on the desktop that, when double-clicked, lets her browse the USB stick's files. Of course, if the user looks closely, she will see that she's actually browsing the folder that the USB memory stick has been mounted at.

File & folder names

File and folder names can contain spaces, as with Windows, but upper/lowercase letters are important in Linux. A folder can feasibly contain separate files called **Report.doc**, **REPORT.doc**, **report.doc**, **RePORT.doc**, and so on.

NOTE This ability of an operating system to differentiate between upper and lower case letters is called case sensitivity.

Additionally, file and folder names under Ubuntu can contain practically any letter, number, or symbol, with the exception of the forward slash (/).

NOTE Whereas Windows refers to folders, many Linux users refer to directories. Exactly the same thing is being discussed. The term directory is nearly always used at the command-line, although the term folder is preferred when using the Ubuntu desktop.

Important filesystem locations

Each user on the system is given their own folder within the `/home` folder in which to save personal data. For example, the user `jane` is given the folder `/home/jane`. The `/home` folder is akin to `C:\Documents and Settings` under Windows.

TIP Linux users often refer to their folder within `/home` as their “home folder”, saying things like, “I couldn’t find the file but I remembered I’d saved it in my home folder.”

Users aren’t permitted to save their personal files outside of their `/home` folder. This is rigidly enforced using ownerships and file permissions, as I explain in the *Understanding Users* section below.

Outside of the `/home` folder, the Ubuntu filesystem is a little more complicated than Windows, and it isn’t quite a case of program files being in one location, and system files in another.

A cursory rundown of the Ubuntu filesystem can be found in Table 4-1, although this is not essential knowledge and is provided largely for reference purposes.

Perhaps the most important locations for the majority of users are `/home`, as described above; `/usr/bin`, where practically all software is located; and `/etc`, where system configuration files are found.

NOTE Like many versions of Linux, Ubuntu broadly follows the Filesystem Hierarchy Standard (FHS) to decide where things should go in the filesystem. For more details, including in-depth descriptions of each location, see www.pathname.com/fhs/.

Hidden files and folders

Windows lets users hide files and folders by setting a file attribute.

Linux takes a simpler approach. Any file or folder that has a period (.) at the beginning doesn't appear in file listings, unless the user specifically requests all files/folders be listed.

In other words, if you rename `report.doc` to `.report.doc`, it will instantly become invisible and will seem to disappear from the file browsing window (you might have to hit the Refresh button in the file browser window to update the listing before the file actually vanishes).

A user's personal configuration files are stored in his or her `/home` folder and are hidden in this way. To view them, and other hidden files, click View > Show Hidden Files in a file browsing window.

NOTE Any file or folder that has a tilde (~) at the end of its filename (i.e. `report.doc~`) will be hidden in file listings provided by the Nautilus file manager, and on the desktop. They will be visible everywhere else, including at the command-line.

Table 4-1. Key locations in the Ubuntu filesystem.

Location Details

Location	Description
<code>/bin</code>	Essential software, typically needed to get the system running
<code>/boot</code>	Files related to the boot menu/loader
<code>/dev</code>	Virtual files representing hardware devices
<code>/etc</code>	System (global) configuration files
<code>/home</code>	Users' personal folders
<code>/lib</code>	Support (library) files required by software
<code>/media</code>	Contains subfolders where storage devices can be mounted
<code>/proc</code>	Virtual folder containing files representing stats and settings
<code>/root</code>	Personal folder of the root user
<code>/sbin</code>	Essential software for system maintenance, usually used only by the root user
<code>/tmp</code>	Temporary files/folders
<code>/usr</code>	Essentially, subdirectories containing most software used on the system, including system libraries and documentation
<code>/var</code>	Data that is vital to the running of the system and that is constantly being updated

File extensions

Generally speaking, the trend with Linux is not to use file extensions for system files. Executable programs under Ubuntu don't have a file extension, such as `.exe`, as with Windows. Instead, the fact they are programs and not ordinary data files is indicated by the use of the `executable` file attribute.

Configuration files sometimes have a `.conf` file extension, but often have no file extension at all. Many files that are plain text have no file extension, in fact; the use of the `.txt` file extension is rare in the world of Linux. Program documentation files in the `/usr/share/doc` folder, for example, are plain text and have no file extensions.

NOTE It isn't quite true that files in the `/usr/share/doc` folder have no file extensions because some program documentation files are compressed, so have a `.gz` file extension, but this is a minor point.

However, when it comes to the personal files of users, such as documents or images, file extensions are as important as they are under Windows. Files with a `.doc` extension are recognized as Microsoft Word files, for example, and `.jpg` files are recognized as images.

Understanding users

When you installed Ubuntu, a personal user account was created for you. As part of this process, a folder named after your username was created in `/home`, as mentioned previously.

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