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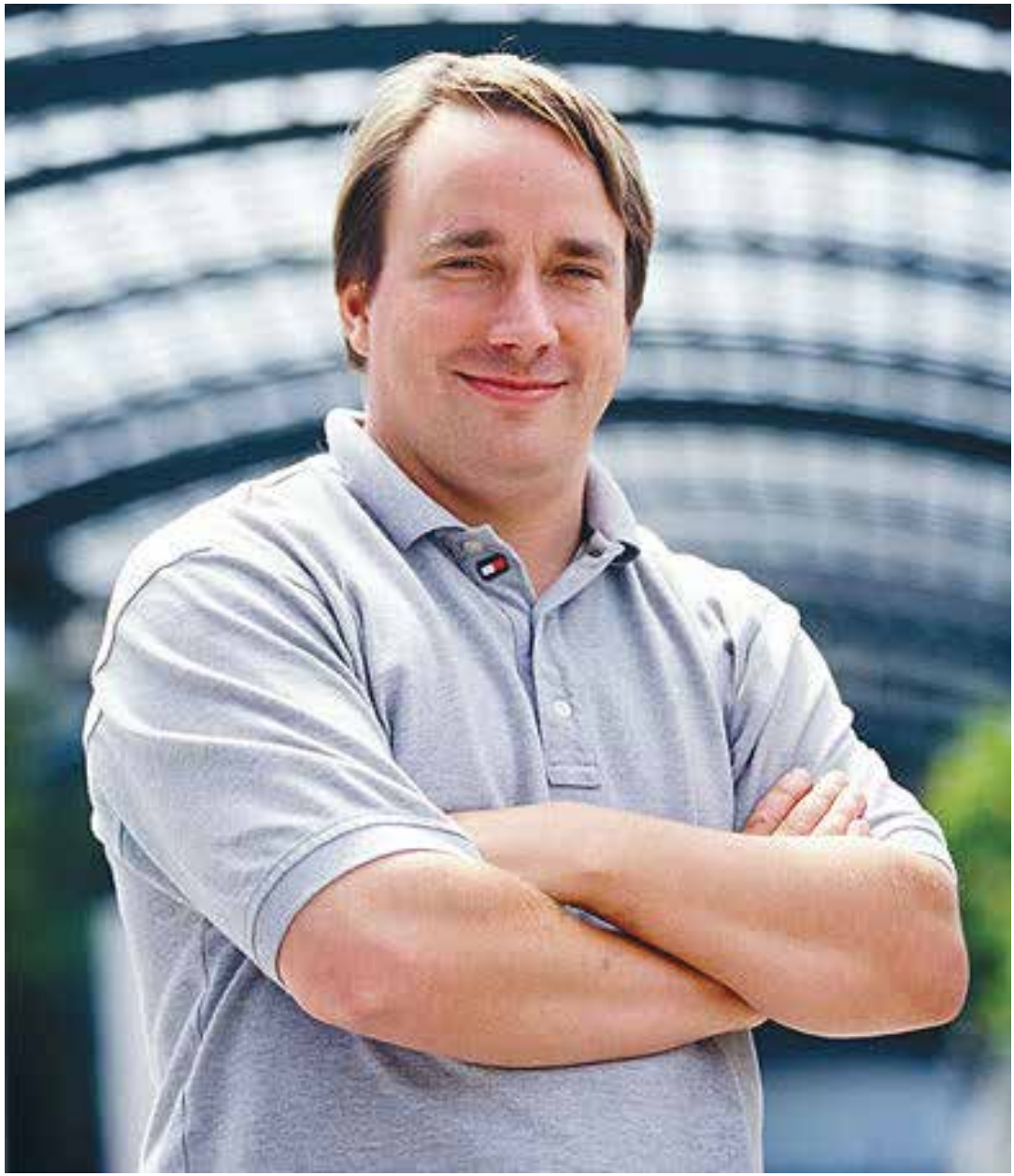

Guess what? Wheels have been round for a really long time, and anybody who "reinvents" the new wheel is generally considered a crackpot. It turns out that "round" is simply a good form for a wheel to have. It may be boring, but it just tends to roll better than a square, and "hipness" has nothing whatsoever to do with it.

Linus Torvalds, creator of the Linux kernel

1 Getting Started

This chapter introduces the Linux operating system and describes a typical installation procedure.

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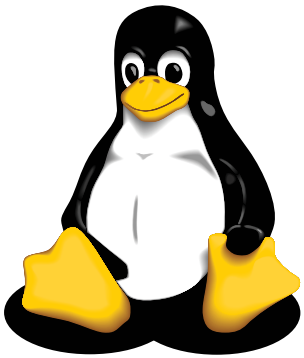
Introducing Linux



This penguin is "Tux" – the happy Linux mascot.

Linux is a computer operating system that can run on a variety of hardware including the popular Intel system found on most desktop computers. It is a modern derivation of the powerful Unix operating system that was introduced way back in 1969. In recent years the popularity of Linux has increased dramatically as computer users have discovered its many benefits:

- Linux is released under the GNU General Public License that ensures it remains free to all users – no-one can charge for this operating system so you will never have to pay for it. It's available as a free download on the internet, but you may have to pay a distribution charge if you prefer a copy on CD/DVD.
- Access to the source code of Linux is unrestricted and it may be changed. This has allowed thousands of programmers around the world to refine the code to improve performance.
- Linux is truly a multi-user, multi-tasking operating system that allows multiple users to simultaneously work with multiple applications without experiencing any traffic problems. Many of the world's web servers run on Linux for this very reason.
- Linux is an extremely stable operating system – continuous uptimes of more than a year are not uncommon. It can be upgraded "on the fly" so it only needs a reboot to add hardware.
- There are a large number of quality applications available to run on the Linux platform. These are comparable to commercial applications that run on other operating systems but, like Linux, these too are free of charge. For instance, the free LibreOffice suite offers similar functionality to the commercial Microsoft Office suite.
- With open-source software an administrator can know exactly what a program can do and the security dangers it presents. An open-source application cannot secretly gather information about the user or send confidential information to third parties.

Pronounce the name Linux with a short "i" – so it's "li-nucks", not "lie-nucks".

Many web servers are said to have a "LAMP" configuration – an acronym for **L**inux, **A**pache, **M**ySQL, **P**HP, which combines operating system, web server, database, and server-side scripting.

The Evolution of Linux

In 1983 a visionary programmer named Richard Stallman began a movement called the GNU Project. Its philosophy was that software should be free from restrictions against copying or modification in order to make better and more efficient programs. This inspired programmers around the world to create programs driven by efficiency rather than by financial incentive.

By 1991 the GNU Project had created a lot of software tools including the GNU C Compiler written by Stallman himself. At that time many of these tools were incorporated into a Unix-compatible operating system by a 21-year old student at the University of Helsinki. His name was Linus Torvalds and he named the operating system Linux (**Linu**s – Uni**x**).

Linux was made available for download on the internet so other programmers could test and tweak the source code, then return it to Linus Torvalds. After a period of enthusiastic development, Linux 1.0 was made available globally under the GNU General Public License, which ensured it would remain free.

Programmers were keen to explore Linux and soon found some amazing uses for it. In April 1996, researchers at Los Alamos National Laboratory used Linux to run 68 PCs as a single parallel processing machine to simulate atomic shock waves. At $150,000 this supercomputer cost just one-tenth the price of a comparable commercial machine. It reached a peak speed of 19 billion calculations per second, making it the 315th most powerful supercomputer in the world. It proved to be robust too – three months later it still didn't have to be rebooted.

Linux continued to grow in popularity as a text-based operating system, while Windows became the dominant graphical desktop operating system. Recognizing that most PC users want the point-and-click convenience of a graphical environment, the Linux camp began to develop a system comparable to the Windows desktop.

From a handful of enthusiasts in 1991 to millions of users now – Linux has come of age. Today's sleek K Desktop Environment (KDE) and the Gnome desktop environment now offer a user-friendly alternative for Windows users – Linux for the desktop!

The term "GNU" is a recursive acronym for **G**NU's **N**ot **U**nix.

Discover more about the GNU General Public License online at gnu.org/licenses/gpl.html

Discover more about the Gnome desktop online at gnome.org

Choosing a Distro

Most Linux distros are available as a "live" version that lets you run Linux from a disk – so you can try it out without installing Linux onto your hard drive.

At the very heart of Linux is a bunch of tried-and-tested compiled code called the "kernel". The kernel provides the operating system with its core functionality, much like the engine in a car. It takes care of the basics, such as helping other programs access hardware and sharing your computer's processor among various programs.

In addition to the kernel, Linux contains a number of system-level programs, such as the services to handle your email, web connection and bootloader. Consider these as a car's transmission, gears, and chassis – without these, the engine is not much use.

Linux distributions generally also include a large number of user-level programs – the applications for daily use: for instance, web browsers, word processors, text editors, graphics editors, media players, and so on. These are the finishing touches to the car that ensure a great ride – whitewall tires and soft leather upholstery.

All of these components are bundled together in a wide variety of Linux distribution packages, commonly referred to as "distros" – just as all the components of a car are bundled together to make a complete car.

In the same way that there are many makes and models of cars, there are many Linux distros to choose from. Some of the best known distros are RedHat Fedora, SUSE, Ubuntu, and Mint. Each distro has its own installer and unique default configuration according to what the distributor considers to be the best arrangement. The ideal one for you will depend on your own personal preferences and how you want to use Linux. The most popular distros are described below to help you choose:

"Choose Freedom. Choose Fedora."

RedHat Fedora

One of the most publicized Linux distros, comprising the commercial RedHat Enterprise Linux product line and the free Fedora distro that is developed by the Fedora Project community. There are several editions of the Fedora distro – "Workstation" for PCs, "Server" for servers, and "Atomic" for cloud computing.
Pros: Widely used, excellent community support, innovative.
Cons: Limited product life-span of Fedora editions, poor multimedia support.
Free download from **getfedora.org**

Novell SUSE

The community-based "openSUSE" distro, sponsored by Novell, is another distro with desktop focus that has received positive reviews for its installer and YaST configuration tools. The documentation, which comes with the boxed product, has been labeled as the most complete, thorough and usable by far. This distro provides the base for Novell's award-winning SUSE Linux Enterprise products.

Pros: Attention to detail, easy-to-use YaST configuration tools.

Cons: Huge distro – including over 1,500 bundled packages.

Free download from **opensuse.org**

"The makers' choice for sysadmins, developers and desktop users."

Ubuntu

This sophisticated community distro typically employs the popular Gnome GUI desktop manager. It has the advantage of a fixed six-month release cycle, and every two years there is an LTS (**L**ong **T**erm **S**upport) release that is supported for five years. There are several editions of the Ubuntu distro – "Desktop" for PCs, "Server" for servers, and "Core" for IoT (Internet of Things) devices. The default interface of the Ubuntu Desktop edition is quite different to that of the Windows desktop.

Pros: Great community, and fixed release cycle.

Cons: The interface will seem unfamiliar to Windows users.

Free download from **ubuntu.com**

"Fast, secure and simple, Ubuntu powers millions of PCs worldwide."

Linux Mint

A modern, elegant operating system that is easy to use. It is based on the Ubuntu operating system and works straight out of the box, with full multimedia support. All Linux Mint distros are LTS releases that appear shortly after each Ubuntu LTS release, and are supported for five years. Users are encouraged to send feedback so their ideas can be used to improve Linux Mint. This operating system typically employs the Cinnamon GUI desktop manager, which will feel familiar to those moving from the Windows operating system. For that reason, Mint is used throughout this book to demonstrate the features of a Linux operating system.

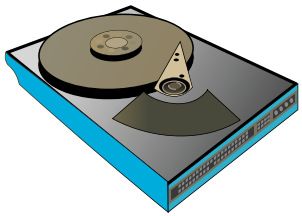
Pros: Great community, and the interface will seem familiar to Windows users – the best distro for beginners.

Cons: Ubuntu has a larger community of users.

Free download from **linuxmint.com**

"Linux Mint. From freedom came elegance".

Providing Disk Space



A **H**ard **D**isk **D**rive (HDD or simply "hard drive") can be partitioned into one or more regions so that the operating system can manage each region separately.

An operating system is installed on an area of the hard disk drive called a "partition". When Windows is the only installed operating system its partition will normally occupy the entire hard drive. To install Linux in this situation there are three possible options:

- **Delete the Windows partition** – replacing it with Linux partitions that occupy the entire drive. This option will delete the Windows operating system along with all the applications and data files. It creates a dedicated Linux computer that will immediately start Linux when the PC gets switched on.
- **Reduce the Windows partition size** – so that it no longer occupies the entire drive, then create Linux partitions in the resulting free space. This option will retain the Windows operating system, applications and data files. It creates a "dual-boot" computer that allows the user to choose whether to start Linux or Windows whenever the PC gets switched on.
- **Add a second hard drive to the system** – this allows Linux partitions to occupy the entire second drive and retains the Windows operating system, applications and data files on the first drive. It too creates a dual-boot computer that allows the user to choose whether to start Linux or Windows whenever the PC gets switched on.

Resizing partitions is a scary process where data loss can, and does, occur – even in expert hands. All contents of the partition must be backed up before attempting this operation.

The option to install an additional hard drive for Linux is a popular choice for many people as they have often upgraded their original hard drive to a larger one, and so have their original drive spare. It also has several benefits over the other options:

- The free space on the Windows drive is not reduced.
- It removes the risk of data loss through partition resizing.
- The familiar Windows operating system is retained.
- It distinctly separates the two operating systems.
- Drive failure would only disrupt one operating system.

Adding a Second Hard Drive

Most modern PCs can accommodate up to four EIDE (**E**nhanced **I**ntegrated **D**evice **E**lectronics) devices, such as hard drives and optical CD/DVD drives, but typically ship with just two – one hard drive and one optical drive. This means that more drives can be added by plugging them into the existing system.

The first hard drive in a system is known as the "Master" drive and a second hard drive is called the "Slave" drive.

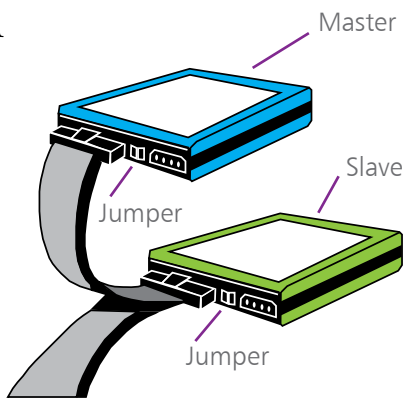
A "jumper" connects two tiny pins to determine if the drive should be regarded as a Master (MA) drive or Slave (SL) drive. The top of each hard drive usually has a diagram depicting which pins need to be connected in each case.

If you are not comfortable working inside your PC case, a computer store should be pleased to undertake the fitting of a second drive for a modest fee.

1. Ensure that the jumper on the original drive is set to Master, then set the jumper on the second drive to Slave

2. Connect the wide SATA data cable to the Master drive, by the plug at the end of the cable – not the plug part way along the cable

3. Now, connect the SATA data cable to the Slave drive, by the plug part way along the cable



4. Connect the power cables to both drives, then close the PC case

5. Start up the PC and check that both drives are now detected by the system – if the second drive is not detected, you may need to change the boot settings to "auto-seek" it when booting up

SATA (**S**erial **A**dvanced **T**echnology **A**ttachment) is the standard for connecting devices such as hard drives and optical drives to the PC's motherboard.

Creating Boot Media

USB Flash Drive – also variously known as Thumb Drive, Pen Drive, Disk Key, Gig Stick, or Memory Stick.

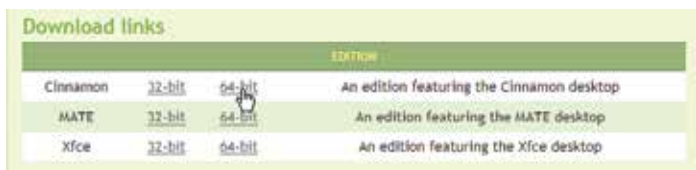
The Linux Mint distro is available in three editions, with desktop environments called "Cinnamon", "MATE", and "Xfce" respectively. The most popular version is the Cinnamon edition that will be used throughout this book. It can be downloaded onto a USB flash drive to create "boot media". This lets you try out Linux without making changes to your system, and lets you install Linux onto your system if desired. But first you will need to ensure your system meets these minimum requirements:

- **1GB of RAM** (2GB preferred)
- **15GB of disk space** (20GB preferred)
- **1024 x 768 screen resolution**

Like other Linux distros, the Linux Mint download is an ISO image file whose content must be "burnt" onto the USB flash drive (not merely copied onto it) to create the boot media:

1. Launch a web browser, then navigate to the download page **linuxmint.com/download.php**

2. Next, click on the **Cinnamon 64-bit** link



3. Now, click a **Download mirror** link in your country from the list that appears

4. Choose to save the ISO image file in a preferred location on your system to begin the download

5. When the ISO download has completed, you now need an app to burn the image onto the USB flash drive. Linux Mint recommends the **Etcher** app. Navigate your web browser to **etcher.io** and download the installer for your system. For example, "Download for Windows x64"

The 32-bit versions are only provided for compatibility with older computers – typically those manufactured before 2008. You should generally download the 64-bit version. If your computer is not compatible you will simply see an error message – no harm will be done.

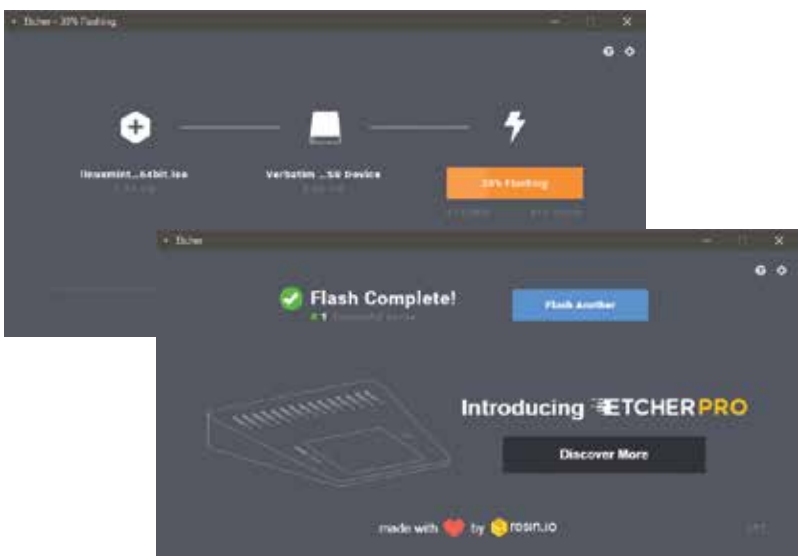
6 When the installer download has completed, run its **Setup** wizard to install Etcher on your system

7 Next, connect a USB flash drive to your computer

8 Now, start the Etcher app and click the **Select image** button, then select the ISO image file you downloaded

9 Click the **Select drive** button, then select the USB flash drive you connected to your computer

10 Click the **Flash!** button to burn the contents of the ISO onto the USB flash drive – creating the Linux boot media



If you wish to verify the ISO image file (recommended) you can find instructions on how to do so at **linuxmint-installation-guide.readthedocs.io/en/latest/verify.html**

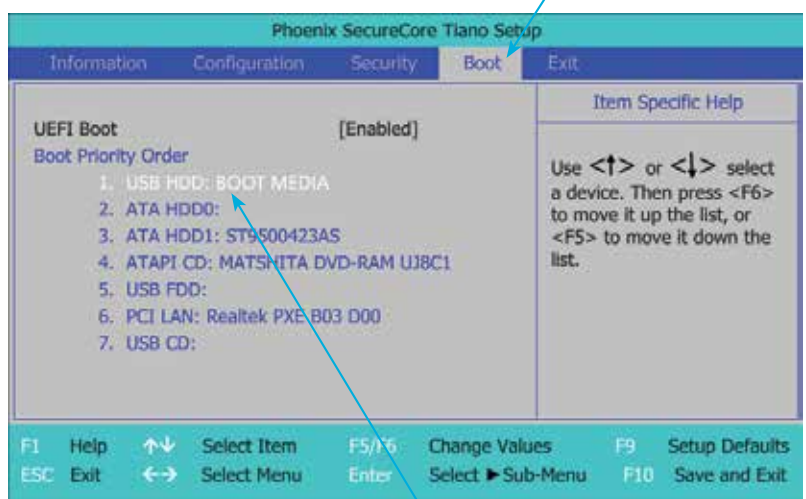
Starting a Live Session

Having created the boot media, by following the steps on pages 14-15, you now have the ability to run Linux Mint in a "Live Session". This means you can safely explore the Linux operating system on a PC where Windows is already installed on the hard drive as its operating system.

In order to begin a Linux Live Session your PC must be able to boot up from the USB flash drive containing the boot media. This requires the PC's boot settings to seek instructions from the USB flash drive before seeking instructions on the hard drive. If your PC looks to boot from the hard drive first, you will need to change the settings:

The UEFI (**U**nified **E**xtensible **F**irmware **I**nterface) in modern PCs replaces the BIOS (**B**asic **I**nput/**O**utput **S**ystem) firmware interface in earlier PCs. These control how your PC boots up.

1. Consult your PC's documentation to discover how to access its **Setup** utility. This often requires you to press the F2 key while starting the PC – but it does vary
2. Connect the USB flash drive boot media to your PC
3. Start up your PC and enter the Setup utility
4. Select the section relating to the PC's **Boot** process



5. Make the flash drive (USB HDD) the first boot device by following the Setup utility's **Help** instructions

The Setup utility is unique to your PC, so its appearance will probably differ from the one shown here. Most PCs will, however, provide a way to change the Boot Priority Order so you can boot the PC from the USB flash drive.

6 Save the new settings and exit the Setup utility – typically by pressing the F10 key

7 If your PC is configured to boot in legacy BIOS mode, Linux Mint will now automatically start a Live Session

When there is an option to choose between UEFI boot mode and legacy BIOS mode, UEFI offers several advantages – UEFI supports large hard drive partitions, has secure booting, and provides efficient system management.

If your PC is configured to boot in UEFI mode, you will be presented with a menu. Select the "Start Linux Mint" option, then hit the **Enter** key to start a Live Session

You may also see "UEFI" referred to as "EFI" – UEFI is simply EFI 2.0.

Beginning Installation

The username in a Live Session is "mint". If asked for a password just hit the **Enter** key.

Having started a Live Session by following the steps on pages 16-17, you can try out the Linux Mint operating system. It will perform in a similar manner to when it is permanently installed on the hard drive, but with these notable exceptions:

- **The Live Session is slower** – it is loaded from the USB flash drive, rather than quickly from a hard drive.
- **Changes are not permanent** – they are not saved on the USB flash drive, or written anywhere on your PC.
- **Some apps behave differently** – system utilities, such as the Update Manager, cannot be used effectively.

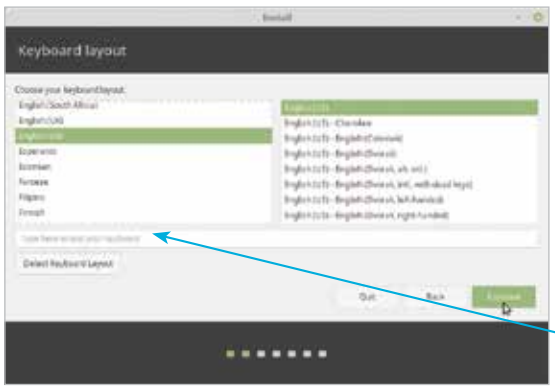
The Live Session provides an installer icon on the Desktop that can be used to begin permanent installation of Linux Mint:

This book features Linux Mint version 19 (Tara) Cinnamon throughout. This version has Long Term Support until 2023.

1 Double-click on the "Install Linux Mint" icon to launch the installer wizard

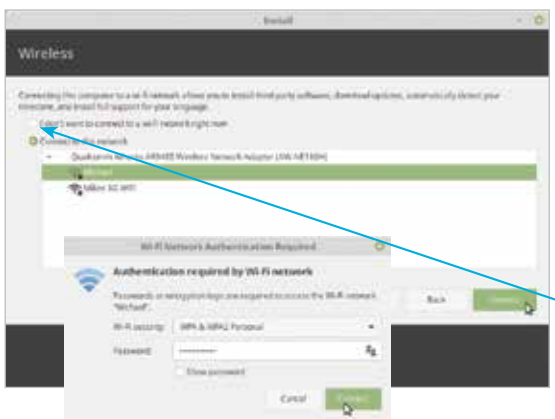
2 On the "Welcome" screen, select your preferred language, then click the **Continue** button

3 On the "Keyboard layout" screen, select your layout, then click the **Continue** button



If you are unsure of the keyboard layout you can type into this box and let the installer figure it out.

4 On the "Wireless" screen, select your preferred network, then click the **Connect** button. Enter your password then click **Connect** again



You can choose the alternative option here to proceed without connecting to a network.

5 On the next screen, check the box to install codecs, then click the **Continue** button

Third-party codecs are required for multimedia support in certain apps. You are almost certainly going to want them.

Completing Installation

New users should avoid choosing the **Encrypt** and **LVM** options here as they can cause problems.

6 On the "Installation type" screen...

If you want this to be the only operating system on your PC, select **Erase disk and install Linux Mint**

OR

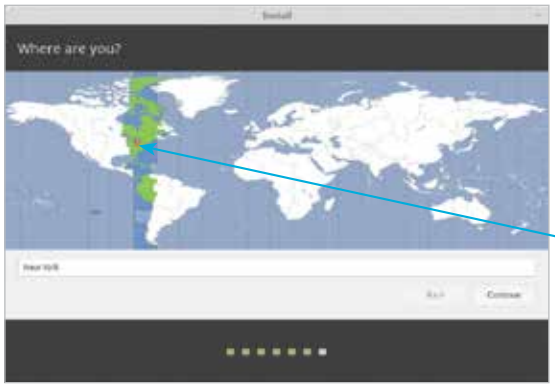
If Windows is installed and you also want to keep that on your PC, select the option to **Install Linux Mint alongside Windows Boot Manager**

Advanced users can choose to manage disk partitions by choosing the **Something else** option here. Linux Mint requires one partition to be mounted on the root/directory. The operating system occupies around 15GB so this partition should ideally be 100GB+. The ext4 Linux filesystem is recommended. A swap partition is also required as a memory buffer, and this should be of equal size to the amount of RAM in your PC.

If you choose to retain Windows alongside Linux Mint, the installer will automatically resize the Windows operating system then install Linux Mint in the free space created. A boot menu will appear so you can choose between operating systems whenever you start your PC – a "dual-boot" setup.

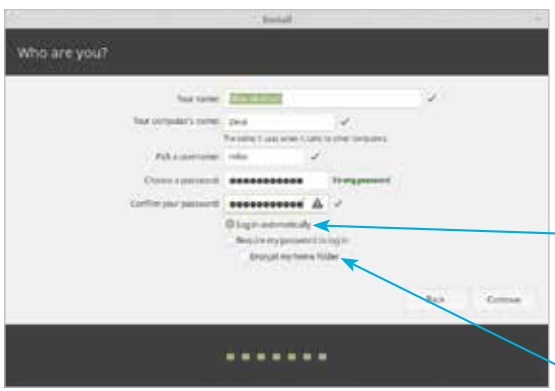
7 After choosing the installation type in either case, click the **Install Now** button to proceed

8 On the "Where are you?" screen, select your timezone then click the **Continue** button



Simply click your approximate location on the global map to select your timezone.

9 On the "Who are you?" screen, enter your details then click the **Continue** button to install system files



If you are the only user of the PC you can select the option to **Log in automatically** so you will not be asked for your password whenever you start Linux Mint. You may also select the **Encrypt my home folder** option if you are concerned about security.

10 Enjoy the slideshow while Linux Mint gets installed, then upon completion click the **Restart Now** button

Enabling Backups

Having completed the installation process, by following the steps on the previous pages, Linux Mint will launch to your Desktop. Before you start using the operating system it is recommended you enable the "Timeshift" backup utility. This is like "System Restore" on Windows and will allow you to restore the operating system to an earlier backup should any problems arise:

Timeshift Utility

The "Timeshift" utility is a new feature that was introduced in Linux Mint version 19 (Tara).

1 Click on **Menu** ("Start" button), **Administration**, **Timeshift**

2 Next, enter the password you chose in the "Who are you?" dialog during the installation process, then click the **Authenticate** button

"RSYNC" is a disk-based backup system that only backs up what has changed since the previous backup.

3 Now, select the "RSYNC" option, then click the **Next** button

4 Select the device on which you want the system backup snapshots to be saved, then click the **Next** button. (Here, the chosen device is an external hard drive that is connected, but you could alternatively connect a USB flash drive and choose that device)

Do not choose your main hard drive as the location at which to save backup snapshots – this would not help you if your hard drive fails.

5 Select the frequency for when you would like system backup snapshots to be saved on your chosen device, then click the **Finish** button

Backup snapshots are saved in a newly-created **timeshift** directory at the root level on the chosen device. Boot snapshots are performed in the background so do not affect the speed at which the system boots.

6 Re-open Timeshift in the future and select a saved backup snapshot, then click the **Restore** button to restore your Linux Mint system

Summary

- **Linux** is a free, stable multi-user operating system that is derived from the powerful Unix operating system.
- The name "Linux" combines letters from the first name of its originator, **Linu**s Torvalds, with the final letter of Uni**x**.
- Both **KDE** and the **Gnome** desktop are user-friendly graphical user interfaces, providing the same point-and-click convenience of the Windows desktop.
- The **kernel** provides the core functionality of Linux.
- Linux **distros** bundle the kernel, system-level programs, and free user-level programs in a variety of combinations.
- The most popular Linux Mint distro employs the **Cinnamon** desktop manager, and is the best distro for beginners.
- Minimum hardware **requirements** to run Linux Mint are 1GB of RAM, 15GB of disk space, and a screen resolution of 1024 x 768 – but higher specifications will perform better.
- A second **hard drive** can easily be added to a PC so it can dual-boot to Linux or Windows.
- A Linux distro can be downloaded and burned as a filesystem image onto a USB flash drive to create **boot media**.
- In order to boot from a USB flash drive it may be necessary to change the boot device order using the boot **Setup Utility**.
- A **Live Session** lets you try out most features of Linux Mint before installation, and also provides an installer.
- The Linux Mint **installer** allows you to install Linux as the sole operating system, or install it alongside Windows.
- Before you start using the Linux Mint operating system it is recommended you enable the **Timeshift** backup utility so you can restore your system should problems arise.