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Chapter 10

Partitioning and Booting

Note:

Partitioning and Booting is an additional section and not an integral part of the desktop course. Many users, especially corporate desktop users who have system administrators to set up their computers for them will find this section irrelevant. Home users, or advanced Ubuntu users may find this extremely useful.

OBJECTIVES

- The benefits of partitioning
- How to create partitions
- How to configure start-up options

10.1 What is Partitioning

Note: Note:

Analogy Time Simply broken down, a new hard disk is similar to the foundations of a house - it needs some structure and walls before you can start putting things (like furniture) into it. The partition is the first level of foundation on the disk. Once the disk is logically carved up into partitions, it can be thought of as a house with rooms. Each partition (room) is of a specific size which could potentially be resized again after you move it, but would cause some disruption as objects get moved to make room. Once a partition (room) is created it can then be formatted using the filesystem of your choice. Once the filesystem has been laid down, it's possible to start populating the partition with data in the form of files and folders (furniture).

So, a partition is a logical chunk of space allocated out of the entire disk. Depending on how a system is configured at installation time, there may be one or more partitions on a disk. In some instances, it is also possible to modify the layout, number and size of partitions, but this is often considered an expert's function.

Many Microsoft Windows users will have just one large partition - often known as "C: drive", however it is also common for Microsoft Windows users to have multiple partitions which are labelled with successive alphabetic characters (D:, E: and so on).

Similarly, with Ubuntu it's possible to install the system in exactly one partition on the disk, or spread data and applications over multiple partitions.

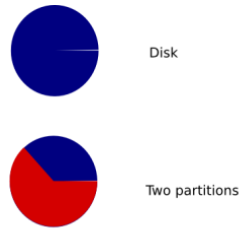


Figure 10.1: Partitioning

There are valid arguments for both scenarios. Having one single partition with all applications, libraries and data will result in a simple to manage system. It also provides flexibility as installing applications or adding data will use space from a common "pool".

If you accept all the defaults when installing Ubuntu, you will end up with a system separated into two partitions on the disk. One contains all files, the other is known as "swap" which can be thought of as an extension to your computer's internal memory.

Alternatively, it is possible to create multiple partitions of differing sizes into which different types of applications, libraries and data can be placed. This is often used in a multi-user or server environment where user data is kept separate from system programmes, log files and configuration files. A significant benefit to this can be seen when there is a problem on the system and log files start to grow. The log files (in one partition) will not consume all available disk space in this scenario because they will be confined to their own (small) partition of the physical disk.

Which ever partitioning scheme has been chosen, this is not set in stone. It is possible to use a partition editing utility to resize partitions (subject to sufficient free space in each partition), however this is quite an advanced topic, and generally nto done while the system is in use.

Whilst it is possible to change the disk partitioning layout after the system has been installed, it is important to make backups before making any changes to the partitions.

About filesystems Partitioning a disk is only the beginning. Once the disk has been divided up, those partitions need to be formatted so that the operating system can place files on the disk in a structured manner. There are many different filesystem types, each with their own advantages. With Microsoft Windows the two main filesystems are FAT (File Allocation Table) and NTFS (New Technology File System). With Ubuntu there are many options including ext2, ext3, reiserfs, xfs and many others. The Ubuntu installer chooses ext3 by default, but of course it is possible to override this.

Nice to Know:

ext3 is a great general purpose journalling filesystem. It handles most tasks well however, xfs is sometimes chosen instead on media-centre systems as it performs better when handling very large files - such as music and video files.

Mount points A mount point is a place in the directory hierarchy where a filesystem could be presented. There is no real Microsoft Windows equivalent to this. With Microsoft Windows the partitions C:, D: and so on, are seen as entirely separate entities so the operating system, applications and data is often referred to by a user as being "on the C: drive" or "in a folder on the D: drive".

Nice to Know:

"Mount" is the term used when referring to a filesystem being made available for access. CD and DVDs are usually automatically mounted when they are inserted. The same goes for USB connected devices such as memory sticks, hard disks and music players.

On Ubuntu, files and folders reside within a partition as they do with Microsoft Windows. However the partition is not normally referenced directly by the user. The user would typically say that files are "in my home directory" (when referring to `/home/<username>`), or "in the root directory" (when referring to `/`) without specifying which partition on the disk those directories reside in.

Under most standard installations of Ubuntu there will be only one partition where all files and folders reside. However if a user plugs in an external USB-connected memory stick or USB hard disk, Ubuntu will mount the partition(s) on that device under mount point(s) within the directory tree. For example a USB attached memory stick or hard disk will usually appear under `/media/disk` (unless the device has partitions which are labelled, in which case they will appear under `/media/<labelname>`)

Further considerations As previously mentioned, resizing partitions is not a trivial task. Under most circumstances it requires that all filesystems involved are unmounted, this means they must not be in use. Typically then to resize partitions the system should be booted to an unused filesystem - such as a bootable Live CD. Considerable thought should therefore be given before partitioning a disk with regards to the number and sizes of partitions to be created to prevent later unnecessary resizing.

**Caution:**

You may run out of hard drive space in your home partition due to the sub-division of the drive into fixed-size partitions. This may occur even if the other partitions have plenty of usable space. Good and logical partitioning requires you to predict how much space each partition needs.

For new users, home users and other single-user set-ups, a single root (`/`) partition with a swap partition would be the easiest and the most convenient to create and use. However, for multi-user systems or computers with lots of disk space, it is best to have the `/home`, `/tmp`, `/usr` and `/var` directories as individual partitions separate from the root (`/`) partition.

Before partitioning your hard drive, you should consider the following:

- `root`: Also called the slash directory, it is the highest directory of the directory tree. When creating the root partition, you need to ensure that the root should contain the `/etc`, `/bin`, `/sbin`, `/lib` and `/dev` directories, otherwise you will not be able to boot-up the system. You also need to ensure that the root partition is allocated at least 150-250 MB of disk space.
- `/home`: This directory contains all user-specific files and data. On a multi-user system, every user will store personal data in a sub-directory of this directory. The size of this directory would depend on the number of users using the system and the files they store in this directory. Ideally, you should plan the disk space for this partition based on your planned usage. In general, about 100-MB disk space can be allocated for each user. However, you may need to reserve a lot more space if you are planning to save a lot of multi-media files in your home directory.

Nice to Know:

It is good practice to have `/home` on a separate partition because it allows for a smoother transition from one distribution to another.

- `/var`: This directory contains variable data, such as news chapters, e-mails, Web sites, databases and the packaging system cache. The size of this directory also depends on system usage. Most probably, the size of this directory would be dictated by your usage of the Ubuntu package management utilities. If you plan to install all the packages that Ubuntu offers, you need to allocate 2 to 3 GB of space for the `/var` directory. However, if you want to save hard disk space and do not plan any major software updates, you can get by with as little as 30- or 40-MB disk space for the `/var` directory.
- `/tmp`: This directory contains temporary data created by programmes. Some applications, including archive manipulators, CD/DVD authoring tools and multi-media software also use this directory to temporarily store image files. You need to plan space allocation for this directory based on your usage of these applications. for this directory.
- `/usr`: This directory contains all user programmes (binaries), their documentation and supporting libraries. This directory tends to use the maximum space on the hard disk. Therefore, you should provide at least 500-MB disk space for this directory. But, you need to increase this space depending on the number and types of software packages you plan to install. Based on your planned usage and the available disk space, you may allocate 1.5 to 6 GB of disk space for this directory.

Nice to Know:

The `/usr` partition is sometimes referred to as User System Resources and not user as was originally intended.

10.2 Creating a Partition

As mentioned earlier, multiple partitions are very useful especially in cases where a partition is corrupted, as it enables you to boot into GNU/Linux to fix the system, without having to reinstall the system. To do this, a root partition is required. This partition should contain the essential components of the system.

**Caution:**

The hard disk drive that you are formatting should not contain any data. If you have already formatted the drive and it contains data, skip the partitioning step and move to the next step - mounting.

If the hard disk drive that you want to format is blank and unformatted, you can use either of the following tools to partition it:

- **Partition Editor (GParted):** GParted is useful for creating space for new operating systems, re-organising disk usage, copying data residing on hard disks and mirroring one partition with another (disk imaging).
- **Command Line:** The command line is faster and more powerful than GParted. When navigating through the file system, you can use the command line to jump from one directory to another in a split second. Use the command-line interface if you are comfortable using the Terminal.

If you want to create a partition using GParted, you need to first install GParted by using **Add/Remove Applications** or **Synaptic Package Manager**.

10.2.1 Installing GParted by Using Synaptic Package Manager

1. On the **System** menu, point to **Administration** and then click **Synaptic Package Manager**. The **Synaptic Package Manager** window opens.



Figure 10.2: Synaptic Package Manager Location

2. When the **Synaptic Package Manager** window opens for the first time, it displays a list of all the software packages available in the Ubuntu software repositories. The left pane lists the various software categories. You can select a specific

category to view the available software packages listed in that category. Alternatively, you can use the **Search** functionality provided in the **Synaptic Package Manager** to locate specific software in the list.

Click the **Search** button to search the package you want to install. The **Find** dialogue box appears.

In the **Search** field of the **Find** dialogue box, type the name of the package, **Partition Editor**, and click the **Search** button. The package, **gparted**, is now displayed in the right pane of the **Synaptic Package Manager** window.

Right-click the package name to select an action that you want to perform on it. Notice that various options are available to perform a number of actions on the selected package. If the selected package is not installed currently, you can mark it for installation. If the selected package is already marked for installation, you can unmark it to clear the selection. Similarly, if the package is already installed, you may select **Upgrade** to upgrade the package and **Mark for Removal** or **Mark for Complete Removal** to delete the package from your computer.

To install the package, select the **Mark for Installation** check box.

The **gparted** package is now selected for installation. To continue with the installation, click **Apply**. This displays the **Summary** dialogue box.

The **Summary** dialogue box prompts you to perform a final check before implementing the marked changes. Click the **Apply** button to apply the marked changes. The **Downloading package files** window opens.

Wait for all the required files to download. After all the required files in the package are downloaded, the **Changes applied** dialogue box appears.

The **Changes applied** dialogue box notifies you that all the requested changes have been applied. Click **Close** to exit the dialogue box.

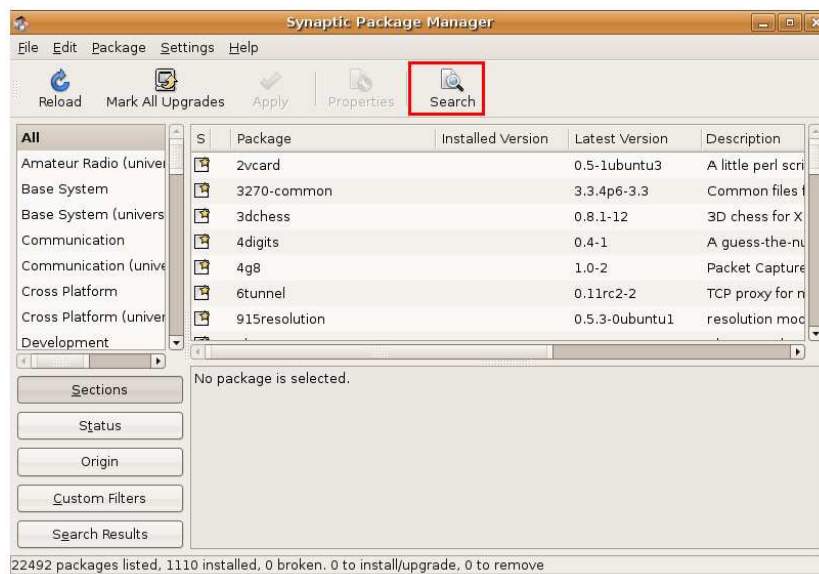


Figure 10.3: Synaptic Package Manager

3. In the **Search** field of the **Find** dialogue box, type the name of the package, **Partition Editor**, and click the **Search** button. The package, **gparted**, is now displayed in the right pane of the **Synaptic Package Manager** window.

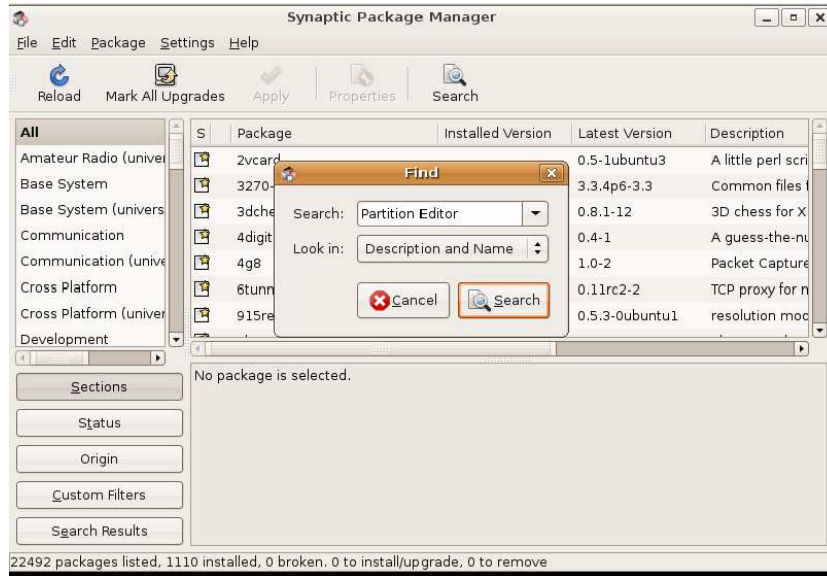


Figure 10.4: Finding a Package in Synaptic

- Right-click the package name to select an action that you want to perform on it. Notice that various options are available to perform a number of actions on the selected package. If the selected package is not installed currently, you can mark it for installation. If the selected package is already marked for installation, you can unmark it to clear the selection. Similarly, if the package is already installed, you may select **Upgrade** to upgrade the package and **Mark for Removal** or **Mark for Complete Removal** to delete the package from your computer.

To install the package, select the **Mark for Installation** check box.

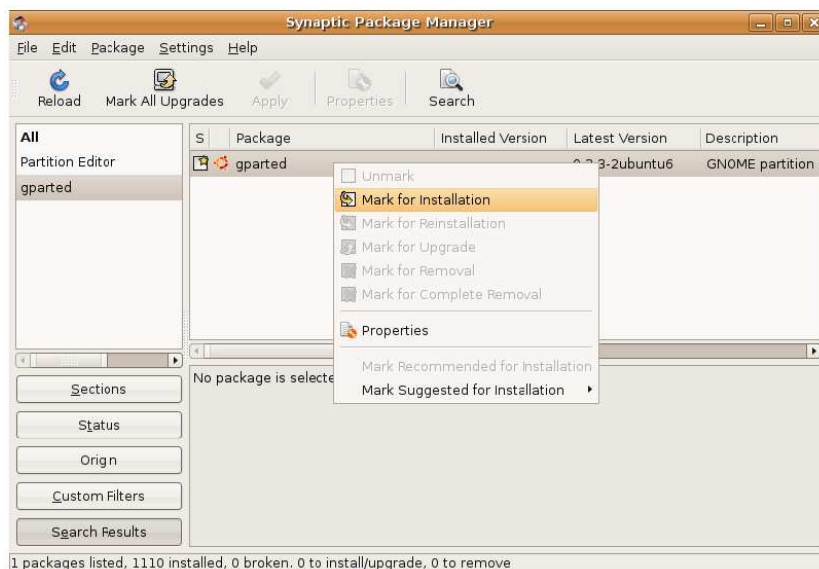


Figure 10.5: Marking a Package for installation

- The gparted package is now selected for installation. To continue with the installation, click **Apply**. This displays the **Summary** dialogue box.

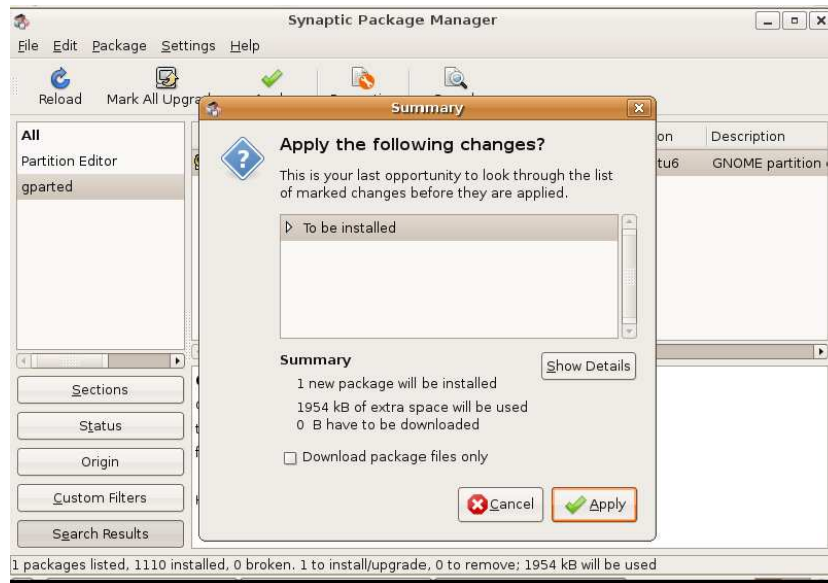


Figure 10.6: Summary Dialog Box

- The **Summary** dialogue box prompts you to perform a final check before implementing the marked changes. Click the **Apply** button to apply the marked changes. The **Downloading package files** window opens.

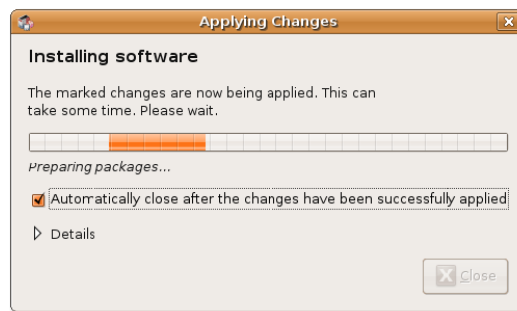


Figure 10.7: Applying Changes Box

- Wait for all the required files to download. After all the required files in the package are downloaded, the **Changes applied** dialogue box appears.



Figure 10.8: Changes Applied Box

- The **Changes applied** dialogue box notifies you that all the requested changes have been applied. Click **Close** to exit the

dialogue box.

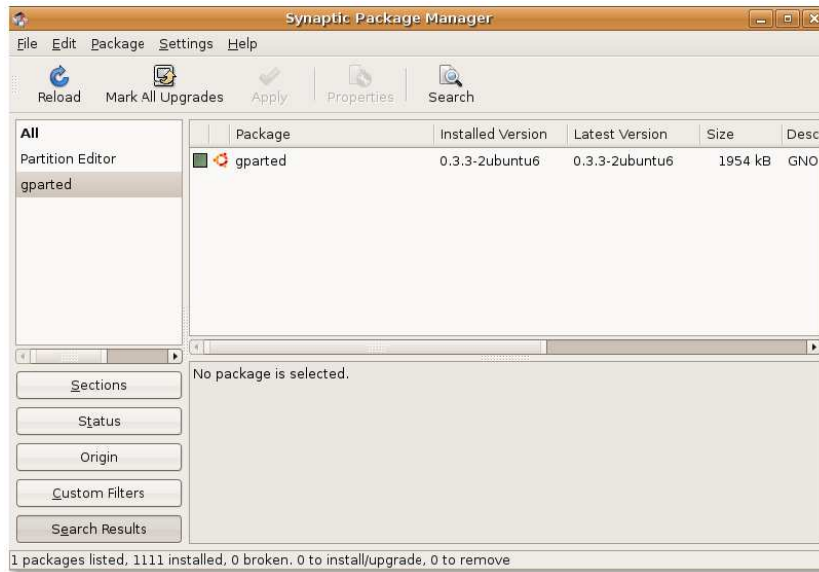


Figure 10.9: Synaptic Package Manager after Installation

9. The partition editor is installed on your computer. You can now partition the hard disk drive.



Figure 10.10: Opening Partition Editor

10.2.2 Partitioning Using Gparted

1. On the **System** menu, point to **Administration** and then click **Partition Editor**. The **GParted** window opens.

Nice to Know:

GParted is also available from the Live CD.

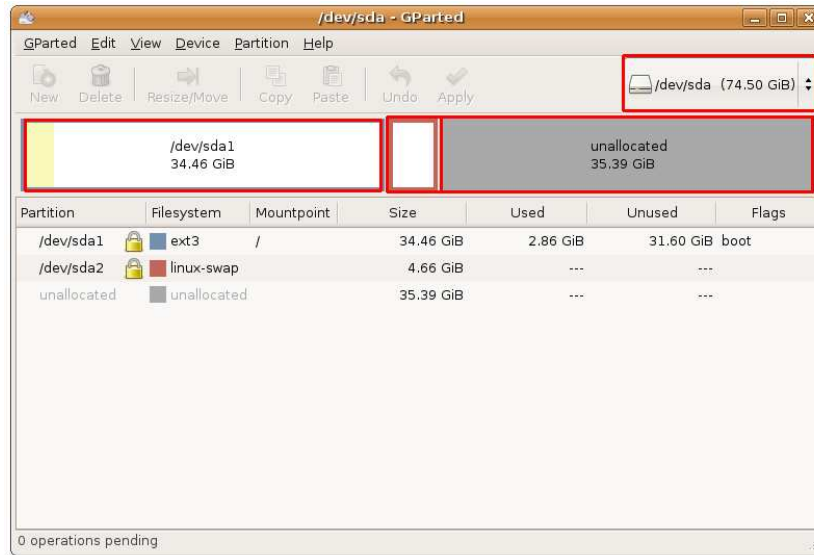


Figure 10.11: GParted Window

2. In the top-right corner of the **GParted** window is the drive drop-down box. You can use this box to select the hard drive that you need to partition by specifying the logical name you noted earlier. The Gparted window refreshes and shows you a representation of the selected drive.

If the existing partitions on the drive have not yet been used, a white bar would run across the window. However, if the existing partitions contain some data, the data will be represented by a pale yellow area.

You can either resize an existing partition or create a new partition in the unallocated space of the hard drive. Before resizing an existing partition, you must make sure that you unmount it by right-clicking the partition and then selecting **Unmount**. Remember that you cannot resize a partition to be smaller than the yellow area, which represents the data on the partition.

To create a new partition in the unallocated drive space, right-click the area and select **New** on the short-cut menu. The **Create new Partition** dialogue box appears.

The **Create new Partition** dialogue box enables you to select specifications for the new partition. Apart from defining the size of the new partition, you can also select the partition type, whether primary or logical, for the new partition. In addition, you can even define the file system to be used on the new partition. By default, Ubuntu uses the ext3 partitions. However, if you want the new drive to be readable by both Microsoft Windows and Ubuntu without installing anything extra, you can format it as Fat 32.

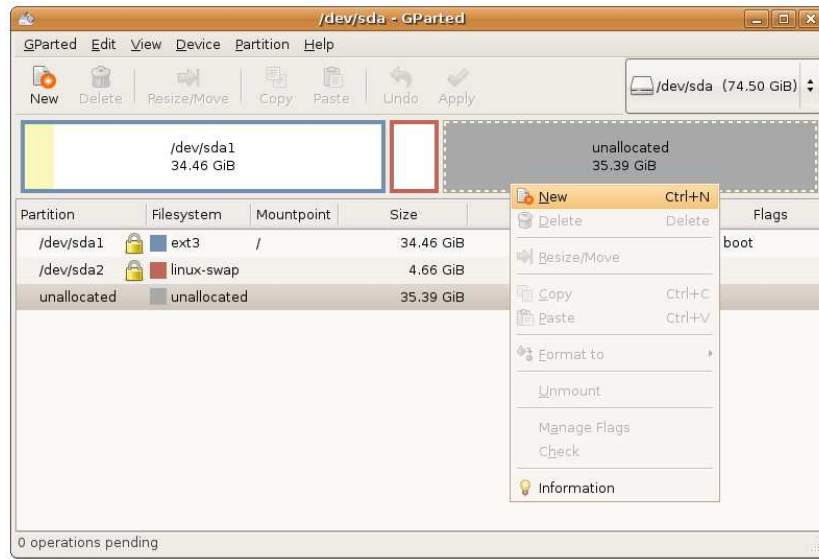


Figure 10.12: Creating a New Partition

3. You can either resize an existing partition or create a new partition in the unallocated space of the hard drive. Before resizing an existing partition, you must make sure that you unmount it by right-clicking the partition and then selecting **Unmount**. Remember that you cannot resize a partition to be smaller than the yellow area, which represents the data on the partition.

To create a new partition in the unallocated drive space, right-click the area and select **New** on the short-cut menu. The **Create new Partition** dialogue box appears.

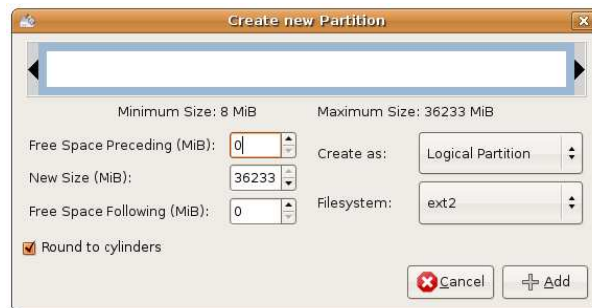


Figure 10.13: Create New Partition Box

4. The **Create new Partition** dialogue box allows you to select specifications for the new partition. Apart from defining the size of the new partition, you can also select the partition type, whether primary or logical, for the new partition. In addition, you can even define the file system to be used on the new partition. By default, Ubuntu uses the ext3 partitions. However, if you want the new drive to be readable by both Microsoft Windows and Ubuntu without installing anything extra, you can format it as Fat 32. **NOTE:**

If you are creating a partition on a new hard drive, select Primary Partition. An SCSI or S-ATA hard disk can have a maximum of 4 primary partitions and 11 logical partitions while an integrated development environment (IDE) hard drive can have up to 63 partitions overall. The primary partition used to house the logical partitions is called an extended partition. Unlike primary partitions, logical partitions must be contiguous: the blocks in the partition are following each other without any gap.

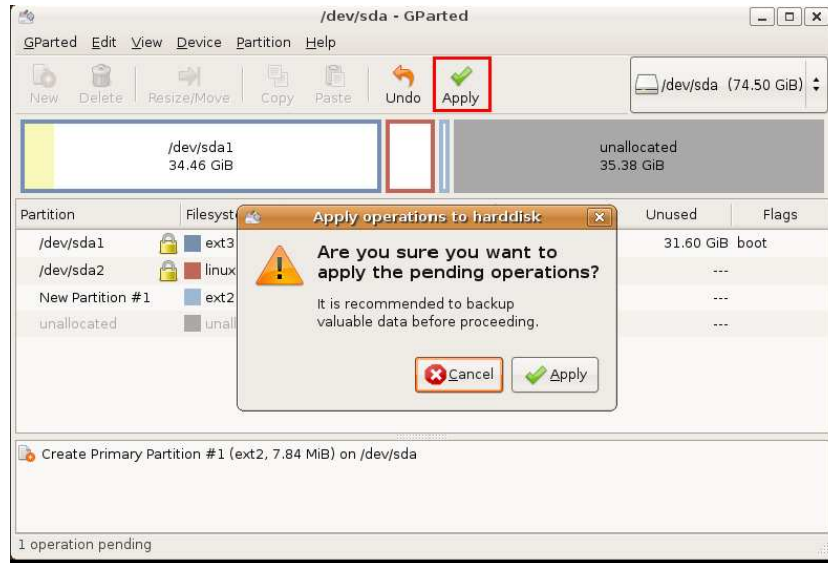


Figure 10.14: Confirmation Box

5. In the **New Size (MiB)** field, specify the size of the partition by using the up or down arrow key. You can also define the size by dragging the black bold arrows on the top white bar.
6. Select Primary, Logical or Extended partition from the **Create as** drop-down list.
7. Next, specify the file system by selecting from the **Filesystem** drop-down list.
8. Click the **Add** button to complete the partition. The white bar updates to show a new partition on the disk.
9. You can create multiple partitions at this stage by following the above-mentioned procedure and then clicking **Apply** to add them to the hard drive. The **Apply operations to hard disk** dialogue box appears.



Figure 10.15: Applying Pending Operations Box

10. The **Apply operations to hard disk** dialogue box recommends that you back up data before performing the changes and seeks your final confirmation before applying the changes to the hard disk. Click the **Apply** button to partition and format the hard disk according to your specifications.

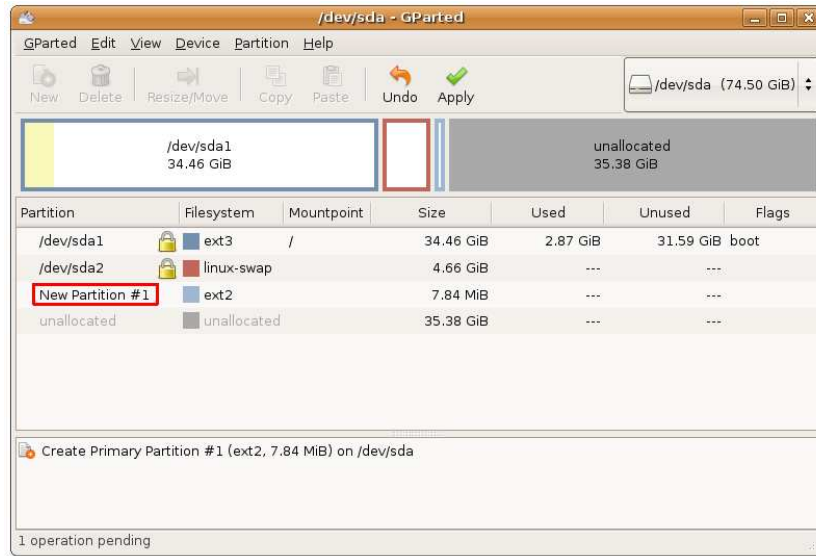


Figure 10.16: GParted with New Partition

11. The system starts applying the changes to the hard disk. The duration of the operation will depend on the size of the new partition. You can click the **Details** button to view more information about where and how changes are being made, whilst the operation is running.

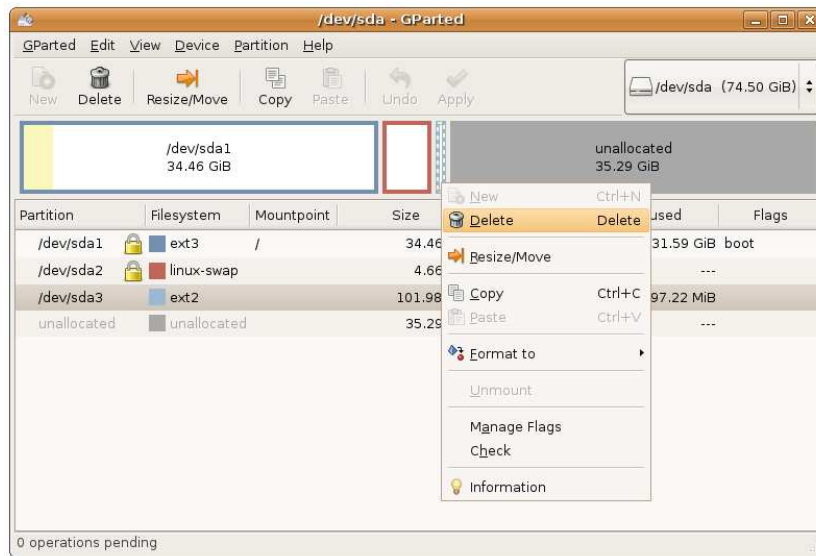


Figure 10.17: Deleting a Partition

12. Once you receive a message that all the specified operations have been successfully completed, you can safely close the window by clicking the **Close** button. However, if something goes wrong and the process does not complete successfully, you can save the process output for future reference by clicking the **Save Details** button.
13. The newly created partition is now visible in the **GParted** window. You will also notice that your system automounts the newly created partition.

Mounting refers to the process of attaching the newly created partition or drive to an existing directory to make it accessible. The directory where the new partition is attached is called the mount point. After the partition is mounted, you can access the files on that partition by accessing the mount point for the new partition. Early Linux distributions did not allow the

auto-mounting of new partitions or drives. However, from Ubuntu 8.04 LTS, you can easily access the new partitions by auto-mounting the partitions. When you create a new partition, the new partition opens as a separate window and the partition appears as a disk icon on the desktop.

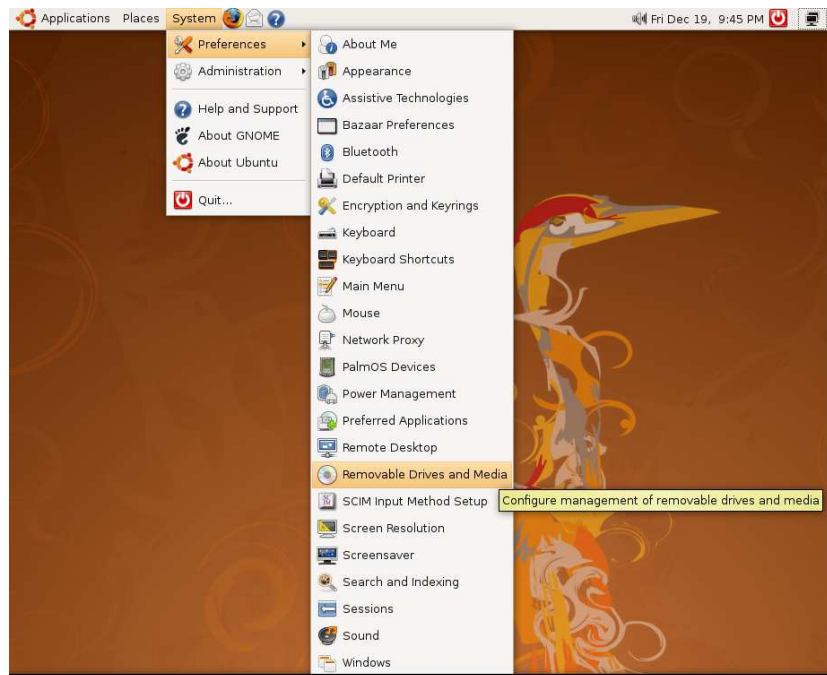


Figure 10.18: Removable Drives and Media Preferences Dialogue Box

14. When you no longer want to access the new partitions, you can unmount them by right-clicking the **disk** icon on the desktop and selecting the **Unmount Volume** option from the short-cut menu.



Figure 10.19: RC.Local File

10.3 Boot-up Options

Booting up is a process through which the operating system is loaded into the computer's main memory or random access memory (RAM). The boot-up process starts when you turn on your computer. During this process, the BIOS takes control

of your computer and decides where to look for software on the computer and in which order. Your computer's BIOS settings determine whether your computer will first check the hard disk or a floppy disc, CD, DVD or flash memory to start the booting-up process. If you have multiple operating systems installed on your computer, the BIOS configuration determines which operating system will be loaded first at boot-up.

Only after all system files have been loaded into the main memory, is the operating system given control of the computer. The operating system performs the requested initial commands and then waits for the first interactive user input.

However, as a superuser or user with administrative privileges, it is possible for you to change the boot-up configuration to define the computer's boot order, change the default operating system to boot-up or make a system command run automatically at boot-up.

One way to change or check your BIOS setting is to restart your computer, and press a key to enter the setup function before it starts to load any operating system. Generally, you can do this by pressing F1, F2, ESC or DELETE. Once you are inside the BIOS setup, you can make the desired changes by following the instructions for using the setup. However, you need to be very cautious when making any changes in the BIOS settings because a wrong setting can prevent your computer from booting-up properly.

You can also perform these configuration changes by using a command line on your computer's terminal.

10.3.1 Running a System Command Automatically at Start-Up

At times, you may wish to add a custom command for the start-up process so that your computer executes this command every time it boots up.

1. On the Terminal, type the following command to open the rc.local file:

```
$ sudo nano  
    /etc/rc.local
```

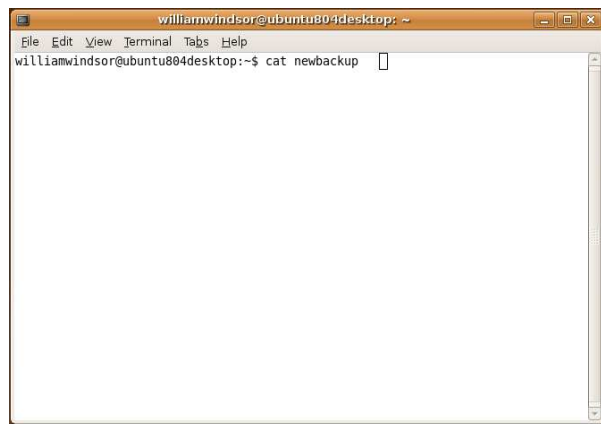


Figure 10.20: Terminal Window

The rc.local file contains a script that is executed after all the other initial scripts. You can insert your own initialisation scripts in this file if you want some services to be executed automatically during the start-up process.

2. The rc.local file opens in the Terminal window. Type the command that you want to run at system start-up before the line, exit 0.

```
$ date >  
    /home/oem/newbackup
```

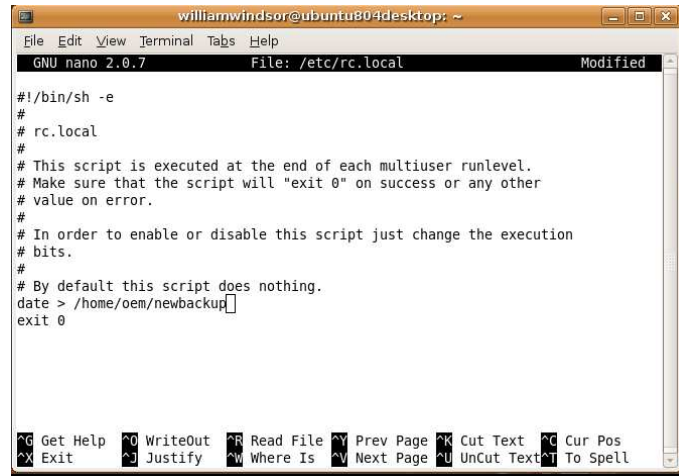


Figure 10.21: Making Settings for rc.local File

3. After you enter the command you want executed at system start-up, press CTRL+X to save and exit the edited file.

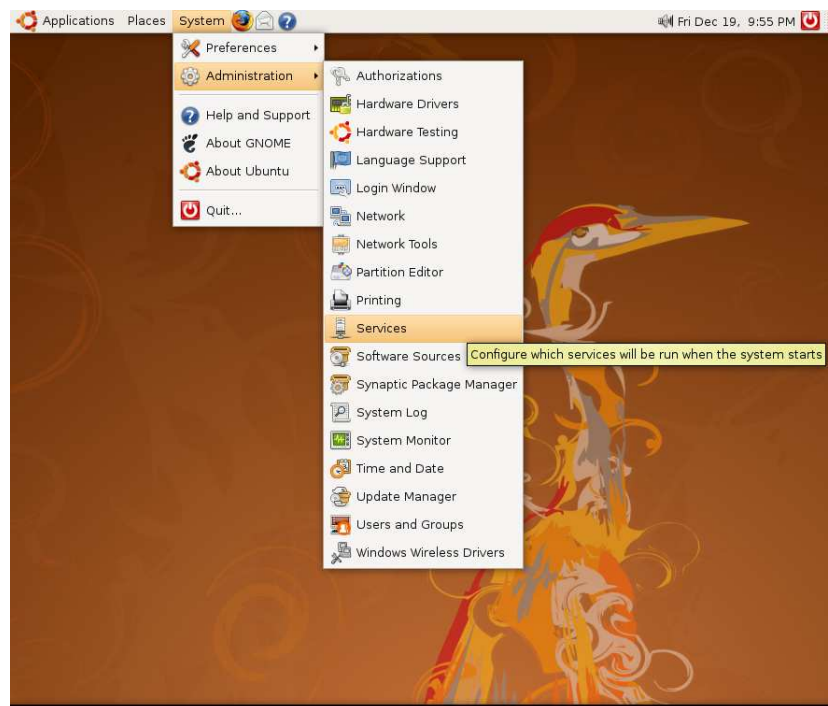


Figure 10.22: Services Window

4. When you reboot the system, the rc.local file executes. If you want to display the output of the above command, type the following command in the Terminal:

```
$ cat newbackup
```

The following image shows the output of the above command:

10.3.2 Changing the Default Operating System at Boot

When multiple operating systems are installed on a computer, this is referred to as a multi-boot configuration. Typically, the operating system that is listed on top in the configuration file is loaded on the computer. To choose the operating system that starts when you turn on your computer, edit the grub configuration file.

1. Back up the configuration file, and open it in a text editor, as follows:

```
$ sudo cp /boot/grub/menu.lst /boot/grub/menu.lst_backup $ sudo gedit /boot/grub/menu.lst
```

2. Find the line written below to change the default sequence:

```
... default 0 ...
```

Replace this line with the following line:

```
default X
```

Replace X with a number based on the order in which your operating systems appear in the configuration file. You should start counting from 0. For example, if you wish the default operating system to be the first in the list, replace X with 0; and if you wish the default operating system to be the second in the list, replace X with 1.

3. Point to saved and save default to reboot the last OS chosen.

10.3.3 Configuring Start-Up Services

When Ubuntu starts up, many services are started for your convenience. Some services are mandatory for Ubuntu to work properly on your computer. Others are services that you'll probably never need, either because you just do not want them (for example, ntpdate, which sets your system time from a time server) or you simply don't have the device (for example, the HP printing and scanning system, which is of no use if you don't own an HP device).

Although these services are harmless, they increase your computer's start-up time. By de-activating some of these services, you should get a slightly faster start-up time.



Caution:

Read the service information before you disable any service because disabling some services may stop your system from booting-up or running properly.

To configure the start-up services, you need to have administrative privileges. Then, perform the following steps:

1. On the **System** menu, point to **Administration** and then click **Services**.
 2. Type your administrative password. The **Services settings** window opens.
 3. Select the services you want running by selecting or clearing the respective check boxes and click **OK**.
-

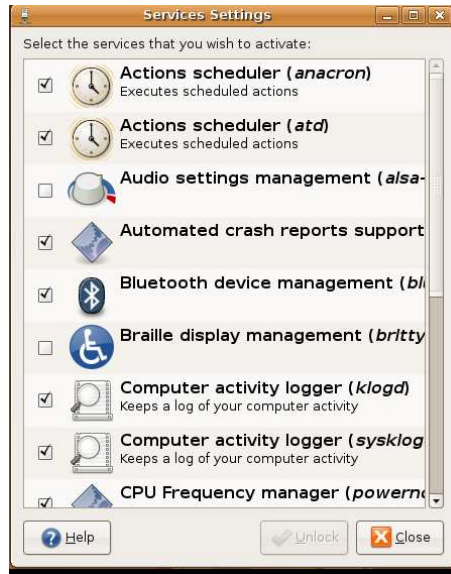


Figure 10.23: Services Settings Window

10.4 Lesson Summary

In this lesson, you learned that:

- Partitioning your hard disk is similar to splitting rooms with walls in a house.
- You can run Ubuntu on a single or multiple partitions or drives.
- Before partitioning the hard drive, you should make sure that there is no data on the hard drive. If the hard drive on which you are creating a partition contains data and you wish to preserve it, it will be safer to back up the data before proceeding.
- You can create a partition by using both the partition editor and the command-line interface.
- It is possible for you to change the boot-up configuration to define the computer's boot order, change the default operating system to boot or make a system command run automatically at boot-up.
- To run a set of commands each time the system boots up, you need to include the commands in the `/etc/rc.local` file so that the computer executes them automatically at every boot-up.
- You can change the default operating system at boot by making changes in the configuration file.
- You must read the service information before disabling any service because disabling some services may stop your system from booting-up or running properly.

10.5 Review Exercise

Question: What are the advantages of partitioning?

Answer:

Question: Why do you need to use the `sudo` command?

Answer:

Question: Which of these file systems does Ubuntu use by default?

- Fat 32
- NTFS
- Ext3

Answer:

Question: If you want to run a system command automatically at start-up, where should you add the command?

Answer:

Question: Is it possible to disable all the start-up services? Why?

Answer:

10.6 Lab Exercise

Exercise 1 As a previous Microsoft Windows user, you want to have a dual-boot configuration on your computer and create a separate partition to run Microsoft Windows on it. To perform this task, you need to create a 5-GB primary partition and format it with a Microsoft Windows-compatible file system.

1. On the **System** menu, point to **Administration** and then click **Partition Editor**.
 2. In the drive drop-down box, select the hard drive you need to partition by specifying its logical name. The window refreshes and shows you a representation of the drive.
 3. Right-click the white bar and click **New** to create a new partition. The **Create new Partition** dialogue box appears, in which you choose the specifications of the new partition.
 4. In the **New Size** dialogue box, select the size of the new partition.
 5. In the **Create as** box, select **Primary Partition**.
 6. Next, specify the file system. Select **ntfs**.
 7. Click **Add** to compute the partition. The graphical display updates to show a new partition on the disk.
 8. If you are sure about the specification of the new partition, click **Apply**. The disk will be partitioned and formatted.
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