

Operating Systems

System software is the set of programs used to operate and maintain a computer system. It includes the **operating system** and **utilities**.

The systems software provides a layer of software that lets users operate the computer without having to know about the underlying processes that are going on all the time.



Operating System

The operating system is responsible for managing the hardware and communicating with the user. It can be broken down into various layers. At the top layer the user communicates with the computer with no knowledge of the internal workings of the computer, at the bottom layer is the hardware communications. The advantage of putting software into layers is that, if a part of your system changes, only the software dealing with that layer needs to be rewritten.

Disk Based

Most modern computers keep their operating system on disk and load it into RAM on startup. The main advantage of this is that it is very simple to upgrade the operating system. It also means that only those parts of the operating system that are really needed have to be loaded. Other parts can be left on disk until needed. The main disadvantage is that other programs can corrupt the operating system. Examples of operating systems like this are Windows XP and the Mac OS X.

ROM Based

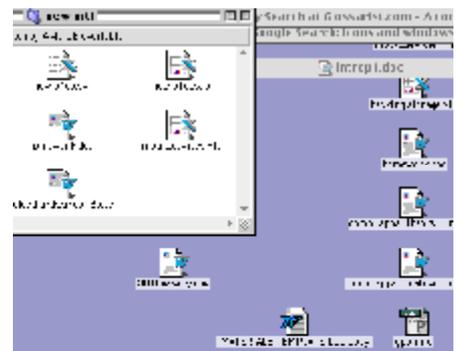
Older computers often had their operating system in ROM. This meant that it was ready as soon as the computer was switched on. This meant that the operating system took very little time to be up and running unlike disc based systems. It is impossible to corrupt the system but very difficult to upgrade it. The BBC Microcomputer uses a ROM based operating system.

Bootstrap Loader

Before a computer is switched on the operating system is not up and running. The **bootstrap loader** is the program that the processor runs on startup and whose task it is to load in the rest of the operating system from the hard disk.

Human Computer Interface

The way in which the operating system has communicated between the human user and the computer has altered over the years and become much more user friendly. Operating systems like Windows XP and Mac OS X use a WIMP environment that makes the interface easier to use for beginners. Many experienced users still prefer the command driven operating systems such as MS-DOS and UNIX which allow the user very fast interaction with the operating system but which require a great deal of time to learn, and a manual at your side.



Command Driven Examples

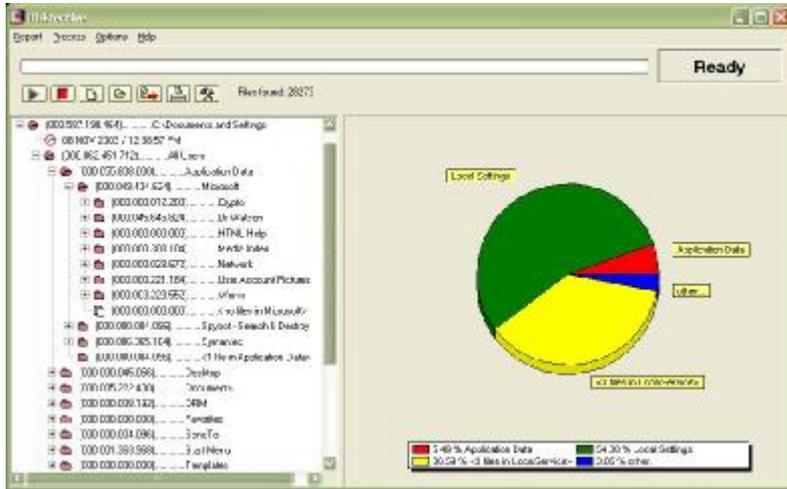
MS-DOS `cd\myprogs make myprogs the current directory`

UNIX `Is > mydir list the contents of the current directory to the file mydir`

Operating Systems

Single User Operating System

The task of a single user operating system is to handle efficiently all the resources of a computer system, hiding their complexity from the user and the rest of the system. The main resources are memory, backing storage, peripherals, processor and the user.



File management

The operating system supervises the creation, deletion and updating of files. A directory has to be kept which keeps track of where files are stored on the various types of backing storage. It has to maintain the hierarchical directory structure. This is when files are placed in directories (or folders) and subdirectories.

Memory management

The operating system has to decide where programs and data are to be placed in memory and, in a multi-tasking environment, keep track of what stage each program is at and ensure that no process tries to access the memory of a different process. This applies especially to the operating system. If it is corrupted in some way it could cause the whole computer system to crash.

Interpret commands

The operating system has to take user commands from the keyboard, mouse etc., interpret the commands and pass them to the appropriate part of the Operating System which deals with that command. If the command cannot be understood, a suitable error message should be given. This is often known as the **Command Language Interpreter**.



Input/Output (I/O) system

The main problem is that all the peripherals work at different speeds and have different characteristics. The I/O system hides these differences and makes them all appear to operate in a similar manner. To an application all peripherals behave the same way (device independence) that makes them much easier to use. It is the task of the I/O system to do all the actual data transfers and issue the appropriate control signals to the peripherals. If extra hardware is added then the manufacturer will supply the appropriate software (**driver**) to handle that peripheral.

Resource allocation

In many operating systems resource could mean data or routines that are available to programs. It can also relate to tasks that are carried out by certain peripherals. This part of the operating system organises what resource is dealt with at any one time.

Process management

The operating system has to decide which of the tasks in a **multi-tasking environment** (many programs running at once) gets to use the processor. In a single user operating system it only has to choose between the operating system itself and the package being run but on larger systems this becomes much more complex. This is usually called the **kernel** as it is right at the core of the operating system.

Utility Programs

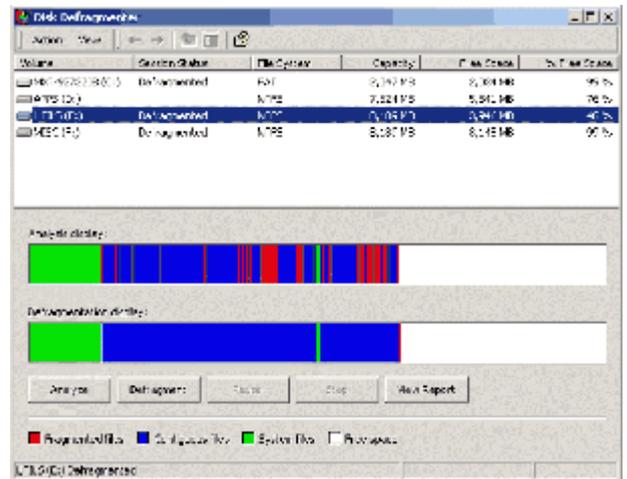
Utility programs are programs that aid the maintenance of the computer. They are not normally essential for the running of the computer and are normally kept on disk until needed. Utilities are programs that perform a variety of functions directly related to managing computer resources. They are supplied with the system software but can be bought as extras e.g. Norton Utilities.

Types Of Utilities



Virus Checker These are programs to detect and remove computer viruses. The simplest kind scans executable files and boot blocks for a list of known viruses. Others are constantly active, attempting to detect the actions of general classes of viruses.

Defragmenter Once disks have been used many times (i.e. files saved and deleted from them), the deleted files cause the disk to have gaps in it (like Swiss cheese). This program move files around a disk until they are all stored in consecutive sectors. Disk defragmentation is the process of reassembling files and folders in one location on a volume. The process, which works only on local volumes, consolidates files and folders in one contiguous place. Defragmentation results in improved disk access because it consolidates most, but not all, of the volume's free space. The time it takes to defragment a volume depends on several factors, including the size of the volume, the amount of fragmentation, the number of files and folders, and the available system resources.



Disk Editor These are used for editing the contents of a disk. This can include disk repairs, finding corrupt files etc.

Disk Repair or First Aid A lot of unused data collects on your hard disk during normal usage. Disk repair utilities scans your hard disk for these unnecessary files and removes them such as wrong aliases etc.

Advantages of using Utilities

- § frees the computer system of unnecessary clutter
- § improves the performance of the computer system
- § can speed up Internet connection
- § frees up system memory
- § recovers accidentally deleted files
- § can prevent virus infection

Standard File Formats

Sometimes it can be really frustrating for users when they want to use another computer to load a file. The problems that can occur are:

- The backing storage drive is different from the media the file is saved on.
For example - the file is saved on a floppy which has been formatted for a Mac and the disc drive will only read PC formatted discs.
- Differing operating systems and the files won't be recognised. An error message from the operating system will be given to the user.
For example - a AppleWorks file was saved on a computer with MacOSX and you try to load it on a PC which has Windows XP as its operating system. The PC will look for the filename to have a specific suffix e.g. cwk.
- The computer does not have the appropriate application software.
For example, the file was created on MicroSoft Word and the other computer only has AppleWorks.

The first two problems could be resolved by using either a different computer or ensuring that your media is formatted for the correct standard or installing different operating system software.

The third problem is typical as each application saves files in its own way and other packages find it difficult to read these files. However, standards have been set which allow the user to save data in a format that can be read by other packages.

Examples are:

<u>Application</u>	<u>Standard</u>
Spreadsheet	SYLK
Text	RTF (Rich Text Format)
Graphics	JPEG (Joint Photographic Expert Group)

Sometimes it is possible to save a file in one package as another application's file e.g. a AppleWorks file as a MicroSoft Word file.

However, the disadvantage of saving files using these standards is that special formatting created within the original file may be lost e.g. different styles, fonts and sizes.

These different formats can usually be chosen in the **Save As....** menu option in each package.

Creating and manipulating text

Text can be captured using almost any word processor, (AppleWorks, Word etc.), and each word processor tends to save files under its own format. To transfer files between different word processors, and between a word processor and other applications, there are two standards. The **ASCII** standard transfers just raw text and all formatting data (such as bold, italic and different fonts) is lost in transfer. **RTF** (Rich Text Format) is a file transfer standard in which the data formatting is preserved. When saving text for transfer, it is usual to have to specify the format in which you wish to save it. One of the benefits of an integrated package or a family set of applications is that files can usually be transferred between the different applications with the formatting preserved and the user is protected from having to know about file transfer standards.

Text can also be created in using a desk top publishing (DTP) program. Common features between word processing and DTP packages include text handling (similar fonts, sizes and styles), drawing tools and page layout tools which will divide pages into columns. It is very important to be able to save text documents in a common format as using text between these two packages is a very popular process, especially in the magazine and newspaper industry.

Standard File Formats

Working with standard file formats for graphics

Graphics is a term used to cover the following formats: clip art, graphs and charts, drawings and diagrams, digital images from scanners or cameras, animations and video.

Types and Formats of Images

When considering graphical images as opposed to animation and video it is important to look at the formats in which they can be stored. There are two different methods of storing images, **bit-mapped** (or pixel) graphics and **vector** (or object-orientated) graphics. Here are a few standard file formats that are commonly used for representing graphics.

TIFF

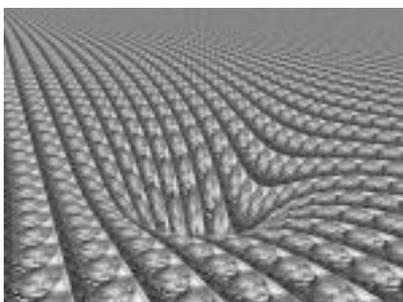
A common method of capturing real pictures is by **scanning**. The software which operates modern colour scanners tends to save the image in a **Tag Image File Format** (TIFF). TIFF format is a standard file format, developed jointly by Aldus and Microsoft, which can handle monochrome, grey scale, 8-bit or 24-bit colour images. TIFF is a standard for pixel graphics and is popular because graphics can be edited right down to pixel level. However, TIFF files tend to be large and need to be compressed. TIFF files tend to be used for DTP rather than Multimedia.

JPEG

If editing at that level is not required then a large TIFF file is often converted into a JPEG format and saved as a JPEG file. JPEG is a standard developed by the **Joint Photographic Experts Group** and provides 'lossy' compression. This follows an algorithm which cuts out certain pixels and then saves the resulting image in a vector format. This means that the image is not as sharp as the original.

Currently JPEG is the most popular standard for several reasons.

- * It can handle a large number of colours.
- * A large number of applications recognise it.
- * It is a cross-platform standard.



GIF

The **Graphic Interchange Format** (GIF) is an older graphics format which operates in a similar way to JPEG files. The GIF standard was originally devised by CompuServe to make graphic files smaller for downloading on the Internet and hence provide faster access. GIF files can have a colour range up to 256 colours (2 to the power of 8). This 256 colour limitation limits its ability to store photo images effectively.

PICT

PICTURE (PICT) files follow a standard originally devised for Apple computers that also stores images in a vector format.

BMP

Bit-Mapped Picture is the Windows standard bitmap graphics file. It is uncompressed and hence takes up unnecessary file space.

EPS

Encapsulated Postscript uses the standard Postscript language to communicate with Postscript printers. The output is high quality and the make of printer is not important as long as it has Postscript printing capability.

There are many different formats for storing graphics such as PNG, PCX TGA etc. However JPEG, GIF and TIFF are the most commonly used format and allow graphic files to be exchanged between software packages.

Software Compatibility

When purchasing application software it is vitally important that the software can be run on your computer. If it does not then you won't be able to use your software. Each piece of software includes details of the **minimum system specification** required to run the application. This will include:

Operating System
Minimum RAM
Processor
Hard disc space
Peripherals required



Here are **two** typical examples of the type of specification given:

Software	Excel 97
Type	Spreadsheet
Operating System	Windows 95 or Windows NT 3.5.1
Processor	Intel 486 or higher
Memory	12Mb for Windows 95 16Mb for Windows NT 3.5.1
Disk Space	28 - 60 Mb with 40Mb Recommended
Peripherals	CD-ROM drive VGA Display



Software	PageMaker 6.5 Plus
Type	Desk Top Publisher
Operating System	Mac OS 7.5.3 or later
Processor	Power PC
Memory	12 Mb
Disk Space	56 Mb
Peripherals	CD-ROM drive Video display card (24-bit screen display) PostScript printer



Types Of Virus

A virus is a program that has been designed to attach itself to other programs and make a computer system unreliable. A virus is a piece of software that latches on to other programs. For example, a virus might attach itself to a program such as a word processor. Each time the word processing program runs, the virus runs, too, and it has the chance to reproduce by attaching to other programs. Even a simple virus is dangerous because it will quickly use all available memory and bring the system to a halt. More dangerous types of virus are capable of transmitting across networks and bypassing security systems.

Viruses can:

- § damage data stored in memory or on disk
- § affect the computer's usual operations
- § copy itself automatically onto a disk or network.



Most viruses only affect particular operating systems usually Windows based ones. All computer viruses are manmade. Recent viruses include the Mydoom worm, ILOVEYOU virus and Melissa virus.

Viruses that affect files

There are many classification of virus that can affect different file types.

File virus - As viruses can replicate themselves, they can attach themselves to files. More common are files that are attached to email messages. Since virus code must be executed to have any effect, files that the computer treats as pure data are safe. This includes graphics and sound files such as .gif, .jpg, .mp3, .wav, .txt etc. The virus code has to be in a form, such as an .exe program file or a Word .doc file, that the computer will actually try to execute.

Boot sector virus - This virus has the ability to infect the boot sector (bootstrap loader) on floppy disks and hard disks. The boot sector contains a tiny program that tells the computer how to load the rest of the operating system. By putting its code in the boot sector, a virus can guarantee it gets executed. It can load itself into memory immediately, and it is able to run whenever the computer is on. Most boot sector viruses are not very common any more as most operating systems can now protect the boot sector.



Macro virus - This virus is encoded as a macro that is embedded in a document. Many applications support macro languages. These applications allow you to embed a macro in a document, and have the macro execute each time the document is opened. According to some estimates, 75% of all viruses today are macro viruses. Once a macro virus gets onto your machine, it can embed itself in all future documents you create with that application.

Email virus - An email virus attaches itself to email messages, and usually replicates itself by automatically mailing itself to dozens of people in a user's email address book.

Worm

A worm is a program or algorithm that replicates itself over a computer network and usually performs actions, such as using up the computer's resources and possibly shutting the system down.

Trojan horse

This program 'pretends' to be a normal working program, however they also perform harmful processes at the same time. Unlike viruses, Trojan horses do not replicate themselves but they can be just as destructive. One of the most dangerous types of Trojan horse is a program that claims to rid your computer of viruses but instead introduces viruses onto your computer.

"At approximately 5pm on November 2 1988 the "Morris Worm" was created in the MIT AI laboratory in Cambridge, Massachusetts. It quickly spread to Cornell, Stanford, and then on to other sites. By the next morning, almost the entire Internet was infected."
Worm.net

Actions of Viruses And Anti-Virus Techniques

Different actions of viruses

There are various virus codes that can be used to try and create actions of different forms.

§ **Replication**

Most viruses use replication to infect computer systems. Basically the virus has the ability to copy itself by attaching to other files.

§ **Camouflage**

Some viruses can avoid detection by taking on characteristics that cannot be found or monitored.

§ **Watching**

Other viruses can wait until a particular event happens before it attaches itself to a program or file. Usually some action or condition has to be met before the virus will attach itself.

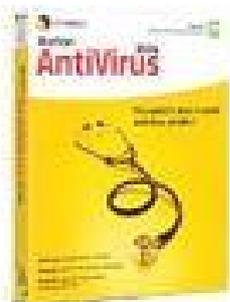
§ **Delivery**

Sometimes viruses can be attached to external backing storage media such as floppy disks. Once the disk has loaded its contents into memory the virus can attach itself to executable programs.



Anti-Virus Software Detection Techniques

Anti-virus programs are used to detect and remove viruses. A **virus scanner** is a type of anti-virus program that searches a system for virus signatures that have attached to executable programs and applications such as e-mail clients. A virus scanner can either search all executables when a system is booted or scan a file only when a change is made to that file. However, detection and removal of viruses are often difficult. Techniques that can be used by anti-virus software are:



○ **Use of Checksum**

A checksum of a file can be formed by adding up all the instructions used within that file. This is then added to the file. When the file is about to be run the checksum is recalculated and if there is an error then it is assumed that the file could be infected and a warning is given

○ **Searching for virus signatures**

A virus signature is a unique string of bits of a virus. The virus signature is like a fingerprint in that it can be used to detect and identify specific viruses. Anti-virus software uses the virus signature to scan for the presence of malicious code and remove (**disinfect**) it.

○ **Heuristic detection**

This type of detection is based upon learning through previous knowledge. Using a virus' signature heuristics are used by looking at characteristics of viruses that are already known. This is useful for finding unknown viruses. By using previous knowledge the heuristic can measure how likely it is that the computer system has been infected.

○ **Memory resident monitoring**

Executable programs are divided into memory resident and non resident ones. A memory resident program leaves its code or part of it in RAM after ending and the operating system allocates a memory area necessary for program operation. After that, the memory resident program operates in parallel with other programs. A non resident program does not leave its code in memory after its termination, and the memory area occupied by it is cleared. Some anti-virus software can be memory resident and hence it monitors the computer system by checking any program that is run once the computer is switched on. The downside of this type of anti-virus software is it takes up RAM and hence can slow down the usual function of the computer as checks are consistently carried out as programs are being loaded and run.

Actions of Viruses And Anti-Virus Techniques

Recent Viruses

The list below provides a synopsis of the latest virus-related threats discovered by Symantec Security Response, including information on: Name of Threat (threat), the day on which the threat was identified (discovered), and the day on which a virus definition was added to protect against the threat (protection).

Backdoor.Win32.BoomRaster.a (KAV)	September 2, 2004	September 3, 2004
Backdoor.Balkart	September 2, 2004	September 2, 2004
Trojan.Yipid	September 1, 2004	September 1, 2004
Troj/Tofger-BG [Sophos]	September 1, 2004	September 2, 2004
W32.Beagle.AQ@mm	August 31, 2004	August 31, 2004
Backdoor.Alets	August 31, 2004	August 31, 2004
Trojan.Hiva	August 31, 2004	August 31, 2004
Downloader.CDT	August 30, 2004	August 31, 2004
Backdoor.Rbot.gen [Kaspersky]	August 27, 2004	August 27, 2004

When dealing with these types of viruses as well as using anti-virus software, there are various ways of either preventing viruses or making the virus infection less costly and painful.

- § Install anti-virus software from a well known, reputable company, Update it regularly, and use it. New viruses come out every single day (see above).



- § In addition to scanning for viruses on a regular basis, install an 'on access' scanner and configure it to start automatically each time you boot your system. This will protect your system by checking for viruses each time your computer accesses an executable file.

- § Virus scan any new programs or other files that may contain executable code before you run or open them, no matter where they come from. There have been cases of commercially distributed floppy disks and CD-ROMs spreading virus infections.

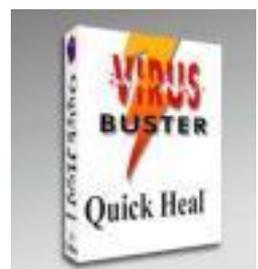
- § Anti-virus programs aren't very good at detecting Trojan horse programs, so be extremely careful about opening binary files and Word/Excel documents from unknown sources. This includes posts in binary newsgroups, downloads from web/ftp sites that aren't well known or don't have a good reputation, and executable files unexpectedly received as attachments to email or during an on-line chat session.



- § Be extremely careful about accepting programs or other files during on-line chat sessions. This is one of the more common means that users end up with a virus or trojan horse problems.

- § Do regular backups. Some viruses and trojan horse programs will erase or corrupt files on your hard drive, and a recent backup may be the only way to recover your data.

- § Ideally, you should back up your entire system on a regular basis. If this isn't practical, at least backup files that you can't afford to lose or that would be difficult to replace: documents, bookmark files, address books, important email, etc.



Selecting Software

When using a computer system, software must be used in order to work the computer properly and carry out any tasks. There is a wide range of software on the market, whether it be system software or application software, that can be used with computers. Unfortunately the cost of software has risen considerably in the last decade. So which ones do you choose? Basically it is down to the task that needs to be solved and the computer system and peripherals that being used. Typical questions that need to be considered are:

- § How much backing storage does the software require?
- § How data types are being used?
- § What is the task that needs to be solved?
- § What are the RAM requirements for the software?
- § Does the software require a high processor performance?
- § Are there specific peripherals that are required for the software to operate?

As the cost of tackling problems using a computer system with a range of software can be a costly one, it is necessary to be able to justify why choices have been made.

Here are typical tasks that a computer system could solve:

- § Production of a multimedia catalogue
- § Setting up a LAN in a school
- § Development of a school website
- § Creating an audio CD
- § Creating a DVD movie with added extras

Here are possible solutions to three of these typical tasks:

Production Of A Multimedia Catalogue

Multimedia involves the use of media elements, such as text, graphics, sound, video and animation. The computer system itself must be of a good specification to create, edit and run these elements. In order to put the catalogue together these media elements need particular software to create them.

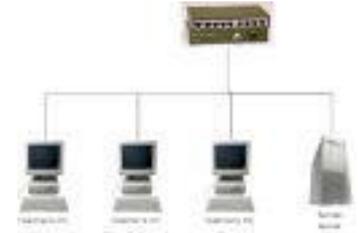


Software	Justification
<i>Computer System with:</i>	
System software	Operating system and utilities that can support multimedia
Video editing software	To create and edit video frames
Graphics manipulation software	To create and edit graphics
Sound manipulation software	To create and edit audio
Word processor	To create and edit text
Animation software	To create and edit animations
Multimedia authoring software	To create and edit multimedia catalogue
Photo editing software	To create and edit digital photographs

Selecting Software

Setting Up A Local Area Network (LAN) In School

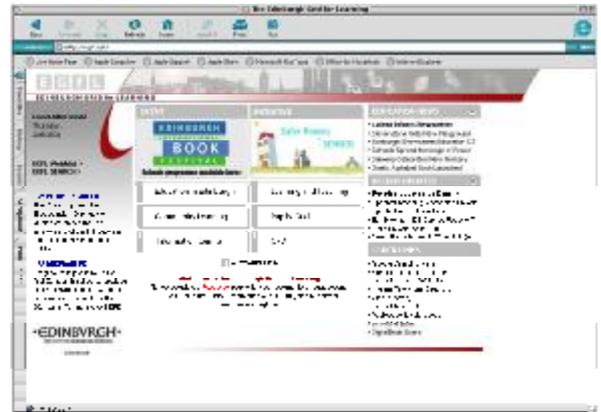
Setting up a network would require many desktop computers to be linked together.
Possible software for this task could be:



Hardware	Justification
50 Computer Systems with:	
System software	Operating system and utilities that can support networking
Communication software	To allow computers to operate across the network
Networking card drivers	To allow networking cards to operate
Browsers	To be able to search and use the network facilities
Network operating system	To manage and administer the network

Development Of A School Website

Creating a school website could possibly involve using multimedia elements, so a higher specification computer system is required. Also possible Internet access may be a requirement. Software that might be used for this task could be:



Hardware	Justification
Computer System with:	
System software	Operating system and utilities that can support networking and multimedia
Video editing software	To create and edit video frames
Graphics manipulation software	To create and edit graphics
Sound manipulation software	To create and edit audio
Word processor	To create and edit text
Animation software	To create and edit animations
Web authoring software	To create and edit website
Photo editing software	To create and edit digital photographs
Communication software	To allow computers to operate across the network
Networking card drivers	To allow networking cards to operate
Web browser	To be able to view website
Network operating system	To manage and administer the network