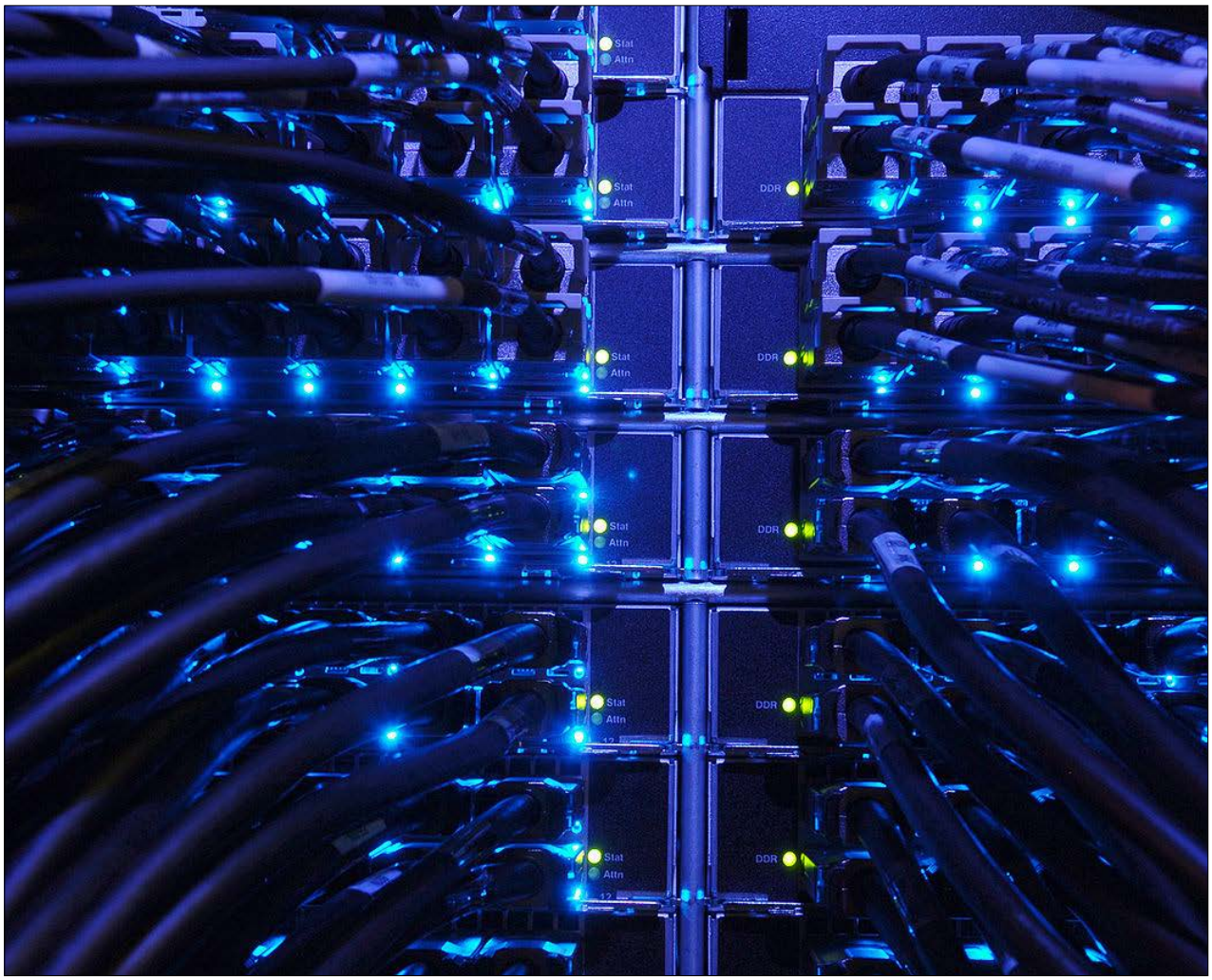
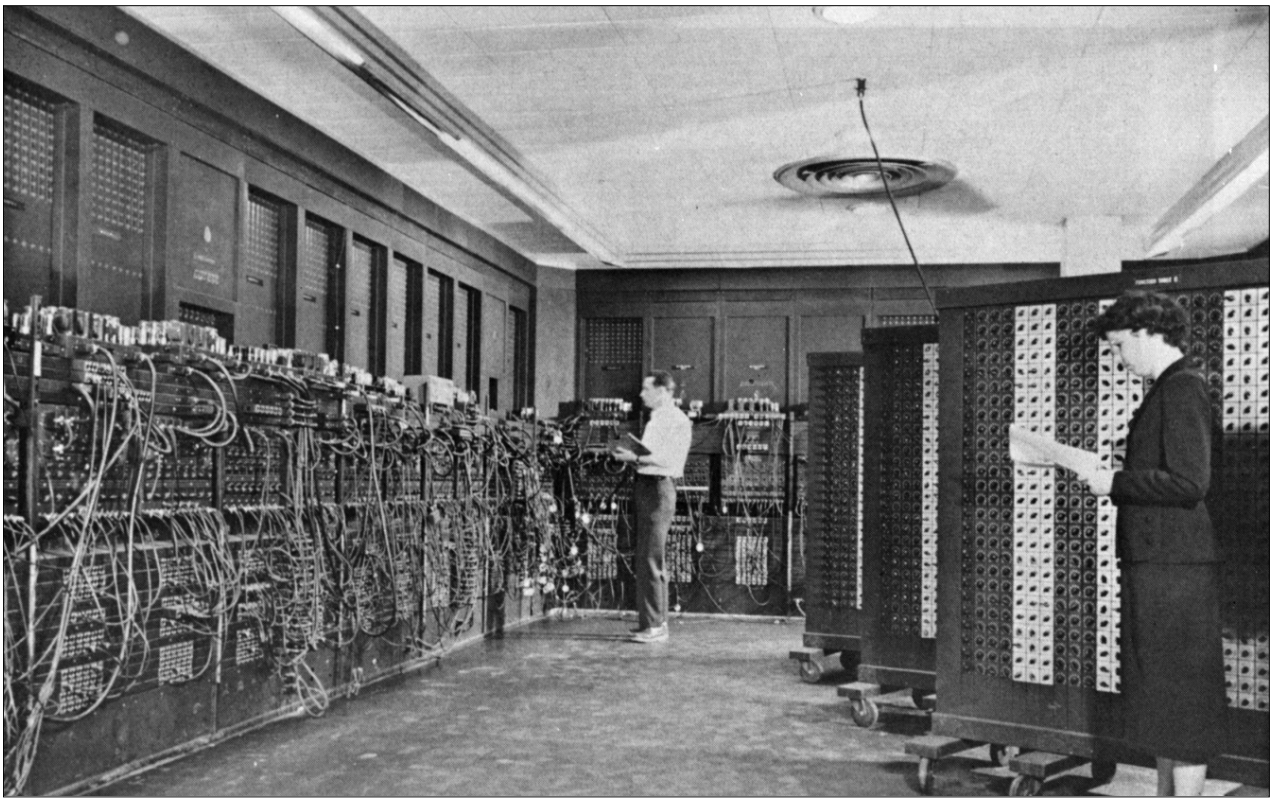


GCSE COMPUTING THEORY

Name:_____

Group:_____

Contents



COMPUTER FUNDAMENTALS

computer |kəmˈpjuːtə|

noun

an electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals.

INPUT, PROCESSING & OUTPUT

Computer systems all have input, processing and output. When you think of a computer system you may picture a desktop computer or laptop, but it could easily be a mobile phone, games console or your DVD player. They are all computer systems that have inputs, processing and outputs.

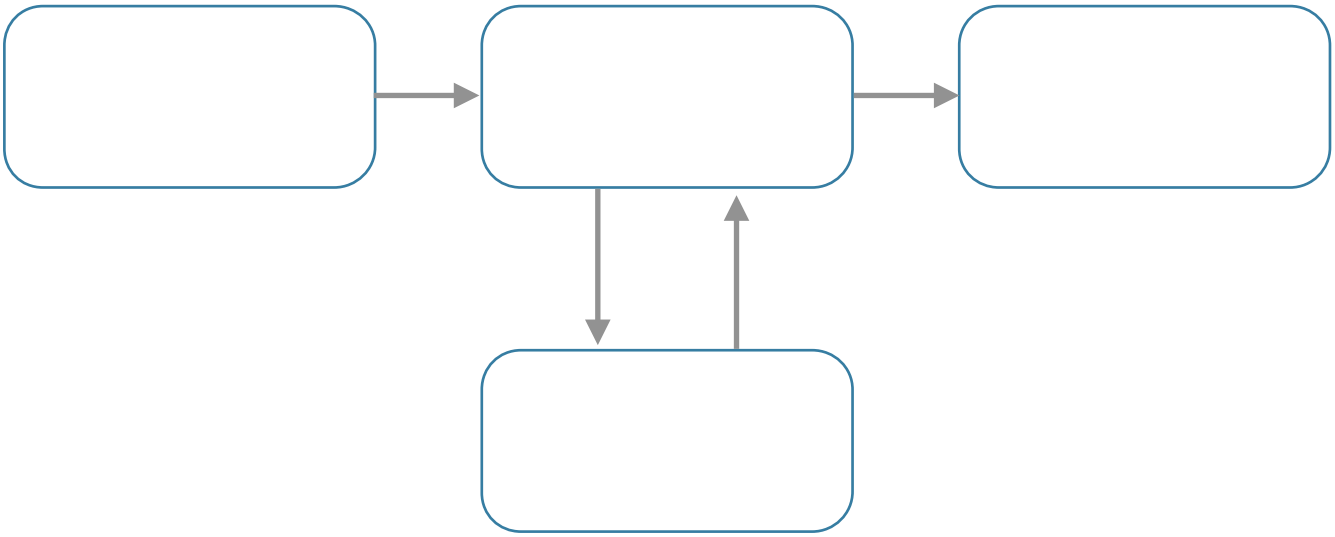





Examples of computer systems

Write below examples of computer systems that you may have in your house.

Computer systems have a number of things in common. They all have take an INPUT and PROCESS it using instructions called programs. The results of the processing are shown as OUTPUTS. Computer systems can store programs and data for later use.



INPUT

PROCESSING

OUTPUT

STORAGE

THE IMPORTANCE OF COMPUTER SYSTEMS

Computer systems are used in almost every aspect of our lives. They have become important in our society and have brought us great advantages in our lives.

How have computers helped us in the following areas?

Business

Medicine

Entertainment

Education

RELIABILITY

It is important for computer systems to be reliable. Some systems need to be more reliable than others however.

When we say something is reliable, we mean that it does what we expect. Many computers are complex pieces of hardware running complex software. Occasionally something will go wrong, such as a program may crash or a piece of hardware such as a hard drive may fail.

Some computer systems could put people in danger if they fail or even lead to death. If your games console fails and a game crashes, whilst it is frustrating it does not compare with a computer system on an air liner. If a computer system on an aeroplane fails, it could lead to the plane crashing and people being killed.

There are different ways of measuring reliability. One way is to measure how often a system is down for in a given time. So for example if a Superstore's computer systems were run for 100 hours and in that time, computer failure resulted in the computers not working for 3 hours then we could say that the system has a 97% reliability. The Superstore company would have to decide whether this was acceptable or not.

If you need to have a computer system that is close to being 100% reliable then extra steps would need to be taken to make sure that things do not fail.

What steps could be taken to make a computer system more reliable?

COMPUTERS AND THE LAW

COMPUTER MISUSE ACT

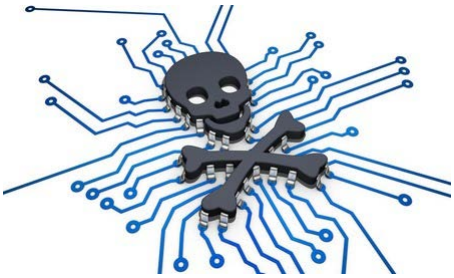
In the 1980's a number of people were caught hacking into other people's computer systems but the law at the time was not able to deal with these new crimes.

The Computer Misuse Act 1990 was designed to protect the integrity of computer systems by deterring the activities of hackers. It created three new offences:

- Unauthorised access to computer programs or data
- Unauthorised access with a further criminal intent (known as the 'ulterior intent' offence)
- Unauthorised modification of computer material.

So what does all this mean? Well to start with it makes hacking illegal. Hacking is accessing a computer either physically or remotely, without the user's permission. So you are not allowed to access a person's computer or work area or look at the data stored there without the permission of the person whose data it is. This means hacking into some's email account is illegal. This could lead to a fine of up to £5000 or 6 months in prison.

If the hacker then makes a change to any data on the computer system or they use their access to commit a further crime, like fraud or blackmail, they could face up to 5 years in prison. This is in addition to the sentence given for that additional crime.



Some people write computer viruses. These pieces of software can travel from computer to computer and often change data on an infected machine. This means that virus writers can be sent to prison for up to 5 years.

How do you think the following people broken the laws in the Computer Misuse Act?

A WPC used police national computer to access electoral rolls and car registration records in attempts to track down woman who had an affair with her boyfriend.

A disgruntled IT supplier hacked estate agency website and replaced pictures of houses with inappropriate images.

An employee who is about to made redundant finds the Managing Director's password; logs into the computer system using this and looks at some confidential files.

DATA PROTECTION ACT

Many companies collect personal data which they use for their business. Some of this data is vital to the day to day running of these companies, such as being able to insure a car or house, or deliver goods. However this data can be valuable in other ways. If a car insurance company knew the names and addresses of who bought cars and when, then they could target them for mail shots at the right time for insurance renewal. The chances of getting a response would be higher.

It was decided that the company who collects the data must look after it and can only pass it on with the owner's permission. The Data Protection Act has eight statements about how a company must look after personal data they store. Failing to uphold these statements could lead to criminal prosecution.

- Personal data must be obtained and processed fairly and lawfully.
- Personal data must be held only for the purposes which the data user has declared. Personal data must not be used for purposes other than those which have been declared.
- The personal data kept for the declared purpose must be relevant, adequate, and not excessive in relation to that purpose.
- Personal data should be accurate and kept up to date (where appropriate).
- Personal data must not be kept longer than is necessary for the purpose for which it is held.
- An individual is entitled to find out whether and what data is held on him or her and, where appropriate, to have such data corrected or erased.
- Appropriate measures must be taken to prevent unauthorised access, or modification of personal data.
- Data should not transferred outside the UK without adequate protection.

COPYRIGHT & PATENTS ACT

With digital data, making copies has never been easier. Even though it is easy however, does not make it legal. Many things are covered under the copyright law such as music, film, photographs and software. Making copies of such items and sharing them with friends is often against copyright law and as such can be prosecuted.

When buying a software pack it usually comes with a license that covers its use. This licence will inform you how many computers you are allowed to install the software onto.

Explain the different types of license.

Single User License

Multi-User License

Site License

Some media file such as music and films may have DRM. What is DRM and what is it used for?

ETHICS

Laws are there to prevent and punish illegal behaviour but there are some situations that are not covered by the law. These are often ethical issues.

Imagine a company could buy a computer system that would do the work of 50 people and could work 24 hours a day, 365 days a year. This could save the company a great deal of money and so would make sense commercially. However just making 50 people unemployed would be unethical. The company has an obligation to look after its work force. This may mean retraining them so they can work in areas that computer systems are not so well suited for.

Employers need to make sure they respect health and safety regulations for their computer users. This may mean paying for eye tests and providing equipment to make it easier for people with disabilities to work effectively.

A superstore chain in the USA used loyalty cards to track user purchases and to target vouchers. They were able to use buying habits to predict which women were pregnant and estimate when they would give birth. They were able to target vouchers for baby goods before the baby was born. Is this ethical? What would happen if the women didn't want to announce the pregnancy and started receiving coupons for nappies and baby food?

What do you think should be in a code of conduct for a computer company that is employed to create software for a number of different clients?

PROFESSIONAL STANDARDS

THE NEED FOR STANDARDS

Most computer programs are very complex and require teams of people working together to complete the task. This requires some organisation if the program is going to work and perform the tasks required of it. There are many different standards that have been created for the design, development and testing of software.

When creating a new computer system a number of stages need to be gone through in order to implement a solution effectively.

Analysis of the current system. Understand what the current system does (if there is one), including what works well and what doesn't work well.

- Designing a new solution. Creating a new computer system to replace the old one, hopefully taking note of the things that don't work well with the old system so they can be avoided.
- Implementation the new system according to the design.
- Testing the solution. This may have a number of stages. Alpha testing is usually done by the programmers to test against their designs. Beta testing often involves the end users so they can test it doing the types of jobs they do in real life situations.
- Installing and training. This means putting in the new system and make sure the users have been trained sufficiently to do their job.

Explain what is meant by the following types of standards.

Proprietary Standards

Open Standards

Defacto Standards

Industry Standards

Standards in Software Development

The programmers need to adhere to standards when they work in teams. Programs are usually broken down into chunks that can be implemented independently. In this way many programmers can work on a different parts of the program.

For example if a new word processor is being written, one programmer may work on the code to format the text, while another programmer may work on making tables work and yet another may implement a spell checker.

These separate tasks need to come together to work as a whole. The programmers need to make sure the interaction of the various parts work well together.

What things do developers need to do to make sure they can work well together in the programs they create?

COMPUTERS AND THE ENVIRONMENT

RECYCLING

The electronic circuit boards and components used in making modern computer devices often contain valuable materials. Much of the wiring is made of copper, which is a good electrical conductor. Small amounts of gold may be used instead, which is an even better conductor. There are also other rare metals such as tantalum. When computer systems such as PCs, games consoles and mobile phones come to the end of their usefulness they can often be thrown away. This is extremely wasteful.

Laws have been passed in many countries to ensure that computer systems can be recycled easily or their life extended. Many businesses and organisations run powerful computers that when they become too slow to do the work they were purchased for, are often useful for schools and charities as well as in developing countries. There are companies that will even buy you old mobile phone and refurbish it before selling it to developing countries. In developing countries mobile phones can often be used in areas where it would not be economical to have fixed line telephones, and so there is big demand.

Manufacturers also are being forced to make sure that the electronics they create can be more easily recycled to get the precious metals and other materials back so they can be used to make the next generation of gadgets.

ENERGY EFFICIENCY

We use computer systems so much in todays lifestyle that they are now making up a significant role in our usage of electricity. The electronics in your house hold could contribute around 6% of your electricity bill. Modern computer systems are designed to save energy when not in use. There are energy saving settings in most modern operating systems that allow you to configure your computer so that it can save energy when you are not using it.

What features are there on modern computers that help make them energy efficient?

ASSESSMENT CRITERIA

In this topic you should be able to:

a) define a computer system
b) describe the importance of computer systems in the modern world
c) explain the need for reliability in computer systems
d) explain the need for adherence to suitable professional standards in the development, use and maintenance of computer systems
e) explain the importance of ethical, environmental and legal considerations when creating computer systems.

Assessment 1 Criteria

Grade	Description	Achieved?
F	Able to recognise what is a computer system and what is not.	
E	Able to recognise what is a computer system and what is not. Able to give some limited examples as to the importance of computer systems.	
D	Able to recognise what is a computer system and what is not. Able to give some limited examples as to the importance of computer systems. Some understanding of reliability and its issues in relation to computer systems.	
C	Able to recognise what is a computer system and what is not. Able to give some good examples as to the importance of computer systems. Fairly good understanding of reliability and its issues in relation to computer systems.	
B	Able to recognise what is a computer system and what is not. Able to give some Good examples as to the importance of computer systems. Good understanding of reliability and its issues in relation to computer systems.	
A	Able to recognise what is a computer system and what is not. Able to give some Excellent examples as to the importance of computer systems. Excellent understanding of reliability and its issues in relation to computer systems.	

Targets

Target	Need to achieve
Need to define a computer system with examples.	
Need to be able to describe the importance of computer systems in the modern world with examples	
Need to explain the need for reliability in computer systems with examples.	

Assessment 2 Criteria

Grade	Description	Achieved?
F	Able to recognise what is a computer system and what is not.	
E	Able to recognise what is a computer system and what is not. Able to give some limited examples as to the importance of computer systems.	
D	Able to recognise what is a computer system and what is not. Able to give some limited examples as to the importance of computer systems. Some understanding of reliability and its issues in relation to computer systems.	
C	Able to recognise what is a computer system and what is not. Able to give some good examples as to the importance of computer systems. Fairly good understanding of reliability and its issues in relation to computer systems.	
B	Able to recognise what is a computer system and what is not. Able to give some Good examples as to the importance of computer systems. Good understanding of reliability and its issues in relation to computer systems.	
A	Able to recognise what is a computer system and what is not. Able to give some Excellent examples as to the importance of computer systems. Excellent understanding of reliability and its issues in relation to computer systems.	

Targets

Target	Need to achieve
Need to explain the need for adherence to suitable professional standards in the development, use and maintenance of computer systems with examples.	
Need to be able to explain the importance of ethical, environmental and legal considerations when creating computer systems with examples.	

ASSESSMENT 1

1. Which of the following is a computer system? Tick the correct column (5)

Item	Is a computer system	Is NOT a computer system
Games console		
Food processor		
Smart phone		
Smoke detector		
Burglar alarm system		

2. Jake has a new calculator. He claims that his calculator is a very basic computer. Is he correct? Explain your answer.(2)

3. Computers have had a big impact on our everyday lives. Pick one area where computer systems have changed our lives and using examples explain how computer systems have benefited us. (5)

4. What is mean by the term reliable?(2)

5. A school has just purchased a new computer system to keep electronic registers and mark books. The system manufacturers say the system is reliable. In this case what do you think this means and what would the possible problems be if the system was not as reliable as advertised? (6)

ASSESSMENT 2

1. Which law would you be breaking if you did the following: (3)

Crime	Law Broken
Released a computer virus	
Shared digital music	
Sold a customer database without the customer's permission	

2. Computers are usually designed to save energy. Describe two ways in which they can save energy. (2)

3. Describe the difference between an open standard and a proprietary standard. (2)

4. Bob's Cars is a car sales business. Bob wants to sell his customer information to insurance companies. Can he do this? (2)

5. A youth club decides to buy a software package to record the details of its members and the activities they offer. What legal issues does the youth club need to consider when using such a system? (6)

HARDWARE

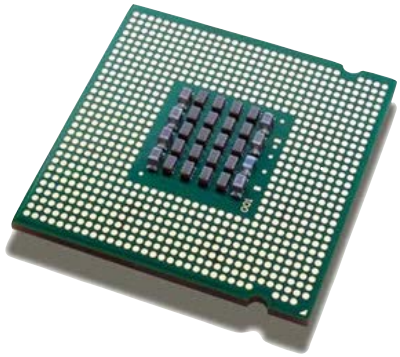
hardware |ˈhɑːdwɛː|

noun [mass noun]

the machines, wiring, and other physical components of a computer or other electronic system. *select a software package that suits your requirements and buy the hardware to run it on.*

THE CENTRAL PROCESSING UNIT

The Central Processing Unit (CPU) is the brain of the computer. It is the part of the computer that carries out the instructions of the computer system.



The CPU has understands a number of instructions. The CPU has two parts. The Arithmetic Logic Unit which performs arithmetic and logical operations such as addition, subtraction and comparing values. The Control Unit gets instructions from memory (**RAM**), decodes them and executes the instructions, using the ALU when needed. Putting it simply, the CPU fetches instructions and then executes them. There are three basic types of instructions.

- Get some data from RAM and perform some arithmetic or logic on it such as add them together, multiply them together or compare them (such as decide which number is the largest).
- Move data from one part of memory to another.
- Make a decision and fetch a different instruction from memory based on that decision.
-

There are a number of factors that effect the speed of the processor.

Explain how these factors affect the speed of the computer's CPU.

Clock Speed

Number of Cores

Cache memory

BINARY LOGIC

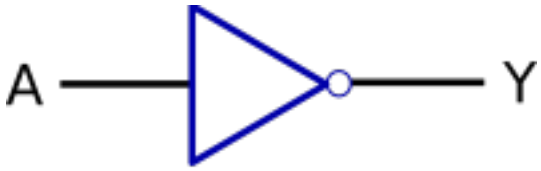
JUST ON AND OFF

For all the complexity of a computer system, at their heart is something really simple. The CPU, and the memory are just a series of switches. These switches have two settings, on or off. There are billions of switches that make up a modern computer, and all the data and programs that run on them must be stored on a series of switches that are either on or off. The CPU when it processes instructions, really just turns different switches on and off. It is when the settings of these switches are turned into something we can understand, like a sound or pixels on a screen, that we can interpret what the computer has done.

In order for the computer system to be able to make decisions about which switches to turn on or off, there are a series of circuits called gates. These take a signal which can either be on or off, and then alter it in some way. These gates are called logic gates. By combining them in different ways the computer system can make decisions. Its using logic gates that enable the computer system to work.

The NOT Gate

This is the simplest of the logic gates. The symbol for a logic gate is shown below.

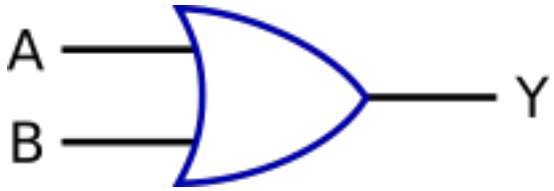


The NOT gate takes a signal A and inverts it. This means that if A is ON then Y will be OFF. Similarly if A is OFF then Y will be on. This can be shown in a table known as a truth table.

INPUT A	OUTPUT Y
1	
0	

The OR Gate

The OR gate takes two inputs. Each of these inputs can be ON or OFF. Diagram for an OR gate is shown below.



The OR gate is so called because if input A or Input B are on then output Y will be on too. This can be shown in the truth table.

INPUT A	INPUT B	OUTPUT Y
1	0	
0	0	
1	1	
0	1	

Notice that even if A **and** B are on then the output Y is on.

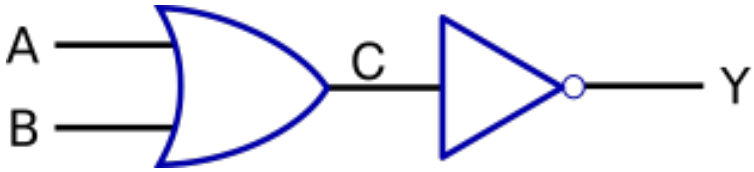
The AND Gate

The AND gate has two inputs like the OR gate. It gets its name from the fact that both inputs A and B need to be on for the output Y to be on. The diagram for an AND gate is shown below.

INPUT A	INPUT B	OUTPUT Y
1	0	
0	0	
1	1	
0	1	

COMBINING GATES

In a computer chip these logic gates can be combined to make more complex gates, to make more complex decisions. Take a look at the example below.



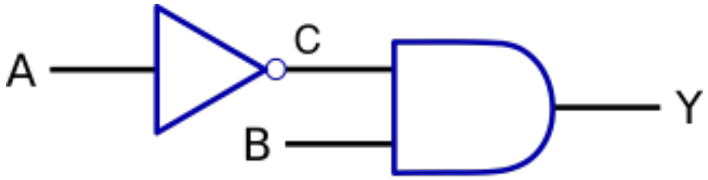
It is an OR gate that flows into a NOT gate. If A or B are on then C will be on. If C is on then the NOT gate will invert that switch and turn it off.

Writing a truth table is often a good idea to see all the different combinations and allows us to work out what is going on more easily.

INPUT A	INPUT B	OUTPUT C	OUTPUT Y
1	0		
0	0		
1	1		
0	1		

So we can see that as long as there is an input in A or B the final result will be that Y is off. Only when A and B are both off will the output Y be on.

Lets have a look at another example.
Here we have a NOT gate moving into one of the inputs of an AND gate. So lets look at our truth table for this.



INPUT A	INPUT B	OUTPUT C	OUTPUT Y
1	0		
0	0		
1	1		
0	1		

MEMORY

Computers need to remember a lot of data. This includes all the programs that are currently running, all the data associated with those programs, along with data to do with the computer's current settings, user input and output. All this data is stored in the computer's memory. There are two types of computer memory, **RAM** and **ROM**.

RAM stands for Random Access Memory. It is called random access memory because the data stored in it can be accessed in any order. ROM stands for Read Only Memory.

Complete the table below for the differences between RAM and ROM.

RAM	ROM

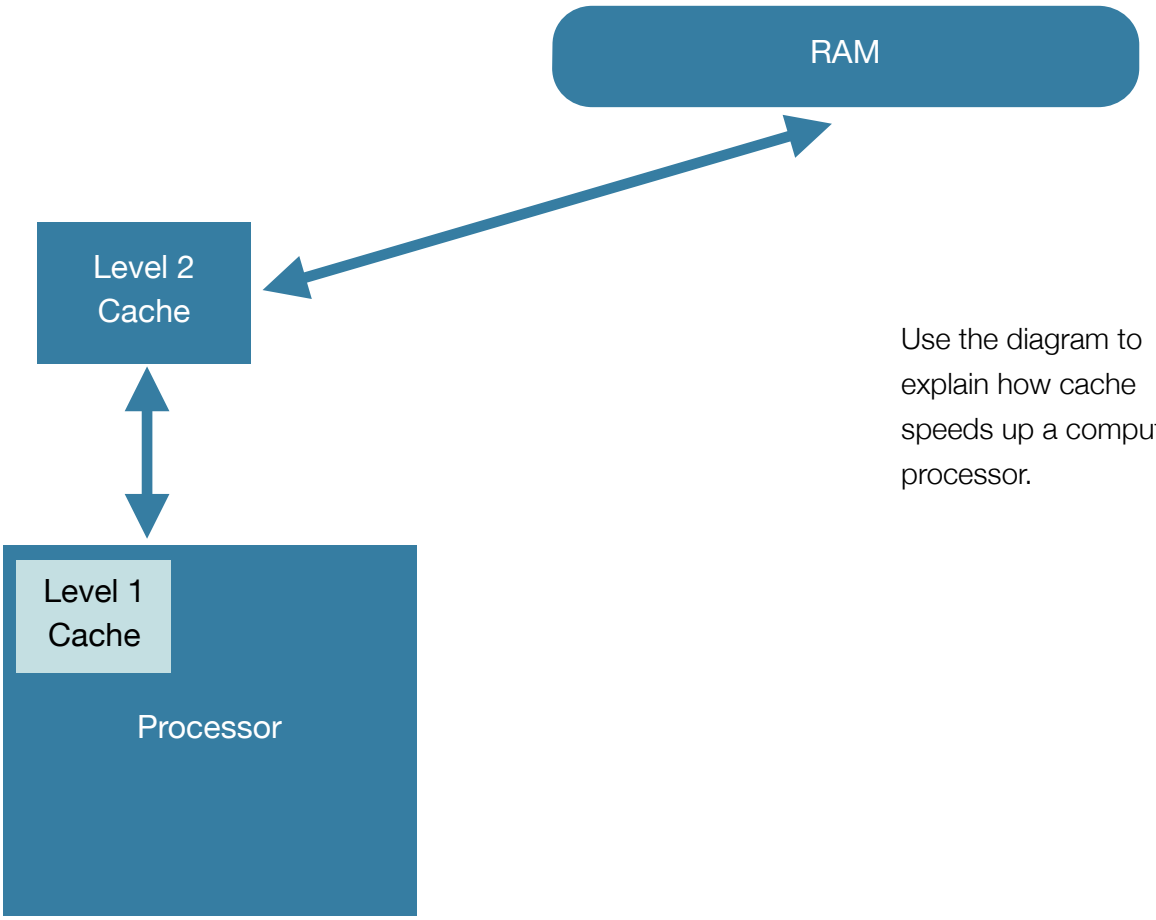
VIRTUAL RAM

Modern operating systems have a way of using the hard disc to extend the amount of RAM available to the computer. This virtual memory enables computer systems to act like they have more RAM than they have by using the hard disc.

Reading and writing from the hard disc is much slower than using RAM, so one way to increase the speed of a computer system is to have more RAM and rely less on virtual memory.

CACHE MEMORY

This type of RAM is usually made from faster more expensive chips than the computer systems main memory and is located either in the CPU or close to it. It is used to store data or instructions from commonly used parts of RAM.



Use the diagram to explain how cache speeds up a computer processor.

INPUT & OUTPUT DEVICES

Input and output devices allow us to communicate with and control computer systems and enable them to communicate with us in ways we can understand. There are a variety of different input and output devices, each suited to a particular job.

INPUT DEVICES

Device	Description
Keyboard	The keyboard is probably the most common type of input device on a computer system. The keyboard is inspired by mechanical type writers, and still adopts the QWERTY layout of keys. Pressing a key on a keyboard to input some data. Sometimes the key press creates a letter on the screen, while a combination of keystrokes can cause a more complex action.
Mouse	
Microphone	
Camera	

OUTPUT DEVICES

Output devices convert the binary data stored in the computer into a form we can understand.

Device	Description
Screen/Monitor	
Speakers	
Printer	
Vibration	

STORAGE DEVICES

Why we need to store?

Computers need computer programs to run and data to manipulate. When the computer system is working, these are stored in the memory or RAM. When a computer system is turned off, all the programs and data stored in RAM are lost. If you had to type in a computer program every time you wanted to use it, it would be a very slow and tedious task. Some modern computer programs can be millions of lines of code long. Entering a document over and over again would also be a waste of time.

Computers need a way of storing data so that it can be loaded into RAM quickly when the computer system is turned on again. We also need to be able to transport data from one computer to another. Computer systems have different ways of storing data. These ways each have their advantages and disadvantages and can hold different amounts of data.

Magnetic Discs

Most computer systems have a hard disc drive. This is used to store the operating system, programs and data and is usually located inside the computer system itself. The hard disc is a platter of metal that can be magnetised. The disc spins rapidly and arm can move across the disc to read or write data. In some hard discs there may be more than one platter to increase the storage capacity.

Advantages

Disadvantages

Optical Discs

These drives use lasers to read from an optical disc such as a CD, DVD or a Blu-ray disc. The disc is removable and so can be used in a number of computers. Many optical discs are read only. Once the data has been encoded on the disc, it cannot be altered. It is often used to store the installation program for software. So a DVD disc is used to install or copy the important files onto a computer's hard drive. Once this is done the DVD is not needed, unless you need to install the software again.

Advantages

Disadvantages

Solid State

These are erasable ROM chips that can be wiped and written to electronically, but when the power is off they retain the data stored on them. These discs were initially used for removable storage for portable devices such as digital cameras. The removable discs have a limit to their capacity due to their size. They do have a limit to how many times they can be erased and re-written to, but advances in technology make the latest drives comparable with hard discs in terms of life span.

Advantages

Disadvantages

ASSESSMENT CRITERIA

In this topic you should be able to:

a) state the purpose of the CPU,describe the function of the CPU as fetching and executing instructions stored in memory and explain how common characteristics of CPUs such as clock speed, cache size and number of cores affect their performance.

b) explain why data is represented in computer systems in binary form

c) understand and produce simple logic diagrams using the operations NOT, AND and OR, produce a truth table from a given logic diagram.

d) describe the difference between RAM and ROM and explain the need for ROM in a computer system. Be able to describe the purpose of RAM in a computer system and explain how the amount of RAM in a personal computer affects the performance of the computer. Be able to explain the need for virtual memory,describe cache memory and describe flash memory. Be able to discuss how changes in memory technologies are leading to innovative computer designs.

e) understand the need for input and output devices and describe suitable input devices for a wide range of computer controlled situations as well as describe suitable output devices for a wide range of computer controlled situations. Be able to discuss input and output devices for users with specific needs.

f) explain the need for secondary storage and describe common storage technologies such as optical, magnetic and solid state. Be able to select suitable storage devices and storage media for a given application and justify their choice using characteristics such as capacity, speed, portability, durability and reliability.

Assessment 3 Criteria

Grade	Description	Achieved?
F	Have very basic knowledge of the CPU and Binary Logic gates.	
D	Have basic knowledge of the CPU and Binary Logic gates.	
C	Have a good understanding of Logic gates and a some knowledge of the CPU and factor that effect its speed.	
A	Have an excellent understanding of logic gates and the CPU and the factors that effect its performance in a computer system.	

Targets

Target	Need to achieve
Need to be able to state the purpose of the CPU,describe the function of the CPU as fetching and executing instructions stored in memory and explain how common characteristics of CPUs such as clock speed, cache size and number of cores affect their performance.	
Need to be able to understand and produce simple logic diagrams using the operations NOT, AND and OR, produce a truth table from a given logic diagram.	

Assessment 4

Grade	Description	Achieved?
F	Can recall, select and communicate a basic knowledge and understanding computer hardware.	
E	Have a basic knowledge and understanding of the function, application merits and implications of some computer hardware.	
D	Have a reasonable knowledge and understanding of the function, application merits and implications of some computer hardware.	
C	Have a good knowledge and understanding of the function, application merits and implications of a range of computer hardware.	
B	Can recall, select and communicate a fairly thorough knowledge and understanding of the function, application, merits and implications of a broad range of computer hardware.	
A	Can recall, select and communicate a thorough knowledge and understanding of the function, application, merits and implications of a broad range of computer hardware.	

Targets

Target	Need to achieve
Need to be able describe the difference between RAM and ROM and explain the need for ROM in a computer system. Be able to describe the purpose of RAM in a computer system and explain how the amount of RAM in a personal computer affects the performance of the computer. Be able to explain the need for virtual memory,describe cache memory and describe flash memory. Be able to discuss how changes in memory technologies are leading to innovative computer designs.	
Need to be able understand the need for input and output devices and describe suitable input devices for a wide range of computer controlled situations as well as describe suitable output devices for a wide range of computer controlled situations. Be able to discuss input and output devices for users with specific needs.	
Need to be able explain the need for secondary storage and describe common storage technologies such as optical, magnetic and solid state. Be able to select suitable storage devices and storage media for a given application and justify their choice using characteristics such as capacity, speed, portability, durability and reliability.	

ASSESSMENT 3

1. Lawrence is buying a new computer. He is comparing two computers. The first one has these specifications.

   Quad-Core and Dual GPU
   3.7GHz Quad-Core Intel Xeon E5 processor
   10MB of L3 cache
   12GB 1866MHz DDR3 ECC memory
   Dual AMD FirePro D300 with 2GB GDDR5 VRAM each
   256GB PCIe-based flash storage

   a. Explain what is meant by Quad core. (1)

   b. Explain what is meant by cache. (1)

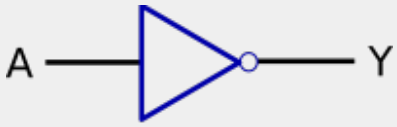
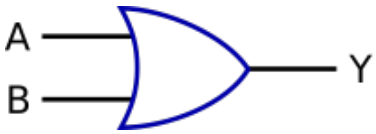
   c. Explain what is meant by clock speed (1)

He is also looking at this computer.

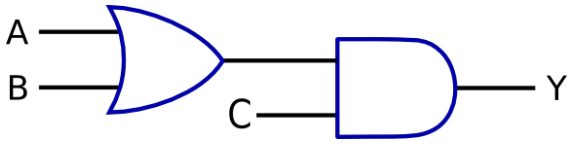
6-Core and Dual GPU
3.5GHz 6-Core Intel Xeon E5 processor
12MB of L3 cache
16GB 1866MHz DDR3 ECC memory
Dual AMD FirePro D500 with 3GB GDDR5 VRAM each
256GB PCIe-based flash storage

d. Which processor will perform better and why? (2)

2. What are the following logic gates? (3)

Gate Diagram	Name
	
	
	

3. Complete the truth table for the following logic gate diagram.(8)



A	B	C	Y
1	1	0	
1	0	0	
0	1	0	
0	0	0	
1	1	1	
1	0	1	
0	1	1	
0	0	1	

ASSESSMENT 4

1. What is the difference between RAM and ROM? Complete the table. (4)

Feature	RAM	ROM
Data wiped when turned off		
Data can be changed		
Used as the computer's main memory		
Used to store a computer's BIOS		

2. Melissa's computer has 4Gb RAM and has been running slow. Rebecca tells Melissa it is because she is running a lot of programs at once and is using a lot of Virtual RAM. What is virtual RAM and how could Melissa use less of it to speed her computer up? (3)

3. A smart phone has input and output devices on them. Which device are the following.(6)

Device	Input device	Output device
Home button		
Screen		
Camera		
Volume buttons		
Vibration alert		
Microphone		

4. A computer has accessibility options to help those who have disabilities to use the computer. How could these options help someone who is visually impaired? (3)

5. Which storage device is most suitable for the following tasks. (3)

Task	Storage device
Store computer programs for everyday use	
Transport documents between school and home	
Distribute software to customers	
Record pictures from a digital camera	
Back up photographs	
Store files for access on a network	

6. What is the difference between primary storage and secondary storage?(1)

7. Explain how cache memory works to speed up a computer processor. (3)

COMPUTER SOFTWARE

software |ˈsɒf(t)wɛː|
noun [mass noun]
the programs and other operating information used by a computer. [as modifier] : *the software industry*.

WHAT IS SOFTWARE?

Without software to make them work, computer systems are just electronic circuits without instructions telling them what to do.

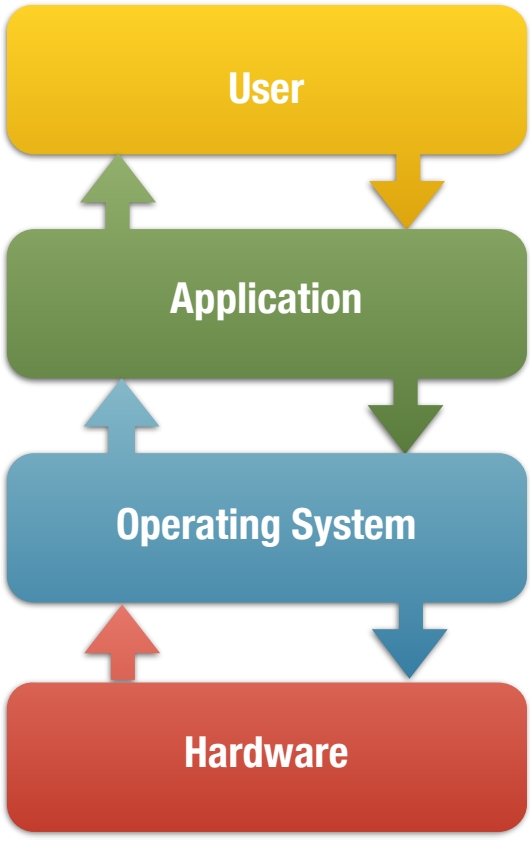
Software is the why we use a computer. These are the programs that allow us to do something useful with our computer.

OPERATING SYSTEMS

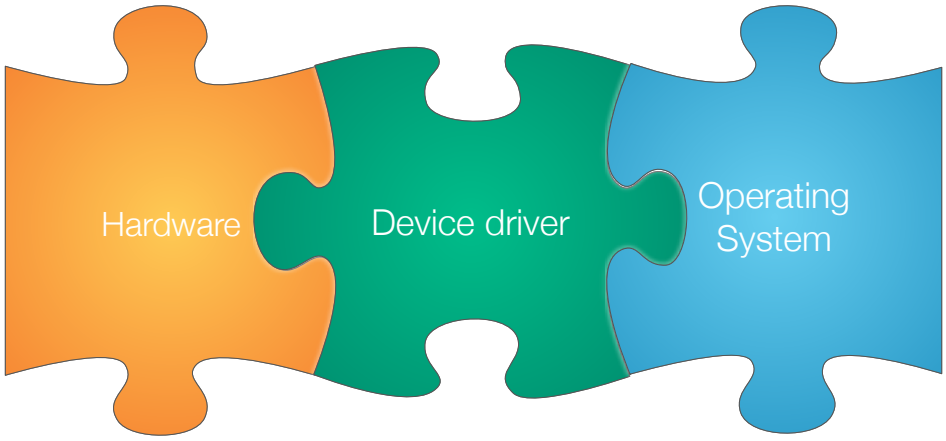
Most modern computer systems, from laptops to phones to games consoles, need to have some software that makes the hardware work properly. This is called an **Operating System** (OS).

Can you name some operating systems?

The Operating System (OS) allows the programs that run on the computer to interact with the different hardware in a consistent way. When you save a document to a disc, you don't need to worry about whether it is a hard disc from one manufacturer or a solid state drive from another. The way the data is written to these discs is different, but the OS hides these differences from the user and the programmer who wrote your application.



The OS enables your computing device to communicate with the different hardware that can connect to your computer, from disc drives and printers to monitors and network connections. When you need to use these different devices the OS provides a consistent way to use them.



When you get a new piece of hardware you will get a driver that enables the OS to communicate with it. So when you when you want to print a document, the OS loads the printer driver for the printer you want to use. It provides a similar set of options no matter which printer you use. There may be some options though that are specific to each printer.

When you want to save a document to a drive the Operating System takes care of that. It uses the appropriate device driver for the hardware and passes the document data to the driver. The driver takes that data and gives instructions as to how to save that data to the device. These instructions would be different if the data is being saved to a hard drive or a solid state USB memory stick or a writable CDR. The Operating system gives the user the same interface and experience, even though how the data gets saved may be different each time.

If there is no device driver available for a piece of hardware then it will not work and is not compatible with your Operating System.

INTERFACES

The OS provides the interface for the user to interact with the computer system. There are different types of interfaces.

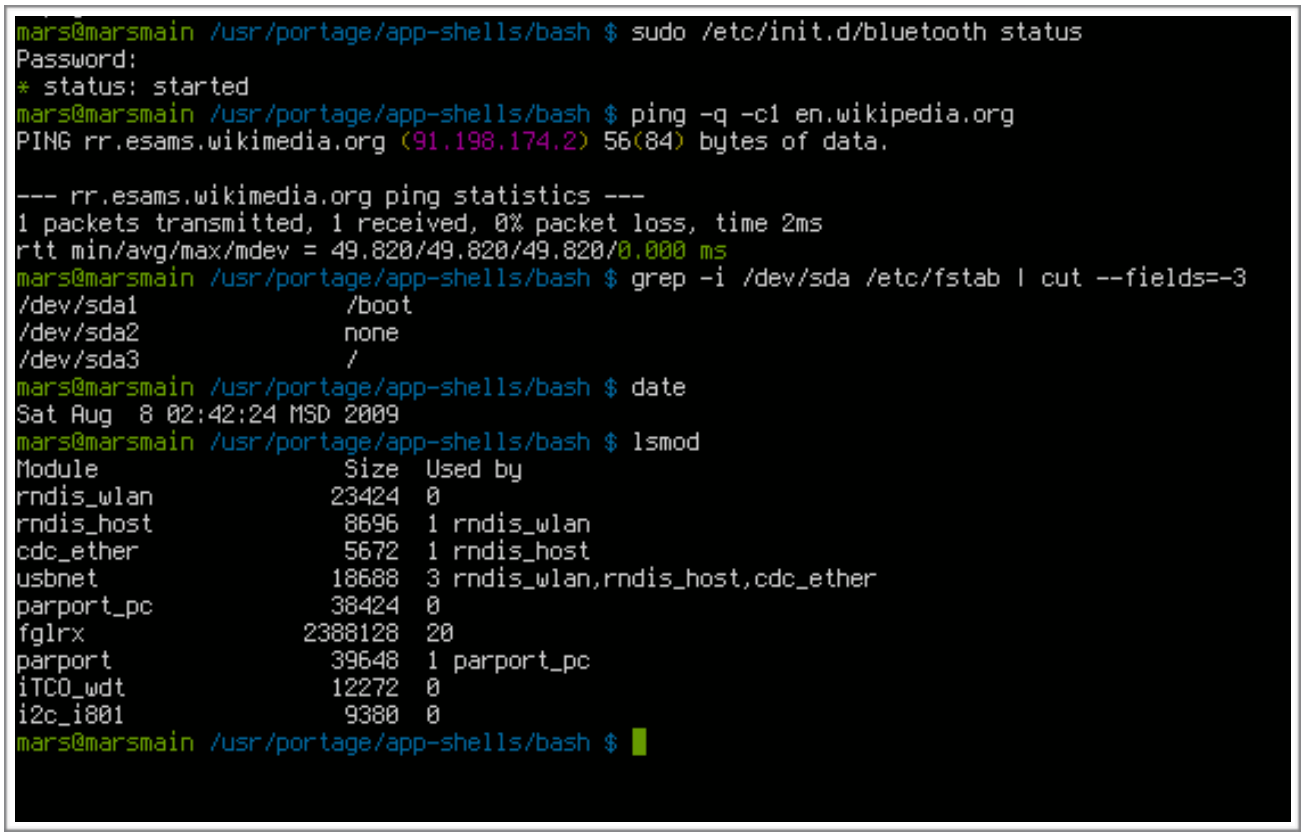
Below is the electronic program guide (**epg**) for Sky+

What type of interface is this?

Explain how the interface is used to control this computer system.

What are the advantages and disadvantages of this type of system.

This type of interface used to be the only interface computers could use. Now-a-days it is used mainly by experts and computer technicians to perform tasks.

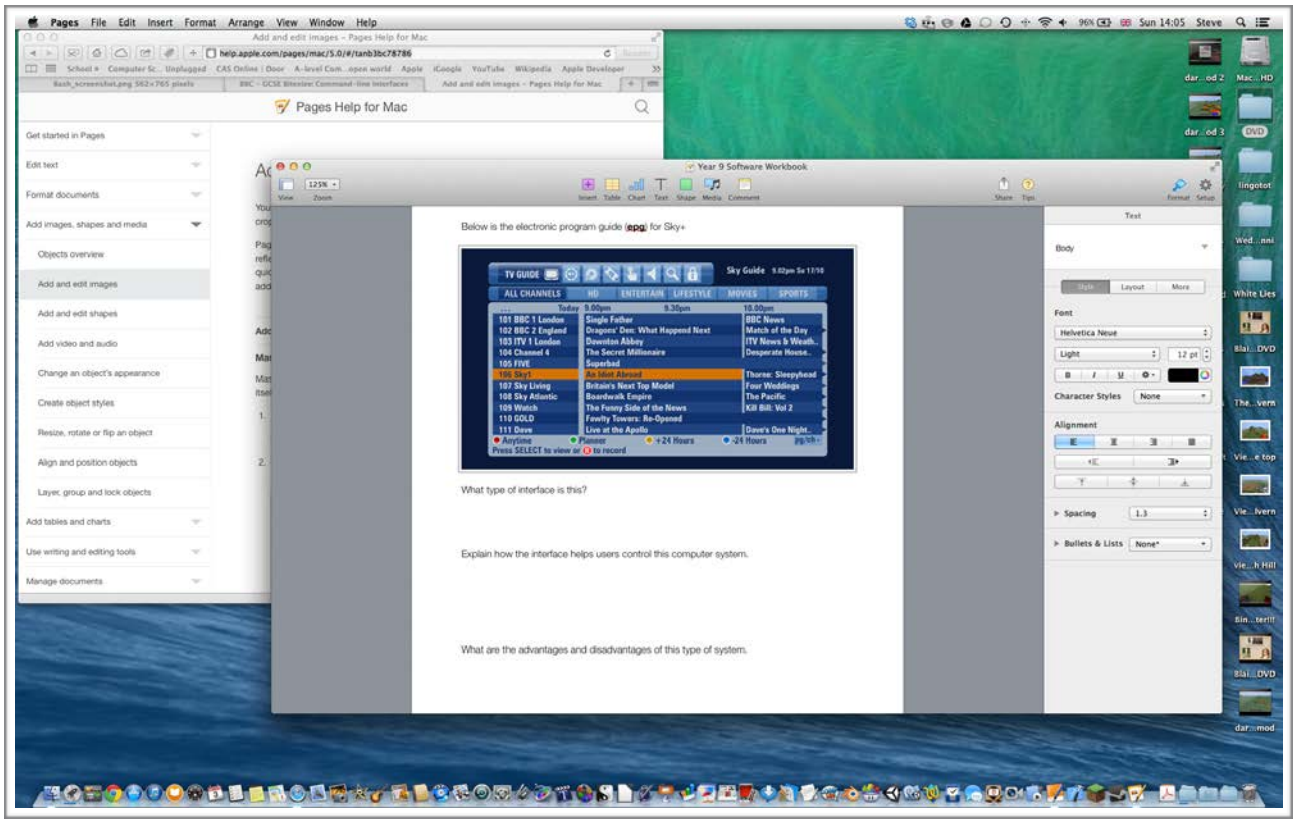


What type of interface is this?

Explain how the interface is used to control this computer system.

What are the advantages and disadvantages of this type of system.

This type of interface is one you are most used to seeing. This type of user interface is common on modern desktop and laptop computers. Tablets and smartphones may have a touch sensitive version of this interface.



What type of interface is this?

Explain how the interface is used to control this computer system.

What are the advantages and disadvantages of this type of system.

MANAGING MEMORY

The OS manages how memory is given to applications so they do not clash. When you start a new program or load a file the OS assigns each its own computer memory space so they do not interfere with each other.

What type of computer memory are computer programs loaded into?

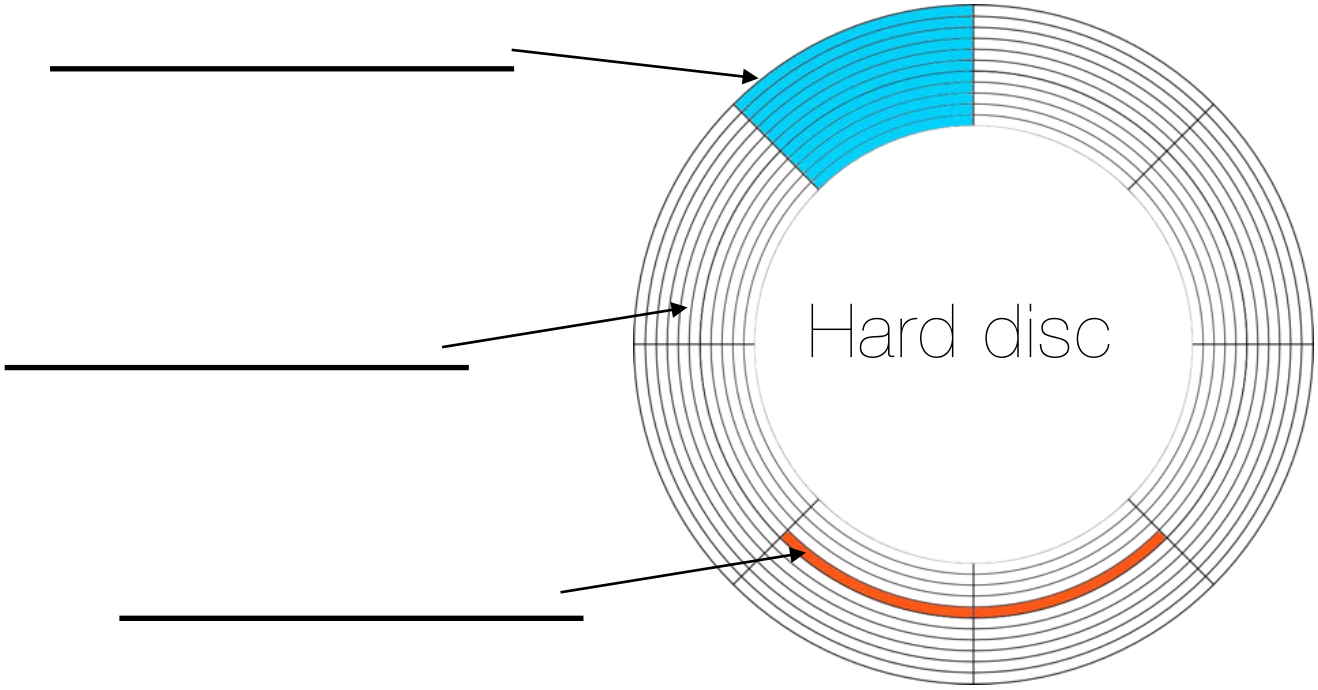
What is the size of computer memory measured in?

MANAGING STORAGE

When the computer is turned off all data is wiped from the computer's memory. So programs and data can easily be loaded back into memory they are stored.

What type of devices can be used to store programs and data for computer systems?

Before a storage device can be used it needs to be formatted before it can be used. The OS does this. When a hard disc is formatted. This breaks the disc down into chunks that the OS can address. Each region can store some data and each region has an address so the OS can read and write data.



SECURITY

The OS also deals with system security. This makes sure that only certain users can perform particular actions like install new software and delete files. Each user has a username and a password and the OS can give each user permissions to be able to carry out various tasks.

UTILITY SOFTWARE

There are some programs that come with the OS or that can be bought separately, that can help keep the computer running smoothly. There are a number of different types of utility software.

There are a number of types of utility software.

ANTI-VIRUS SOFTWARE

This software scans the computer for viruses and removes any found. It can also prevent any new viruses from infecting the computer.

What is meant by a computer virus?

What types of things could a computer virus do?

Why must Antivirus software be kept up to date?

FIREWALL

When you connect to a network such as the Internet, there is data leaving your computer and data returning. A firewall is software (or sometimes hardware) that checks data travelling along the network connection and blocks it if is not allowed.

How might a firewall be used in school to protect students?

How does a firewall help prevent you from being attacked by hackers?

SPYWARE PROTECTION

Some software that you install monitors what you do without you knowing. It may monitor your Internet use or log your key presses.

What type of data could the spyware monitor?

DISK DEFRAGMENT

When you add files and programs to a new computer it can often slow down. This is often due to the the way some OS's save files. Each sector on the hard disc is capable of holding files of a certain size. If a file is bigger than one sector it may take up a number of sectors. Sometimes when the OS saves a file it starts saving it some sectors but runs out before the file is completely saved. It then breaks up the file and saves the rest in a different part of the hard drive. This means that the file is in fragments. Reading the file can be slow as the mechanical read/write heads on the drive need to move to different parts of the disc. Defragmenting a drive moves the fragments so they are all together on the disc.

Draw what the files in a hard disc may look like in a fragmented drive.

Draw what the disc would look like after it has been defragmented.

TYPES OF SOFTWARE

OFF THE SHELF SOFTWARE

Most, if not all the software on your computer will be **off the shelf** software.

Most people start with software that has been written by someone else, usually a software company, that designs software to sell to a mass market. This software includes programs like image editing packages and office applications like word processors, spreadsheets and databases. These programs have mass appeal because they can be used for a variety of tasks. A word processor for example can be used to write a thank you letter to grandma, a school report or your next novel. As result these types of software packages are known as general purpose software for their ability to perform a number of related tasks.

SOFTWARE	USAGE
Word processor	Reports, letters, books, scripts

The price and availability of off the shelf software is often low. The more specialised the market for that type of software, the higher the price, due to the fact that fewer people would buy the software. A simple word processor like Apple's Pages may cost a few pounds while Microsoft Word has more features and so costs more.

The advantages of *off the shelf software* are:

The disadvantages of *off the shelf software* are:

BESPOKE SOFTWARE

Sometimes the software available for purchase just doesn't meet the needs of what you require. In these instances you can have the software custom written for you needs. There are considerable challenges and costs involved but the result is that you get a piece of software that does exactly what you want. This custom designed software is known as bespoke software.

The advantages of *bespoke software* are:

The disadvantages of *bespoke software* are:

OPEN SOURCE V PROPRIETARY SOFTWARE

Proprietary software is software that you buy from a company. They write the programming code to make the application and this code is then compiled to produce the binary executable program that they sell on disc or as a download. You cannot look at the code that was used to make the program. That code belongs to the software development company that wrote the program. They will often guard this code as it makes sure that the techniques they used cannot be used by other people freely. The company often wants to guard it their code so as to have a competitive advantage over other companies. A lot of the programs that you have bought will be proprietary. If you want a feature adding to the software, or you have found a bug, then you need to wait for the software developer to do that. This may take some time and in the case of new features, may never happen. Proprietary software will often be developed behind closed doors, so that customers do not know what features are being developed in new versions of the software and when they may arrive. Proprietary software can often lock users into using that software, making sure that data cannot be transferred easily to other programs, especially those of a competitor. This makes it difficult to change to a different program.

What is Open Source Software?

Some programmers create programs and then share the code they used with other people. In this way the source code is open and anyone can see how it works, make changes and improvements, contributing to the continued development of the software. Open source software is often free, and can have hundreds of developers around the world contributing to the development of the software. There are many open sources projects, many trying to mimic proprietary applications.

The advantage of open source software is that you can download the source code and see how it works. Changes can be made to give the software the features you want without having to write a program from scratch.

Many, (though not all) open source programs have many developers from all over the world working on them. As there are so many developers looking at the code and checking it, bugs get found and fixed more rapidly than proprietary software. It can be more quickly updated. The web browsers Whilst some of the big open source applications like Blender and Linux have books written about them, some of the smaller projects have very little in the way of documentation, let alone a published book or tutorial.

Open source projects often have a roadmap published showing a plan for when features are going to be added. This can make it easy to see when an important feature may be added. Some open source projected are released before being version 1 and so may be lacking some features, and there may still be bugs in the application.

SOFTWARE

There is a great deal of open source software that can be as good as or sometimes better than proprietary software. Open source software is free.

Proprietary Software	Open Source Equivalent
Microsoft Windows	
Microsoft Office	
Adobe Photoshop	
Adobe Illustrator	
3DS Max	
Microsoft SQL Server	
Adobe Audition	
Adobe InDesign	
Microsoft Internet Explorer	

ASSESSMENT CRITERIA

In this topic you should be able to:

a) explain the need for the following functions of an operating system: user interface, memory management, peripheral management, multi-tasking and security

b) describe the purpose and use of common utility programs for computer security (antivirus, spyware protection and firewalls), disk organisation (formatting, file transfer, and defragmentation), and system maintenance (system information and diagnosis, system cleanup tools, automatic updating)

c) discuss the relative merits of custom written, off the shelf, open source and proprietary software.

Assessment 5 Criteria

Grade	Description	Achieved?
F	Can recall, select and communicate a basic knowledge and understanding of computer operating systems and their functions.	
D	Can recall, select and communicate a fairly good knowledge and understanding of the function, application merits and implications of a range of computer operating systems and their functions.	
C	Can recall, select and communicate a good knowledge and understanding of the function, application merits and implications of a range of computer operating systems and their functions.	
A	Can recall, select and communicate a thorough knowledge and understanding of the function, application, merits and implications of a broad range of computer operating systems and their functions.	

Targets

Target	Need to achieve
Need to be able to explain the need for the following functions of an operating system: user interface, memory management, peripheral management, multi-tasking and security with examples.	

Assessment 6 Criteria

Grade	Description	Achieved?
F	Can recall, select and communicate a basic knowledge and understanding of software and related issues.	
D	Can recall, select and communicate a fairly good knowledge and understanding of the function, application merits and implications of a range of software and related issues.	
C	Can recall, select and communicate a good knowledge and understanding of the function, application merits and implications of a range of software and related issues.	
B	Can recall, select and communicate a fairly thorough knowledge and understanding of the function, application, merits and implications of a broad range of software and related issues.	
A	Can recall, select and communicate a thorough knowledge and understanding of the function, application, merits and implications of a broad range of software and related issues.	

Targets

Target	Need to achieve
Need to be able to describe the purpose and use of common utility programs for computer security (antivirus, spyware protection and firewalls), disk organisation (formatting, file transfer, and defragmentation), and system maintenance (system information and diagnosis, system cleanup tools, automatic updating)	
Need to be able to discuss the relative merits of custom written, off the shelf, open source and proprietary software.	

ASSESSMENT 5

1. Which of the following is NOT a function of a modern operating system? (6)

Function	Carried out by the Operating System	NOT carried out by the Operating System
Controlling hardware		
Creating a user interface		
Scanning files for viruses		
Defragmenting hard drives		
Allocating memory to programs		
Creating a firewall to protect against unauthorised network access		

2. A low powered computer system is used to control a ticket machine. Which type of user interface would best be suited for the ticket machine and why? (3)

3. A computer technician controls a network switch using a command line interface. What are the advantages and disadvantages that a command line interface have? (4)

   Advantages

   Disadvantages

4. Ellie has bought a new scanner for her computer but cannot get it working. What does she need to install to get her new hardware working with her Operating System and why? (2)

5. Before a hard drive can be used it must be formatted. What does this mean? (2)

6. An Operating System can add security to a computer system. The users of a computer system have their own user accounts. How does having different user accounts provide security for the computer system? (2)

ASSESSMENT 6

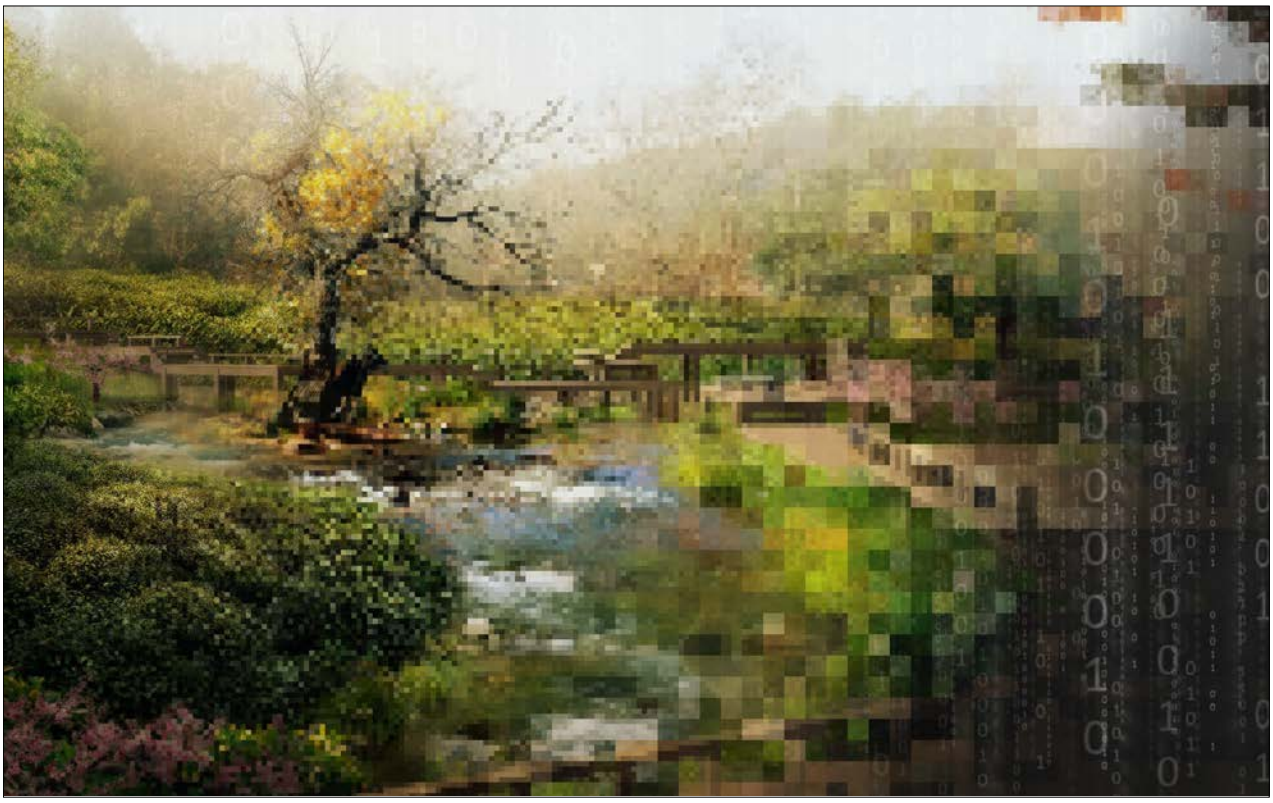
1. What is meant by Utility software? (1)

2. Antivirus and Firewall software are two examples of utility software. Explain how each protects your computer from harm. (4)

3. Defragmentation software can keep your hard drive running quickly. Explain how it works. (3)

4. What is the difference between bespoke software and 'Off-the-shelf' software?(4)

5. What are the advantages and disadvantages of proprietary software over open source software. (5)



DATA REPRESENTATION

data |ˈdeɪtə|
noun [mass noun]
facts and statistics collected together for reference or analysis:
• the quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media.

THE NEED TO REPRESENT DATA DIFFERENTLY?

There are 10 types of people in the world. Those who understand binary and those who don't.

If that quote doesn't make any sense now then hopefully by the end of this chapter it will.

In primary school when learning about place value you may have put headings above numbers like the table below.

H	T	U
		5
	1	2
2	5	4

Can you remember what do the headings mean? They stand for hundreds, tens and units. The smallest digit that a column can hold is 0 while the largest is 9. If 1 is added to a column then that column goes back to 0 and 1 is added to the next column. So when 1 is added to 9 this becomes 10. So we now have 1 ten and no units.

How data is stored in computers

Computers are made up from millions of switches. These switches can be ON or OFF. Everything in a computer from numbers to text, from sounds to pictures must be converted into a series of ON's and OFF's.

Computer scientists often think of these switches as 0s and 1s.

0 = OFF

1 = ON

Each 0 or 1 is known as a binary digit or Bit.

Computers would be pretty useless if the biggest number it could deal with was the number 1 unless it had a way of storing larger numbers from a series of 0s and 1s. This is Binary. It is a way of storing numbers as a series of 0s and 1s.

BINARY

Introduction to Binary

Computers often group together 8 bits. This makes one byte.
Just like in denary (the number system we use) we often use column headings to remind us of the place value.

128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	1

This is the number 1. Each column heading is a power of 2.

How to convert from denary to binary

You often need to convert a number from denary into binary.
How to convert 37 into a binary number.
What is the biggest number that goes into 37 without going over. Looking at the grid 32 is the highest number, so we put a 1 in that column.

128	64	32	16	8	4	2	1
0	0	1	0	0	0	0	0

Now we take 32 from 37.
This leaves 5. Now we repeat the process.
4 goes into 5 without going over. So we put a 1 in the 4 column.

128	64	32	16	8	4	2	1
0	0	1	0	0	1	0	0

That leaves us with 1. So we can put a 1 in the 1 column and then this is our answer.

128	64	32	16	8	4	2	1
0	0	1	0	0	1	0	1

So 37 in binary is 00100101 or just 100101.

Converting binary numbers into denary

This is much easier. It is just a matter of adding up the columns which contain a 1.

Convert 01010110 into denary.

Put the numbers under the place headings.

128	64	32	16	8	4	2	1
0	1	0	1	0	1	1	0

So the answer is 64+16+4+2 = 86.

Exercise

Convert the following decimal numbers into an eight bit binary number

Convert this number to binary	128	64	32	16	8	4	2	1
5								
7								
17								
38								
39								
41								
46								
58								
69								
115								
128								
133								
134								
156								
160								
166								
203								
239								

Convert the following binary numbers into decimal.

00000011	
00010110	
00011011	
00100010	
00100111	
00101011	
00110000	
00110010	
00110100	
00110100	
01010110	
01100000	
01110000	
01111010	
10000110	
10001101	
10100011	
10101001	
11101101	
11110101	

Binary Addition

You may be asked to add two binary numbers together. You will not be asked to add numbers bigger than eight bits.

Binary addition is simpler than denary addition as there are fewer things to remember.

0 + 0 = 0

1 + 0 = 1

1 + 1 = 0 and carry 1

Adding two binary numbers

128	64	32	16	8	4	2	1	
0	1	1	0	1	0	1	0	+
0	0	1	0	1	0	0	1	

By following the simple rules we get the answer:

128	64	32	16	8	4	2	1	
0	1	1	0	1	0	1	0	+
0	0	1	0	1	0	0	1	
1	**0**	**0**	**1**	**0**	**0**	**1**	**1**	

You will never be asked to add up numbers that are more than 8 bits.
What happens if we need to carry a 1 after the 128 column?

128	64	32	16	8	4	2	1	
1	1	1	1	1	1	1	1	
0	0	0	0	0	0	0	1	+
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

The last carry digit has nowhere to go. This is an **overflow** leading to an incorrect answer.

Exercise

Add the following pairs of binary numbers. Answers as an eight bit binary number.

00000111	+	00000011	
00011000	+	00000101	
00100000	+	00011111	
01001110	+	00010110	
11001000	+	00111000	

HEXADECIMAL

Hexadecimal is another number system used in computer science. It is often used as a shorthand way of writing a binary number.

Hexadecimal is a base 16 number system. So the column headings are based on powers of 16.

16	U
1	0

This gives us a problem as the number 16 has 2 digits and number systems need to have just a single digit in each column.

16	U
0	10

So the number 10 above in base 16 is the same as 16 in denary, 1 sixteen and zero units. The problem arises when we have more than 9 units.

The example above us impossible. If we were to write down 010 in base 16 we would confuse it with the previous example.

The solution is to use letters instead of numbers. So the values that you can get in a column in base 16 are as follows.

Denary	Hexadecimal
0-9	0-9
10	A
11	B
12	C
13	D
14	E
15	F

So if we want to display the number 12 as a hexadecimal number we would write C. We would write 20 in hexadecimal as 14 and we would write 31 in hexadecimal as 1F (one 16 and 15 units).
How is this used as a short cut for a binary number?
Well look at the following binary number.

128	64	32	16	8	4	2	1
1	0	1	0	1	1	0	0

We can split this into two 4 bit chunks (nibbles) like this.

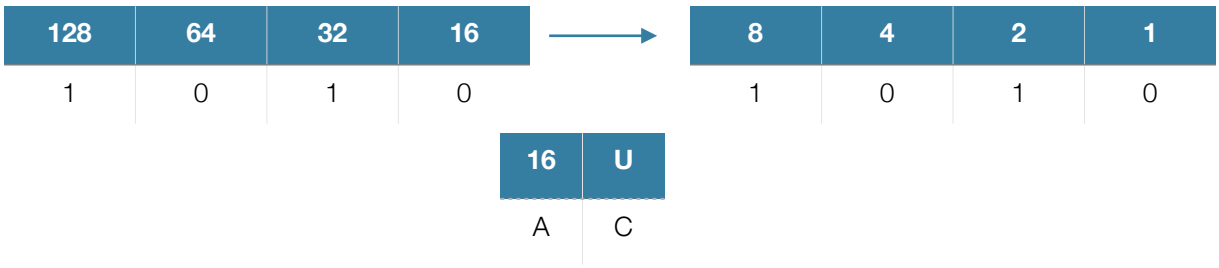
128	64	32	16	8	4	2	1
1	0	1	0	1	1	0	0

128	64	32	16
1	0	1	0

8	4	2	1
1	1	0	0

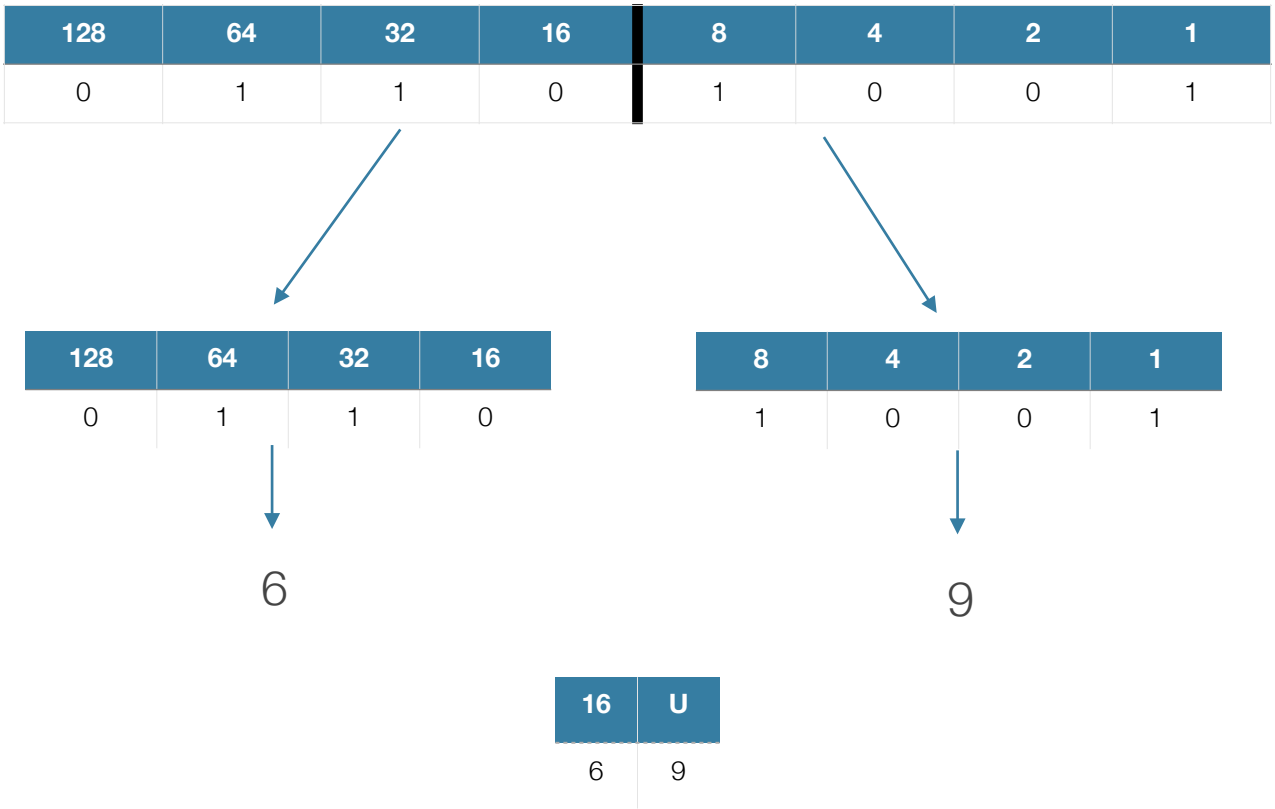
Looking at the right most digits we can see that it is the number 12 in denary. We can write this as the hexadecimal number C.
Now looking at the left most digits in the same way. We will deal with the column headings just like we did for the right most digits.

So 1010 in binary is ten in denary.
We would write this as A in hexadecimal. So the binary number 10101100 can be written more simply as AC in hexadecimal.



Remember that AC means:
So this means there are 10 sixteens and 12 units. This makes 160 + 12 = 172.
Checking this against the binary 10101100 we have 128 + 32 + 8 + 4 = 172

Lets look at another example. The number 01101001 in binary would result in:



Converting from denary to hexadecimal and back again

To convert a number from denary to hexadecimal we first divide the number by 16. So if we look at the denary number 75. If we divide 75 by 16 we get 4 remainder 11(16 * 4 = 64 so 75 - 64 gives us a remainder of 11). So the number in the 16s column is 4 and we have 11 units. Remember we need to use letters for denary numbers above 9. So 11 is B in hex.
So 75 in denary is the same as 4B in hexadecimal.
To convert a hexadecimal number into denary we need to first convert any letters into numbers. Then multiply the first digit by 16 and add on the units. So converting E6 into denary would be 14 x 16 + 6 = 230

Exercise

Convert these numbers into Hexadecimal.

10001100	
11110000	
11000011	
01111111	
00111100	

MEMORY SIZES

So we now know that the smallest piece of data that can be stored on a computer is one binary digit or Bit. This can only store two values, 0 and 1. We have already said that in computers bits are usually grouped in 8s to form one byte. What about larger measurements? Look at the table below.

Name	Size
bit	0 or 1
nimble	4 bits
byte	8 bits
kilobyte	1024 bits
megabyte	1024 kilobytes
gigabyte	1024 megabytes
terrabyte	1024 gigabytes

What unit of size would you typically measure the following files in.

File type	Typical size
Text file	bytes
Word processed document	
Picture from the Internet	
An MP3 file	
A Video file	

STORING NON-NUMERICAL DATA

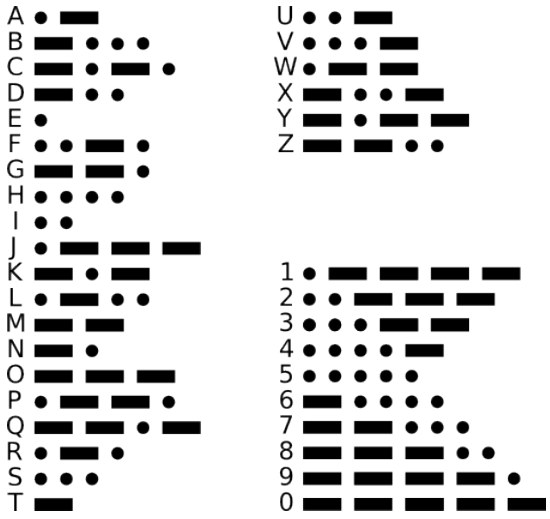
All non numerical data such as text, sounds, images and instructions are first converted into a number and then stored as a binary sequence. The computer deals with data depending on the instructions given to it.

TEXT

Character sets

Just like numbers, text needs to be stored as a binary code too. Each letter has a particular binary code. It is important for transfer of information that the binary codes used for each character are known between Operating Systems, so that data can be accurately transferred between computers no matter what type of computer system is used.
Character sets are nothing new.

Morse code has a character set to describe the codes used for letters and numbers. As each telegraph operator knew morse code it made it possible to transmit text in a binary form (dots and dashes).



When computers were developed, they needed a way to store text that could be encoded. The problem with morse code is that each character has a different length. The byte is the unit of data storage in a computer and so it using this unit that the text has to be stored.

ASCII

One of the first character sets created was ASCII. This stands for American Standard Code for Information Interchange. This encoded 128 characters in a 7 bit binary code. The characters encoded included the alphabet (uppercase and lowercase), numbers, punctuation marks and non printing characters such as a line break and a carriage return. The final bit of the eight bit byte was initially used as a check digit. Check digits are used to make sure that the data has been transferred correctly.
As computers became more popular and used internationally, problems arose with languages such as French and German which have accents on some of their characters. As 8 bit Operating Systems were becoming the norm then ASCII was extended to include other glyphs such as accented letters and mathematical symbols such as ÷, ≠ and π.

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH (start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX (start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX (end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT (end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ (enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK (acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL (bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS (backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB (horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT (vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF (NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR (carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO (shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI (shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE (data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1 (device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2 (device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3 (device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4 (device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK (negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN (synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB (end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN (cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM (end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB (substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC (escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS (file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS (group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS (record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US (unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Unicode

In the 2000's it became clear that ASCII did not have enough characters for all the symbols that needed to be used. Some languages such as Japanese and Mandarin have character sets that are much bigger than the latin character sets used by the west. Also some languages such as Arabic are read from right to left.

Unicode was developed to store letters as a 16 bit code. As more bits are used then more characters could be encoded. Unicode was designed to be large enough so that would it encompass all the characters in all the major languages of the world.

Most modern computer systems use Unicode to store text.

Remember that the letter is not actually stored, but a binary code to represent that character. When the computer reads that data, a computer program has to figure out which character to display on the screen for each binary code.

There is also a problem when storing numbers. The binary code for the digits 0-9 is not the binary numbers 0-9. The ASCII value for the character 5 is 53 in binary. In some computer programs data may be stored as text or as numbers. If a calculation needs to be done on numbers which have been stored as text characters, then the data will need to be converted into the right data type first.

Exercise

What is the character in ASCII if the binary value stored is:

Binary value	ASCII Character
01000001	
01100001	
01100100	
00110010	

IMAGES

Pixels

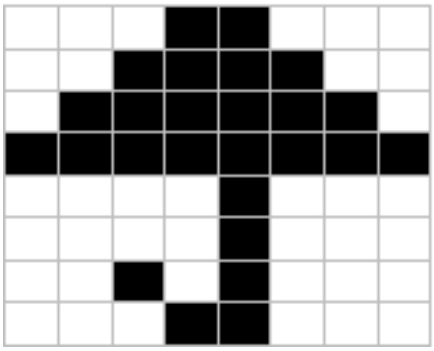
Images are broken down into tiny coloured squares called picture elements or pixels for short. Each pixel represents just one colour.

Different images can store different numbers of colours. A simple black an white image only needs to store two colours, black and white, and so an image could store the colours as a simple binary sequence.

Example

The following binary sequence could be used to store this simple picture of an umbrella.

0	0	0	1	1	0	0	0
0	0	1	1	1	1	0	0
0	1	1	1	1	1	1	0
1	1	1	1	1	1	1	1
0	0	0	0	1	0	0	0
0	0	0	0	1	0	0	0
0	0	1	0	1	0	0	0
0	0	0	1	1	0	0	0

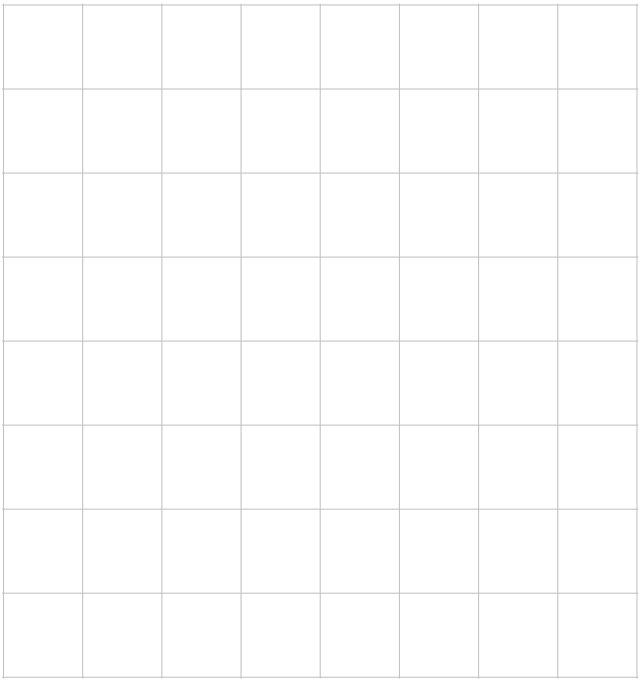


Shade in the image using the data below.

DATA

0	0	0	0	0	0	0	0
0	1	0	0	0	1	0	0
0	1	0	0	0	1	1	1
0	1	0	0	0	1	0	1
0	1	0	0	0	1	1	1
0	1	0	0	0	1	0	0
1	0	1	1	1	0	0	1
0	1	1	1	1	1	1	0

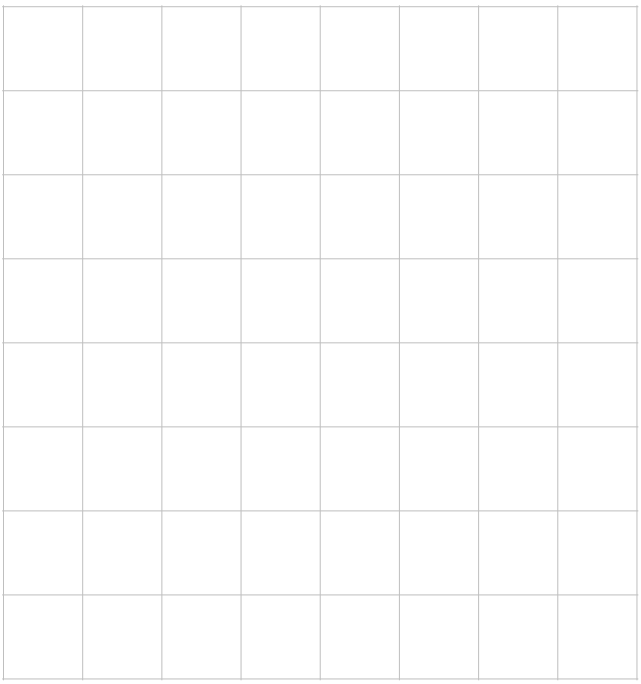
IMAGE



DATA

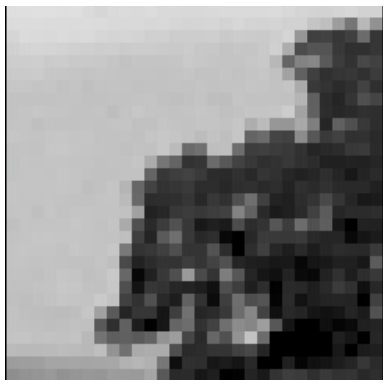
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
1	1	0	0	0	0	1	1
1	0	1	0	0	1	0	1
1	0	0	1	1	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	1	1	1	1	1	1	1

IMAGE

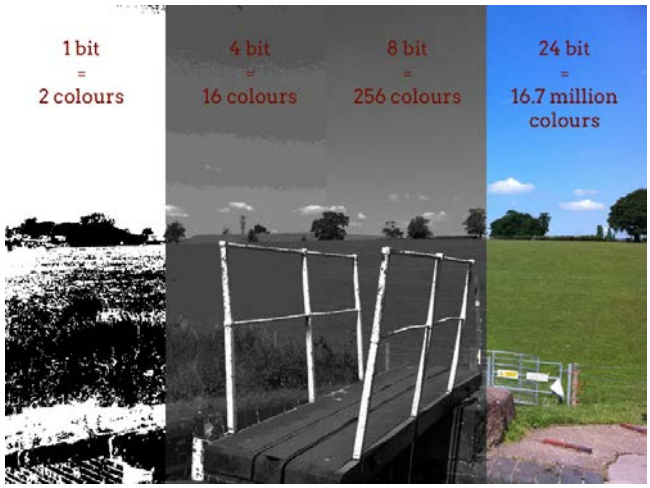


In the example above a 1 represents black and a 0 represents white.

If we want more colours then we need to use more data to represent more colours. If we use more bits to represent each colour then we can have more colours available to use. This is known as an image's colour depth.



To display photographic images on the screen 3 whole bytes (24 bits) are used to represent the colour of each pixel. This is split up into one byte for each of the primary colours of light, red, green and blue. This is because computer displays uses these primary colours of light to display all the different colours we see on the screen. By mixing the three colours with different intensities the display is able to show over 16 million different colours.



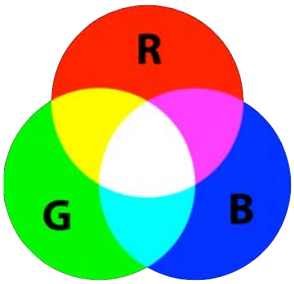
The amount of red, green and blue is usually stored as an 8 bit value, giving 256 levels of brightness for each colour (zero representing no colour and 255 representing the maximum brightness of that colour). So to represent bright yellow the values 255, 255,0 can be used to represent the brightness of red, green and blue.

Complete the table

No of Bits per pixel	No of possible colours
1	
4	
8	
24	

Image resolution

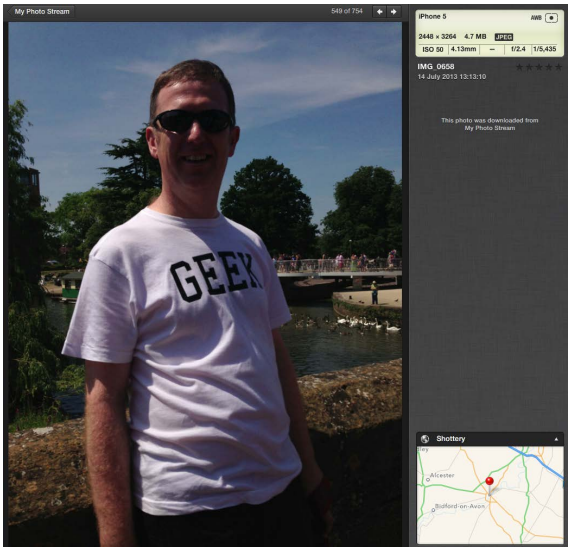
Image resolution is a measure of how much detail there is in the image. Resolution is defined as the ability to distinguish between two points. In a high resolution image it will be easier to distinguish between two dots close together, while in a low resolution image the two dots may become blurred into one shape. A high resolution image has smaller pixels and so can pack in more into a smaller space. This results in a sharper image, however the file will be larger as it requires more pixels and so more data needs to be stored.



Metadata

As well as the data about the pixels there is other data that is stored with the image that describes the file. This type of data is called metadata as it describes the image data. Most images contain some basic meta data such as the image height, width or colour depth.

Some digital cameras also store metadata in the photographs that are taken. This information may include data about the camera's settings when the image was taken, such as the focal length of the lens and the exposure settings. If the camera has GPS it may also store the data about where the image was taken too. Data stored in my photograph contains data about my camera settings, the file size and dimensions, the date and time it was taken as well as the GPS coordinates it was taken at.



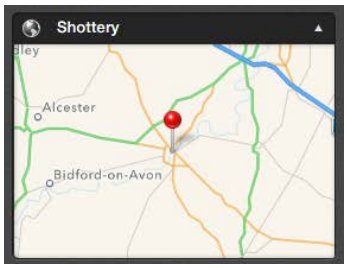
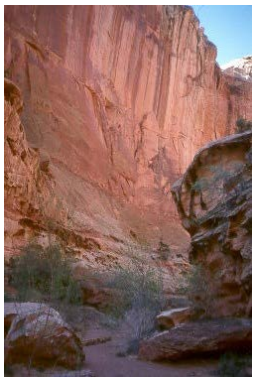


IMAGE FILES

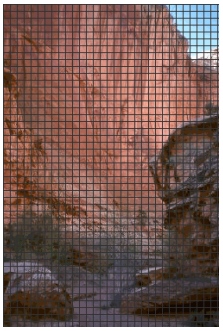
There are three main image files that are used on the Internet. All of them are designed to compress the image to make it smaller so that it be transmitted over the Internet faster. The files all compress data in different ways.

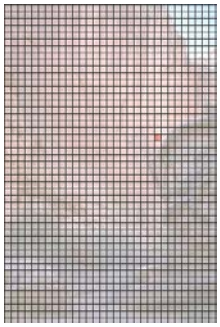
JPEGs

Jpeg files are usually used to store images with lots of colours and complex shading. These are generally photographs. Look at this photograph.



The image is split up into a grid. Each block on the grid is dealt with individually.





The image is split up into regions using a grid
Each block in the grid is dealt with on its own.

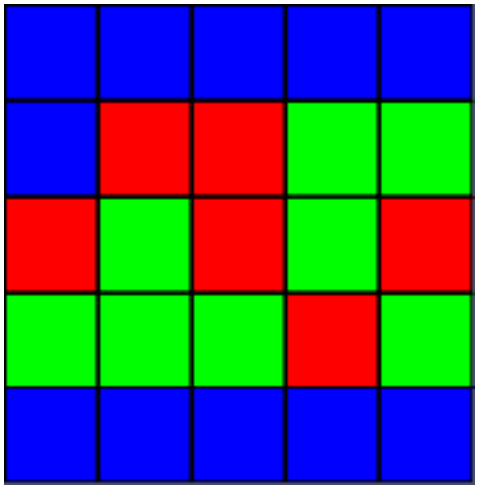
Original pixels

Compressed pixels

The shades of the colours are compared with their neighbours. If the shades are similar then they will be combined. This loses data and so a Jpeg is a lossy format.

GIFs

GIFs can only store a maximum of 256 colours, one of which can be transparent. This means that it works best for cartoon like graphics and logos. Look at the graphic to the left. If we assign values to the pixels where: Blue = x Red = y Green = z, now we can describe this image row by row. The first row is all blue, so five x's would represent the five blue pixels in the first row. The following rows are a little more complicated:



1: x-x-x-x-x
2: x-y-y-z-z
3: y-z-y-z-y
4: z-z-z-y-z
5: x-x-x-x-x

When a GIF is compressed, the description could look more like this:

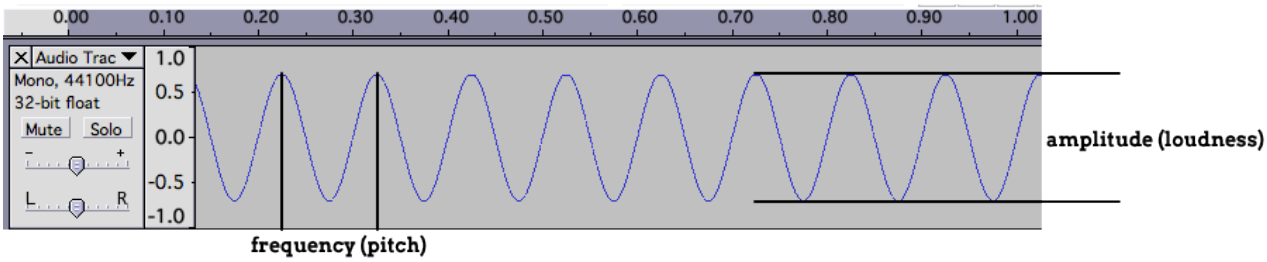
1: 5x
2: x-2y-2z
3: y-z-y-z-y
4: 3z-y-z
5: 5x

As you can see, longer stretches of a solid color make the file more compressible (lines 1 and 5 are the most compressed) and speckled images cannot compress (line 3 is not compressed at all). When the color changes with each pixel in a row, there is no shorter way to convey the information. So images with large blocks of the same colour compress very well. As data is not lost when the image is compressed the file format is lossless.

SOUND

Analogue Sound

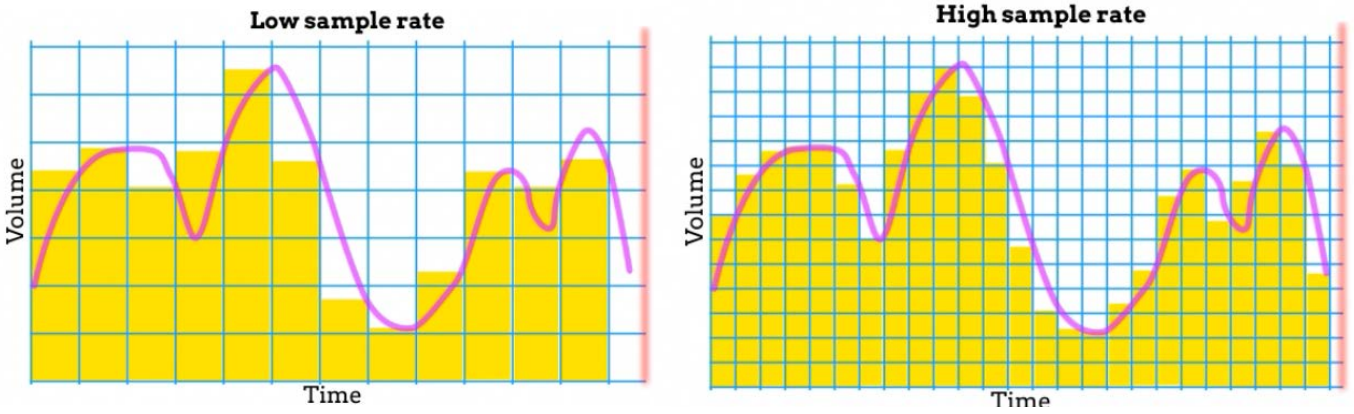
Sounds are analogue signals. This means that the sound wave has a range of values. Look at the blue sound wave below. The height of the wave (amplitude) is the volume of the sound. The distance between two peaks is known as the frequency and corresponds to the pitch of the sound.



The distance between each peak is known as the frequency and is measured in hertz. The height of the wave (amplitude) corresponds to the loudness.

Digital Conversion

The sound wave needs to be converted to into numbers that can be stored in binary. To convert an analogue sound into a digital sound, the computer samples the height of the sound wave a number of times a second.

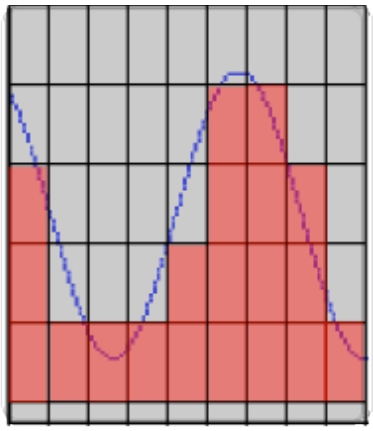


The number of samples in one second is known as the sample rate. This is measured in Hertz (samples per second) or more commonly Kilo Hertz (1000 Hz). A CD quality sound is sampled at 44kHz. This means the sound wave is checked 44,000 times a second and the height of the wave at that point is stored as a binary number. This is represented by the yellow bars. Notice that this does not follow the pink analogue line perfectly. The more times a sound wave is sampled in one second the closer to the original sound wave and the

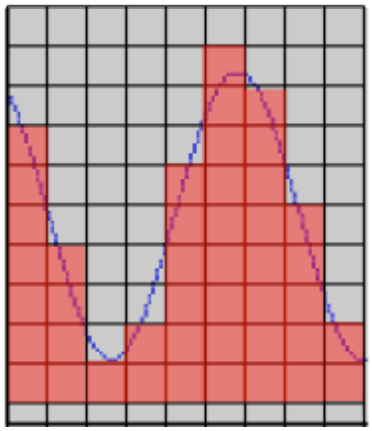
better it will sound. This however results in a larger file. When music is recorded in a studio it is often sampled at 192kHz.
Saving files such as MP3 and WAV files with a lower sample rate will compress a file. This is a lossy compression as data is lost in the re-sampling and cannot be brought back. MP3 files also saved take advantage of the way our ear works to combine two frequencies to make one without any perceivable loss of quality.

Another factor that determines the quality of the sound as it is digitised is the amount of data used to store the height of the wave. This is know as the **bit rate**.
A 2 bit number can only have 4 possible values. This would not accurately measure the different possible wave heights. If we used 8 bits there would be 255 different levels of volume that could be encoded. This would result in telephone quality sound. For music 16 bits are more commonly used, giving 65536 different possible values for the height of the wave. This can more accurately give a smoother transition between different volumes.

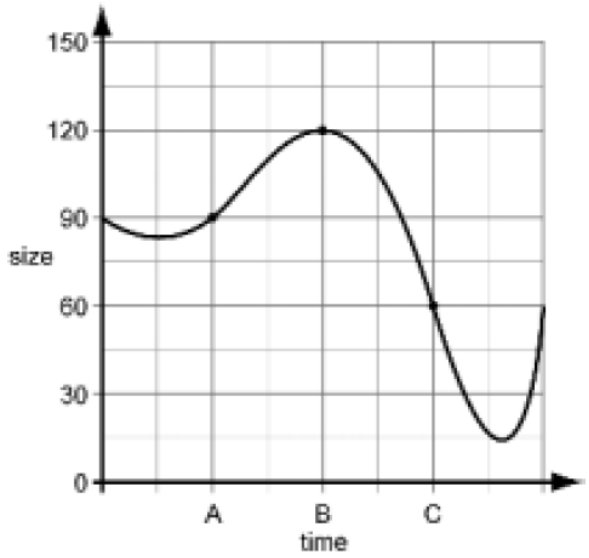
Imagine the diagram at the top shows a sound encoded so the height can either be 0,1,2,3 or 4. This does not give enough detail so the digitised sound does not mimic the sound wave closely enough.



The diagram below shows more detail so that the digitised sound more accurately follows the sound wave, even though the sample rate remains the same.



An artist is recording sound using a computer. The graph below represents the pressure wave of the sound being recorded.



At point A on the graph, the size of the sound wave is 90. This is stored digitally using the binary value of 0101 1010 (or 5A in Hex). Complete the table below to show how points B and C are stored:

	Point A	Point B	Point C
Size	90		
Binary value	01011010		
Hex Value	5A		

Explain how sampling intervals and compression can affect the size of a sound file and the quality of its playback. The quality of your written communication will be assessed in your answer to this question.

INSTRUCTIONS

Encoding Instructions

When the first computers were created they were just simple calculating devices. If you wanted to change what the computer did then you needed to rewire the computer.
In World War II an American scientist called John Von Neumann was thinking about this problem. He thought that there was no difference between data and a digital instruction. He thought that both data and the computer programs that work on that data could be stored in the computers memory. The instructions could determine which data to retrieve from which memory location and what to do with it. This is called a store-program computer and is the basis for modern computing.

Storing Instructions

Each computer processor understands a series of instructions. Each instruction is a binary sequence. Each processor has its own set of instructions that it understands. These instructions carry out actions on the data that is stored in the memory. This may mean moving data from memory to another location, such as a register in the processor, or adding data from two different locations together.

These instructions are located in one part of the computer's memory while the data is located in a different part. Both the data and the instructions can be accessed via the address of the memory location. The instructions have two parts to them. The instruction and the memory address of the data they are operating on. As these instructions and the memory addresses are both binary, this can cause problems for programmers who need to write instructions in this way.
Assembly code is a way of using short text commands and memory addresses instead of binary. This code can then be converted into binary by an assembler.

Example

LDR R1, [R5]
This LOADs the Register R1 with the value from location R5.
STR R1, [R6]
This STORES the value in register R1 into memory location R6.

The instructions LDR and STR will have specific binary bit patterns that the computer processor understands. When the computer comes across the bit patterns it knows how to follow that instruction. Each instruction is followed in turn. Some instructions tell the processor to jump to another location and carry out instructions from there.
Writing in assembly language is difficult and specific to the type of processor. Most computer programs are written in a higher programming language.

ASSESSMENT CRITERIA

In this topic you should be able to:

a) define the terms bit, nibble, byte, kilobyte, megabyte, gigabyte, terabyte

b) understand that data needs to be converted into a binary format to be processed by a computer.

c) convert positive denary whole numbers (0-255) into 8-bit binary numbers and vice versa

d) add two 8-bit binary integers and explain overflow errors which may occur

e) convert positive denary whole numbers (0-255) into 2-digit hexadecimal numbers and vice versa

f) convert between binary and hexadecimal equivalents of the same number and explain the use of hexadecimal numbers to represent binary numbers.

g) explain the use of binary codes to represent characters. Be able to explain the term character set and describe with examples (for example ASCII and Unicode) the relationship between the number of bits per character in a character set and the number of characters which can be represented.

h) explain the representation of an image as a series of pixels represented in binary and explain the need for metadata to be included in the file such as height, width and colour depth. Be able to discuss the effect of colour depth and resolution on the size of an image file.

i) explain how sound can be sampled and stored in digital form and explain how sampling intervals and other considerations affect the size of a sound file and quality of its playback.

j) explain how instructions are coded as bit patterns and explain how the computer distinguishes between instructions and data

Assessment 7

Grade	Description	Achieved?
F		
D		
C		
A		

Targets

Target	Need to achieve

ASSESSMENT 7

1. What are these binary numbers in denary (base 10)? (5)

Binary	Denary
00100010	
01000100	
01100100	
01111111	
10010110	

2. Convert the following denary numbers into binary. (5)

Denary	Binary
17	
47	
74	
120	
255	

3. Add up the following binary numbers as an 8 bit binary number. (2)

0	1	1	0	1	0	1	0	
0	1	0	0	1	0	0	1	+

4. Add up the following binary numbers as an 8 bit binary number. (2)

1	1	1	0	0	0	0	0
0	1	0	1	1	0	1	1

+

Why is the answer wrong?

5. What are the following binary numbers as their hexadecimal equivalent? (4)

Binary	Hexadecimal
00100000	
00111111	
10100000	
11111111	

6. Order the following in terms of the size in a computer's memory.(3)

a video file, a short text document, an MP3, a photograph

File size (largest first)

ASSESSMENT 8

1. What is meant by a character set?(1)

2. What is the difference between how the number 5 is stored as an integer and when it is stored as a character? (2)

3. What is the difference between ASCII and Unicode?(2)

4. When storing sound, how does the sample rate effect the file size and the quality of the sound saved? (2)

5. What is meant by bit rate in terms of sound files and how does it effect the quality of a sound?(2)

6. When a photograph is taken using a smart phone, meta-data is stored along with the file. What is meant by meta-data and give examples of the type of data that could be stored? (3)

7. What is the smallest element of a picture called? (1)

8. A picture file uses 4 bits to store colour information. How many different colours can it display? (1)

9. What is meant by image resolution? (2)

10. Instructions for computer programs are stored as binary numbers. How do these numbers result in the computer carrying out the instructions to complete a program.(2)

DATABASES

database |ˈdeɪtəbeɪs|

noun

a structured set of data held in a computer, especially one that is accessible in various ways.

Introduction

WHAT IS A DATABASE?

A database is a data that is stored in an organised way to make searching through it to find information easier. We have had databases long before computers.

Address books are an example. People would have a special book to write the names an addresses of the people who you know stored in alphabetical order. So if you wanted to write to Becky Smith you would open your book to the S section and look through until you found the entry for Becky Smith. The problem with address books is that while they have sections for each letter of the alphabet, the entries within each section are probably not in any order. If you have 30 names and addresses under one letter, you would still have to look at each in turn until you found the correct one. This is because you may enter a new name and address into the book at anytime. You may have entered the name and address for Becky Smith and then a week later you make friends with Marla Singer and add her into your address book. Singer is before Smith in the alphabet and so they would not be in order. Also when people move houses updating the book becomes messy as old addresses are crossed out.

Card files

The some of the problems with data stored in books can be solved by having data on cards. New cards can be added or replaced and they can be resorted when new cards are added. This is how recipe cards are organised so new ones can be added. The cards can be organised in different ways, either by main ingredient, or by type of meal (lunch or main meal or dessert).

In Library's card file systems have been used to help people find the books they want. There are often two card file systems in libraries. One has the cards ordered by book title and another set has the books ordered by author name. This duplication of data is one of the disadvantages of a paper based database. Also the way the data is currently organised may make searching for data problematic.

When I check my home telephone to see if someone has called whilst I was out (using 1471) I am only given the telephone number of the person who has called. If I can only remember a handful of telephone numbers then how could I find out who had called me? I don't want to call back someone who I don't wish to

speak to (a cold calling sales person for example) but then again the call may be from someone who I do wish to speak with. As my paper address book is organised by the surnames of the people in it, I cannot easily search through each entry to find the phone number, to see if it is someone I know. When computers began to be used to store data, searching for data became easier. The computer could sort the data in different ways and I could search through the data more effectively. The address book on my phone allows me to search through the list by either forename, surname, telephone number and even post code.

There is special software that manages and searches through databases. These types of software are know as Database Management Software (DBMS).

Flat File Databases

The databases I have discussed so far can be described as flat file databases. The data is stored as a record. Each record has a number of fields to store data. This is like a table made up of rows and columns.
A table column is a database field such as First name, last name and phone number. Each record would have data for each of these fields. Looking at the flat file database below we can we that the column headings are the fields and the rows are the individual records.

Last name	First name	Phone	Email	Total in Party	Attending?	Notes
Ryan	Craig	(123) 456 8643	cryan@noreply.com	2	TRUE	
Field	Diane	(123) 456 3103	dfield@noreply.com	1	TRUE	
Smith	Richard	(123) 456 6498	rsmith@noreply.com	1	FALSE	Vegetarian
Jones	Chris	(123) 456 5264	cjones@noreply.com	1	TRUE	No dairy products
Summers	Christine	(123) 456 4123	csummers@noreply.com	1	TRUE	
Sloan	Robert	(123) 456 5503	rstevents@noreply.com	2	TRUE	
Scott	Marie	(123) 456 6791	mrichards@noreply.com	1	FALSE	
Johnson	Kelly	(123) 456 2766	kjohnson@noreply.com	1	TRUE	

This data can be searched, to find out who is attending for example. It can also be sorted, in order of surname or by how many in the party.

Computer based databases have advantages over paper based ones.

Computer based DB	Paper based DB

Problems with Flat File Databases

There are problems however with flat file computer databases. These problems occur when the number of fields increases. Look at the table below.

Surname	Forename	Address1	Town/City	Post Code	Phone	Ward	Item Code	Description	price	Date Loaned	Date Returned
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA1	Crutch - Adult	£25	02/05/13	05/05/13
Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421	W6	CA2	Crutch - Adult	£25	03/05/13	14/05/13
Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874	W6	NCJ1	Neck Collar - Junior	£6	03/05/13	10/05/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W3	WCL 1	Wheel Chair - Large	£300	07/05/13	16/05/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA1	Crutch - Adult	£25	07/05/13	09/05/13
Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421	W6	CA2	Crutch - Adult	£25	21/05/13	28/05/13
Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874	W6	WCJ 1	Wheel Chair - Junior	£250	03/06/13	09/06/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA2	Crutch - Adult	£25	06/06/13	19/06/13

This flat file database is for a hospital that loans out equipment to out patients. In the database data about both the patient and the item loaned needs to be stored. As items are returned then the item can appear in the database more than once. So you can see that the *Crutch Adult - CA1* gets loaned more than once, as does *Crutch Adult - CA2*. Patients can also return, so their details will need to be entered for every item that is loaned to them. This duplication of data is time consuming to enter and also makes the database very large very quickly, making searching through it slower. Duplicating data is known as **data redundancy**.

Another problem is that items can only be entered if they are loaned out. What happens if there is a new wheel chair *WCL2*. This would only get entered if when it is loaned out. This is not good record keeping. Also if a patient changed their address, do you update the past records too or leave them. This may look like two different patients if you do not, but this could be a lot of updates if you do.

In order to fix these problems the data can be split up into smaller tables that can be linked together. This is called a relational database.

DATABASE MANAGEMENT SYSTEMS

The database is the file or files that store the data. Often this data is separate from the program that actually manipulates that data. The application used to access, manipulate and present the data is known as a Database Management System (DBMS). The separation of the data from the DBMS is often desirable for a number of reasons.

- Standard way of Accessing Data - the DBMS provides a uniform way of accessing the data, regardless of how that data is stored. Many DBMS's use a special programming language called SQL (Structured Query Language) to access the data. The DBMS uses these SQL commands to access the data in the databases. This may mean pulling together data from a number of separate files. SQL can be used both to create new databases and tables as well as accessing and querying existing databases.
- Security - The DBMS provides a level of security around the data, allowing you to password protect the data and even giving different users different access.
- Multi User Access - the database can be accessed by different users and even different applications at the same time. This means that the data could be accessed through a website by one user and by an administrator updating records through the DBMS software.
- Data Maintenance - The DBMS makes sure that the data is stored efficiently and also keeps data integrity. If a record exists in one table that is linked to data in another table, the DBMS makes sure that you cannot delete one record without also deleting related records.

Modern databases are often relational databases and so the software used to create and manage such systems are known as Relational Database Management Systems (RDBMS). Examples of which include Microsoft Access, MySQL and Base which is included in the Open Office suite of applications.

Relational Databases

SOLVING THE PROBLEMS OF FLAT FILE DATABASES

Looking again at our bad flat file database we can see that the first issue is that that we have duplication of a lot of data. This is known as data redundancy.

A relational database solves this by separating the data into different tables. To do this we use the concept of entities. An entity is a thing. This can be a physical thing like a customer or a item to be loaned, or it can be a concept like the loan itself. Each entity is stored in its own table. However these entities are related to each other and so we need a way of keeping this relationship intact.

Each record in a table is unique and is given a unique identifier. This identifier is used to create a link between tables. An identifier can be any field as long as its unique. Unfortunately unique fields are hard to come by, so often a number is often generated that is unique. This is why we often have ID numbers for this like passports, bank accounts and student IDs in schools.

Surname	Forename	Address1	Town/City	Post Code	Phone	Ward	Item Code	Description	price	Date Loaned	Date Returned
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA1	Crutch - Adult	£25	02/05/13	05/05/13
Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421	W6	CA2	Crutch - Adult	£25	03/05/13	14/05/13
Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874	W6	NCJ1	Neck Collar - Junior	£6	03/05/13	10/05/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W3	WCL 1	Wheel Chair - Large	£300	07/05/13	16/05/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA1	Crutch - Adult	£25	07/05/13	09/05/13
Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421	W6	CA2	Crutch - Adult	£25	21/05/13	28/05/13
Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874	W6	WCJ 1	Wheel Chair - Junior	£250	03/06/13	09/06/13
Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897	W4	CA2	Crutch - Adult	£25	06/06/13	19/06/13

Looking at our bad flat file database we can see that we only have 3 patients that are in the database multiple times. We can create a Patient table and create an unique ID for each record in the table. The unique ID field is known as a Primary Key. A Primary Key is a field that uniquely

identifies a record in that table. In table below we can see our new Patient Table with the PatientID as the primary key.

PatientID	Surname	Forename	Address1	Town/City	PostCode	Telephone
1	Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897
2	Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421
3	Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874

Now we need to link this data to the item loan. Looking at the loan table now we have removed the patient data from the table. In its place we have the patientID which is the primary key from the Patient table.

LoanID	Ward	ItemCode	Description	price	DateLoaned	DateReturned	PatientID
1	W4	CA1	Crutch - Adult	£25.00	02/05/2013	05/05/2013	1
2	W6	CA2	Crutch - Adult	£25.00	03/05/2013	14/05/2013	2
3	W6	NCJ1	Neck Collar - Junior	£6.00	03/05/2013	10/05/2013	3
4	W3	WCL1	WheelChair - Large	£300.00	07/05/2013	16/05/2013	1
5	W4	CA1	Crutch - Adult	£25.00	07/05/2013	09/05/2013	1
6	W6	CA2	Crutch - Adult	£25.00	21/05/2013	28/05/2013	2
7	W6	WCJ1	WheelChair - Junior	£250.00	03/06/2013	09/06/2013	3
8	W4	CA2	Crutch - Adult	£25.00	06/06/2013	19/06/2013	1

A field that contains a primary key from another table is known as a foreign key. Foreign keys are used to create a link between tables. So in record 5 in the Loans table we can see that Patient 1 loaned the crutch. We can use the patient ID to look up who that is in the Patient table. We can see that the patient with the patientID of 1 is Homer Simpson. Using a foreign key in the loan table means that we do not have to duplicate all the patient data when they loan an item.

We still have the item information duplicated. When we remove this entity from the Loans table we get three tables that can be seen in below.

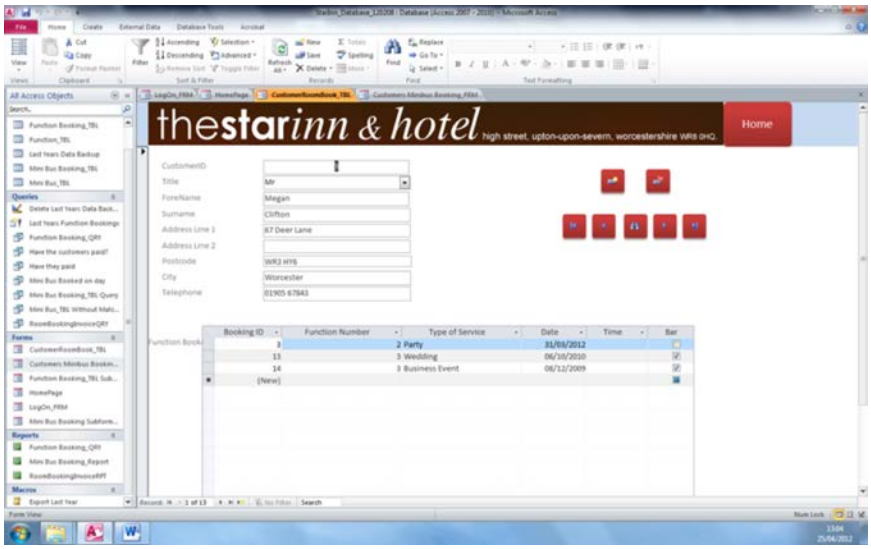
PatientID	Surname	Forename	Address1	Town/City	PostCode	Telephone
1	Simpson	Homer	768 Evergreen Terrace	Springfield	SP12 3WE	01471 555 897
2	Gumble	Barney	7 Beer Gardens	Springfield	SP24 6AW	01471 555 421
3	Cartman	Eric	1245 Snowy Cresent	South Park	SP 12 7UY	01247 555 874

LoanID	Ward	Item Code	Date Loaned	Date Returned	PatientID
1	W4	CA1	02/05/2013	05/05/2013	1
2	W6	CA2	03/05/2013	14/05/2013	2
3	W6	NCJ1	03/05/2013	10/05/2013	3
4	W3	WCL1	07/05/2013	16/05/2013	1
5	W4	CA1	07/05/2013	09/05/2013	1
6	W6	CA2	21/05/2013	28/05/2013	2
7	W6	WCJ1	03/06/2013	09/06/2013	3
8	W4	CA2	06/06/2013	19/06/2013	1

ItemCode	Description	price
CA1	Crutch - Adult	£25.00
CA2	Crutch - Adult	£25.00
NCJ1	Neck Collar - Junior	£6.00
WCL1	WheelChair - Large	£300.00
CA1	Crutch - Adult	£25.00
CA2	Crutch - Adult	£25.00
WCJ1	WheelChair - Junior	£250.00
CA2	Crutch - Adult	£25.00

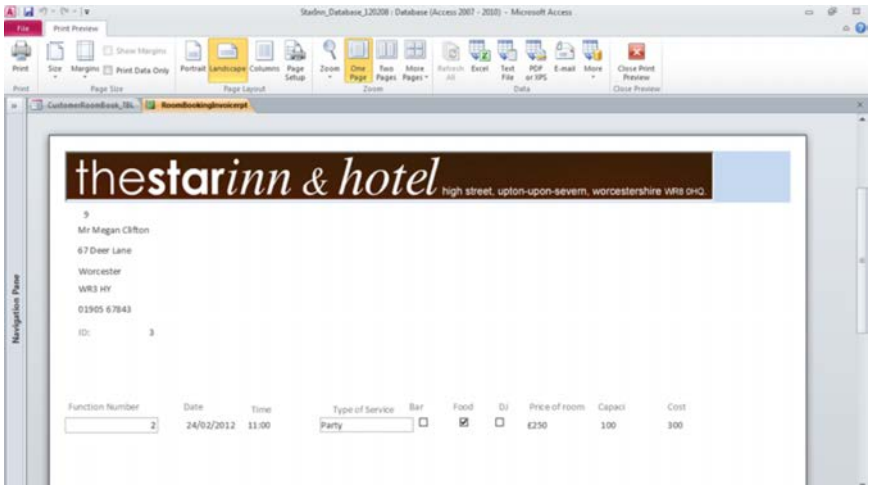
This type of database is known as a Relational Databases due to the relationships between each table. A RDBMS has a number of components that are used to access the data stored in the database. Accessing the data directly through the tables is not recommended. Often data is accessed through forms, queries and reports.

Forms



A form is used for data entry. They provide a more user friendly way of entering data into a table and even multiple tables in one form. A user form can also provide some data validation checks. Validation checks are used to make sure that the data is in a valid form before it is entered. This can anything from making sure a telephone number is the correct length to making sure an item number actually exists. Forms can also make some database fields read only so that some data cannot be altered.

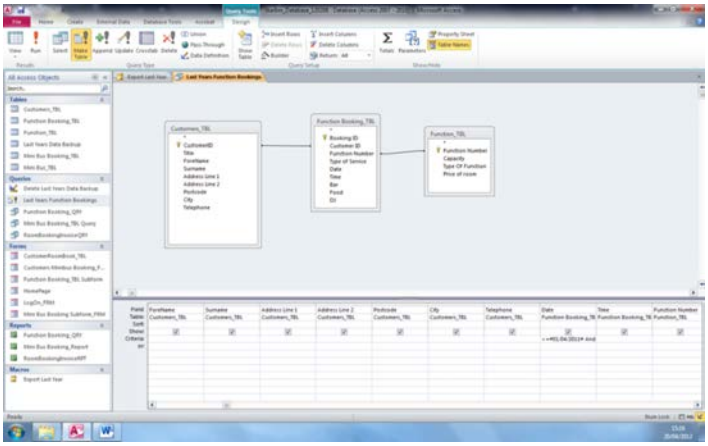
Reports



Reports are used to properly format data from queries or when the data needs to be printed out. The reports can calculate results based on the data from fields, adding up the prices to give a grand total for example.

Queries

Queries when the DBMS selects and searches for specific data from the database. This can be done using a specialist language like SQL or can be done through a query by example interface which is often easier for beginners.



Queries are really important in databases, allowing us to get to the data we need.
Looking back at our hospital loans example database we have three tables. If we wanted to search for data relating to the loans we would need to start with the loans table.

Loans

LoanID	Ward	ItemCode	DateLoaned	DateReturned	PatientID
1	W4	CA1	02/05/2013	05/05/2013	1
2	W6	CA2	03/05/2013	14/05/2013	2
3	W6	NCJ1	03/05/2013	10/05/2013	3
4	W3	WCL1	07/05/2013	16/05/2013	1
5	W4	CA1	07/05/2013	09/05/2013	1
6	W6	CA2	21/05/2013	28/05/2013	2
7	W6	WCJ1	03/06/2013	09/06/2013	3
8	W4	CA2	06/06/2013	19/06/2013	1

If we wanted to know what loans patient two had we could query the data using
PatientID = 2
This would return these rows.

PatientID = 2 Query Results

LoanID	Ward	ItemCode	DateLoaned	DateReturned	PatientID
2	W6	CA2	03/05/2013	14/05/2013	2
6	W6	CA2	21/05/2013	28/05/2013	2

We can see that the patient has loaned the same item on two different occasions.
We could find out which which loans were done with patients in Ward W6 by using this query:

Ward = “W6”

That would return this data.

Ward = “W6” Query Results

LoanID	Ward	ItemCode	DateLoaned	DateReturned	PatientID
2	W6	CA2	03/05/2013	14/05/2013	2
3	W6	NCJ1	03/05/2013	10/05/2013	3
6	W6	CA2	21/05/2013	28/05/2013	2
7	W6	WCJ1	03/06/2013	09/06/2013	3

As the field contains text data, the query must put the data in quotes.

MORE COMPLEX QUERIES USING LOGICAL OPERATORS

Sometimes we need to select data between particular ranges. If we wanted to know about all the loans in may 2013 we would need all the dates equal to or greater than 1st May and all those below or equal to 31st May.

DateLoaned >= 1/05/2013 AND DateLoaned<= 31/05/2013

That would return the following data.

DateLoaned >= 1/05/2013 AND DateLoaned<= 31/05/2013 Query Results

LoanID	Ward	ItemCode	DateLoaned	DateReturned	PatientID
1	W4	CA1	02/05/2013	05/05/2013	1
2	W6	CA2	03/05/2013	14/05/2013	2
3	W6	NCJ1	03/05/2013	10/05/2013	3
4	W3	WCL1	07/05/2013	16/05/2013	1
5	W4	CA1	07/05/2013	09/05/2013	1
6	W6	CA2	21/05/2013	28/05/2013	2

The query uses the AND keyword to make sure that both criteria are met. The date must be both greater than or equal to 1/05/2013 AND be less than or equal to 31/05/2013.

If we wanted all the adult crutch loans we could perform this query.

ItemCode = “CA1” OR ItemCode = “CA2”

That would return these rows.

ItemCode = “CA1” OR ItemCode = “CA2” Query Results

LoanID	Ward	ItemCode	DateLoaned	DateReturned	PatientID
1	W4	CA1	02/05/2013	05/05/2013	1
2	W6	CA2	03/05/2013	14/05/2013	2
5	W4	CA1	07/05/2013	09/05/2013	1
6	W6	CA2	21/05/2013	28/05/2013	2
8	W4	CA2	06/06/2013	19/06/2013	1

We use the OR keyword to make sure we return records that match either “CA1” or “CA2”. Each record can only be one or the other, not both so here we need to use the OR operator.

AND & OR are know as logical operators. NOT is another logical operator. It means do not get records that have this value.
Another way of performing the last query is to use a wildcard. A wildcard is a symbol (usually an asterisk) to represent any other letters or numbers.

So the query
ItemCode = “CA”*
is the same as
ItemCode = “CA1” OR ItemCode = “CA2”.

Table name:

Table name:

DATABASE TASK

A music player has a database of tracks. We are going to use this as an example.

In a DBMS create the following table.

Field	Data type	Validation rule	Default value
TrackID	Auto number (Primary Key)		
Artist	Short Text		
Track	Short Text		
Length	Date/Time		
Rating	Number (byte)	>=0 and <=5	0
TimesPlayed	Number (integer)	>=0	0
ReleaseDate	Number (integer)	<=Year(now())	

Save the table and enter the data below.

MUSIC

Track ID	Artist	Track	Length	Rating	TimesPlayed	ReleaseDate
1	Dead Sea Skulls	I wanna buy a rolex	3:15	4	21	2014
2	Eureka Machines	Popstar	3:43	5	98	2013
3	Hey Hello	Feral Days	3:42	4	43	2013
4	3 Colours Red	Pure	3:08	3	78	1997
5	CJ Wildheart	Down the Drain	2:43	3	15	2014
6	The Wildhearts	Red Light - Green Light	2:53	4	45	1996
7	The Wildhearts	Caffeine Bomb	2:41	5	54	1994
8	Baby Chaos	Swimming Trunks	2:33	4	12	1998
9	Hey Hello	Swimwear	2:18	5	43	2013
10	Eureka Machines	Champion the Underdog	3:59	5	60	2011

Using this database run the following queries. Write in the criteria you used to search for the data required.

1. Songs that have a rating over 3.

2. Songs that have been played less than 20 times.

3. Artists that released songs in 2014 or 2013.

4. Songs that are less than 3 minutes long.

5. Songs that contain the word **swim**.

6. Songs released in the 1990s that have a rating of 5.

7. Songs that have been play more than 50 times that were not released in the 1990's.

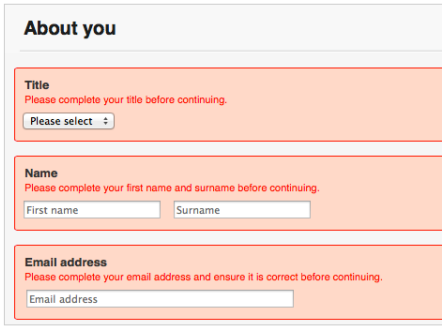
DATA VALIDATION

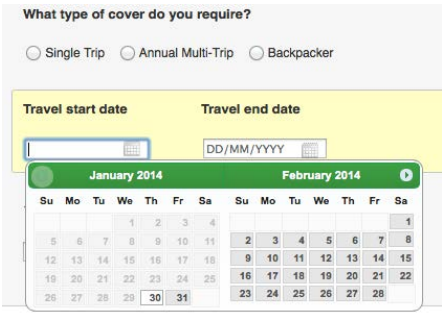
It is important that the data in a database is sensible and correct. Validation helps in this process by checking to see if the data being entered is sensible and valid and in the correct format.You often see this being performed on web forms which often send their data into a database.

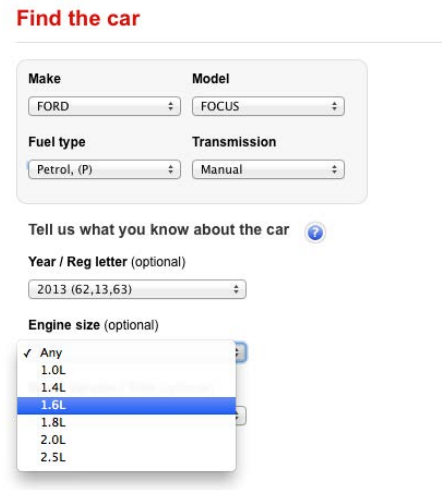
One database may contain a table to store bookings. One field may store the date for the booking. We could enter the data as 21/3/2014 or 21st March 2014. Americans often put the month first so they would enter 3/21/2014. If we are going to be able to search through the data we need to store it consistently. Validation can help us enter data in the correct format. Validation is also used to make sure the data is sensible. 30th Feb 2014 is not a valid date, so we should not allow that to be entered into our database.

There are different types of validation checks that can be performed on data before it is allowed into our database.

- **Presence check** - This is the simplest of all validation checks. it simply checks to see if data is being entered into a field. Often these fields have an asterisk showing they are required and are highlighted if they are left blank.
- **Date Check** - This field will often be a calendar to make sure a valid date is selected. The calendar ensures it shows they correct year, allowing the user to pick easily.
- **Range Check** - This type of validation ensures that numerical data is between a particular range. Shoe sizes may go from 4 to 12 on a particular online shopping site.
- **Length Check** - This will check to see if the length of the data is acceptable. Mobile phone numbers, ISBN numbers and credit card numbers all have particular lengths. If the data was too short of too long then the data would not be valid.
- **Format check** - Some fields require data to be in a particular format. Some product codes may need to have a combination of letters and numbers in a particular order. Car registrations have to follow a particular format, so do Post Codes. National insurance numbers follow a particular format, LL 99 99 99 L where L is a letter and 9 is a number 0-9.
- **Lookup check** - This type of validation looks up the data to make sure it exists. This could be a product number in a catalogue superstore or a car registration number on an insurance website.







- **Check digit** - Some numbers end in a number that is calculated from the previous numbers. Credit card numbers, ISBN numbers and barcodes all have a check digit. If any number is incorrectly entered the check digit calculated will not match the one entered.

Validation does not check to see if the data is correct, only if the data is sensible and valid. If a field asked me to enter my date of birth I could enter 21/3/1981. This would be a valid date, but it is not by true birthdate.
Some fields are difficult to validate. People's names are very hard to validate. While most people have names that probably appear and a baby naming book, what about foreign names and those parents who give their children made up names. In New Zealand some children were named Violence; Number 16 Bus Shelter; Midnight Chardonnay; Benson and Hedges.(http://news.bbc.co.uk/1/hi/7522952.stm) These names would be hard to validate for.

SEPARATING DATA FROM APPLICATIONS

Having a database on a single user computer is perhaps OK for a small business but usually the databases needs to be accessed by a number of people, sometimes millions of people.

Often the database will be stored on a server, allowing access via a number of different applications. A search engine like Google has a database of web-pages on the Internet and keywords that link to them. This database can be accessed through a web-browser, but the same data can be displayed through the GoogleMaps application on a mobile phone.

FaceBook store millions of accounts in their database along with all the data people post online. This data can be accessed via a web browser, or mobile app but can also be accessed via games like Candy Crush or Words with Friends, allowing you to see which of your friends are playing the game.

The separation of the data in the database from the application that uses it gives the users greater flexibility in how the data can be used.

ASSESSMENT CRITERIA

In this topic you should be able to:

a) describe a database as a persistent organised store of data
b) explain the use of data handling software to create, maintain and interrogate a database.
c) describe how a DBMS allows the separation of data from applications and why this is desirable
d) describe the principal features of a DBMS and how they can be used to create customised data handling applications.
e) understand the relationship between entities and tables
f) understand the components of a relational database, such as tables, forms, queries, reports and modules
g) understand the use of logical operators in framing database queries
h) explain the use of key fields to connect tables and avoid data redundancy
i) describe methods of validating data as it is input.

Assessment 9

Grade	Description	Achieved?
F	Have a basic understanding of a database and how the data is stored.	
D	Have a fairly good understanding of a how a computer database is better than a paper based one.	
C	Have a good understanding of a how a computer database is better than a paper based one. Have a good understanding of how a database stores data and some of the problems with a flat file database.	
A	Have a thorough understanding of how a computer database stores data and of the problems with a flat file database.	

Targets

Target	Need to achieve
Need to be able to describe a database as a persistent organised store of data	
Need to be able to explain the use of data handling software to create, maintain and interrogate a database.	

Assessment 10

Grade	Description	Achieved?
F	Be able to describe some aspects of a relational database and its features.	
E	Have a some understanding of the relational database concept and the components of a DBMS and their uses.	
D	Have a some understanding of the relational database concept and the components of a DBMS and their uses. Have a some understanding of how queries are formed.	
C	Have a good understanding of the relational database concept and the components of a DBMS and their uses. Have a good understanding of how queries are formed.	
B	Have a fairly good understanding of the relational database concept and the components of a DBMS and their uses. Have a thorough understanding of how queries are formed and able to use logical operators.	
A	Have a thorough understanding of the relational database concept and the components of a DBMS and their uses. Have a thorough understanding of how queries are formed and able to use logical operators effectively.	

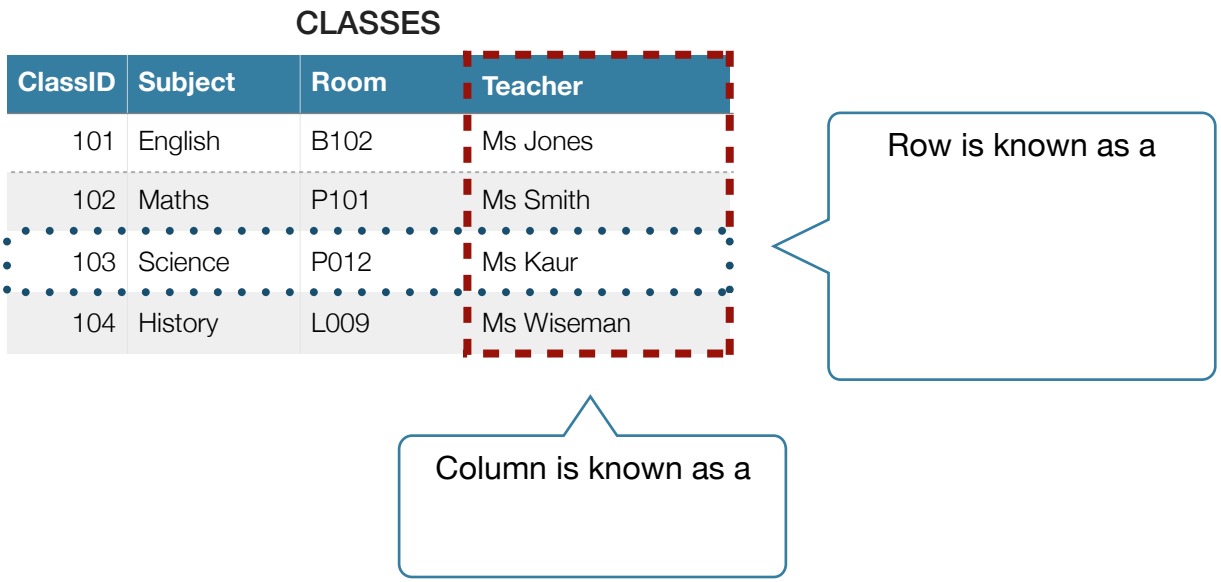
Targets

Target	Need to achieve
Need to be able to describe how a DBMS allows the separation of data from applications and why this is desirable.	
Need to be able to describe the principal features of a DBMS and how they can be used to create customised data handling applications.	
Need to be able to understand the relationship between entities and tables	
Need to be able to understand the components of a relational database, such as tables, forms, queries, reports and modules	
Need to be able to understand the use of logical operators in framing database queries	
Need to be able to explain the use of key fields to connect tables and avoid data redundancy	
Need to be able to describe methods of validating data as it is input.	

ASSESSMENT 9

1. What is meant by the term entity in terms of databases? (1)

2. In a database data is stored in tables. The rows and columns have specific names. Label the table below. (2)



3. A card file system is an example of a paper based database. What are the problems with this type of system that a computer database does not have? (4)

4. What is the difference between a database and a database management system? (4)

5. What is meant by the term data redundancy? (1)

6. Storing data in a single table can lead to a number of problems. What are the main issues with storing data in a single table? (4)

ASSESSMENT 10

1. In a relational database data is separated into different tables. How are these tables linked together to find data? (3)

2. What is the purpose of validation? (3)

3. Rita is designing a database for her online clothes store. She is creating a table to store the order item details. She has a field that stores the quantity of each item bought and the date. What validation rules could she use on each of these fields? (4)

Quantity field:

Date field:

4. Why is it useful to separate the data from the database management system? (2)

5. Below is a flat file database that needs to be converted into three tables to make it a relational database.

Fudge Orders

Data of order	Customer First Name	Customer Last Name	Customer Address	Customer Postcode	Product name	Price	QTY
16/10/2012	Fred	Marshall	6 New Road, Newtown	NE1 3PW	Vanilla Fuffle Cake	£5.99	1
16/10/2012	Louis	Wallis	7 Old Road, Newton	NE1 6TR	18 Swirls Of Jack Daniels Fuffle	£7.99	1
16/10/2012	Louis	Wallis	7 Old Road, Newton	NE1 6TR	Amaretto 12 Pc	£5.99	2
16/10/2012	Ellie	Smith	23 Nice Road, Newtown	NE1 7BF	5 Fuffle Bars	£9.99	2
16/10/2012	Ellie	Smith	23 Nice Road, Newtown	NE1 7BF	Bustin Vanilla Bar	£2.50	1
02/11/2012	Fred	Marshall	6 New Road, Newtown	NE1 3PW	Chocochino	£7.00	1
12/11/2012	Fred	Marshall	6 New Road, Newtown	NE1 3PW	Baileys Comet Fuffle Cake	£5.99	1
20/12/2012	Louis	Wallis	7 Old Road, Newton	NE1 6TR	English Summer	£7.00	1

Which fields would need to be in each table? Write the name of the table and list the fields that would be in each table. You may need to add new fields not listed in the table above. (8)

Table name:

Table name:

Table name:

NETWORKING

network |ˈnɛtwəːk|

noun

1 an arrangement of intersecting horizontal and vertical lines. *a spider constructs a complex network of several different kinds of threads.*

2 a number of interconnected computers, machines, or operations. *a computer network.*

WHY NETWORK COMPUTERS?

Joining computers together, either with cabling such as ethernet or wirelessly can be complex, so why do we do it? There are many reasons why we would want to network computer together. The main reason is to share. This may be to share files and data, or a resources like a printer or a connection to the Internet.

TYPE OF NETWORK

There are different types of computer network. They can be defined by the relationship the computers have with each other and the way they are joined together. We will look first at the relationship between each computer.

Peer to Peer

All stations are joined together in the network have equal status. If you have a number of computers at home on sharing a wireless router then this is the type of network you will probably have. Each device shares the connection to the Internet, whether that is a tablet, games console or computer. You may have other shared resources like a printer or even a media server. You may be able to get access to your media server through your tablet or games console, to stream music or video on to your TV.

So in a peer to peer network, there is no central computer or data store. You may be able to share data from one computer to another. This needs to be set up on each device and is not done centrally.

Applications may be stored on different computers and accessed by all as longer as the owner gives permission. Work is backed up on individual user PCs.

In a peer to peer network you get the benefit of being able to share resources but each computer must be set up individually. This is fine for the home but becomes inefficient the more computers you have.

Client-Server Network

A client-server network has different types of computers. A powerful central computer called a server manages the client computers the users use. The data is stored centrally. This means that it does not matter which client computer the user logs on to, they can still access all their work.

In a client server network, the client computers can be managed centrally from the server. This means that installation of programs, back ups, security and access rights can all be managed from one place. This can save a great deal of time. However this does mean there is a reliance of this central computer. If the server goes down then no-one can access anything. Also it is more technically challenging to set up and maintain such a network. This means there is often someone responsible for managing the computer. For large networks this is the most efficient and flexible despite the reliance on the central computers. Effort is taken to make sure this central computer is always backed up and working properly.

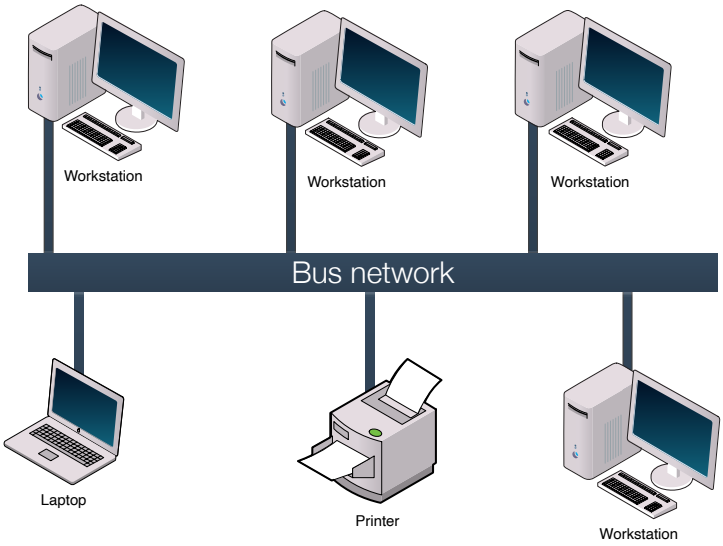
Complete the table to summarise the differences between networks.

Peer to Peer	Client Server

TOPOLOGY

Computers can be joined together in different ways. The way they are joined together is known as topology. There are three main network topologies that we need to be aware of.

BUS NETWORK

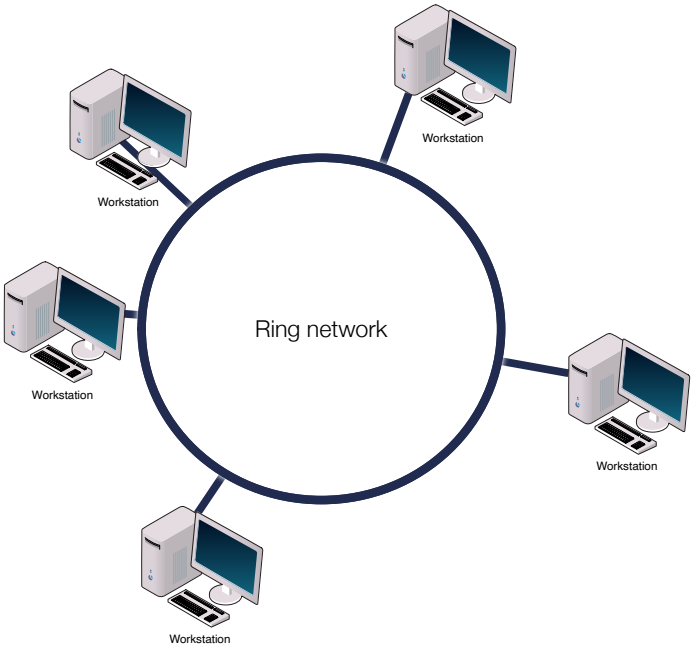


Description

Advantages

Disadvantages

RING NETWORK

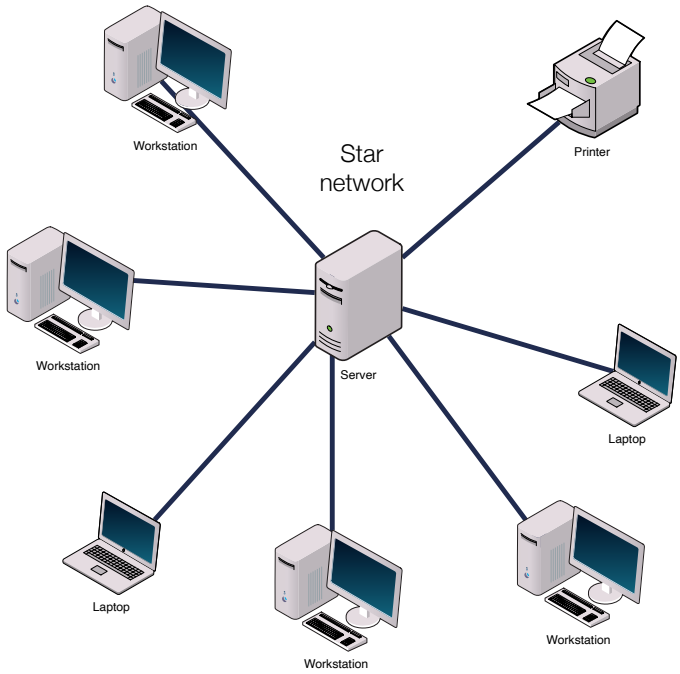


Description

Advantages

Disadvantages

STAR NETWORK



Description

Advantages

Disadvantages

LOCAL AREA NETWORKS AND WIDE AREA NETWORKS

As well as being able to describe a network based on its topology, we can also describe a network in terms of geography.

A Local Area Network (LAN) is a network that is on one geographical location. This may be just one room of computers or as big as a single site, covering a number of buildings. The computers are all connected together through wiring such as ethernet, fibre optic or wireless LAN.

Some large organisations have more than one site, but still need to communicate between sites. These separate LANs are joined together through the telephone networks to create a Wide Area Network or WAN. The Internet is the biggest WAN, joining together millions of computers.

HOW COMPUTERS COMMUNICATE

ADDRESSING

Each computer on a network needs to be uniquely identified so that data can be sent and received from it. There are many different ways of doing this.

Protocols are used to help control network communication. Protocols are a set of rules that all the devices on a network must follow if they are to be able to communicate with each other.
When connected to a network or the Internet each computer will have an Internet Protocol address or **IP** address. This is made up of 4 bytes. We often see this as a series of 4 numbers ranging from 0-255 separated by full stops. So 10.1.128.240 is an example of an IP address. Computers use these addresses to communicate with each other in the same way we use phone numbers.
These numbers are hard for people to remember, so on the Internet each IP address of a website has a domain name, a text based name that is easier to remember. See the next section for more details.

As well as IP addresses, each network interface in a computer (ethernet card or wifi card) also has a unique Media Access Control address or MAC address. Each device usually has this address hardwired into them when they are manufactured. Again these addresses help a network identify each device, making sure that data travels to the correct destination.

PACKETS AND PROTOCOLS

Imagine you are an author and you have written a 500 page manuscript which must be sent by post. The problem is that due to the postal charges, you can only send 50 pages at a time.

How do you get the manuscript to your publishers, so they can assemble it correctly?

Firstly you would split your document into 50 page sections, putting each into an envelope. On the envelope you would put the publisher's address as well as your own address, so they know who sent it. You would also need to label each envelope so that the publisher know which set of pages were in each. So the first one would be labelled packet 1/10 pages 1-50, the second packet 2/10 pages 51-100 etc. Then the envelopes could be posted and the publisher knows from the envelopes how to reassemble to manuscript. It does not matter if the envelopes do not arrive in order. If one goes missing, the publisher can figure out which one it is and ask for a replacement.

This is how data gets sent around networks.

Use the following terms to explain how data gets sent from one computer to another.

APPLICATION, PACKET, IP ADDRESS, PROTOCOL, SWITCHES

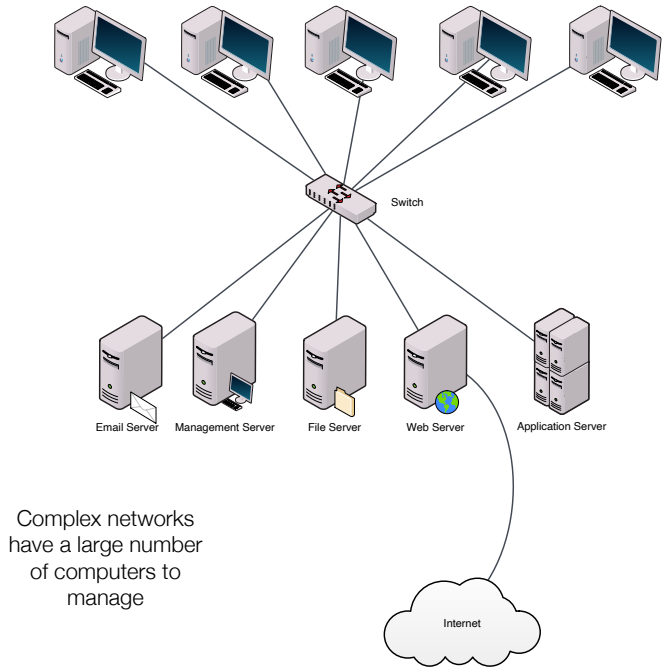
SECURITY ON NETWORKS

When we have so many users on a network, security becomes a big issue. In big companies and organisations, while they often want to be able to access data from any computer on their network, it does not mean that every employee should have the same access to all the data and programs.

How does a network manager make sure that their network is kept secure?

MANAGING A NETWORK

A computer network needs a great deal of effort to manage and keep it running smoothly. Computer networks often have A network manager who has a number of responsibilities.



Complex networks have a large number of computers to manage

Each user often has just signed an acceptable use policy. This document in forms the users have a network can be used in an acceptable way. This may be different for each organisation. For example some companies may prohibit the use of USB memory sticks, as they may be a source of viruses and other malware as well as be a device to steal sensitive documents. An acceptable use policy would also cover the use of the Internet. Internet use in a company is often monitored and any unacceptable use could result in the employee being disciplined or even sacked.

Another task needs to be completed is that of archiving and backing up of data. Computer hardware like hard disks can fail. This would result in the loss of all the data that was on the disk. Backing up means copying that data onto another storage medium such as another hard disk, a tape or the cloud. If I hard disk was to fail and data could be restored from the backup onto a new hard disk.

Explain Grandfather, Father, Son backup procedures.

THE INTERNET

The Internet is an enormous network of networks. Today almost a third of the entire Earth's population uses the Internet. We get access to the Internet through Internet Service Providers or ISPs. These companies attach to the Internet proper. We connect with them through fixed line or mobile phone networks. The Internet is uses a number of technologies to transfer data. Email, World Wide Web, File Transfer, Messaging all use the Internet.

The services that make up the Internet, such as the World Wide Web, are hosted on thousands of computers all over the world. Special servers allow access to data and transfer this from server to computer. The world wide web for example is hosted on web servers by a variety of web hosting companies and private companies. These web servers host the webpages and other files that people want to view.

When you browse the Internet using a web browser, a number of things happen when you request a page. Normally when we request a page we type in a web address or click on a hyperlink to an address. For example if we clicked on a link to http://www.bbc.co.uk your web browser is making a request to that computer. Computers however don't have names, they are identified by numbers known as **IP addresses**. These addresses are stored on special servers called **Domain Name Service** servers. These are a little like telephone directories. The name of the website is looked up in one of the **DNS** servers and finds out the IP address of the web host. The message then gets passed on to that server at the BBC. The web server understands that a web page has been asked for. It then sends this page back to the computer that asked for it.

The Internet is often described as a Mesh topology. Draw a mesh network. What are the advantages of a mesh network?

WEB PAGES

There are billions of web pages on the Internet. These pages are all written in a special language called Hypertext Markup Language (HTML).

HTML is the language of the World Wide Web. Every web page that you have looked at is written in this language. HTML is a text based language that tells the web browser (Internet Explorer, Google Chrome and the like) how to display the page.

HTML is made up of tags that describe to the web browser how to display the web page. Tags are surrounded by less than and greater than signs, < tag >.
Tags generally come in pairs. One tag opens the formatting and the closing tag ends the formatting. A closing tag has a slash (/) to show that it is a closing tag.

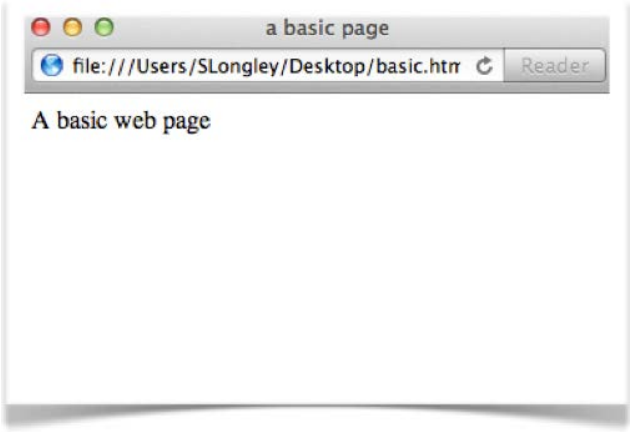
TAGS

All web pages start with a <html> tag and end with the closing </html> tag. This tells the web browser that the page is a web page.

Web pages are divided into two sections. The head section contains information that is not displayed in the main browser window. This is often JavaScript code that can make the page interactive or style information that can make a page look more colourful. The next section is the body section. Everything in this section is displayed inside the browser window.

A basic web page.

```
<html>
<head>
<title>a basic page</title>
</head>
<body>
A basic web page
</body>
</html>
```



Tag	Description
`<h1> .. <h6>`	Headings 1 - 6. This tag make text look bold. `<h1>` is a large heading while `<h6>` is a very small heading
`<a>`	
`<table>`	
`<tr>`	
`<td>`	
`<form>`	
`<input>`	
`<ul>`	
`<li>`	
`<img>`	

TAG ATTRIBUTES

Many tags have attributes. These are keywords followed by a value in quotes.
Eg:
<table width="70%">

The table tag has a width attribute that is set to 70%. This means the table is 70% of the browser window. A common attribute is a tag's id. This can be used by JavaScript to select a tag to change it.

CSS

Another web technology is cascading style sheets or CSS. These help provide more style information as to how the browser displays the content. CSS cover things like colours and borders and helps with organising the layout of the content. Often one style sheet can be used to style a series of pages giving them a similar appearance.

Changing a style sheet can be used to dramatically change the appearance of a web page without actually changing the underlying HTML code. This means that web designers can keep their websites looking fresh without having to rewrite all their web pages and often by only altering one style sheet.

JAVASCRIPT

To make web pages interactive a programming language must be used. JavaScript is a script based interpreted language that can be embedded in webpages to allow for interactivity and animation. A combination of HTML, CSS and JavaScript can be used to create complex interactive websites and even games. A version of Angry Birds and Cut the Rope is playable online and all programmed using HTML, CSS and JavaScript.

Javascript is often used to validate forms. This prevents data that is not sensible or acceptable from being submitted to websites for processing.

What types of validation would a car insurance website want to perform?

FILES OF THE INTERNET

Web pages are pure text files. The HTML, CSS and JavaScript that make up web pages can be viewed using any simple text editor. It is the web browser than converts the tags into the formatting we see when we view a page. So what about things like images, sounds and videos? These files are linked to inside the HTML code. When the web browser finds these links it requests them from the web server and when they have been downloaded, inserts them into the page.

There are some special file formats that have been developed for use on the Internet. Usually these formats are compressed in some way to speed up download times.

File Format	Use
JPG	
GIF	
PNG	
PDF	
MP3	
MPEG	

COMPRESSION

Sending large files over the Internet takes time. Back when most people had dial up modems to connect to the Internet, it was very slow to download a web page, 30 seconds or more for a page with lots of images. Making sure that the image file sizes were small helped to make sure that these download times were as low as possible.

Nowadays most people have broadband and pages generally load pretty fast. However there is an increasing number of people access the Internet on a mobile phone and file sizes not only affect speed of download but also affect peoples data limit.

Compressing a file means finding a way to save the same data into a smaller space. One way to do this is to use an algorithm to search for repeating patterns. In many files there is data that is repeated. Instead of saving all the data multiple times in a file it is just saved once. When the data is repeated a code referring to the data is used instead.

Types of Compression

There are two types of compression, lossless compression and lossy compression.

Explain each type of compression and give examples of the type of file/data that could be compressed using that method and why.

Lossless Compression

Lossy Compression

ASSESSMENT CRITERIA

In this topic you should be able to:

a) explain the advantages of networking stand-alone computers into a local area network and describe the hardware needed to connect stand-alone computers into a local area network, including hub/switches, wireless access points

b) explain the different roles of computers in a client-server and a peer-to-peer network and describe, using diagrams or otherwise, the ring, bus and star network topologies. Be able to describe the differences between a local area network and a wide area network such as the internet

c) explain the terms IP addressing, MAC addressing, packet and protocols

d) explain the need for security measures in networks, such as user access levels, suitable passwords and encryption techniques and describe and justify network policies such as acceptable use, disaster recovery, failover, back up, archiving.

e) describe the nature of the internet as a worldwide collection of computer networks and describe the hardware needed to connect to the internet including modems, routers

f) explain the need for IP addressing of resources on the internet and how this can be facilitated by the role of DNS services

g) explain the importance of HTML and its derivatives as a standard for the creation of web pages

h) describe common file standards associated with the internet such as JPG, GIF, PDF, MP3, MPEG. Be able to explain the importance of compressing files that are transmitted via the internet and describe the differences between lossy and lossless compression.

Assessment 11

Grade	Description	Achieved?
F	Can understand basic network concepts like topology and other types of network.	
D	Can understand different types of networks and their advantages and disadvantages.	
C	Can understand different types of networks and their advantages and disadvantages. Good understanding of network technologies like IP addressing, protocols and packets. Understands that networks need to be managed.	
B	Can understand different types of networks and their advantages and disadvantages. Good understanding of network technologies like IP addressing, protocols and packets. Understands that networks need to be managed and can explain some of the issues surrounding network security.	
A	Can understand different types of networks and their advantages and disadvantages. Thorough understanding of network technologies like IP addressing, protocols and packets. Understands that networks need to be managed and can explain the issues surrounding network security.	

Targets

Target	Need to achieve
explain the advantages of networking stand-alone computers into a local area network and describe the hardware needed to connect stand-alone computers into a local area network, including hub/switches, wireless access points	
Need to be able to explain the different roles of computers in a client-server and a peer-to-peer network and describe, using diagrams or otherwise, the ring, bus and star network topologies. Be able to describe the differences between a local area network and a wide area network such as the internet	
Need to be able to explain the terms IP addressing, MAC addressing, packet and protocols explain the need for security measures in networks, such as user access levels, suitable passwords and encryption techniques and describe and justify network policies such as acceptable use, disaster recovery, failover, back up, archiving.	
Need to be able to explain the need for security measures in networks, such as user access levels, suitable passwords and encryption techniques and describe and justify network policies such as acceptable use, disaster recovery, failover, back up, archiving.	

Assessment 12

Grade	Description	Achieved?
F	Have a basic understanding of Internet technologies such as IP addressing, DNS, HTML and file compression.	
C	Have a good understanding of Internet technologies such as IP addressing, DNS, HTML and file compression.	
A	Have a thorough understanding of Internet technologies such as IP addressing, DNS, HTML and file compression.	

Targets

Target	Need to achieve
Need to be able to describe the nature of the internet as a worldwide collection of computer networks and describe the hardware needed to connect to the internet including modems, routers	
Need to be able to explain the need for IP addressing of resources on the internet and how this can be facilitated by the role of DNS services	
Need to be able to explain the importance of HTML and its derivatives as a standard for the creation of web pages	
Need to be able to describe common file standards associated with the internet such as JPG, GIF, PDF, MP3, MPEG. Be able to explain the importance of compressing files that are transmitted via the internet and describe the differences between lossy and lossless compression.	

ASSESSMENT 11

1. What is meant by a network? (1)

2. The way computers are connected in a network is know as topology. What are the three basic types of topology and describe an advantage and disadvantage for each. (9)

Network Topology :

Advantage:

Disadvantage

Network Topology :
Advantage:
Disadvantage

Network Topology :

Advantage:

Disadvantage

3. Explain what is meant by an IP address. (2)

4. Data is sent around a network in a packet. Explain what is contained in this packet (3)

5. What is meant by Grandfather - father - son backup? (2)

6. How are can a network be kept secure? (4)

ASSESSMENT 12

1. Explain how a web browser gets the IP address of a web server from entering a domain name such as bbc.co.uk. (2)

2. What hardware do you need to connect a network to the Internet? (1)

3. What does HTML stand for? (1)

4. What is CSS used for in web pages? (2)

5. Files transmitted over the Internet often need to be compressed. Why is this? (1)

6. What is the difference between lossless and lossy compression?(2)

7. What are these types of files used for?(5)

File extension	Use
mp3	
jpg	
pdf	
mpeg	
png	

8. It is possible to turn JavaScript off in a web browser. Explain what might happen if you do this when you are completing a registration form on a web site.(2)

Target Grade	
Current Working Grades	
Half Term 1	
Half Term 2	
Half Term 3	
Half Term 4	
Half Term 5	
End of Year Exam	
Half Term 1	
Half Term 2	
Half Term 3	
Half Term 4	