1. Create or obtain a map of a campus, with at least ten labelled buildings. Set up an app that displays this map on the phone or emulator.

2. For each of the ten labelled buildings, you will need to store the maximum number of computers available. Develop your app so that when the image of a building is touched or clicked, the number of available computers in that building is displayed.

3. Create two buttons, ‘reserve’ and ‘cancel’. Ensure that when the ‘reserve’ button is clicked, the number of computers shown as available for that building is decremented. Similarly, the ‘cancel’ button increments the number of computers available. Make sure that operating the ‘cancel’ button cannot increase the number of available computers beyond the maximum in that building.

4. Create a feature that displays the location of computers available in other buildings in case there are none available in the chosen building.

5. Evaluate the success of your app and comment on how useful it might be to a member of the university.

6. Describe one simple additional feature that you would recommend adding to the app. Explain why it would be useful.

7. Extend your original app to include this additional feature. Make sure you show and explain all the planning and code blocks that you use.

8. A real implementation of this app would require an online database. Discuss the issues that need to be considered when planning the implementation of an online database for this app.

OCR Computing GCSE Notes.

Read Only Memory (ROM)
Virtual Memory
Cache Memory
Flash memory
Input Output devices
For users with special needs
Secondary Storage
Optical storage
Magnetic storage
Solid state
Software
Operating system
Functions of the OS
Memory Management
Multitasking
User interface
Security
Peripheral management
Utility Programs
Security software
Disk management software
System maintenance
Types of software
Custom Software
Off the shelf software
Open source software
Proprietary software
Representation of data in a computer system
Character
ASCII
Unicode
Images
Colour depth
Resolution
Metadata
Sound
Instructions
Databases
DBMS
Relational databases
Data redundancy
Key field
Resources:

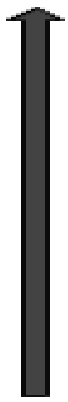
Data Conversion

		From		
		Denary	**Binary**	**Hexadecimal**
	Denary		Table	Table
	Binary	÷ 2 Method		Nibble
	Hexadecimal	÷ 16 Method	NIbble	

Denary to Binary

÷ 2 Method:
Original | *÷ 2* | = | *c/f* | *Remainder*

147 into Binary:
147 ÷ 2 = 73 1
73 ÷ 2 = 36 1
36 ÷ 2 = 18 0
18 ÷ 2 = 9 0
9 ÷ 2 = 4 1
4 ÷ 2 = 2 0
2 ÷ 2 = 1 0
1 ÷ 2 = 0 1
=10010011



Denary to Hexadecimal

If number is 36:
36 / 16 = 2.25, so we put 2 in the “16” column
Next we do 36 - (16 x 2) = 4, so we put 4 in the “1” column

16^1	**1 (16^0)**
2	4

Therefore 36 in hex is 24.
The spec says we only need to do two digit numbers.

If the value for the “1” column is more than 10, we use letters A - F, A being 10.

Binary to Denary

Table
01010101 into Denary

128	64	32	16	8	4	2	1

Nibble

- a nibble is four bits
- a byte is made from two nibbles

01010101 into Hex

Headers	8	4	2	1		8	4	2	1
Binary	0	1	0	1		0	1	0	1
Total	0	4	0	1		0	4	0	1

= 55

A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

Hex to Denary

Table

FA into Denary

16	1
F	A
15	10
240	10

= 250

Hex to Binary

Table method - reversed

Standards

Standards are an important part of the computing industry, the help keep competition up, lowering prices. As well as improving communication amongst developers. Examples of standards are: HTML, PHP, TCP/IP, IP, IPv6, ASCII, UNICODE and the Qwerty Keyboard

International Standards Organisation.
Types of standards
De jure:
Means 'by law' you must follow this if you wish to communicate: HTML

De facto:
Means 'of fact' that it originally wasn't intended to become a standard but came to be a standard through common use e.g. Qwerty

Open source:
Not owned by any single company. Often means it is free for use and has a wide community who can help quickly. However does mean there is no one responsible when something goes wrong.

Proprietary:
Owned by a company or person. This means all the products using the standard have a common look and feel and are easier to use. But does mean they are often outside the user's control and to use it you have to seek the company's permission to use it. e.g.

Industry
Agreed on by a group of companies in an industry e.g. USB. This means that there is increased competition, waste is reduced and greater compatibility between devices and between different manufacturer's equipment.

Legal:
Data protection 1998
Computer Misuse ACT ***1990*** NOT 1999 IT'S ***1990***
Copyright and Patent

Environment:
Data Centres use lots of energy and fossil fuels: - Companies now using more green energy to power their centres. Server farms may also use air conditioning to keep a constant temperature which uses many damaging chemicals.

Disposal:
cE-Waste often goes to LEDCs where dioxins and chromium can toxicate those who search the dumps for components such as gold or copper (which are valuable materials).

Computer Systems

Input - Process - Output

Moves data from a system (often into human readable format).
Process data in a system.
Moves data into a system.
Encompassed by a system boundary

Types of systems

Dedicated - Single purpose
General Purpose - Multiple uses
Control System - Controls hardware, non-human-readable output
Embedded System - Forms part of an electronic device (A system within a system)
Expert System - Interface, knowledge base, inference engine. Diagnoses illness.

Benefits and Concerns of Computer Systems:

- Allow worldwide communication.
- Allow for secure data transfer worldwide.
- In some cases, can improve the quality of life (disabilities?) Through the use of
- peripherals which are either outputs or inputs. ie. a microphone, an input.
- Coordinates businesses and emergency services over a large scale.

- User Privacy? NSA and GCHQ (UK version of NSA) and other spying such as phone tapping, and tapping internet connections going through UK between Europe and North America (so some organisations now prefer to route them through Asia instead of UK)
- Environmental Issues (what materials are used in devices)
- Patent Issues (infringes on existing designs/code)

Reliability:

How much you can depend on the computer system being available when you need it. Usually measured in terms of availability.

Availability - The proportion of time that a system is operational, usually expressed as a percentage over a certain period of time. For example, 95% measured over 1 year.

Parts of a Computer's Hardware:

CPU:

Shortened from Central Processing Unit, uses a FETCH, DECODE, EXECUTE cycle:
FETCH: the search and retrieval of instructions from memory.
DECODE: sorting instructions into parts for specific areas of the CPU.
EXECUTE: the execution of instructions (such as mathematical computation).

The Limitations of a CPU:

- **Clock Speed**: Often measured in Gigahertz, is the amount of instructions which can be processed each second (Fetch, Decode, Execute cycle). This will often be shortened to GHz, and this may come up in the exam. The higher the clock speed, the more instructions can be processed, and hence, resulting in a faster computer.

- **Cache Size:** Cache is high-level **volatile** memory that is extremely fast, and used to **store instructions** that are due to be fetched in the very near future. While the Cache is not unlike RAM, there are a few key differences. Firstly, cache is much **faster** than RAM, and found in the CPU. Additionally, cache is much more expensive, and because of this, found in smaller capacity than RAM. Usually, a computer with a modern CPU will have **1-4MB** of this cache stored in the CPU. More Cache will make a computer faster, remember this if the exam asks you to outline why one computer may be faster than another.

- **Cores**: cores are individual processing units, each handling tasks concurrently. For example, a **dual-core processor** will have **two processing units**, each able to handle a single instruction at a time, resulting in the execution of two instructions at a single point in time. Provided that a piece of software is optimized to make use of multiple cores, the computer will ultimately be faster.

e

TIP: Do not be fooled by the name CPU, when in-fact, a dual-core CPU will literally have two processing units. (and Quad-Core will have 4, etc)

RAM:

Shortened from Random Access Memory. Volatile - meaning data is lost when power to the system is lost.

Used to store data and instructions currently in use by the Operating System such as currently running programs.

More RAM will result in a faster computer, but only to a point, modern computers will have 4-32GB of RAM, more than this may be useless, as a user will be unlikely to use all of the RAM during multi-tasking. Higher amounts of RAM are useful in intensive software, such as video editing and photo-editing software.

ROM:

Shortened from Read Only Memory, Non-volatile - meaning data isn't lost when power is lost.

ROM can only be read by the computer. This is vital, as it means that the user cannot accidentally change important information that is needed for the computer to boot.

Used to store motherboard settings, boot sequence (bootstrap). A form of flash memory - used in small embedded systems.

Secondary Storage & Virtual Memory:

Definition: Secondary storage is the term applied to any storage that is not directly accessed by the processor, and is non-volatile e.g. HDD

Non-volatile memory such as a Hard Disk Drive (HDD) or a Solid State Drive (SSD). **Secondary storage** comes second after main memory (RAM or cache). Main memory is volatile meaning data cannot be saved long term. The solution to this is secondary storage although it comes at a cost, speed. Secondary storage usually holds terabytes compared to main memory gigabytes.

Some examples of secondary storage include:

- Magnetic storage (such as Hard Disk Drives (HDD));
- Optical storage (such as CD-ROMs);
- Solid-state (such as Solid State Drives (SSDs)).

Virtual Memory - When the RAM and cache cannot store any more memory due to the computer's processes, the CPU allocates storage space directly on the secondary storage (The Hard Drive) to store this excess data. This will prevent the computer from crashing as it will be able to store data somewhere but Virtual Memory allowance tends to not be recommended as this form of data storage is slow (since it is intended to prevent the computer from crashing- not for common usage).

Solid State vs Magnetic Hard Drive:

This is **unlikely** to come up in much detail, but is useful to know if you want to achieve top grades.

SOLID STATE	HARD DISK DRIVE
Faster than a HDD as it has no mechanical moving parts	Cheaper than an SSD because it is a developed technology, with relatively simple manufacturing.
As it has no mechanical moving parts it lasts theoretically lasts longer	Can break easily due to mechanical parts, thus reducing portability.
Smaller amount of storage than a Hard Disk Drive Limited number of writes	Relatively fast read and write speeds (in comparison to tape and optical drives) due to layering. (Not as fast as an SSD!)
More expensive per GB	Higher failure rate than an SSD. The problem with a mechanical disk/header is that if scratched or if the header malfunctions, data may be lost.
No need to defragment	Contains moving parts (actuator) so will produce noise when writing memory onto the disk drive.

Bus- Computer architecture that transports data between components.

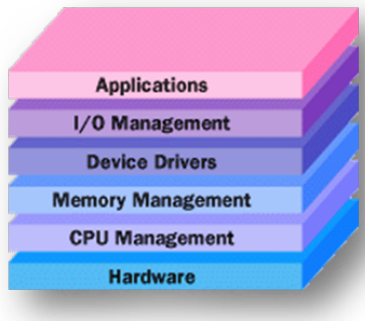
Software

System Software

System software is the software which controls the hardware. Without system software, application programmers would have to take into account the precise movement of data between locations. System software takes care of this so that developers can concentrate on developing the software.
System software acts as an intermediary between the application and the hardware.

- It hides the complexities of the hardware from the user and the developer.
- It allows the user to operate the computer without having to write programs.

The main part of the system software is the operating system. The operating system is a set of programs which control the hardware and lets a user's applications work with the computer. At its heart is the Kernel. The kernel is the part of the system which actually makes the hardware do things.



User Interface Software

An operating system must provide a way for the user to control and interact with the computer. The interface is the boundary between the human user and the machine. The interface:

- Lets the user send commands
- Asks questions
- Displays a response

There are two main forms of interface.

Command-Line interface (CLI)

illl add to this later

Graphical User Interface (GUI)

and this

Images

BITMAP:

A bitmap is an image file format that is represented in pixels, with a fixed resolution.

The **resolution** is the amount of pixels within a certain image. A low resolution will mean that details are not captured properly, and a high resolution will mean greater detailing, but a higher file size too.

A pixel can be thought of as a coloured 'dot', with a colour depth that indicates the number of bits used to represent the colour of that pixel. For example, a picture with pixels of a 24-bit colour depth will be less accurate than a image with pixels with a colour depth of 48-bits. This is because the colour depth represents how Red, Blue or Green the pixel is. The colour depth is *'divided'* by the colours Red, Blue and Green. So in a 24-bit colour depth, the picture will have 8 bits to define how red shaded the pixel is, 8 bits for how blue the pixel is, and 8 more for how green it is. This is often referred to as RGB, the greater the colour depth, the better the colour resolution.

Resolution is the amount of detail the image holds, and usually measured in DPI (dots per inch). Greater resolution and colour depth will cause an increase in file size. Images may be compressed to be transferred to another computer or sent via email.

JPEG:

Lossy (loses detail, reduces quality) compressed image format; leaves artifacts in images but they are not generally visible to the human eye as intended usecase is for photographs, where there is a lot of visual detail anyway (JPEG'ing a flat colour will look terrible with). See example images at https://en.wikipedia.org/wiki/Compression_artifact

METADATA:

Metadata is located at the start of an image file. It tells the computer how to render the image. This means it has to contain how many vertical pixels the image contains, and how many horizontal pixels there are.

In addition to this, for the computer to accurately recreate the image, it must know the colour depth of the file. The software used to display photos on your computer will find this information and can render the photo with it.

If this metadata is tampered with or removed, the file is corrupted.

Metadata can also contain information such as the copyright owner's information, the program/camera used to create the image and other (Ir)relevant information.

Sound

Sound in our world is analogue, our ears hear everything as a **frequency** and a **wave**. Obviously, a computer can't store anything as an analogue signal - so recorded sound must first be changed into digital sound.

Frequency: measured in Hertz (Hz), frequency is the amount of cycles per second. The higher the frequency, the higher the pitch of a sound. Frequency is the repeated pattern of a wave.

Amplitude: the height of a wave. Higher amplitude = louder. Lesser Amplitude = quieter.

In-order to transfer data to a computer, we must **sample** it. This is achieved using an ADC (Analog-to-Digital Converter). Ever wondered why you need an audio card in your computer? An audio card contains an ADC and a DAC (Digital-to-Analog Converter), allowing the input and output of audio signals from your computer.

If we wish to record a sound on our computer, we must sample it at a set **sampling rate.** Sampling rate is measured in Hz, the amount of samples taken per second. When we take a sample, we measure the *amplitude* and *frequency*, and store these as a binary value.

However, that's not all that makes up the recording of sound. Additionally, there is **sampling depth**. This is not much different to colour depth. Sampling depth indicates how many bits represent sound. 8 bits will represent sound at a higher quality than 4 bits, for example.

If we choose a high sampling rate, we will end up with a greater file size. This is the reason why you may get better audio from downloaded music than streamed music, as Spotify streams your music at a lower sampling rate. Usually, music will be recorded with a sampling rate of around 44kHz, with a bit depth (sampling depth) of 16 or 24 bits.

Instructions

There are low-level and high-level programming languages.

An example of a low-level programming language is **Machine Code along with Assembly Language.** Machine code is the raw binary instructions that are executed by the CPU.

An example of a high-level programming language is **C#**, this is used by humans to program computer software, but must be compiled (by a compiler) into machine code to be executed. **Python** is also a high-level language, but is interpreted at run-time, not compiled as such.

When you write code, it will be compiled into machine code. Machine code in further detail is patterns of bits (**bit patterns**) forming an operator and an operand. Together, this is **opcode**.

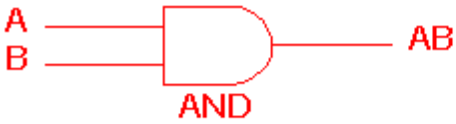
The operator is the **instruction** that the CPU must carry out, and the operand is the address of the data/data the instruction will be applied *to*.

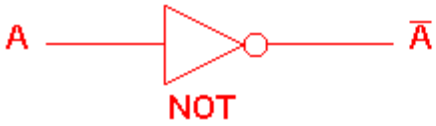
If we wish to add two numbers, the 'addition' function is the operator, and the number we wish to add would be the operand. The compiler knows what to convert the instructions into due to an instruction set, unique to the processor you are using. This instruction set contains the operator codes needed for each instruction.

E.g: 01001000

he command (e.g. instruction 4)	oes it apply to (e.g. memory location 8)

Logic Gates





A truth table is used to show the possible outputs of a logic gate, or several logic gates joined together.

NOT.

A	$\overline{A}$
0	1
1	0

AND.

A	B	AB
0	0	0
0	1	0
1	0	0
1	1	1

OR

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

Databases

Database - A persistent, organised store of data.
Table - contains any number of rows.
Row - contains information for one entity, or record

Example table with four rows:

	me	**e**

Each horizontal line above is a row. The row contains information on one item, entity or record.

Querying a database:

y	**returns from the table above**	
`* FROM tablename`	drew smith drews en	o WHERE operator here (see below g is returned.
`* FROM tablename WHERE`	drews	y is asking for everything (*) where nly row above that contains an ID Andrews one.
`FirstName,LastName FRO` `me WHERE ID=4`		y is asking for **only** the FirstName a e where the ID is 4.
`* FROM tablename WHERE`	drews en	g (*) where the ID is larger than 2.
`* FROM tablename WHERE` `stName='John'`	w	g (*) where the ID is 1 **and** the First

Important notes on databases:

● In a table, the ID row is nearly always **unique**. This means that there are no two of the same ID in the table. This makes it easier for queries to get the right information. For example, if two people in the database had the same name, there would be no way to differentiate them, which is why there is a unique ID. **A unique column is also known as a primary key.**

Relational database

			dress
		's first address n Road	
		ib	
		use	
		's second address n Road	

- This shows an example of a relational database, which links to the table of users above. In this example, each customer can have several addresses.
- The "UserID" is what is known as a foreign key, and it links the address to the user, for example, User with the ID of 1 has two addresses.

Entity

An entity is a real-life variable within a database. Or something we store data about from the real world. Each table could be an entity in a relational database.
E.g. a room in a hotel, a name or a place

Attribute/Field

An attribute is a variable within an entity, each entity can have multiple attributes. For example, the entity 'customer' could have the attributes: name, date of birth and weight. An attribute describes the characteristics of the entity.

DBMS

Database Management System.

The software that bridges the gap between a user and the database.

- Necessary if lots of users are using DB
- Has features to create customised data handling applications
  - Provides tools for accessing and maintaining the database
  - Creates tables and runs queries
- Independent from the database
- Automatically validates data
- Controls access to data
  - Filters out malicious requests
  - Good for security

- Prevents users overwriting data

Microsoft Access is a DBMS, it allows for data input. A DBMS can be made for a company, making it bespoke software. A DBMS can verify the data before entering it into the database to ensure accuracy and prevent errors. Filters bad requests, for example, if someone was to like a post on Facebook, and then try to like it again, Facebook's DBMS would filter this request out as the like had already been processed.

Networks

http://www.compedonline.org.uk/GCSEComputing/WebPages/A451_CompSys/216_CommsNetworks/216_Intro.html

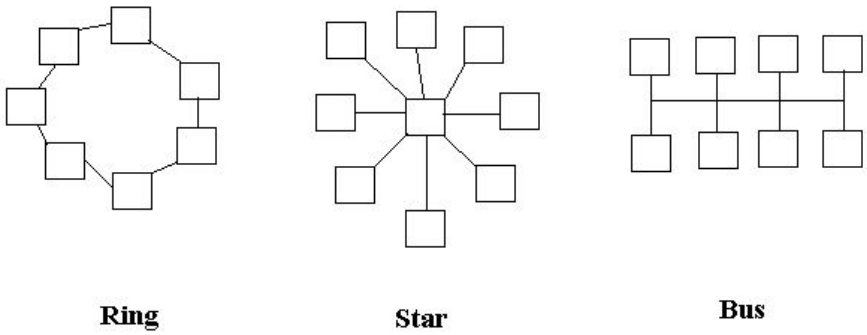
Two types:
Peer-to-Peer (P2P)
Client-Server

Peer-to-Peer	Client-server
+Faster	-Slower
+Cheaper	-Expensive
-Less Secure	Work backed up on the server
all nodes have equal responsibilities; it is decentralised	No data redundancy

Topologies:

Three of them;
-Ring
-Star
-Bus

Networking Topologies



Ring Star Bus

Fundamentals of a computer system

- Data is input, processed, output and (sometimes) stored
- A computer system is a system that can take a set of inputs, process them and create a set of outputs, achieved from a combination of software and hardware
- Computer systems are important as they are used for many things in our everyday lives
- Computer systems must be reliable to protect user's privacy and data
- Standards are needed so that systems are more reliable and helps ensure systems can communicate with each other
  - Ensures software works in a predictable way (e.g. agreed set of icons for common functions)
  - Ensures a range of devices can connect to different systems
  - Lots of developers can write for the same system or software
  - Companies can update their software
- Ethics refers to what is right and wrong
  - Privacy concerns in computing
- Environmental concerns
  - Large uses of energy in data centres
  - Disposing of computers safely
  - Recycling
- Legal considerations
  - 1998 data protection act
  - 1990 computer misuse act

The CPU

- Central processing unit
- Processes computer programs and data
- Is the core of every computer system
- Performs arithmetic calculations
- Function of the CPU is to fetch and execute instructions stored in memory and to perform arithmetic and logical operations

Clock speed

- Is how many instructions can be calculated per second

- Measured in MHz or GHz (mega/gigahertz)
  - The higher the clock speed, the more instructions can be executed per second and so the faster the computer

The Number of Cores

- A CPU can have multiple processors (cores)
- This allowed multiple instructions to be executed simultaneously
- More cores means better performance (usually)
- Not all software can handle parallel computations

CPU Cache

- Cache is type of memory that stores frequently accessed data so it can be retrieved quickly
- CPU cache contains small blocks of memory that are frequently accessed to save time
- Large cache means better performance

Binary Logic

- Binary is a base-2 system
  - Either 0 or 1
- Used in a computer as it represents on and off states of a transistor
  - Processors are made from transistors
  - Transistors are a tiny switch activated by electronic signals
  - 1 = on, 0 = off
- A bit is either 0 or 1
- A byte is 8 bits
- A nibble is 4 bits

Boolean algebra

- Tests if statement is TRUE or FALSE
- TRUE = 1, FALSE = 0

- A truth table lists all possible outcomes of a logic gate
  - This helps keep track of all possible combinations

  - Loses everything stored on it when power is turned off
- Function is to store data associated with currently opened programs
  - Makes programs quicker to run than if on hard drive
- More RAM means more programs can be open and used at the same time

Read Only Memory (ROM)

- Form of storage containing pre-recorded data
- Can only be read and not edited
- Non-volatile
- Needed to store essential programs
  - Allows computer to start up

- Contains BIOS and boot menu

Virtual Memory

- A procedure that comes into place when all the RAM is used up
- Data in the RAM that has not been used for a while is moved temporarily to a space on the hard drive
- This extends the capacity of the RAM
- Read and write times on the hard drive are slower
- Virtual memory is accessed slower than RAM

Cache Memory

- Store of data allowing future requests to be completed faster
- Data stored in cache is data that is frequently accessed
- Very fast read and write times

Flash memory

- A form of non-volatile memory
- Solid state technology
- No moving parts
- More durable and reliable
- SSDs are expected to eventually replace hard disks

Input Output devices

- For a computer system to function it needs a device to input data and a device to output data
- An input device allows data to be entered for processing
- An output device presents data that has been processed

For users with special needs

- Eye tracking control to navigate screen using eyes
- Braille devices (displays and keyboards)
- Voice recognition
- Puff suck switch

Secondary Storage

- Needed as a place to store data when computer is turned off
- Form of non-volatile memory
- Capacity – how much data can be stored on the storage device
- Speed – how quickly data can be written or read to the storage device
- Reliability – how dependable the device is
- Portability – how easily the device can be moved around
- Durability – how likely the device is to break

Optical storage

- Binary stored as variations of height on the surface in the form of dots
- A light is shined on it and can distinguish between a “pit” and a “land”, allowing the drive to detect differences and read the data
- A “pit” refracts light away from sensor and so is read as 0
- A “land” reflects light back at sensor and so is read as 1
- Includes CD, DVD, Blu-ray
- ~~Data is written with a laser burning pits into the medium~~ When writing RW CDs the laser heats the surface of the disk, which causes it to change reflectance (like a pit or flat on pressed CDs)

Magnetic storage

- Uses read and write heads containing electromagnets
- Surface is either demagnetised (0) or magnetised (1)
- Includes Cassette tapes and hard disks

Solid state

- Non-mechanical flash memory
- Consists of circuits with complex logic gates
- Non-volatile, walter white
- SSDs

	Optical	*Magnetic*	*Solid State*
Capacity	Small capacity	Largest capacity	Medium to large
Speed	Medium	Medium	Very fast
Durability	Easily scratched	Easily broken	Most durable
Portability	Easy to transport (CD)	Not very easy to transport	Very easy to transport (USB)
Reliability	Reliable	Reliable	Most reliable as non-mechanical
Volatility	Non-volatile	Non-volatile	Non-volatile

Software

- Software is programs used to control a computer

Operating system

- Essential piece of software linking hardware and other software together
- Bridges the gap between applications and hardware

Functions of the OS

Memory Management

- Prevents multiple programs interfering with the same memory
- Safely allows access to the memory that programs require
- E.g. preventing file names being edited whilst file is open

Multitasking

- OS allows programs to run concurrently (overlapping)
- Gives impression of, and allows, multitasking

User interface

- Allows user to interact with computer
- Can be a command line or a GUI

Security

- Able to distinguish between legitimate and illegitimate program requests
- Authenticates each requests
- Prevents a program taking over computer

Peripheral management

- OS ensures all peripherals work by installing drivers
- Ensures everything can work together

Utility Programs

- Includes security software, disk management software and system maintenance

Security software

- Antivirus
  - A program that detects and eliminates malicious software
- Firewalls
  - A network system that filters incoming and outgoing traffic
  - Prevents connecting to bad website
- Spyware protection
  - Spyware is software that gathers information about the user
  - Spyware protection block the threat and eliminate it

Disk management software

- Defragmentation
  - Organises related data
  - Access data quicker
- File transfer
  - Allows files to be moved, copied or deleted
- Formatting
  - Can partition sections of secondary storage
  - Prepares hard drive for secondary storage

System maintenance

- System clean-up
  - Removes temporary or old files
  - May clean the cache
- Automatic updating
  - Searches online to find, download, and install updates to software when it is released
- System information and diagnostics
  - Keeps specifications of computer and can be checked if functioning properly
  - Gives information on errors with the computer

Types of software

Bespoke (custom-made) software

- Specifically commissioned software to fit exact needs of user
- Used when existing software doesn't fit needs
- Expensive
- Can take long time to create
- No support online if problem

Off-the-shelf software

- Software you can buy in a shop
- Aimed at meeting needs of lots of users
  - Contains lots of features that most people won't use
- Cheap
- Lots of support
- Usually bug free

Open source software

- Free of charge
- Code is freely available for anyone to modify

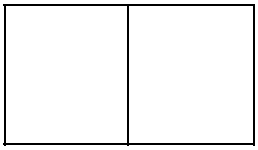
Proprietary software

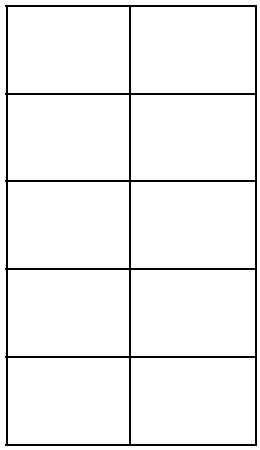
- AKA closed source software
- ~~Licence needed~~ **JUST BECAUSE YOU CAN'T SEE THE SOURCE CODE, DOESN'T MEAN THE SOFTWARE COSTS MONEY**
- Source is kept secret
- ~~Expensive~~
- Usually free updates
- Tested well, lots of support

Representation of data in a computer system

- Data must be converted to binary to be understood by a computer
- In binary everything is either 0 or 1, off or on, true or false, high or low
- A binary digit is called a bit

- Bit = binary digit
  - Either 0 or 1
- Nibble/nybble = four bits
  - 0011
- Byte = two nibbles, 8 bits
  - 0010 1101
- Kilobyte = 1024 bytes (KB)
- Megabyte = 1024^2 bytes (MB)
- Gigabyte = 1024^3 bytes (GB)
- Terabyte = 1024^4 bytes
- Overflow error
  - Happens when there are too many bits to fit into available memory - in the exam you'll be told to add two 8-bit binary numbers and the answer will need 9 bits (**make sure to mention overflow**)
  - Number is too large so an extra bit is needed to display the number





Character

- A letter, number or symbol
- To input or output characters, a coding system that converts binary to characters must be used
  - This is called a character set
- A character set translates a character into binary code and back again

ASCII

- Based on the English language
- Represents 256 characters as 8 bit binary numbers (0 – 255)
- Main limitation is that no extra characters can be added
- No other languages such as Arabic can be used

Unicode

- ~~An addition to ASCII~~
- ~~Used the same 256 first characters~~
- Based on 16 bit so lots more character can be used and other languages

Images

- Images are a series of pixels represented in binary
- Computer finds average colour of each pixel and give it 1 or 0 for black or white
  - For RGB these will be different values

Colour depth

- Number of bits used to represent the colour of a pixel
- If a nibble was used to represent RGB colours, there wouldn't be a lot of colours
- Colour depth increase = larger size

Resolution

- Measures the detail an image holds
- Measured in DPI
- Larger resolution is more information so larger file size

Metadata

- Data about the photo
- Contains height, width resolution, colour depth
- Allows an image viewer to know how to display the image
- Automatically stored with the file

Sound

- Sound sampling converts analogue sound to digital
- Computer takes reading of sound wave at predetermined rate called the sampling interval
- Sampling rate/interval of 2Hz = 2 samplings per second
- Values of the amplitude at each of these points is converted to binary and stored
- A great sample rate or lower sample interval gives better sound and a larger file
- Sampling depth is similar to colour depth
  - 4 bits representing sound will sound worse than 8 bits
  - 4 bits would mean only 4 different amplitude heights can be recorded

Instructions

- At machine level the instruction in computer memory are stored as binary
- Each instruction is represented by a different bit pattern that the computer recognises as an instruction
- When the CPU fetches data from memory it cannot tell the difference between data and an instruction
- Finds what it expects to find based on the program running
- Instruction has two parts:
- Operator
  - Tells the CPU what to do
- Operand
  - Tells the CPU the subject of the operation

Databases

- A persistent organised store of data

DBMS

- Database management system
- Allows separation of data from other applications
- Bridges gap between a user and the database
- Necessary if lots of users are using DB
- Has features to create customised data handling applications
  - Provides tools for accessing and maintaining the database
  - Creates tables and runs queries CD

- Independent from the database
- Automatically validates data
- Controls access to data
  - Filters out malicious requests
  - Good for security
  - Prevents user's overwriting data

Relational databases

- Database with more than one table and the tables are linked with key fields
- Entities
- Things data has been written about
- Teachers, students etc
- Tables
- 2 dimensional representation of data stored in rows and columns
- Tables contain data about the entities
- Forms
- What people submit data in
- Query
- Requests for data that is retrieved from DB
- Report
- Presentations of data from the database
- Modules
- Adds additional functionality to database

Data redundancy

- Unnecessary data repeated in two or more rows
- Inefficient

Key field

- Unique identifier linking one table to another
- Prevents data redundancy

- Validation is act of checking data to make sure it is correct and reasonable, makes sure data will not cause errors
  - Makes database more robust

Networks

- Networks are connections between nodes that allows data to be exchanged

LAN

- A network connecting computers close to each other in a limited area

WAN

- Network over very large area e.g. the internet

Network vs stand alone PC

- Share files and data
- Peripherals can be shared
- Data can be backed up

Switches

- Forwards packets only to intended destination
- Sends to particular MAC address
  - Media access control
  - Unique ID for each device

Hub

- Sends packet to every device on network

Router

- Forwards data packets to appropriate part of a network
  - Packet is a small amount of data sent over a network
  - When something is being sent over a network it is broken into packets
  - Packets are reassembled at its destination

Client server network

- A network where every computer is either a client or a server
- Server is provider of resources and services

Peer to peer network

- No central server, all computers are connected to each other with equal responsibility and ability to work as either a client or a server

Bus network

- Data transmitted to all devices until stopped by a terminator
- Cheap and easy to install
- If bus fails then the whole network fails
- Lots of data collisions so slow
- Security risk
- All clients, servers and resources connected to one cable, the bus

Star network

- Each node connected to central connection point
- Reliable
- Expensive
- If central device fails then the whole network fails

Ring network
- Each device connected to two others
- Message travels round ring
- Received by all devices until the recipient receives it
- No data collisions as all in one direction
- If one cable fails whole network fails

Network security
- Encryption, passwords, user access levels

Network policies
- Acceptable use agreement, data protection, disaster recovery, failover, archiving

Modem
- Converts digital data to analogue for transmission across telephone lines

Programming

Translator
- Converts high level code to machine code
- High levels code must be translated to be run by CPU

Assembler
- Converts low level assembly language to machine code

Compiler
- Translates high level language to machine code
- Scans whole code first and then translates
- After translation it may produce an error

Interpreter
- High level to machine code
- Translates line by line, stops if error
- Executes each line after it is translated
- Slower than compiler (well, it effectively spreads the compilation out; compiling a program and executing it should take around the same amount of time as interpreting/executing a program)

IDE Editor
- Allows user to write code
- May use syntax highlighting
- May autocomplete

Error diagnostics
- Debug tools to find errors
- Highlight errors
- Say what error occurred

Run-time environment

- IDE runs code as if it were run by CPU
- Not full translation

Auto-documentation

- Lists variables or modules used
- Useful for large projects

Syntax error – programming rules not obeyed
Semantic error – code runs but not as expected