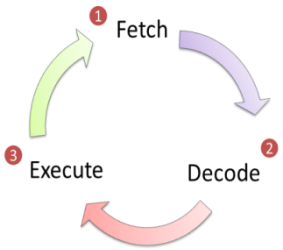
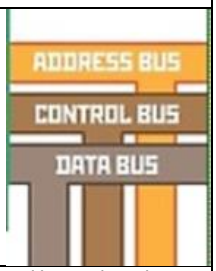
Knowledge Organiser

Computer Science

Computing

System Architecture	
Question:	**Answer:**
Define the term computer system?	A combination of hardware and software into which data is input, processed and stored, and information is output.
What is hardware?	The physical components that make up a computer system.
What is software?	The programs and operating data.
Define the term peripheral device?	Input, output and storage devices connected to the main computer (External pieces of hardware)
Explain the purpose of the CPU	The Central Processing Unit which fetches instructions from main memory and executes them
Explain what the fetch, decode and execute cycle is	The process carried out by the CPU to execute instructions. This is repeated until the computer is shut down. 
Explain the what happens during the fetch cycle	The instruction is fetched from RAM.
Explain the what happens during the decode cycle	*The opcode is decoded so the CPU knows how to handle the instruction*. If the operand contains an address the data is fetched from primary memory. Because a second fetch is carried out in a single cycle, the CPU knows the new binary received is data.
Explain the what happens during the execute cycle	The instruction is carried out.

Describe what is meant by the clock speed?	The clock speed determines the amount of Fetch, Decode and Execute cycles happen per second. The higher the clock speed the more instructions are fetched, decoded and executed each second. 1 hertz = 1 cycle per second. 1GHz = 1 billion clock cycles per second.
How does the clock speed affect the performance of a CPU?	The higher the clock speed value is the more instructions the CPU can process per second
Define the term core?	A core is a mini processor inside a CPU
Define the term single core processor?	A CPU with a single core. This can only process one instruction per clock cycle.
What is the difference between quad core CPU compared to a dual core CPU?	A quad core has 4 cores and a dual core has 2 cores. Cores work together to process data at one time. As quadcore has more cores, it can process more data at one time.
Explain how cores can affect the performance of a CPU	The more cores you have, the more data can be processed by the CPU at one time. This is because they all work together to process data at one time. Therefore, improving the speed of processing data.
Define cache memory?	Small memory in the CPU that is used to store frequently used data.
What is the purpose of the cache?	The purpose of the Cache is to store frequently used data on the CPU so the data can be retrieved quicker.
Explain how cache can affect the performance of a CPU	The larger the cache, the more frequently used data can be held, reducing the time taken to fetch instructions. Therefore, speeding up the process of fetching, decoding and executing data.
Where is level 1 cache located?	L1 Cache is located on the CPU core.
Where is level 2 cache located?	This is located outside the core.
Define the term bus?	A communication system for transferring data. 
State the purpose of the address bus?	Used to send addresses from the CPU to the RAM of data and instructions the CPU is fetching.
State the purpose of the data bus used?	Used to transfer data/instructions between the CPU and RAM.
State the purpose of the control bus used?	Used by the CPU to send control signals around the computer.
What is a Von Neumann processor?	A processor design that stores the current programs and data in a single primary memory connected to the CPU via a bus.

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Define the term register?	A small memory location within the CPU used for specialised tasks. 
State the purpose of the program counter?	Holds the address of the next instruction to be executed. Once an instruction is fetched, this is increased by one.
State the purpose of the MDR?	Holds the data fetched from the RAM.
State the purpose of the MAR?	*Holds the address of data/instructions to be fetched*, this is copied to the address bus.
State the purpose of the CIR?	Holds the current instruction that has just been fetched from RAM.
State the purpose of the accumulator?	Results of arithmetic and logic operations are stored here until the CPU is instructed what to do next.
State the purpose of the control unit?	Decodes the opcode and informs the other CPU components and peripherals what to do.
State the purpose of the arithmetic and logic unit?	Performs all arithmetic and logical operations on data.

Memory	
State the purpose of storage in a computer system?	Retain data permanently or temporarily on a computer
Define the term primary storage?	This is a type of storage that is used by the CPU when processing data. e.g. RAM, Cache, Virtual memory
Define the term secondary storage?	This is a type of storage that is used to store data permanently when the power is off. e.g. Hard disc drive, USB Memory stick, optical.
Define volatile storage?	Volatile storage is a type of storage that stores data temporarily whilst the CPU is using it. When the power turns off, all data is lost. RAM is Volatile.
Define non-volatile storage?	Non-volatile storage is a type of storage that stores data permanently. The hard disk drive is non-volatile as when you turn the power off, data will remain stored.
State the purpose of the ROM?	Read Only Memory. Stores data such as the operating system. The ROM is read only, which means it stores data that cannot be changed.
State the purpose of the RAM/primary storage?	Random Access Memory. Holds the programs and data currently in use. The more RAM a computer has, the more programs and files that can be loaded at once. This is volatile, the contents are deleted when the computer is switched off.
Explain what is meant by virtual memory?	A segment located on the hard disk drive, used as temporary storage while a program is being used.
State the need for virtual memory?	This is used when there is not enough RAM to contain the programs and data currently being used. An area of the hard disk is used to hold the programs and data not frequently being used. As the user changes programs, their page files are swapped with others in RAM. Too much swapping can cause the disk to be thrashed.

Storage	
State the three types of secondary storage	Optical Magnetic Solid state
Describe the characteristics of optical storage?	low cost Robust portable Low capacity Slow at reading and writing data.
Describe the characteristics of magnetic storage?	High capacity Fast at reading and writing data
Describe the characteristics of solid-state storage?	Very fast at reading and writing, High cost per gig Lightweight and portable Fast at reading and writing data
State the 6 characteristics of secondary storage devices	capacity speed portability durability reliability cost.

Networks - General terms and Network Media	
Define the term Network?	Two or more devices are connected to each other to share data and services.
Describe is the difference between a server and a client?	Server - A device connected to a network that *provides resources*. Client - A device connected to a network that *consumes resources*.
Describe a peer –peer network?	A flat network model in which all hosts provide and consume resources.
Describe a client-server?	A hierarchical network model in which some nodes provide and others consume services.
Define each network cable?	Ethernet - Copper cable connection used to transmit data at speed up to 1GBit/s.

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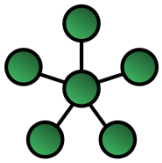
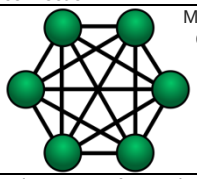
	STP - Shielded Twisted Pair. Ethernet cable wrapped in electromagnetic shield to protect data from corruption. UTP - Unshielded Twisted Pair. Ethernet cable without shielding so the data can be affected by electromagnetic signals. Fibre optic - Medium used to transfer data via light pulses. 100Mbit/s can be transferred at distances of up to 2km, 10GBit/s can be transferred up to 550m.

Networks - Topologies and components	
Define a “Star” Network topology?	 Each node has own cable that is linked to a central network component (Hub or Switch). This component will broadcast data to all devices or a relevant device + Fast + Higher security - Complex to build/fix - Expensive
Explain the advantages and disadvantages of a Star network	The advantages of a star network are: it is very reliable – if one cable or device fails then all the others will continue to work it is high-performing as no data collisions can occur The disadvantages of a star network are: it is expensive to install as this type of network uses the most cable (network cable is expensive) extra hardware is required (hubs or switches) which adds to cost if a hub or switch fails, all the devices connected to it will have no network connection
Define a “Mesh” network topology	 Mesh network topology is a key network architecture in which devices are connected with many redundant interconnections between network nodes. If any batteries or nodes fail in a wireless mesh topology, many other ways are available for two nodes to communicate. There are two types of mesh networks, full/partial
Explain the advantages and disadvantages of a mesh network	Advantages of a mesh topology: messages can be received more quickly if the route to the intended recipient is short messages should always get through as they have many possible routes on which to travel multiple connections mean (in theory) that no node should be isolated multiple connections mean each node can transmit to and receive from more than one node at the same time new nodes can be added without interruption or interfering with other nodes Disadvantages of a mesh topology: full mesh networks can be impractical to set up because of the high number of connections needed many connections require a lot of maintenance
Define the components that make up a network?	NIC - Network Interface card. Hardware needed to provide physical access to a network. Modem - Modulator/Demodulator. Device used to convert digital signals to analogue for transmission down a telephone cable and vice-versa. Hub - A hub broadcasts an incoming signal to all components on a network. Router - Connects independent networks that have different setups. Switch - Forwards data packets on to the appropriate device on a network, thus reducing traffic.

Transmitting data	
Identify and describe the role of protocols for data transmission?	TCP/IP - Transmission Control Protocol/Internet Protocol. Used to decide how data should be split into packets, address, transmitted, routed and received. POP - Post Office Protocol. Method used to retrieve email stored on a server. IMAP - Internet Mail Access Protocol. Used to manage mailboxes on a remote server. Internet Mail Access Protocol. Used to manage mailboxes on a remote server. HTTP- Hyper Text Transfer Protocol. Used to request files. HTTPS is an authenticated service that uses SSL to prevent interaction with unauthorised websites. FTP - File Transfer Protocol SMTP - Simple Mail Transfer Protocol. Used to push email from a device on to a server for delivery.

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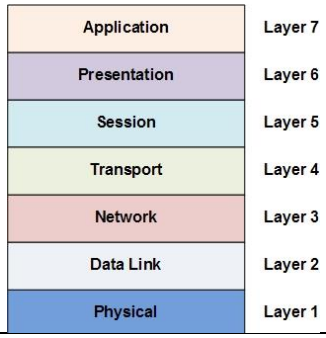
Network classifications	
Describe what a LAN is	LAN - Local Area Network confined to a single geographical location.
Describe what a WANis	WAN - Wide Area Network spread over multiple geographic locations. Internet - A global WAN.
Describe what a MAN is	MAN - Metropolitan Area Network. Uses public communication links and covers a wide area such as a city of town.
Describe what a VPN is	VPN (Virtual private network - Network that simulates the behaviour of a LAN, but is created across a LAN. Encryption is used to prevent data falling into the wrong hands

Transmitting data	
Explain the difference between and IP address and a MAC address?	IP address - 32-bit Software based address, which can be changed when a device connects to a network. The address (IP v4) is split up into 4 octets (groups of 8-bits), each part of the address ranges from 0-255. Example address in denary: 137.12.168.255 The internet of things has meant that 32-bit addresses are not enough, so the new version of IP (v6) addressing has 128-bit addresses. MAC address - A unique physical address assigned to a device by a manufacturer that cannot be changed.
Define the term bandwidth?	Bandwidth - The amount of data that can be transferred in a specific time. This is measured in megabits per second (Mbps).
Explain what decomposing is?	Breaking down a network (decomposing) so that different parts are independent of each other. By organising the rules for each layer and the order in which they are applied, different manufacturers and developers can make solutions for different parts of a network. Each layer has an interface to the layers above and below it. 
Describe the stages of packet switching when sending data through a network?	*Data is split into small packets* Each packet contains information such as sender address, recipient address, sequence number, error checking data. The quickest and shortest route is determined before transmission All data packets are sent through the network, taking their own route. If all packets are received by the recipient, the data is put back into order and is available for use. If all packets are not received, an error message is sent back to the sender, and the missing data packet will be resent to the recipient.
Can we check for errors when data is sent across the internet?	CRC - Cyclic Redundancy Check. An error checking process. A mathematical expression is applied to packet. This generates a code which is transmitted with data. Receiving device performs same check, if codes don't match then a transmission error has occurred and a resend is requested.
Describe what is meant by "Routing"?	Routing - The way in which data is sent across a network (circuit or packet switching).
Describe what is meant by packet switching?	Packet switching - Sending data via packets. The packets take different routes across the network and are reassembled by the receiving device. If a network segment has a lot of traffic or cannot transmit data, the packets are rerouted.
Describe what is meant by circuit switching?	Circuit switching - Creating a direct connection between two devices to transmit data, meaning the full bandwidth is available. If the circuit is broken the connection fails.

Network security – Key terms	
Defines Hacking?	Attempting to bypass security systems to access data.
Describe what backdoor is, as a way of gaining unauthorised access to data?	Backdoor - A feature or defect of a computer system that allows secret unauthorized access to data.
Describe what a security policy is?	Security policy - A document that explains to employees how they are expected to think and behave while using computer systems. This explains the 5 Ws of security related issues in the organisation.
Explain the purpose of an acceptable use policy?	Acceptable use policy - Set of rules that explains the restrictions in place on the network, and guides users on suitable behaviour.
Describe what is meant by remote access?	Remote access - Accessing network resources & services from outside the physical LAN
What happens when there is a security failure on a network?	Incident response plan - Plan that explains what to do if there is a security failure.
Describe the meaning of back up?	Backup - A copy of data that is made in case the original data is lost or damaged. The backup can be used to restore the original data.

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Describe what is meant by disaster recovery?	Disaster recovery - The policies and procedures that a company or organisation has in place so it can carry on with normal business after a disaster, such as a major ICT failure, a fire, etc.
What method is used to ensure customer data on a network is safe?	User security - The use of methods such as usernames & passwords, encryption, restricted physical access, access rights, transaction logs.
Define the term malware?	Malware - Software designed for malicious purposes (cause damage or steal information).
Describe what is meant by spyware?	Spyware - Software installed in order to pass on user data relating to user names and passwords to a 3rd party.
Describe what is meant by a virus	Virus - A small program designed to replicate itself.
Describe what is meant by a firewall	Firewall - A filter used to protect a network by preventing access to unauthorised users.
describe what is meant by version control?	Version control - Managing the changes made to a document on a network.
Encryption - Encoding data to produce ciphertext	
Describe the key terms do we need to know when discussing encryption?	Key - A mathematical algorithm used to encrypt and decrypt data. The larger the numbers used in the key, the harder it is to crack. Ciphertext - Data scrambled using a key. Symmetric encryption - Use of a single key to encrypt and decrypt data. If the key is intercepted then the ciphertext has been compromised. Caesar cipher - Using an offset to shift characters in a message e.g. Message = “apple”, Offset = 4, ciphertext = “ettpi”. Asymmetric encryption - Using linked keys to encrypt/decrypt data. 1) A uses B’s public key used to encrypt data 2) Ciphertext is transmitted to B 3) B uses their private key to decrypt the message. It is possible to discover a private key by reverse engineering a public key, however this is very difficult.

Hacking strategies	
Describe what a brute force attack is?	Brute force - Using software to try every possible combination for a password until the correct one is found.
State one solution that could be used to prevent a brute force attack?	Password strength - The complexity of the password.
Describe what is meant by phishing?	Phishing - Emails pretending to be from an official source, often asking the recipient to click on a link to reset their account details.
Describe what is meant by denial of service attack?	DoS - Denial of Service attack. These are not aimed at breaking in to a network but shutting it down. These can be by giving the targets computational intensive tasks or by bombarding them with requests.
Explain the 3 hazards when data is intercepted before it has reached its destination?	Data interception - Capturing data while it is being transferred. Packet sniffing - Examining data packets to see if they match pre-determined rules. MITM - Intercepting data by disrupting the route & pretending to be the other party.
Describe what is meant by SQL injection?	SQL injection - Putting SQL statements into a web-form to trick the database into giving up data.
Describe what is meant by penetration testing	Penetration testing - Looking for a vulnerability in a network, setting up and carrying out an attack to test the security and ability to recover (data).

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Systems software	
Define the term Software	Programs and operating data.
Explain the meaning of Applications software	Software that allows the computer to be applied to a particular problem. It is used for a particular purpose e.g. creating slides, word processing, creating spreadsheets.
Describe Systems software	Any computer software that manages and controls the hardware thus allowing the applications software to do a useful job.
Describe the Operating System	System that controls the hardware and allows other software to run. Provides a user interface, memory management, peripheral management, multi-tasking and security.
What is the purpose of a Drivers?	Software that allows the OS to communicate with the hardware devices attached to the computer.
What is meant by UI?	User Interface. The way in which the user communicates with the computer.
Explain what is meant by Command Line	UI where the user interacts by typing commands. Very powerful and fast to use, uses very little system resources. Difficult to learn and useless if you don't know commands.
What is meant by Menu driven?	UI where the user selects options from a list. This may drill down into further menus and options e.g. TV guide on Sky/cable. Easy to use without specialist knowledge, can be slow and frustrating to use, limited to menu options only.
What are the advantages and disadvantages of a GUI?	Graphical User Interface, makes use of a WIMP (Windows Icons Menu Pointer). Most intuitive UI and easy to learn. Slower than Command Line and uses the most system resources.
State the 3 functions of Utility software	Software for security*, performing maintenance♦ and disk organisation⏀ tasks.
What is the purpose of an Antivirus*?	Software for detecting, quarantining and removing viruses from infected files.
Explain the purpose of a Firewall*	Software that prevents unauthorised users from accessing a network (or device).
Explain the purpose of Anti-Spyware*	Software that can stop spyware from secretly gathering data from a user and passing it on to a malicious 3rd party.
Describe is the role of Formatting	Software that prepares a disk for first use by organising the clusters,

File types	
Define the term Executable	File which can be run by the computer (as an application).
Define the term File type	The way in which a file is written in order to allow software to understand them.
What is an MPEG file format used for?	A file format used to save video files. This is a lossy format.
What is a JPG file format used for?	A file format for saving bitmap graphics in a (lossy) compressed form so they can be easily downloaded.
What is a PDF file format used for?	File Portable Document Format. Used to share documents easily between computers that may have a different OS or applications.
What is a GIF file format used for?	File A lossy image format. This can only store 256 colours. It can be used to create animations.
What is a MP3 file format used for?	A lossy file format used for sound.

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Software for writing code	
Describe what is meant by Programming software	Software used to create Applications and Systems software.
Define Editors	Any software that lets you write code. This can be simple e.g. Notepad, or a more complex IDE like Netbeans.
Define IDE	Integrated Development Environment. Software that makes it easy to create and test programming code.
Describe the purpose of Run-time environment	Allows you to run the code (e.g. line by line) and see what is happening for debugging purposes.
Describe the purpose of Breakpoints	The ability to pause a program while it is running to debug it.
Describe the purpose of Error diagnostics	Helpful hints for the programmer to find errors e.g. Syntax highlighting (when you make a mistake), variables watches (so you can track values while debugging).
Describe the purpose of Translators	Software that turns your code (written in a human-understandable programming language) into binary machine code that can be understood by a CPU.
Describe the purpose of Auto-documentation	A tool that generates documentation for a program based on the comments written by the programmer

Utility software	
Describe the meaning of File transfer	Software for transferring data between disks or over a network.
Describe the functions of Defragmentation	Software for reorganising fragmented data into contiguous clusters that make up a whole file. Can increase the speed of a magnetic hard disk.
Describe the role of System Diagnosis	Software that helps the user troubleshoot faults with a system e.g. printer trouble shooter.
What is the purpose of System information?	Software that informs the user about the different components of your system.
How is Automatic updating used in a computer system?	Software that downloads the latest feature updates, software and security patches for your system.
What are the roles of System clean-up tools?	Software for improving the performance of a system by deleting unused data, clearing internet browsing cache and cookies.

Types of software	
Explain the meaning of Custom written	Software written especially for the user. often expensive, can provided competitive advantage as the software will be specifically designed for the way a company works.
Explain the meaning of Off the shelf	Generic software bought from a retailer. Can have extra unused features (bloatware) therefore take up more space (memory) on a computer
Explain the meaning of Open source	Software where you can see the source code. Often free.
Explain the meaning of Proprietary	Software where the software is kept secret. This is often because the software is for sale or provides competitive advantage.

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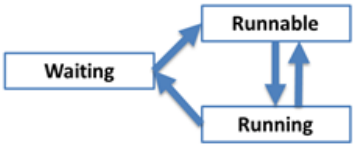
Running software	
Explain the meaning of Multitasking	Dividing the total number of clock cycles available in a second between different applications so the CPU is sharing its time between different applications. The CPU is so fast that it looks like applications are running simultaneously. **Possible process states:** 
Explain the meaning of Waiting	When an application is paused because it is waiting for data or resources to become available.
Explain the meaning of Runnable	When an application is paused, but has the data or resources it needs ready.
Explain the meaning of Running	When an application is being processed by the CPU.
Explain the meaning of Memory Manager	Part of the OS that is used to: 1. Allocate memory to processes when they want to run 2. Deallocate memory when they are finished. The memory manager prevents one program from seeing the memory allocated to another to maintain security.

Legal, cultural and ethical issues	
What issues need to be considered when using technologies?	Ethical, legal, privacy, environmental and cultural
State which 5 laws were bought into place to help with legal issues?	Computer Misuse Act(1990) Freedom of Information Act(2000) Communications Act(2003) Data Protection Act(1998) Copyright, Designs and Patents Act, CPDA(1988)
State the purpose of the Computer Misuse Act?	The Computer Misuse Act makes unauthorised access to computer material illegal.
State the purpose of the Freedom of Information Act?	The Freedom of Information Act allows the public to see data related to the activities of public authorities.
State the purpose of the Commutations Act?	The communications Act makes it illegal to access WIFI networks without permission and to send offensive communications.
State the purpose of the Data Protection Act?	The Data Protection Act sets out the requirements for the control of the stored data about individuals.
State the purpose of the Copyright, Designs and Patents Act?	The Copyright, Designs and Patents Act protects the intellectual rights of individuals and organisations
State the purpose of the Creative Commons Licence ?	The Creative Commons Licence allows the author to give up some of the rights to allow others to modify and redistribute their work under certain conditions.
Explain the difference between Open source and Proprietary software?	Open sources software can be accessed and adapted by anyone for free, whereas Proprietary software is written by organisations to make a profit and cannot be modified.
State privacy issues	CCTV cameras, Electronic tags, Black boxes in cars, Mobile phone signals, workplace logging systems
Explain how can computer technology be used to analyse personal information?	Whenever we check into social media, the location and time is logged Whenever we take a picture with our phone's camera the location and time is logged.
Define the term e-waste and explain why it is a problem?	E-waste is electronic waste. All of our electronic waste is hazardous, and causes problems to health and our environment.
Explain what is meant by the digital divide?	The digital divide is the social and economic gap between those who have and those who do not have access to computer technology.
Describe how cookies impact your browsing?	Cookies store personal information about your browsing history

Algorithms	
Computational thinking is ...	The ability to solve a problem in a structured way
Describe what is meant by the term 'abstraction'.	The removal of unwanted unnecessary information from a task. Therefore, allowing you to focus on the important part making the task easier to solve.
Describe what is meant by decomposition?	The process of breaking a big task into small tasks and solving them one by one. Therefore, making the problem easier to solve.
Describe what is meant by algorithmic thinking?	Thinking in a structure way and completing task in a step by step basis to complete a task/solve a problem

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State two searching algorithm's.	A searching algorithm searches for data based on specific criterion. There are 2 types of searching algorithms, Binary and Linear.
Explain the term binary search?	Looks for a specific value in a list. The algorithm is designed to find the middle number and decide if the number will be higher or lower. It will then disregard half the data and repeat the instructions again until the number is found
Explain the term linear search?	This algorithm simply checks every item in the list from start until finished. It reads the first value, compares it to the value you are looking for, if it is not the same then it will continue looking through each item.
State 3 types of standard sorting algorithms?	Sorting algorithm is designed to sort data so that is is easier to find data. There are 3 common types: Bubble sort Merge sort Insertion sort
Describe what happens when a bubble sort algorithm is used?	A simple algorithm used for taking a list of jumbled up numbers and putting them into the correct order. The algorithm runs as follows: Look at the first number in the list. Compare the current number with the next number. Is the next number smaller than the current number? If so, swap the two numbers around. If not, do not swap. Move to the next number along in the list and make this the current number. Repeat from step 2 until the last number in the list has been reached. If any numbers were swapped, repeat again from step 1. If the end of the list is reached without any swaps being made, then the list is ordered and the algorithm can stop.
Describe what happens when a merge sort algorithm is used?	Another example of a computer sorting algorithm is merge sort. This is a more complex algorithm than bubble sort, but can be more efficient. The merge sort algorithm repeatedly divides a list into two until all the elements are separated individually. Pairs of elements are then compared, placed into order and combined. The process is then repeated until the list is recompiled as a whole.
Describe what happens when an insertion sort algorithm is used?	Insertion sort An insertion sort is less complex and efficient than a merge sort, but more efficient than a bubble sort. An insertion sort compares values in turn, starting with the second value in the list. If this value is greater than the value to the left of it, no changes are made. Otherwise this value is repeatedly moved left until it meets a value that is less than it. The sort process then starts again with the next value. This continues until the end of the list is reached.
Describe the meaning of sequence?	This type of algorithm is designed to execute a set of instructions one after the other.
Describe the meaning of selection?	When a decision needs to be made in a computer program selection is used. This is typically done using conditional IF statements, the most common conditional statements are IF, THEN, ELSE. These statements allow different instructions to be run depending on whether or not a condition has been met.
Describe the meaning of iteration?	The process of repeating specific instructions until a condition is met. Mainly for loops and while loops
What is a count-controlled loop?	A count controlled loops is a set of instructions being repeated a specific amount of times. For example, a username and password can only be entered 5 times for being locked out.
What is a condition-controlled loop?	A condition controlled loop will repeatedly execute a set of until a condition is met. There is no set amount of times the instructions are repeated.
Explain what is meant by Structured Query Language ?	SQL is a programming language used to search and query databases .
Explain the use of SQL query in searching of data	A line of code can be written to find a particular piece of data from a set of data. For example, in your contact list on your phone you have a list of names. If your search for john, it searches through all of the names and finds john. When you press search a line of code will be used to find it.
Define the purpose of a translator?	Translators are needed to translate programs written in high level languages into the machine code that a computer understands
Define machine code?	Machine code is a computer programming language that uses binary or hexadecimal. This is the language that the computer understands and responds to directly
Computer programmers written in a form that is close to our human language are called ……?	High level programming is written by humans. A program such as python is a high-level programming language
Computer programming language that sit close to the computer's instruction set are called ……..?	Low-level programming languages are more difficult to read and write and very close to being machine language. This type of programming is used to control hardware devices.
Describe the characteristics of an assembler	An assembler is designed to convert low level code into machine code for the computer to understand and use.
State the purpose of a compiler	A compiler will convert high level programming languages into machine code. However, if there is an error the program will stop and start again.
State the purpose of an interpreter	Interpreters examine high level language and one line at a time and convert them into machine code, one by one. This process is slower, but it allows the user will identify errors quicker.

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<table>
<tr><th colspan="2">Data representation</th></tr>
<tr><td colspan="2">Number systems</td></tr>
<tr><td>Define the term denary</td><td>The standard (base-10) number system that uses 10 symbols to represent number values (0,1,2,3,4,5,6,7,8,9). Each place has a value of 10 times the place to its right.</td></tr>
<tr><td>Define the term binary</td><td>A base-2 number system used by computer systems that uses 2 symbols to represent number values. The 2 symbols are 0,1. Each place has a value of 2 times the place to its right. Binary makes it easy to represent 2 electrical states: on and off.</td></tr>
<tr><td>Define the term Bit</td><td>A single binary digit: 1 or 0.</td></tr>
<tr><td>Define the term nibble</td><td>4 bits. Storing 16 possible values from 0000 (0) to 1111 (15).</td></tr>
<tr><td>Define the term byte</td><td>8 bits. This can store 256 possible values from 0 to 255.</td></tr>
<tr><td>Define the term hexadecimal</td><td>A base-16 number system that uses 16 symbols to represent values (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f). Each place value is 16 times the value of the place to its right. Hexadecimal is used because a single hexadecimal digit can represent a nibble. This makes it easy for humans to understand compared to long binary strings.</td></tr>
<tr><td>State is the purpose of a check digit</td><td>A method used to check for errors when reading an identification number. A calculation is performed on the first set of numbers in the string. The result of this should match the final digit.</td></tr>
<tr><td>State the purpose of parity bit</td><td>A bit added to a binary string to indicate whether the total number of 1-bits in the string is even or odd.
<table>
<tr><th rowspan="2">7 bits of data</th><th rowspan="2">(count of 1-bits)</th><th colspan="2">8 bits including parity</th></tr>
<tr><th>Even</th><th>odd</th></tr>
<tr><td>0000000</td><td>0</td><td>00000000</td><td>00000001</td></tr>
<tr><td>1010001</td><td>3</td><td>10100011</td><td>10100010</td></tr>
</table></td></tr>
</table>

<table>
<tr><th colspan="2">Compression</th></tr>
<tr><td>What is meant by the term compression?</td><td>Reducing the number of bits in a file so it takes up less space and can be transmitted quicker over a network connection.</td></tr>
<tr><td>Explain the difference between lossy and lossless compression</td><td>Lossy: A form of compression that discards data to reduce the file size. This means that the file can never be restored to its original form e.g. JPG images or MP3 music.

Lossless: A form of compression that allows the original data to be reconstructed from the compressed data e.g. zip files</td></tr>
<tr><td colspan="2">Text</td></tr>
<tr><td>Define the term character set</td><td>The set of characters that can be understood by a computer system. Each character is represented by a numeric code.</td></tr>
<tr><td>Explain what is meant by ASCII</td><td>American standard Code for Information Interchange. The first standard for encoding text. It used 7-bits so could only store 128 characters.</td></tr>
<tr><td>Explain what is meant by UNICODE</td><td>A newer system for encoding text which uses up to 4-bytes (32 bits) for each character. This allows different languages from around the world to be encoded. The first 128 characters of Unicode correspond to ASCII to ensure backwards compatibility.</td></tr>
</table>

<table>
<tr><th colspan="2">Images</th></tr>
<tr><td>Describe a pixel</td><td>A single dot in an image.</td></tr>
<tr><td>Explain the meaning of the term colour depth</td><td>The number of bits used to indicate the colour of a pixel. The more bits, the more colour possibilities, however the file size will also be larger.</td></tr>
<tr><td>What is meant by resolution?</td><td>The density of pixels per unit of measurement. Measured in PPI (pixels per inch). The higher the resolution, the more pixels are in the image therefore more data is stored so the file size is larger.</td></tr>
<tr><td>State the properties of metadata</td><td>Data about data. Metadata included in an image would be the colour depth, resolution, width x height. Other possible items might be the camera model, GPS co-ordinates, lens and other settings</td></tr>
</table>

<table>
<tr><th colspan="2">Sound</th></tr>
<tr><td>Describe what a sample is</td><td>Measuring the amplitude of an analogue sound wave and converting this to digital.</td></tr>
<tr><td>Explain the meaning of sample size/bit rate</td><td>The number of bits used to store the sample. Higher bit rate means better quality sound, but more data for each sample so a larger file size.</td></tr>
<tr><td>Describe what is meant by sample rate/frequency</td><td>The number of samples a second. A high sample rate means more samples therefore more data resulting in better sound quality and a larger sound file.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Computing

<table>
<tr><th colspan="2">Binary conversions</th></tr>
<tr><td>Convert denary to binary

To convert 78</td><td>To convert 78

<table>
<tr><td>2^7</td><td>2^6</td><td>2^5</td><td>2^4</td><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>

64 + 8 + 4 + 2 = 01001110
Method:
Look for the largest binary value that fits into your denary number and keep doing that until you reach the target denary number.</td></tr>
<tr><td>Convert binary to denary

To convert 10101111</td><td>To convert 10101111

<table>
<tr><td>2^7</td><td>2^6</td><td>2^5</td><td>2^4</td><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

128 + 32 + 8 + 4 + 2 + 1 = 175
Method:
Add the value of each binary digit.</td></tr>
<tr><td>Convert denary to hex

To convert 0101011</td><td>To convert 0101011
Add any extra 0s to left hand side to make a byte: 00101011

<table>
<tr><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">2 = 2</td></tr>
</table>

<table>
<tr><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="4">8+2+1 = 11 = B</td></tr>
</table>

Answer = 2B

Method:
1) Add any extra 0s to left hand side to create a byte
2) Split the byte into two nibbles
3) Convert each nibble individually
4) Combine to create hex number</td></tr>
</table>

Computing

<table>
<tr>
<td>Convert hex to denary

To convert 5F</td>
<td>
To convert 5F

5 = 5
<table>
<tr><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
</table>

F = 15
<table>
<tr><td>2^3</td><td>2^2</td><td>2^1</td><td>2^0</td></tr>
<tr><td>8</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

Answer = 0101 1111

Method:
1) Split the number into two digits
2) Convert each number as a separate nibble
3) Combine both nibbles to create a byte
</td>
</tr>
<tr>
<td>What are the rules of binary addition?</td>
<td>
Rule 1

0
+0
0

Rule 2:

1
+0
1 OR 0
+1
1

Rule 3:

1
+1
10
1
Carry

Think about it! If you add the place values in: (1+1=2)
<table>
<tr><td></td><td>2^1</td><td>2^0</td></tr>
<tr><td></td><td>2</td><td>1</td></tr>
<tr><td></td><td></td><td>1</td></tr>
<tr><td>+</td><td></td><td>1</td></tr>
<tr><td></td><td>1</td><td>0</td></tr>
</table>

Example addition using a nibble:

1101 + 0010 = 1111
1001 + 0101 = 1110
1111 + 1011 = 11010
Carry
1 1111
This is an overflow error as a nibble can only contain 4 bits, the result needs 5 as it is larger than 15 (max value of a nibble). This can also occur when adding two bytes if the result is larger than 255.
</td>
</tr>
<tr>
<td>Describe the term binary shift</td>
<td>A bit shift is used when multiplying or dividing by factors of two. Factors of two apply because binary is a base-2 number system.</td>
</tr>
<tr>
<td>Perform a left binary shift

Left shift on 00110101.</td>
<td>
Left shift on 00110101.
The digits are shifted to the left, and the digit on the right is filled with a zero.

<table>
<tr><th>Number of shifts:</th><th>Result</th><th>Notes</th></tr>
<tr><td>1</td><td>01101010</td><td>Multiply by 2^1 i.e. Multiply by 2.</td></tr>
<tr><td>2</td><td>10101000</td><td>Multiply by 2^2 i.e. Multiply by 4.</td></tr>
<tr><td>3</td><td>01010000</td><td>Multiply by 2^3 i.e. Multiply by 8. Note the digit that was shifted off the end has been lost. This means the result is not correct.</td></tr>
</table>
</td>
</tr>
</table>

Computing

Perform a right binary shift

Right shift on 11010100

Right shift on 11010100

The **digits** are **shifted to the right**, and the **digit** on the **left** is filled with a **zero**.

Number of shifts:	Result	Notes
1	**0**1101010	Divide by 2^1 i.e. Divide by 2.
2	**00**110101	Divide by 2^2 i.e. Divide by 4.
3	**000**11010	Divide by 2^3 i.e. Divide by 8. Note the digit that was shifted off the end has been lost. This means the result has lost accuracy as there are no decimal places.

Computing

SQL	
Database	A persistent, organised collection of data on a computer.
Flat file	A database made of tables that are not related.
Relational database	A database where two or more tables are joined using primary and foreign keys.
Table	A collection of data representing one entity.
SQL	Structured Query Language A language used to insert, update, delete and retrieve data from a database.
Primary key	A unique identifier for a row in a table
Field	An attribute of an entity; a column heading in a table.
Record	A row of data in a table, that can hold related data of different types.
Query	Retrieving information from a database.
Wildcard	Operand used to substitute characters in a search string.

The SQL examples below use data from these tables.

track

trackID	Title	album	duration
343	I love palm trees	A1	185
345	A coconut fell on Parms' head	A1	210
567	Revenge of Worf	A2	854
789	Skywalker keeps complaining	A3	173

album

albumID	title
A1	Parms under palms
A2	Star trek deep space 10
A3	Star wars
A4	I love bandwidth

Computing

SQL Commands

SELECT	Keyword used to select data from a database.	SELECT * FROM album Results: A1, Parms under palms A2, Star trek deep space 10 A3, Star wars A4, I love bandwidth
FROM	Keyword used to indicate what tables data is going to be selected from. Can be used with * wildcard.	
WHERE	Keyword used to filter records based on criteria.	SELECT title FROM track WHERE album = 'A1' Results: I love palm trees A coconut fell on Parms' head
LIKE	Keyword used with LIKE to find data that matches a specific pattern. Can be used with % wildcard.	SELECT title FROM album WHERE title LIKE 'St%' Results: Star trek deep space 10 Star wars
AND	Boolean operator that only returns records if both criteria are true.	SELECT title from tracks WHERE title LIKE '%pa%' AND duration>200 Results: A coconut fell on Parms' head
OR	Boolean operator that returns records if one of the criteria is true.	SELECT title FROM track WHERE trackID LIKE '34%' OR duration>500 Results: I love palm trees A coconut fell on Parms' head Revenge of Worf

Example nested select: Find all tracks that are longer than "I love palm trees"	
SELECT title, albumID FROM tracks WHERE duration> (SELECT duration FROM tracks WHERE trackID=343)	Result: A coconut fell on Parms' head, A1 Revenge of Worf, A2