Data Representation: Compression of Images and Text

A	**Key Vocab**
Compression	Reduction in file size to lessen download times and storage requirements
Lossy	Compression which loses data (and therefore quality)
Lossless	Compression which preserves the original data
Metadata	Data about data

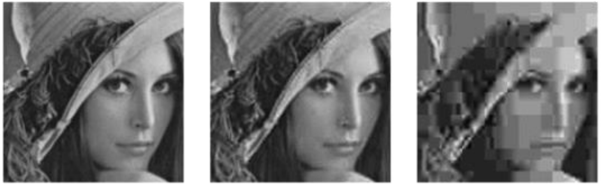
B	**Representing Text**
ASCII	A 7-bit code which represents a basic *character set*
Extended ASCII	A *character set* represented by 8 bits instead of 7, in other ways just like ASCII
Unicode	A modern standard *character set* which uses 16 bits and includes many international characters
Character set	The complete set of letters and symbols available within a given code

C	**Representing Images**
Bitmap	The representation of an image by converting it to pixels and each pixel to a binary number
Vector	The representation of an image by splitting it into shapes and storing each shape as a binary number
Pixel	The smallest element of an image. One dot of one colour.
Resolution	The level of detail in an image, measured in pixels (dots) per inch (dpi)
Colour depth	The number of bits used per pixel to record colour.
File Size	width (px) × height (px) × *colour depth*

D	**File types**	
PDF	document	lossless
PNG	image	lossless
JPEG	image	lossy
GIF	image	lossy
BMP	image	uncompressed
MPEG	video	lossy
MP4	video	lossy
MOV	video	lossless
MP3	audio	lossy
WAV	audio	lossy

E	**Image metadata**
Filename	
File format	
Dimensions	
Resolution	
Colour depth	
Time and Date	
Location	
Camera settings	

F	**Lossy compression**

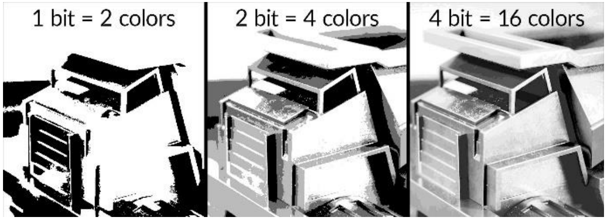


Original: 12KB

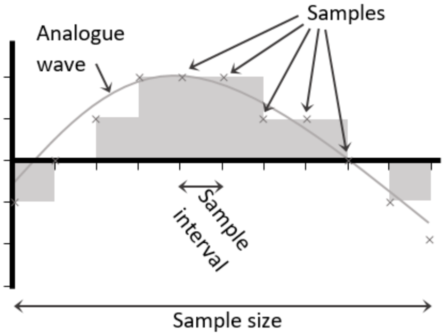
Compressed: 1.8KB

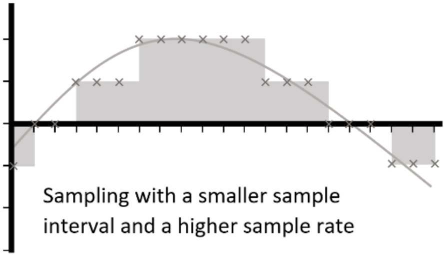
Very compressed: 0.56KB

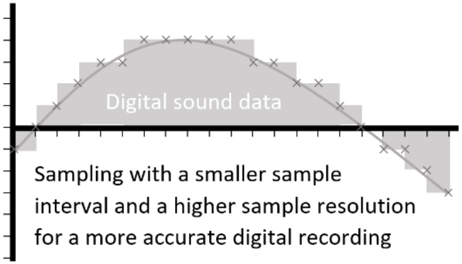
G	**Colour depth**



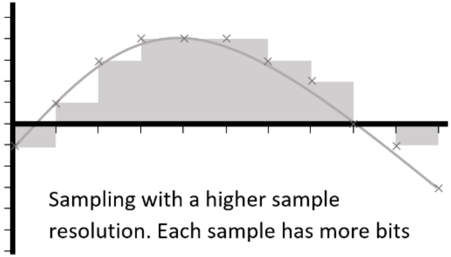
Data Representation: Compression of Sound

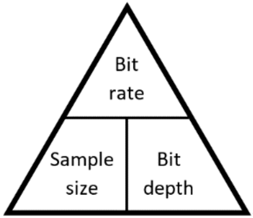


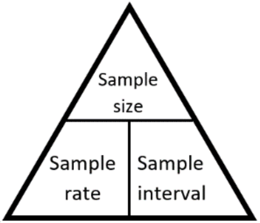

Sampling with a smaller sample interval and a higher sample rate



Sampling with a smaller sample interval and a higher sample resolution for a more accurate digital recording


Sampling with a higher sample resolution. Each sample has more bits





A	**Representing Sound**	
Digital	Having discrete values which can be stored as binary	
Analogue	Having continuously changing values	
Sample	The smallest element of a recorded sound. A value or set of values which represent a sound at a specific moment	
Sample size	The number of seconds over which a *sample* was taken	*s*
Sample rate	The number of times per second the sound is sampled. *Sample size ÷ sample interval*	*Hz*
Bit rate	The number of bits used to store a second of sampled sound. *Bit depth × sample rate*	*bps*
Sample interval	The length of time between two samples	*s*
Bit depth / Sample resolution	The number of bits used to store each sample	*b*
Channel	An audio file which is intended to be played at the same time as another	
File size	*Sample rate × bit depth × sample size*	

Programming: Basics

A	Key Vocab
Debugging	Finding and fixing errors in code
Execution	When a command or program is run by the processor
Operation	A mathematical process which takes one or two inputs and produces one output
Programming Language	A set of instructions and syntax which can be used to make programs
Script	A small simple program, particularly run on command line interfaces
Sequence	The order in which a list of instructions is carried out

B	Syntax
Comment	A part of a program which is ignored by the computer but can be read by the programmer
Indentation	A stylistic approach for writing code. The contents of loops or selection are set a few spaces in from the previous indentation
Syntax	Rules for the structure of a programming language

C	Variables and Constants - Initialisation
Assign	Give a value to a variable or constant at the beginning of a program
Data Type	The nature of information used by a computer
Declare	Set up a *variable* by naming it and allocating memory to it
Initialise	*Declare* variables and *assign* values at the beginning of a program

D	Variables and Constants - Types
Variable	A named value which can be changed as the program is running
Constant	A label that refers to a location in memory containing a fixed value
Global	A *variable* which is used throughout the program
Local	A *variable* which is defined and used only within a sub program

E	Sub Programs
Sub program	Any section of the program which might be *called* by the main program and is self-contained
Argument	Data supplied to a *function* or *procedure* when it is *called*
Breakpoint	The part of a subprogram where it stops and returns to the main program or where the main program stops completely
Call	An instruction to run a sub program
Function	A *sub program* which can take any amount of *arguments* and *return* a value
Parameter	A *variable* which is defined within a *sub program* and which the *sub program* needs to run
Procedure	A *sub program* which can take arguments but which does not return a value
Return	To give back a value from a sub program to the main program

Programming: Operations

A	Key vocab
Operand	A number (or string or Boolean) which is to be operated on
String manipulation	Operating on strings

B	Unfamiliar operations	
Concatenation	Joins two strings together	“:” + “-)”
Exponentiation	Raises one number to the power of another	2**3
Modulus / mod	Returns the remainder after division	10 % 3 = 1
Quotient / floor division	Returns the whole number part of the division	10 // 3 = 3
Unary	Only has one operand	-7

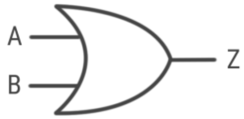
C	Types of operator	
Arithmetic operator	An operator which turns two numbers into a single number with a mathematical process	**, /, %, //, *, +, -
Assignment operator	An operator which assigns a value to a name	=, ⇒
Boolean operator	An operator which compares Boolean values	AND, OR, NOT
Comparison operator	An operator which compares two numbers	>, <, >=, <=, ==, !=

D	Order of operations	
1	**Brackets**	Whatever is in the brackets is resolved first
2	**Unary**	An operation with only one *operand*
3	**Indices**	Raising to the power of a number
4	**Division**	Including *quotient* and *modulus* division
5	**Multiplication**	× or *
6	**Addition**	+
7	**Subtraction**	-
8	**Comparison**	An operation which returns a Boolean by comparing two operands
9	**Boolean**	An operation which returns a Boolean by comparing two Booleans
10	**Assignment**	An operation which assigns a value to a name

E	Logic vocab
Boolean algebra	Mathematical expression of logic circuits
Logic gate	A component which takes in one or two binary inputs and produces a single binary output
Logic circuit	A circuit made of a combination of logic gates
Truth table	A table of inputs and outputs for a logic gate system

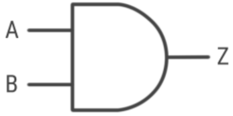
F	Logic gates

OR gate



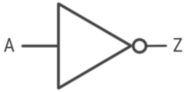
A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

AND gate



A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate



A	Z
0	1
1	0

Programming: Structures

A	Key Vocab
Iteration	Repeated execution of a group of instructions
Condition controlled loop	An iteration statement which repeats until a certain requirement is met
Count controlled loop	An iteration statement which repeats for a specified number of times
Search	Find a specific item in a list of data using an algorithm
Selection	A choice of which branch to take in a program, often with IF statements
Sort	Arranging a list into an order
Statement	An instruction or clause in a program
Recursive	An algorithm which calls itself

B	Iteration structures
DO UNTIL	Iteration structure which has a stop condition at the end of the loop
DO WHILE	Iteration structure which has a continuation condition at the end of the loop
FOR NEXT	Iteration structure which has an index variable, a step value and a stop condition
WHILE	Iteration structure which has a start condition at the beginning of the loop

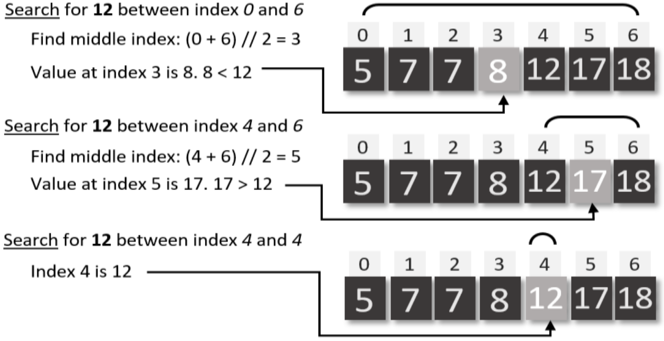
C	Selection structures
IF (ELIF) ELSE	A selection statement which branches the program under certain conditions
SWITCH CASE	A type of selection statement where there are a number of possible branches

D	Search
Linear search	A search algorithm which starts by looking at the first item in an unordered list, then moves to the second etc.
Binary search	A search algorithm which starts by looking at the middle term in an ordered list, then if the item is not found, recursively searching on the half of the list with the item in it

E	Sort
Bubble sort	A sorting algorithm which swaps adjacent items in a list if they are not in the right order, before moving onto the next pair.
Insertion sort	A sorting algorithm which goes through a list by item, removes the item and puts it into the appropriate place in a new ordered list
Merge sort	A sorting algorithm which splits a list in two, sorts each list recursively, then merges them back together

Binary search

F



Search for **12** between index *0* and *6*

Find middle index: (0 + 6) // 2 = 3

Value at index 3 is 8. 8 < 12

Search for **12** between index *4* and *6*

Find middle index: (4 + 6) // 2 = 5

Value at index 5 is 17. 17 > 12

Search for **12** between index *4* and *4*

Index 4 is 12

Programming: Data and Data types

A	Key vocab
Alphanumeric	Containing letters, digits and symbols
Data	A unit of information without context, measured in bits
Information	Data, made intelligible by context
Typecast	Force a variable into a certain data type

B	Number Systems
Binary	Counting system using 1s and 0s. Computers use it because transistors can be used as switches: 1 is 'on' and 0 is 'off'.
Denary	Our normal numbering system with digits from 0 to 9
Hexadecimal	A number system using the digits from 0 to 9 and A to E. Easy to convert to and from binary and easier to read than binary

C	Data types	Python
Array	An indexed list of values. The index normally starts at 0. Unlike a Python list, all values have the same data type and the maximum size is normally declared	[‘o’,‘m’,‘g’] [6, 0, 8, 1] [0.1, 5.0]
Boolean	A data type which is either true or false	True, False
Character	A single alphanumeric symbol	‘B’, ‘@’, ‘8’
Integer	A data type which is a whole number	50, -7, 2
List	An indexed collection of data in Python	[“a”, 2, True]
Real / Float	A number with a decimal point	5.0, 3.14, 1.9
String	A data type which is a collection of any number of characters	“hello”, “”, “01273”

D	Data measurements	
Bit	A single unit of information. A 1 or a 0. A binary digit.	*b*
Nibble	Half a byte. Four bits.	
Byte	Eight bits	*B*
Kilobyte	1000 B	*KB*
Megabyte	1000 KB	*MB*
Gigabyte	1000 MB	*GB*
Petabyte	1000 GB	*PB*
Terabyte	1000 PB	*TB*

E	Binary manipulation
Binary shift	Adding or taking a zero at the end of a binary number
Left shift	Adding a zero to the end of a binary number, multiplying it by 2
Right shift	Taking a bit from the end of a binary number, dividing by 2 and rounding down
Binary addition	Adding binary numbers together
Overflow	A carried digit which is lost because the number is too big for the space allotted to it. ie 1111 + 0011 = 0010 (4 bit addition)

Programming: Translators and Debugging

A	Translators vocab
Assembly language	A simple low-level language where opcodes are replaced with mnemonics and the instruction set is small (maybe 9 instructions)
Compiler	A program which turns source code into object code and saves it as an executable file
Editor	A program which allows the user to write code
GUI builder	An IDE for developing a graphical user interface
High-level (language)	A language which is easy to read and requires translating before the computer understands it
Instruction set	The full list of commands available within a language
Integrated Development Environment (IDE)	Software for writing code, which will usually incorporate an editor, debugging tools, an interpreter and compiler
Interpreter	A program which translates source code as it is read, stopping if it reaches an error
Linker	A tool which can combine different compiled codes
Low-level (language)	A language which is close to the format read by the computer
Machine code / Object code	Code written in binary
One-to-many	A language where one written instruction corresponds to a number of actions by the processor
One-to-one	A language where one written instruction corresponds to one action by the processor
Pretty printing	A feature of an editor which makes code easier to read by colouring and indenting
Runtime environment	Everything you need to run a program
Translation	Conversion of high-level language to machine code
Translator	A program which converts high-level language or assembly language to machine code

B	Command breakdown
Opcode	The part of the instruction which tells the CPU what operation is to be done
Operand	The part of the instruction which is to be operated on

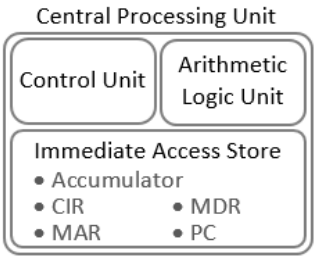
C **A single command at different levels**

	Opcode	**Operand**
Machine code	0000 0001	0010 1110
Hex	01	2E
Assembly	ADD	2E
Python	+	num
Effect	adds	the value at 0010 1110 (named num)

D	Debugging
Trace table	An offline method of tracking the values of variables through the running of a procedure
Overflow error	An error produced when a number becomes longer than the number of bits allocated to it. The extra bits are lost.
Logic error	An error with code where it compiles correctly but produces incorrect results
Syntax error	An error with the code where the computer can not recognise it as code
Runtime error	An error which occurs during operation of the program, not during compilation

CPU and von Neumann Architecture

A	CPU structure		
Control Unit		CU	Communicates with the ALU, immediate access store and main memory to perform the functions of the CPU.
Immediate access store			A collection of registers with specific roles in the CPU
1	Accumulator		Stores data to be operated on, or the result of any operation carried out by the ALU
2	Current Instruction Register	CIR	Stores the instruction to be used next
3	Memory Address Register	MAR	Stores the address to be used next (all stages)
4	Memory Data (or Buffer) Register	MDR MBR	Stores data which has been retrieved from or is about to be sent to RAM
5	Program Counter	PC	Stores the next address in the program (Fetch stage)
Arithmetic and Logic Unit		ALU	Takes two operands from the Accumulator and an operator from the CIR and returns a single result to the Accumulator



D	CPU vocab
Boot Process	Set of instructions required to make the computer start
Clock speed	The frequency which the CPU runs at, and the number of instructions which can be processed per second (Hz)
Overclock	Run the CPU at a higher clock speed than its default

B	Key vocab
Systems Architecture	The way the components of a computer are arranged.
von Neumann architecture	System architecture where the data is stored in the same place as the instructions
Fetch-Decode-Execute cycle	The cycle followed by the von Neumann architecture

C	CPU hardware
Bus	A connector which transfers data between components. Three types are data, address and control
Cache	Fast, expensive memory which is loaded from RAM and called by the CPU
Clock generator	A circuit which produces a square wave, which is the maximum frequency a CPU can perform instructions
Core	A processing unit which can run simultaneously with others. It will have its own L1 and L2 cache, but share L3 cache and RAM
Single-core	Only one core
Dual-core	Two cores
Quad-core	Four cores
Multi-core	More than one core
Register	A section of high speed memory

Hardware

A	Integral hardware	
Central Processing Unit	CPU	Main processing unit of the computer, comprising the Arithmetic and Logic Unit, the Control Unit and the immediate access store
Network Interface Controller	NIC	The part of the computer which connects to networks
Hard Disk Drive	HDD	The storage hardware which stores data permanently
Heat sink		A device which draws heat away from any component which is likely to overheat
Graphics Card		A piece of hardware which contains the GPU
Graphical Processing Unit	GPU	Dedicated processor for rendering images
Motherboard		The printed circuit board on which the CPU is installed, with connectors to peripherals

B	Peripherals
Peripheral	Input, output or storage device which is not integral to the computer
Input device	A device which introduces data to the computer
Mouse, touchscreen, keyboard, microphone, webcam, scanner, digital camera, controller, accelerometer	
Output device	A device which displays or transmits data from the computer
Speaker, screen, printer, headphones, buzzer, motor	
Storage device	A device which can hold, read and write data
HDD, DVD drive, CD drive, USB stick, SD card reader	
Dongle	A device which attaches to a networked computer and makes it behave like a WAP

C	Network media vocab
Cat 5e/ Cat 6	Common types of UTP
Coaxial cable	Single copper wire surrounded by a metallic mesh for shielding
Fibre optic cable	Glass or plastic cable where data is transmitted as light
Shielding	Anything which goes around a data carrying wire to absorb interference
Unshielded Twisted Pair (UTP)	A type of copper wire which is often used for wired networks
Wireless	Without wires

D	Network hardware
Hub	A device which receives signals and rebroadcasts it to all connected nodes
Repeater	A device which listens for a signal and then resends it on to help reduce data collisions
Router	A device which connects networks together, and also splits data into packets, and forwards packets onward
Server	A computer which provides services for the rest of the network
Switch	A device which receives data and sends it only to the intended destination

Computer Science: Basics

A	Key vocab
Algorithm	A set of instructions for a specific task
Application	A program which has a user interface
Data	A unit of information without context, measured in bits
Device	A tool or machine with a particular purpose
Email	A system of sending message files over the internet
File	Data, stored and named
General purpose computer	A computer which is designed to do a variety of jobs
Hardware	Physical parts of a computing
Image	Visual stored data
Internet	A huge network of millions of networks
Memory	Normally a synonym for RAM
Network	A collection of computers and other devices (nodes), connected together (by links)
Program	A series of coded instructions which can be run by a processor
Random Access Memory (RAM)	Volatile primary storage which contains the data and instructions for any program being currently run, including the OS
Sampling	Converting an analogue sound signal to a digital signal by recording the sound values at set intervals
Software	Completed computer programs in general
Storage	Where data, programs and files are kept semi-permanently
World Wide Web	The collection of web pages available over the internet

B	Computer systems
Control system	A computer which is used to control machinery
Dedicated system	A computer which is dedicated to a specific job
Embedded system	A computer which is dedicated to a specific job as part of a larger device
Real time system	A system which can guarantee response time to be short and fixed. Useful for safety-critical systems

C	LECE
Cyber bullying	Emotionally abusing someone via social media or other online methods
Cyber security	Issues surrounding protection of data and computers from the threat of hacking or malware
Digital divide	The inequality created by the fact that some people have greater access to technology than others
Sharing economy	Technology enabled renting of services or products such as Uber or AirBnB
Stakeholder	Someone with an interest
Trolling	Trying to provoke arguments or upset people online

Memory

A	Secondary Storage: Types
Flash	A type of SSD which stores information by forcing electrons through a barrier with a large current
Magnetic	Cheap storage which requires moving parts and writable magnetic disks
Optical	Cheap storage which requires a laser and a disk
Solid State Drive (SSD)	Memory with no moving parts

C	Primary Storage
Main memory	Other ways of saying RAM
Primary storage	
Virtual memory	Part of secondary storage which is used as main memory when RAM is full
Dynamic RAM	Single transistor / capacitor RAM which needs to be refreshed every few milliseconds
Static RAM	4/5 transistor RAM which can hold data without being refreshed (but does need power)

D	Key Vocab
Read Only Memory (ROM)	Non-volatile memory which cannot be over-written. Generally used for booting
Storage device	Any hardware which can hold, read and write data
Storage medium	The type of material or method used to store data
Tertiary storage	External high-capacity storage
Volatile	Memory which requires power
Non-volatile	Memory which persists without power

B	Secondary Storage: Qualities	
1	**Capacity**	Amount of data a storage device can hold
2	**Durability**	How well the device resists damage
3	**Portability**	How easily the device can be carried
4	**Reliability**	How well the data resists corruption
5	**Speed**	How quickly the data can be read from the storage device
6	**Cost**	Pounds per GB

E	The Cloud
Cloud	Remotely located storage and software, accessed via the internet

	Advantages	Disadvantages
1	No need to update application software	Entrusting potentially sensitive data with outsiders
2	No need to maintain the equipment, software or data	Safety and security of sensitive data is outside your control
3	No need to employ network managers or other technical staff	The service must be totally reliable
4	Service provider takes care of backups	Requires internet connection
5	Easy to share files and collaborate across platforms and locations	

Networks: Basics

A	Key vocab
Address	The direction of where a piece of data should go
Bandwidth	The amount of data that can be transferred on a mobile network at one time
Channel	A division of a link (either wired or wireless)
File sharing	Transferring files across a network
Hotspot	A location that provides an internet connection
Interoperable	When two different systems can communicate and use shared data
MAC address	Unique ID for every device that might join a network
Malware	Malicious software
Media	Plural of medium
Medium	The means of transporting data
Service Set Identifier (SSID)	ID of the wireless access point
Signal	A wave or current which conveys data
Traffic	The amount of data travelling on a network
Virtual Server	A non-physical server
Wireless Access Point (WAP)	The point at which a wireless device connects to a network

C	Network types		
Client-Server	Network architecture where clients connect to a server		
Peer to peer (P2P)	Network architecture where all nodes can act as clients and servers		
MAN	Metropolitan Area Network	**VPN**	Virtual Private Network
PAN	Personal Area Network	**WAN**	Wide Area Network
SAN	Storage Area Network	**WLAN**	Wireless LAN

B	Network specific vocab
Client	A computer or software which uses services over a network
Server	A computer which provides services for the rest of the network
Link	A connection between two nodes in a network
Node	A device in a network
Local Area Network (LAN)	A network where all nodes are on a single geographical site
Protocol	System of rules which must be followed by all parties involved in transferring data over a network
Routing	Getting data to its destination
Topology	The way a network is arranged

D	Topologies
Mesh	Nodes are all connected (directly or indirectly) without an intermediate server
Full mesh	All nodes are involved in the transmission of data without need for an intermediate server
Partial mesh	A mesh network where some nodes are not connected to each other
Bus network	Nodes are connected to a "backbone" which is also connected to servers and peripherals
Ring	Nodes are arranged in a loop, with each node connected to two others
Star	All outer nodes are connected with one link to a central switch

Networks: Protocols and Routing

A	Protocols	
Ethernet		Used to connect devices in a LAN
WiFi		Used to connect devices wirelessly
Dynamic Host Configuration Protocol	DHCP	System for reusing IP addresses by reassigning unused ones
Media Access Control		For addressing devices permanently, stored in the NIC
File Transfer Protocol	FTP	For sending files over the internet
HyperText Transfer Protocol	HTTP(S)	Protocol for transferring HTML files (HTTPS is with encryption)
Internet Message Access Protocol	IMAP	For email where the client can manage a remote mailbox
Post Office Protocol	POP	For email. An email is deleted from the server as the client retrieves it
Simple Mail Transfer Protocol	SMTP	Protocol for pushing email to a server (now becoming obsolete)
Transmission Control Protocol	TCP	A protocol for splitting packets and reassembling them after transmission, and for checking the data has been correctly delivered
Internet Protocol	IP	Protocol for packet switching
Transmission Control Protocol / Internet Protocol	TCP/IP	The protocol for general use of the internet

B	Routing
Encapsulation	Enclosing data inside another data structure to form a single component
De-encapsulation	Stripping external data from an encapsulated item to extract the original data
Header	Information at the beginning of a packet including IP addresses of sender and receiver, protocol, packet number and length of packet
Packet	A division of data which is to be sent over TCP/IP, including a header and trailer. Created by software
Payload	Data in a packet which is what is meant to be sent
Trailer	Information at the end of a packet including error correction and end of packet marker
Layering	A system of rules, organised into an order in which they are applied
Circuit switching	Method of routing which involves opening a connection between two nodes and sending data in a stream before closing the connection
Packet switching	Method of routing which involves data being divided up into packets and sent in multiple pathways to the destination

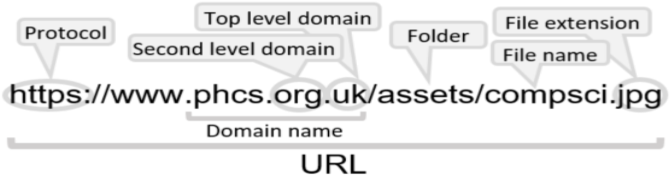
Networks: Internet and Ethernet

A	Key vocab	
Hypertext Markup Language	HTML	Language which websites are written in, and which a browser interprets
Cascading Style Sheets	CSS	File which adds additional styling to HTML files
eXtensible Markup Language	XML	Text-based data file for use with HTML
Uniform Resource Locator	URL	A memorable name for a domain
Internet service provider	ISP	Company which provides access to the internet
Host	A computer which stores a resource	
Service	Software which is available to use via a network	
Dynamic IP address	Temporary IP address assigned by DHCP server on connection to a network	
Static IP address	Permanent IP address assigned to a computer by the ISP	
Virtual machine	A machine (or representation of one) used through the cloud	
Virtual network	A network including virtual machines	

B	Domain naming
Domain	A group of computers on a network which are administered together
Domain Name System (or Server)	A server which contains a list of IP addresses and their associated URL
Top level	The last suffix in a URL

C	Ethernet
Frame	Data unit to be sent over Ethernet, including source and destination MAC address and error checking. Sent to all devices connected on a segment. Created by hardware
Segment	Section of an Ethernet network on a shared medium

D	TCP/IP	
1	**Application layer**	Makes data readable to the senders and recipients by using protocols like HTTP, FTP, SMTP etc
2	**Transport layer**	Breaks down data into packets and applies appropriate headers and trailers according to TCP
3	**Internet / network layer**	Adds sender's and recipient's IP addresses according to Internet Protocol
4	**Data link / physical layer**	Breaks data into frames according to Ethernet protocol for passing between nodes of a network and between different networks



Networks: Security

A	Security policies
Acceptable use	Policy about what a user might reasonably use IT equipment for
Email	Policy about what can be sent over email
Incident response plan	Policy about what to do if there is a security failure
Internet	Policy about what data is allowed in and out
Password	Policy about how often passwords should change and what complexity they must be
Remote access	Policy about how to access the network from off-site
Web	Policy about what sites can be visited
Wireless	Policy about how access points are managed

C	Malware
Adware	Software which displays advertising
Key logger	Spyware which stores every keystroke in a file
Ransomware	Malware which disrupts the use of a system until a ransom has been paid
Rootkit	Modifies operating system to avoid detection
Scareware	Creates alarm and causes the user to follow a malicious link in their panic
Spyware	Gathers and reports data from the host
Trojan	Poses as legitimate software and must be installed by the user. Does not self-replicate
Virus	Hidden in an executable and self-replicates
Worm	Malware which self-replicates but does not require an executable file

B	Preventative Measures
Authentication	A process for checking the identity of the user
Encryption	The process of making data unintelligible except to the intended recipient
Key	The method of decrypting an encrypted message
Public / private key	An asymmetric encryption technique where the encryption key is public and different to the decryption key
Firewall	Software and/or hardware which controls traffic between nodes
Network forensics	Investigation to find the cause of cyber crime
Packet-filter firewall	Firewall which inspects each packet and drops non-qualifying packets
Penetration testing	Testing a system by mimicking different forms of attack
Update	The latest version of a software, including fixes of vulnerabilities
User access level	The amount of the network that a user has access to
Wifi Protected Access (WPA)	Encryption of wireless signals

B	LECE
Lawful interception	Checking data as it is transferred between networks by a legitimate entity, typically for purposes of cyber security

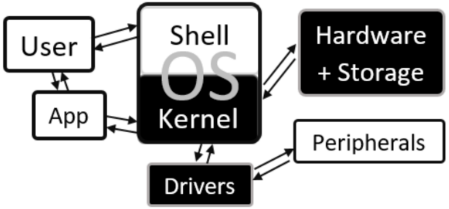
Networks: Attacks and Data Collisions

A	Types of attack
Active	A network attack where the hacker attempts to change data or introduce malware
Backdoor	An access channel which is opened to outsiders without the users' knowledge
Brute force	Hacking technique involving trying every possible combination of a password
Data interception	Picking up data as it is being sent across networks
Denial of Service (DoS)	An attack which aims to stop a server working by using up all its bandwidth
Hacking	Accessing someone else's data without consent
Insider	A network attack where someone within an organisation exploits their network access with malicious intent
Packet sniffing	A form of data interception where packets are analysed as they are being sent
Passive	A network attack where the hacker gains access to unauthorised information
Pharming	Directing a user to a malicious website by an attack on the DNS server
Phishing	Directing a user to a malicious website from a bogus email
SQL injection	Malicious code (rather than data) which enters a system through a form field

B	Data Collisions
Carrier-Sense Multiple Access with Collision Detection (CSMA/CD)	System of preventing data collisions on Ethernet. A combination of waiting until the segment is idle and detecting if a collision has occurred
Cyclic Redundancy Check (CRC)	Error checking technique where a code is generated from the payload and sent in the trailer. The receiver generates the same code from the payload to make sure it is the same as the code in the trailer
Data collision	When packets are sent over the same segment at the same time, in opposite directions. Data can become corrupted as packets try to pass through each other
Duplex (communication)	Communication can be in either direction, so collisions are likely
Half-duplex	Communication can be in either direction, but not at the same time
Simplex	One directional communication for avoiding data collisions

Software: Operating Systems

A	Roles of an operating system
Memory management	Allocation of RAM to all running programs using *paging* and *segmentation*.
Multi-tasking	Running several different programs at the same time by switching between them very quickly (*scheduling*).
User management	Allowing for different users to have different accounts, security and permissions
Peripheral management	Allowing for applications to use peripherals and dealing with interrupts
Utility management	Running and maintaining utilities
CPU management	Running applications, executing and cancelling processes
User Interface	The means of communication between the user and the OS
File management	Providing a file system for storage and retrieval of files
Disk management	Organisation and maintenance of the hard drive
Library provision	Making a range of libraries available.



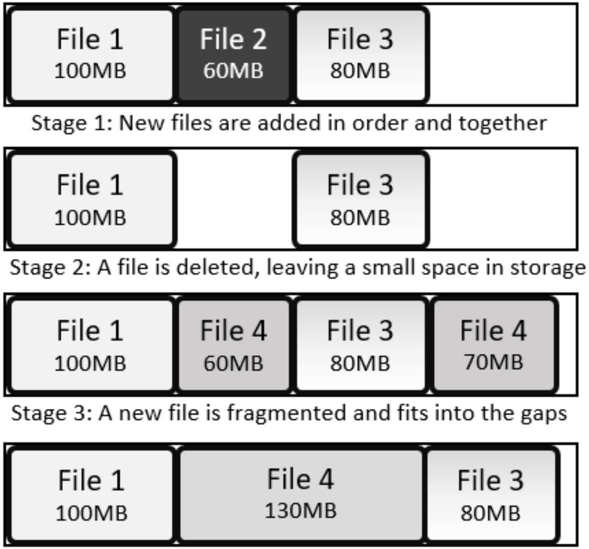
B	Key vocab
Paging	Memory management technique which involves splitting RAM up into equal sized pages, and indexing them
Segmentation	Memory management technique which involves splitting RAM into blocks which fit the gaps
Scheduling	The process of arranging and controlling various processes when multi-tasking
Multi-user	When more than one user has access to the same memory, storage or CPU time
Kernel	The part of the operating system which interacts with hardware on one side and applications on the other
Driver	Software which interfaces between applications and peripherals
Buffer	A temporary area of computer memory used to store data for running processes.
Interrupt	A signal to the OS to stop it running its current program, and instead run a particular driver
Graphical User Interface (GUI)	User interface based around icons
Command Line Interface (CLI)	Text-based user interface
Voice User Interface (VUI)	User interface based around voice
Library	A suite of supporting programs which are incorporated into an OS and can be used by apps. These apps will have the same look as other apps on this OS.
Static library	A library where the routines are loaded during translation so they become part of the code. The library does not need to be present on the executing computer
Dynamic Linked Library (DLL)	A library where the routines are loaded during run time rather than translation. The library must be present on the executing computer

C	Prior Knowledge				
Operating System	Utility	Peripheral	Real time	CPU	System Software

Software: Utilities

A	Utilities
Anti-malware (software)	Software which prevents malicious software entering the system, identifies it when it is there and removes it
Auto update	A utility which makes sure the utilities are up to date
Backup	A copy of data and programs in case they are lost
Compression software	Software which removes redundant data to reduce file size
Defragmentation	Reorganise the files on a hard drive so they are all stored together, reducing the time the heads have to spend moving around
Disk check	Search the hard drive for bad links and record those areas as unusable
Encryption software	Software which encodes data to be stored or transferred
System cleanup	Identify and remove unused or redundant files

B Fragmentation and Defragmentation



Stage 1: New files are added in order and together

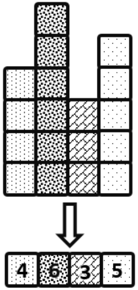
Stage 2: A file is deleted, leaving a small space in storage

Stage 3: A new file is fragmented and fits into the gaps

Stage 4, Defragmentation: Fragments are put together

C	Backup Types
Full backup	All files and folders are copied when backing up
Incremental Backup	All changes since the last incremental backup are saved. To restore, start with the full backup and then restore each incremental backup successively
Differential Backup	All changes since the last full backup are saved. To restore, start with the full backup, then restore the latest differential backup
Backup plan	A scheme of when and how to back up data

B Compression



1	**1**	0	0	0	0
1	**1**	0	0	0	0
1	**1**	**1**	**1**	**1**	**1**
1	**1**	**1**	**1**	**1**	**1**
1	**1**	0	0	0	0
1	**1**	0	0	0	0

⇩

1	0	0
1	**1**	**1**
1	0	0

D	Prior Knowledge
Operating System	
Utility	
Compression	
Encryption	
Malware	

Software: Basics

	A	Key vocab
	Basic Input Output System (BIOS)	Software stored in ROM responsible for booting up a computer system
	Platform	The hardware and operating system for which software is designed
	System software	Software which is necessary for the running of other software, comprising *utilities* and the *OS*
1	**Operating System (OS)**	A collection of programs which tell hardware what to do
2	**Utility**	A single-purpose program for system maintenance
3	**Firmware**	Software that is stored permanently in a device
	Software repository	A server which contains open source software which is available for download
	Package management software	Software which downloads and updates files from a repository
	Batch file	Series of command line instructions stored in a single file
	Run time	The period during which a program is executing
	Instruction	A command that a processor can recognise and follow
	Source code	A program as it was written in high-level language

C	Legal and Ethical Vocab
Copyright	A legal right that prevents others from copying or modifying intellectual work without permission
Intellectual property	A piece of non-physical work which has been created and is owned by someone
Patent	A licence which protects intellectual property

B	Legislation
Copyright, Designs and Patents Act, 1988	Legislation which protects intellectual property by banning its unauthorised copying or redistribution
Computer Misuse Act, 1990	Legislation against hacking and disruptive behaviour on computers
Data Protection Act, 1998	Legislation which prevents storing of data about an individual which is excessive, unlawfully sourced, unsafely stored or inaccurate.
Freedom of Information Act, 2000	Legislation which gives rights for individuals to find out about data held about them

C	Legal and Ethical vocab
Open-source	Software where access to the original code is available to anyone
Proprietary	Software whose source code is kept hidden to avoid loss of profit
Public Domain	Intellectual works which are not copyrighted and are free to use
Creative Commons	Organisation which issues licences which allow the public partial or total access
Licence	A legal agreement about how a piece of software can be used or distributed

Software Development and Defensive Design

A	Software development stages
Analysis	Looking at a problem, decomposing it into sub problems, abstracting into essential points and spotting patterns, then writing success criteria for solving the problem
Design	Planning the solution to a problem, including pseudocode for algorithms and validation for data entered
Development / Implementation	Practical application of a design and its subsequent development
Testing	Making sure a program works under various conditions
Documentation	Clear evidence of and information about a product or activity
Evaluation	Judgement of the success of a product with reference to the success criteria written in the analysis

C	Defensive Design vocab
Authentication	A process for checking the identity of the user
Data validation	As data is inputted, it is checked to make sure it is the correct data type, length, format etc
Error trapping	Planning for erroneous inputs which may be valid but out of range
Input sanitisation	Removing unwanted characters from entered data to protect against SQL injections

B	Software development processes
Input	Any method of introducing data to a computer
Output	Any display or transmission of data from a computer
Process	A change of state of a computer which does not involve an input or an output
Execution order	Input ⇒ Process ⇒ Output
Planning order	Output ⇒ Input ⇒ Process

D	Software development vocab
Defensive design	An approach to programming which tries to anticipate and protect against misuse by the end user through a combination of *authentication*, *data validation, error trapping* and *input sanitisation*
Maintainability	The ability for code to be maintained easily by eg *commenting*, using *functions*, intuitive variable names, indentation and writing *documentation*
Maintenance	Changing code to update and repair it
Auto-documentation	A programming tool which helps to create summary information about a program

Software: Computational Thinking, Testing and Data Checking

A	Computational Thinking
Abstraction	A model or representation removing the inessential elements of a situation to focus on the essential elements
Algorithmic thinking	Approaching a problem by breaking it into steps which need to be followed in order
Decomposition	Breaking apart a complex problem into smaller manageable parts
Computational thinking	Approaching complex problems with a mix of abstraction, decomposition, pattern recognition and algorithmic thinking
Pattern recognition	Identifying situations with the same essential elements
Program flow	The order in which statements are executed which is affected by selection, iteration and sequencing
Testing	Making sure a program works under various conditions

B	Types of test
Fault Tolerance	Testing with illegal or out-of-range inputs
Functional	Testing with a selection of inputs which are chosen to be both normal and extreme
Integration	After a subroutine has been tested in isolation, testing to see that it works with the main program
Iterative	Testing every module before moving on
Parametric	Testing of individual subroutines
Regression	Testing after any changes have been made to see they have not made unexpected changes elsewhere
User Acceptance	Testing with users to see if they interact with the program as expected
Final	Functional testing on a high level to make sure the program works as expected

C	Testing vocab
Erroneous	Test data which should not be accepted by a program
Valid	Test data which is in range and should be handled
Invalid	Test data which is out of range and should be trapped
Extreme	Test data on the border of validity
Test Plan	Carefully chosen inputs and their expected outputs which will be used in testing

D	Data checking
Check digit	A digit which is calculated from an original number. It can be recalculated after transfer or input to make sure no errors have been introduced
Check sum	A number used to check if a packet of data has been sent correctly
Parity check	A binary check digit which is a 0 if the number of 1s is even and 1 if the number of 1s is odd (or vice versa)

Software: Development Cycle and Testing

A	Software development stages
Analysis	Looking at a problem, decomposing it into sub problems, abstracting into essential points and spotting patterns, then writing success criteria for solving the problem
Design	Planning the solution to a problem, including pseudocode for algorithms and validation for data entered
Development	Practical application of a design and its subsequent development
Testing	Making sure a program works under various conditions
Documentation	Clear evidence of and information about a product or activity
Evaluation	Judgement of the success of a product with reference to the success criteria written in the analysis

B	Types of test
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User Acceptance	Testing with users to see if they interact with the program as expected
Final	Functional testing on a high level to make sure the program works as expected

C	Software development vocab
Defensive design	An approach to programming which tries to anticipate and protect against any problems through a combination of authentication, sanitisation, validation, maintenance and testing
Maintainability	The ability for code to be updated and repaired easily
Auto-documentation	A programming tool which helps to create summary information about a program

C	Testing vocab
Erroneous	Test data which should not be accepted by a program
Valid / Invalid	

Databases and SQL

A	Database Vocab
Database	Where data is stored in interconnected *tables*
Field	The name of a column in a *table (eg age)*
Record	A row in a *table*, containing all the data about one entity in a *database*
Table	A collection of records and fields in a database. Looks like a spreadsheet
Query	A search performed on a database
Query Language	A programming language for searching databases
SQL	Structured Query Language
Wildcard	A symbol used to represent one or more characters

B	SQL Operators
AND	Boolean operator where both conditions must be True (prefers a False)
OR	Boolean operator where either condition must be True (prefers a True)
NOT	Boolean operator which reverses the truth value (False ⇒ True, True ⇒ False)
*****	Wildcard operator – means “any” or “all” depending on the circumstances
=	Equal to (different to Python)
<, >, >=, <=	Same as Python – comparison operators
<>	Not equal to (different to Python)

C	SQL Commands
SELECT	The range of fields to show
FROM	The table to look in
WHERE	The conditions for which records to show

eg	`SELECT * FROM Programs WHERE`
	`Genre='Entertainment' AND`
	`Channel='BBC3';`

Shows all fields of the records in `Programmes` where both the genre is `‘Entertainment’` and the channel is `‘BBC3’`	
ORDER BY	Displays results in ascending order according to data in this field

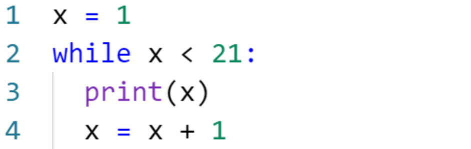
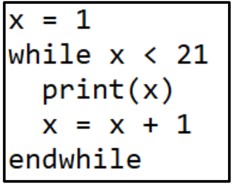
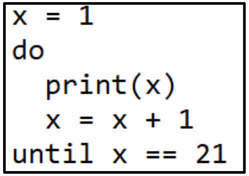
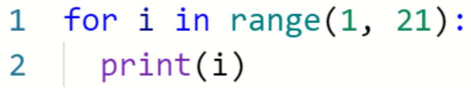
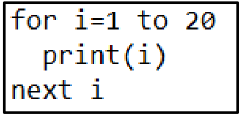
eg	`SELECT Programs.Duration, Programs.Title`
	`FROM Programs`
	`ORDER BY Programs.Duration;`

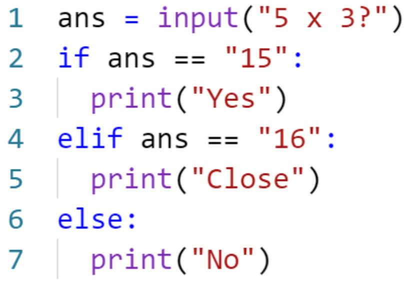
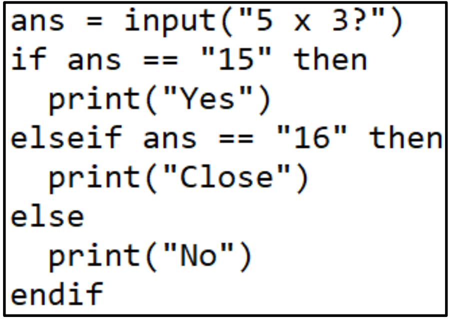
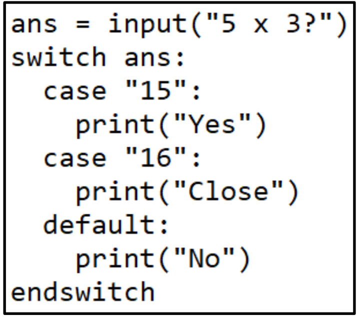
Shows the `Duration` and `Title` fields of all records in `Programs`, ordered by `Duration`.	
LIKE	Boolean operator which returns True if the result fits a specified pattern

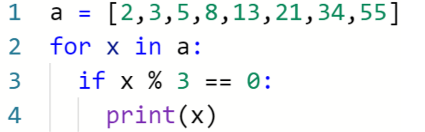
eg	`SELECT * FROM Programs`
	`WHERE Programs.Title LIKE “*i*”;`

Shows all records in `Programs` where the `Title` contains an `“i”`. The asterisks represent “any number of characters”	
INSERT INTO	The table to insert values into
VALUES	The values of each field to be inserted
UPDATE	The table to be updated
SET	eg `Program.Titles = ‘Top Gear’`
CREATE TABLE	Creates a table

Programming: Essential Programs 1

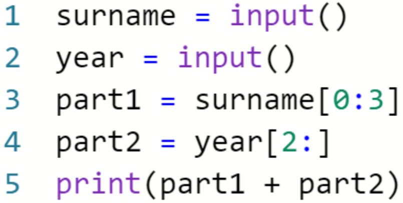
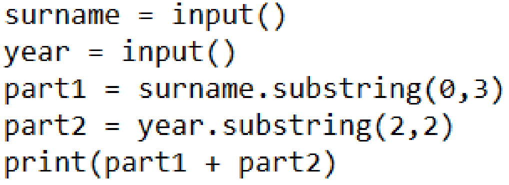
<table>
<tr><th>A</th><th colspan="3">Count from 1 to 20</th></tr>
<tr><th></th><th>Python</th><th>Pseudocode</th><th>Main Differences</th></tr>
<tr><td><b>Condition controlled loop</b></td><td>
<pre>
x = 1
while x < 21:
  print(x)
  x = x + 1
</pre></td><td>
<pre>
x = 1
while x < 21
  print(x)
  x = x + 1
endwhile
</pre>

<pre>
x = 1
do
  print(x)
  x = x + 1
until x == 21
</pre></td><td>• Pseudocode has ENDWHILE
• Pseudocode can use DO UNTIL</td></tr>
<tr><td><b>Count controlled loop</b></td><td>
<pre>
for i in range(1, 21):
  print(i)
</pre></td><td>
<pre>
for i=1 to 20
  print(i)
next i
</pre></td><td>• Pseudocode FOR loop looks like this.
• Must have NEXT i</td></tr>
</table>

<table>
<tr><th>B</th><th colspan="2">One Question Quiz</th></tr>
<tr><th>Python</th><th>Pseudocode</th><th>Main Differences</th></tr>
<tr><td>
<pre>
ans = input("5 x 3?")
if ans == "15":
  print("Yes")
elif ans == "16":
  print("Close")
else:
  print("No")
</pre></td><td>
<pre>
ans = input("5 x 3?")
if ans == "15" then
  print("Yes")
elseif ans == "16" then
  print("Close")
else
  print("No")
endif
</pre>

<pre>
ans = input("5 x 3?")
switch ans:
  case "15":
    print("Yes")
  case "16":
    print("Close")
  default:
    print("No")
endswitch
</pre></td><td>THEN instead of colon
ELSEIF instead of elif
ENDIF at the end
Indentation not necessary
SWITCH CASE is not in Python</td></tr>
</table>

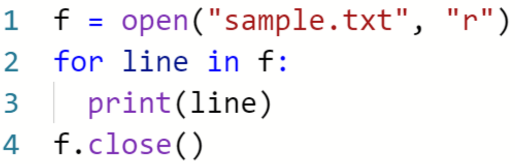
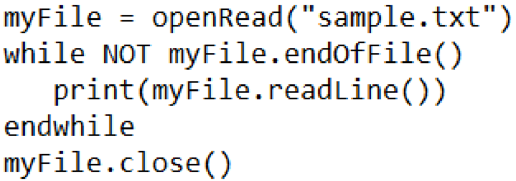
<table>
<tr><th>C</th><th>Output all the members of an array which are multiples of 3.</th></tr>
<tr><td>
<pre>
a = [2,3,5,8,13,21,34,55]
for x in a:
  if x % 3 == 0:
    print(x)
</pre></td><td>Makes use of modulo division – <b>x % 3</b> means <b>x MOD 3</b> which means <b>the remainder when x is divided by 3</b>. If the remainder is 0, there is no remainder. Which means that x is an exact multiple of 3. This program will output 3 and 21</td></tr>
</table>

Programming: Essential Programs 2

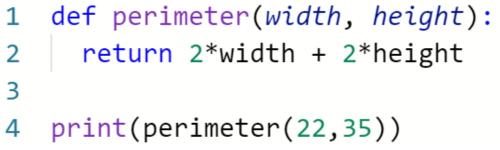
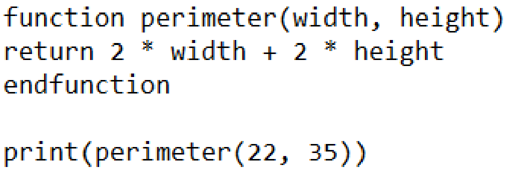
A	**Make a username out of two inputs. It should be the first three letters of the surname and the last two digits of the year they joined**		
Python	**Notes**	**Pseudocode**	**Notes**


`surname = input()`
`year = input()`
`part1 = surname[0:3]`
`part2 = year[2:]`
`print(part1 + part2)`
	a = "string123"
	a[2] is "**r**" because it is the 2nd character (**0 indexed**)
	a[2:6] is "**ring**" because it goes from index 2 to **5**
	a[2:] is "ring123" - it goes from index 2 to the end
		
		`surname = input()`
		`year = input()`
		`part1 = surname.substring(0,3)`
		`part2 = year.substring(2,2)`
		`print(part1 + part2)`
			a = "string"
			a.substring(2,4) is "**ring**" because it **starts** at index 2 and has a **length** of 3

B	**Open a file called sample.txt and print it line by line**		
Python	**Notes**	**Pseudocode**	**Notes**

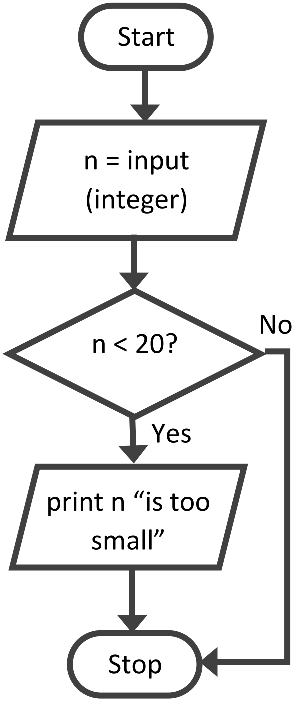

`f = open("sample.txt", "r")`
`for line in f:`
`    print(line)`
`f.close()`
	The second argument, "**r**", means "**read mode**".
	Files get closed
		
		`myFile = openRead("sample.txt")`
		`while NOT myFile.endOfFile()`
		`    print(myFile.readLine())`
		`endwhile`
		`myFile.close()`
			Instead of "**r**" in Python, we have "**openRead**".
			Files get closed

C	**Write a function,** perimeter**, which takes** width **and** height **as arguments. It returns the perimeter of a rectangle with those dimensions. Call the function with the values** width = 22 **and** height = 35 **to print the perimeter**		
Python	**Notes**	**Pseudocode**	**Notes**


`def perimeter(width, height):`
`    return 2*width + 2*height`
 	
`print(perimeter(22,35))`
	width and *height* are **parameters**.
	22 and *35* are **arguments**
		
		`function perimeter(width, height)`
		`return 2 * width + 2 * height`
		`endfunction`
		
		`print(perimeter(22, 35))`
			function instead of **def**
			Indentation is not necessary

Flowcharts

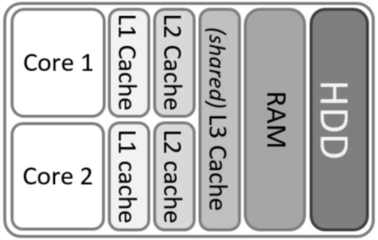
A	Key Vocab		
Component	Shape	Function	Notes
Terminator	Rounded rectangle	**Start or end of the program.** Normally “Start” or “Stop”	The start will always have one arrow coming out. The end may have many arrows going in.
Input/ Output	Parallelogram	**Input – asks for an input** `input()` or wait for click etc. **Output – outputs information** `print()` or make a sound etc.	Can have many arrows coming in. Only one arrow comes out.
Process		**Performs an action internally** ie change the value of a variable, pause etc.	
Decision		**Contains a question where the answer is normally Yes/No** ie `n == 8` or is password == “car”?	Always has two arrows coming out (at least). The paths **must** be labelled (eg Yes and No)

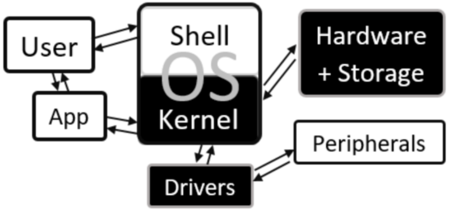


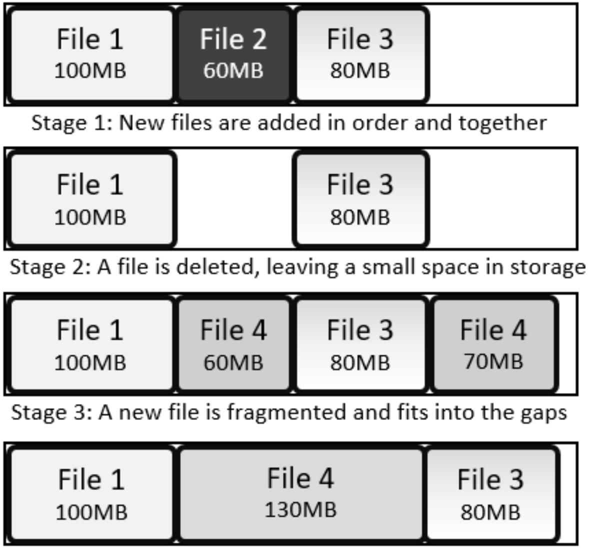
B	Programming Structures in Flowcharts
Sequence	The order of instructions. Shown here with arrows
Iteration	Looping or repeated instructions. Shown here when arrows go back to a previous point in the program
Selection	Where a program can branch in (at least) two directions. Decision components are always examples of selection

C	Key Ideas
Flow	The direction the arrows point in. Similar concept to sequence
Arrows	Always point towards the next component in the sequence
Reason	Visually shows the sequence of a program

Memory on a dual-core CPU







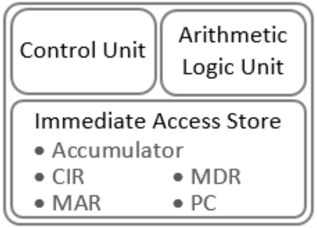
Stage 1: New files are added in order and together

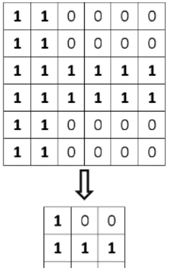
Stage 2: A file is deleted, leaving a small space in storage

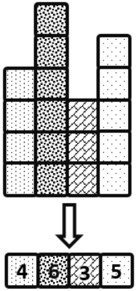
Stage 3: A new file is fragmented and fits into the gaps

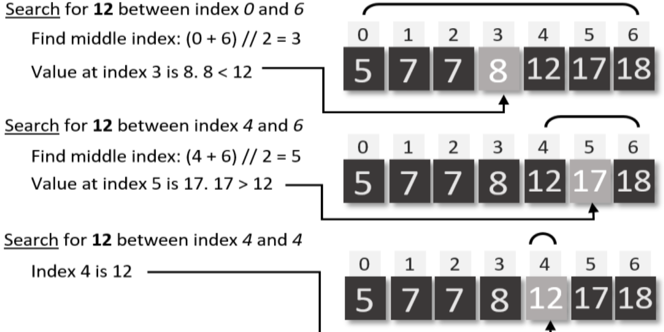
Stage 4, Defragmentation: Fragments are put together

Central Processing Unit








Search for **12** between index *0* and *6*

Find middle index: (0 + 6) // 2 = 3

Value at index 3 is 8. 8 < 12

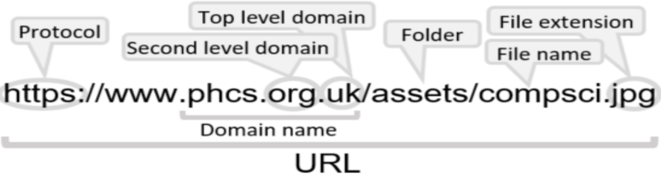
Search for **12** between index *4* and *6*

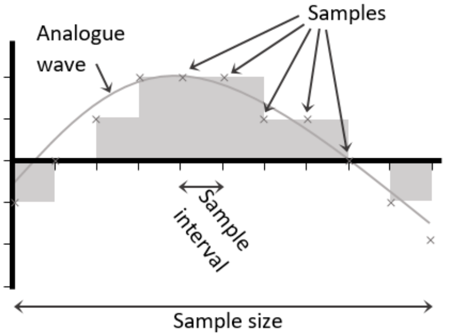
Find middle index: (4 + 6) // 2 = 5

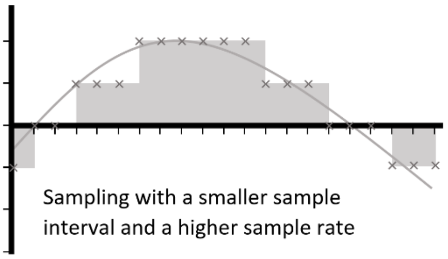
Value at index 5 is 17. 17 > 12

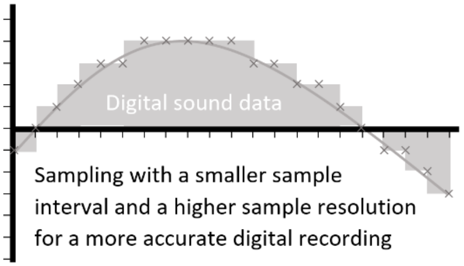
Search for **12** between index *4* and *4*

Index 4 is 12

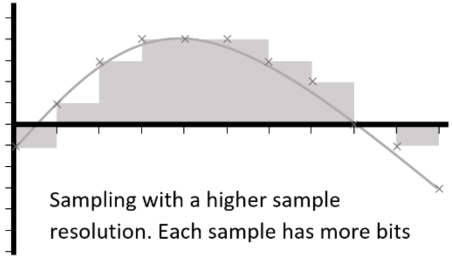


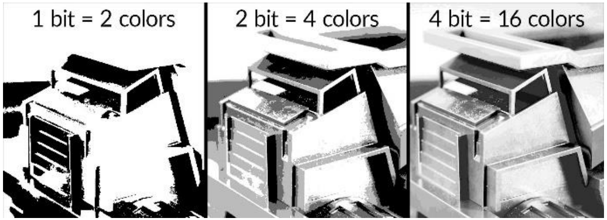


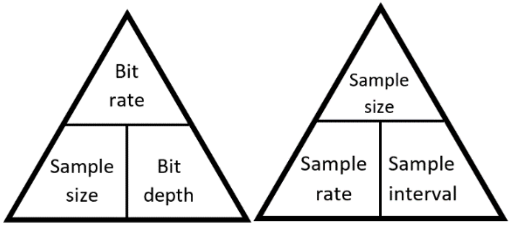

Sampling with a smaller sample interval and a higher sample rate



Sampling with a smaller sample interval and a higher sample resolution for a more accurate digital recording


Sampling with a higher sample resolution. Each sample has more bits




Bit rate
Sample size
Bit depth
Sample size
Sample rate
Sample interval