

Year 11 Computer Science – Autumn Term

Unit 1 – Networks

- Types of network

- Local Area Network [LAN]
- Wide Area Network [WAN]

- Factors affecting performance of networks:

- Bandwidth
- Latency

Bandwidth- The internet is similar to a road network in that it has rules (protocols) that you need to follow and only a certain number of vehicles (**data**) can get through at a time (**bandwidth**). (reduced bandwidth). Measured in bits per second (bps). This indicates the number of bits of information that can travel down the line in 1 second.

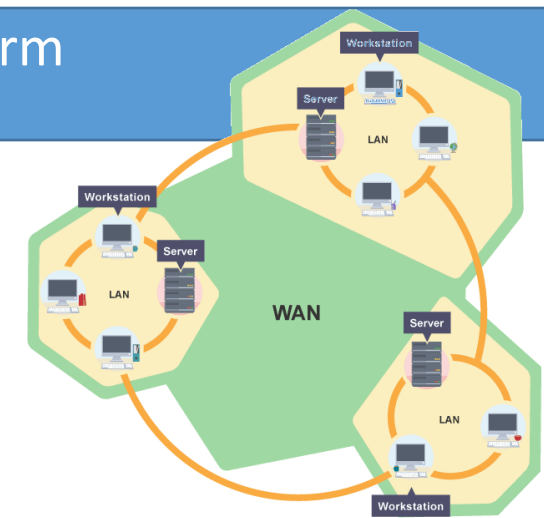
Latency is a measure of delay. The time it takes for some data to get to its destination across the network. It is usually measured as a round trip delay - the time taken for information to get to its destination and back again. Latency is usually measured in milliseconds (ms).

LAN

- Connects computers, peripherals, and other devices in a single building or other small geographic area.
- Typically owned by the company that uses them.

WAN

- Allows the transmission of data across greater geographic distance.
- Organisations hire infrastructure from telecommunications companies who own and manage the WAN.



Hardware

NICs (Network Interface Card) -

- Allows device to connect to a network.
- Built into motherboard.

Switches-

- Connect devices on a LAN.
- Receive data (in units called frames).
- Transmit the data on the network with the correct MAC address.

Cables-

- Ethernet- connect devices in LAN e.g. CAT 5e and CAT 6. Made of twisted copper wires.
- Coaxial- single copper wire surrounded by plastic and metallic mesh to stop interference.
- Fibre optic- transmit data as light, no interference, transmits large distances.

Client server-

- Managed by server.
- Devices called clients.
- Clients send requests to server. Server processes the request and responds.
- Server stores profiles, passwords and access information.

Pros-

- Central storage of files.
- Easy to back up.
- Easy to install software.
- Easy to manage security.
- Reliable

Cons-

- Expensive
- Needs specialists
- If server down, all clients lose access.

Peer to peer networks-

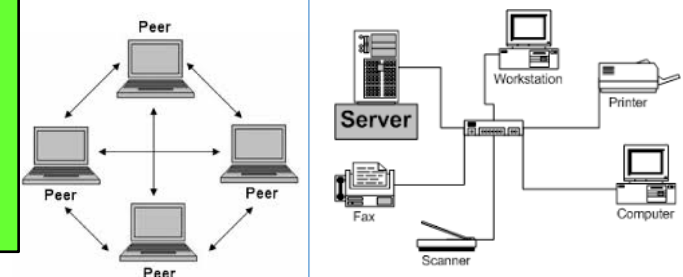
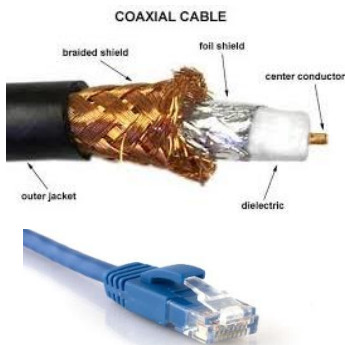
NO server. All devices equal.
Files stored on each device.

Pros-

Easy to maintain.
No dependence on server.

Cons-

- No centralised management so all updates done on each device.
- Copying files causes duplicate files.
- Less reliable.
- Machines prone to slowing down when other devices access them.



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Pros of STAR topologies-

- If device fails the rest of the network is unaffected.
- Simple to add more devices.
- Better performance as data goes straight to device.

Cons-

- All devices need a cable to connect to main switch or server.
- Can be expensive.
- If switch or server breaks whole network affected.

Works by sending the data along the fastest route possible.

Pros of Mesh topologies-

- No single point where network can fail.
- If one device fails the data will be sent along another route.

Cons-

- Used to be expensive with lots of cables. HOWEVER with the use of wireless technology this has become more practical.

The cloud uses the internet to store files and applications.

- Hosting- a business uses servers to store files for other organisations.



Pros of the cloud.

- Access from any device.
- No hardware or IT staff required.
- Can increase storage.
- Provides security.
- Updated automatically.

Cons of the cloud.

- Need to connect to the internet.
- Dependent on host for security.
- Data vulnerable to hackers.
- Unclear of ownership.
- Subscription costs.

The Internet

- Network of networks.
- It's a WAN connecting devices and networks over the world.
- Based around the protocol TCP/IP.

World Wide Web

- Collection of websites hosted on web servers.
- Accessed through the http protocol.

URLs

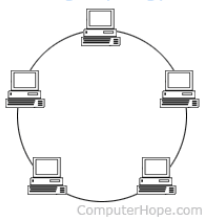
- Addresses used to access web servers and resources on them.

Domain Name Server (DNS)

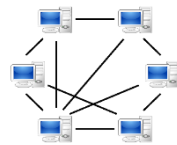
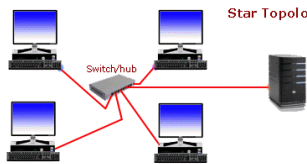
- Websites domain name into its IP address.

Network topologies

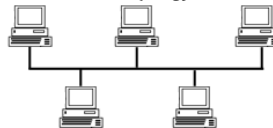
Ring Topology



Star Topology



Bus Topology



Ring

- Data moves in one direction which prevents collisions.
- Only one device can send at a time.
- Data passes through many devices before destination.

Bus

- Devices in a line.
- Connected with backbone cable.
- Data sent both ways which causes data collisions which slows the network.

Ways to keep data secure

Back up files

Passwords

Anti-virus

Authorised
personnel

Log off after use

Safe file storage

Threats to data security

Corrupted

Hacked

Damaged

Destroyed

Lost

Deleted

Virtual networks

- Network that is software based. Partitioning off some physical network bandwidth to form separate network.
- Several virtual networks can exist on the same physical network.
- Share the same hardware.
- Has their own security.
- **A Virtual private network** is a type of virtual network that can be used to send data securely over a large network, like a WAN or the internet. E.g. a VPN could be used to set up a school intranet that all the students access from home.
- **Virtual LAN** allows you to split a LAN into several separate networks using the same hardware.

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Network protocols- set of rules of how devices communicate and how data is transmitted across a network.

MAC addresses-

- Unique identifiers.
- Assigned to all network enabled devices.
- 48 or 64 bit binary numbers converted to HEX.
- Used by Ethernet protocol on LANs. LAN switches read the MAC addresses and use them to direct data to the correct device.

Communication between different networks uses IP Addresses

- Used when sending data between networks.
- IP addresses not linked to hardware.
- Assigned manually when before device can access the network.
- Static IP addresses are permanent and used to connect printers on a LAN & hosting websites on the internet.
- Dynamic IP addresses assigned to the device by a network server. Devices can have different IP addresses each time they log on.
- IP addresses can be 32-bit (converted to denary) or 128-bit (converted to Hexadecimal).

File Transfer Protocol [FTP]

FTP is used to transfer large files. It is often used for organizing files on a web server for a website. You can have private access to an area on an FTP server where you can upload your files. You can then give another user access to download the documents that you have shared.

Hyper Text Transfer Protocol [HTTP]

HTTP transfers web pages from web servers to the client. All web page addresses start with http.

Hyper Text Transfer Protocol Secure [HTTPS]

An https address is a secure web address which has been encrypted. An https address is used for sites holding bank details and secure information.

Simple Mail Transfer Protocol [SMTP] and Post Office Protocol [POP]

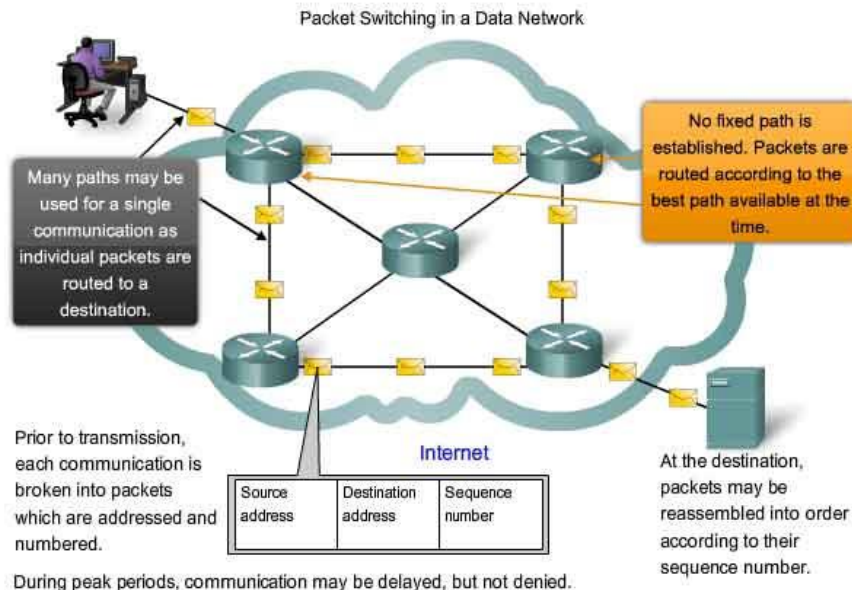
Email uses these protocols to communicate with mail servers. SMTP is used to send the email; POP is used to receive email. Most email clients allow for transfers of up to 10 MB.

Voice Over Internet Protocol (VOIP)

VOIP is a set of protocols that enables people to have voice conversations over the internet.

Internet Message Access Protocol (IMAP)

Used to retrieve emails from a server. Server holds the email until you actually delete it. You only download a copy.



Between networks (e.g. over the internet), data is sent in packets and directed by routers using IP addresses.

Packets

- Data sent split into equal sized packets.
- Packet has header (control info) which includes the destination address, source address and packet number.
- Data packet payload is the email, document, webpage or video.

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Network protocols are divided into layers

- Layer- group of protocols with similar functions.
- Layers are self contained. They do their job and don't worry about the other layers.
- Each layer serves the layer above it e.g. when you send an email (on layer 4) it triggers actions in layer 3, which triggers actions in layer 2, then to 1.



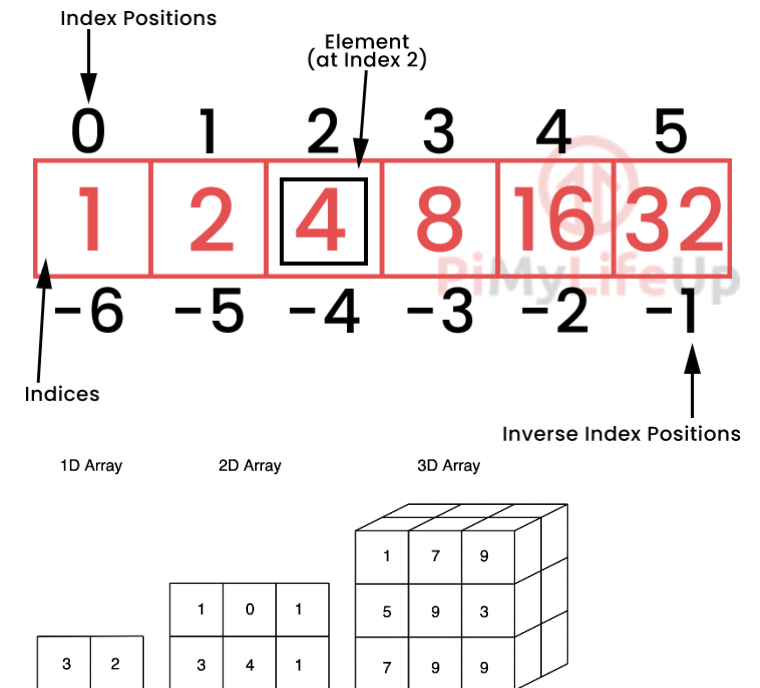
Layer Name	Protocols	Examples
Layer 4- Application	Turning data into websites & other applications.	HTTP, FTP, SMTP
Layer 3- Transport	Controlling data flow e.g. splitting data into packet and checking packets are correctly sent and delivered.	TCP
Layer 2- Network	Making connections between networks, directing data packets and handling traffic. Used by routers.	IP
Layer 1- Data link	Passing data over the physical network. Responsible for how bits are sent as electric signals over cables, wireless and other hardware.	Ethernet

Name	Description	Example and explanations
Malware is short for 'malicious software'.	Malware is a general term for any hostile or intrusive software. For example it may disrupt computer operations (virus), or it may seek to secretly monitor what the user is doing (spyware). image	<ul style="list-style-type: none"> • Computer Virus • Trojan • Spyware • Adware • Pharming • Click fraud • Ransomware • Rootkits • Scareware
Social engineering.	People can make mistakes; they can be tricked, fooled, bribed, or threatened. All of these threats to a network are labeled together as 'social attacks'.	<ul style="list-style-type: none"> • Bribing a user into allowing an attacker access to a system • Putting a thumb-drive full of malware somewhere a user might pick it up, and labelling it like "Salary Records" or "Staff redundancies". • Phoning up a user at work and convincing them to break policy and give them the information they want directly, like patient information records.
SQL injections (structured query language).	SQL is one of the main coding languages used to access information in databases.	<ul style="list-style-type: none"> • SQL injections are pieces of SQL typed into a website input box to reveal sensitive information.
Penetration testing.	Staff simulate potential attacks on the network.	<ul style="list-style-type: none"> • Identifies weakness in the security. • Results reported back.
Network forensics.	Investigations to find the cause of attacks on a network.	<ul style="list-style-type: none"> • They capture the data packets as they enter the network. • The packets are analysed. • Decisions made on how to prevent future attacks.
Passwords	Help prevent unauthorised users accessing the network.	<ul style="list-style-type: none"> • Many characters long. • Combination of letters, numbers and symbols. • Changed regularly.
Encryption	Data translated into a code which only someone with the correct key can access.	<ul style="list-style-type: none"> • Encrypted text is called <u>cipher text</u>. • Data not encrypted is called <u>plain text</u>. • Allows data to be sent securely.

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Unit 2 – Python programming

Python -> English	
<code>print("hello!")</code>	Prints a value on screen (in this case, hello!)
<code>input("")</code>	Inputs a value into the computer.
<code>x = input("")</code>	Inputs a value and stores it into the variable x.
<code>x = int(input(""))</code>	Inputs a value into x, whilst also making it into an integer.
<code>answer = x + y</code>	Saves the result of x and y added together in a variable named answer.
<code>print(str(x))</code>	Prints the variable x, but converts it into a string first.
<code>print("Hello", "World")</code>	Prints the two strings concatenated with a space between. This code would output "Hello World".
<code>age = 12</code> <code>print("Age: " + str(age))</code>	The + joins together two variables when printing. Str has to be used to cast age to be a string. This code will output "Age: 12". Concatenation
<code>if name == "Fred":</code>	Decides whether the variable 'name' has a value which is equal to 'Fred'.
<code>else:</code>	The other option if the conditions for an if statement are not met (eg. name = 'Bob' when it should be Fred)
<code>elif name == "Tim":</code>	elif (short for else if) is for when the first if condition is not met, but you want to specify another option.
<code># COMMENT</code>	# is used to make comments in code – any line which starts with a # will be ignored when the program runs. They are used to describe the code to a programmer.
<code>for i in range(0,10):</code> # WRITE CODE HERE	Repeats any code indented after this line a set number of times, in this case, 10.
<code>while x < 10:</code> # WRITE CODE HERE	Repeats any code indented after this line until a condition is met, in this case x becoming equal to or greater than 10.
<code>list = ["", ""]</code>	Creates a variable and makes it an array – a list which can store many values.



Useful list functions & methods

Name	Purpose
<code>len(x)</code>	Calculate the length of the list x
<code>x.append(y)</code>	Add the object y to the end of the list x
<code>x.extend(y)</code>	Extend the list x with the contents of the list y
<code>x.insert(n, y)</code>	Insert object y into the list x before position n
<code>x.pop()</code> <code>x.pop(n)</code>	Remove and return the first object in the list Remove and return the object at position n
<code>x.count(y)</code>	Count the number of times object y is in the list
<code>x.sort()</code>	Sorts the list x in-place
<code>sorted(x)</code>	Returns sorted version of x (does not change x)
<code>x.reverse()</code>	Reverses the list x in-place

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Unit 1 – Laws and Issues

Environmental impact of computer science

E.g. smartphones

- Companies make these with a limited life – bring out new brands
- When we make devices we use up natural resources
- e.g. plastics that come from crude oil, precious metals like gold, silver copper, mercury
- Extracting these materials take a lot of energy, creates pollution and uses natural resources
- E-waste – when we throw away devices we create this
- Not always disposed of safely
- Much of our e-waste goes to 3rd world countries
- Landfills – precious and poisonous metals and toxins from waste leak into land and water
- This impacts on 3rd world countries environment and health of people e.g. children rummaging through landfill sites looking for food.
- WEEE – Waste electric and electronic Equipment – company that helps dispose of E waste safely and promotes recycling of devices.

Cultural implications

- Shaped our lives – lead to digital divide – some people have greater access to tech than others. This can lead to others being disadvantaged
- Why? Some have more money to buy new devices, urban areas have better network coverage than rural, some don't know how to use the technology e.g. older people haven't grown up with computers so don't know how to use them
- People in richer countries have better access = better opportunities for these people
- Changes in business – streaming media- cheaper – music shops such as HMV closing stores. Cheaper services like Airbnb use internet to rent out rooms – can be cheaper but also risky – safety regulations, insurance might not be in place as if you book through a hotel it would be.
- Shaped our culture – selfies, attention seeking and self obsessed behaviour. Things going viral – easily spread can have positive but a negative impact on peoples lives.

Stakeholders – Individuals or groups of people who have an INTEREST in or are AFFECTED by decisions a company makes

- Owners
- Employees
- Customers
- Shops it sells goods to
- Suppliers to the company
- Local Community

Ethical - what is CONSIDERED to be right and wrong by society

Legal - what is ACTUALLY right and wrong in the eyes of the law

Cultural – how groups of people with certain beliefs, practices or languages may be affected e.g. religions, ethnic groups

Environmental – how we impact the environment

Privacy - keeping data secure and accurate

Legal

Data Protection Act

- Keep Personal data secure
- Keep Personal data accurate
- Keep Personal data for a specific purpose

Computer Misuse Act

- Illegal to access computer material without permission,
- Illegal to access computer material without permission and with intent to commit criminal offences,
- Illegal to alter computer data without permission

Copyright designs and patents act

- Illegal to copy someone else's work, design eg, novel, music, picture, software, designs etc
- Permission is needed from the copyright holder if you want to use anything – may have a small cost
- Difficult to control with internet in play and not easy to police e.g. streaming videos, music illegally

Creative Commons Licensing

- Allow you to legally share media and software online without having to ask for permission first.
- Usually take and build upon the work in the public domain that can be shared again

Freedom of information act (2000)

- allows members of public to access information held by a public organisation about that organisations activities
- Covers data files, email, printed documents - e.g. NHS, armed forces, Police, Schools
- The acts make's these organisations publish data on a regular basis so the public have access to it
- Public can also request certain information
- e.g. school results data, Hospital waiting lists, crime stats etc

Open Source Software vs Proprietary Software

<ul style="list-style-type: none"> • free and openly available to everyone. No licence needed. • The code is published and allow others to use and modify it. • Open source products are usually tested in public by online contributors. • Wide pool of innovative creators – very reliable and secure 	<ul style="list-style-type: none"> • legally remains the property of the organisation, group, or individual who created it. • Source code not usually published • Has help and customer support • Well tested and tried • A special licence key needs to be purchased to use it.
<ul style="list-style-type: none"> • Might not get regular updates • May have security holes • May be limited user documentation • No warranties or customer support • No one to take ownership if something goes wrong 	<ul style="list-style-type: none"> • Can be expensive • Might not exactly fit <u>users needs</u> • May not maintain older versions and warranties will expire – as the companies will want people to buy the latest versions.

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Algorithms

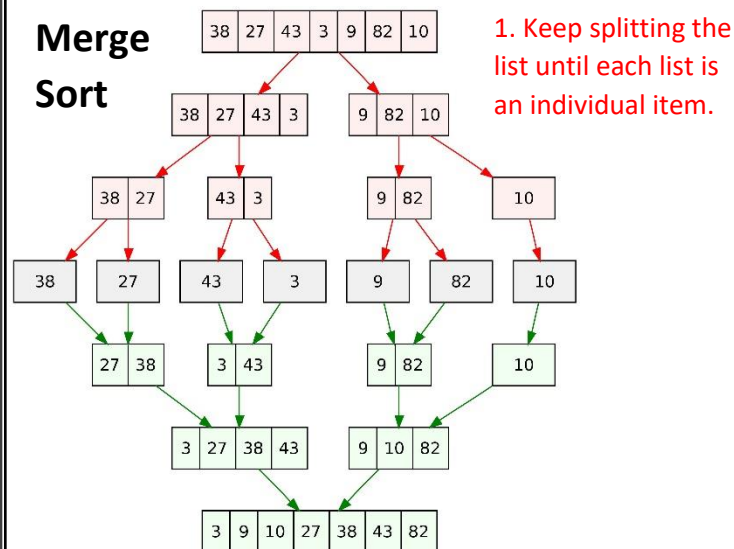
Computational thinking	Thinking like a computer – no common sense or instinct. Every small detail required to complete tasks.
Abstraction	Filtering the problem to only include the relevant/important information.
Decomposition	Breaking the problem down into smaller and more manageable chunks.
Pattern Recognition	Finding patterns within the problem that can be solved together.
Flowchart	A visual way of representing an algorithm. See image.
Pseudocode	A simple way of writing an algorithm, which looks like code, but doesn't use specific syntax (punctuation).

set total to zero	
get list of numbers	
loop through each number in the list add each number to total end loop	INPUT hours INPUT bears hourswage = hours * 7 bearswage = bears * 0.45 total = hourswage + bearswage OUTPUT "Your total wage is £" + total)
if number more than zero print "it's positive" message else print "it's zero or less" message end if	

Pseudocode Examples

Bubble sort example	
Initial	Initial Unsorted array
5 3 8 4 6	5 3 8 4 6
Step 1	Compare 1st and 2nd (Swap)
5 3 8 4 6	5 3 8 4 6
Step 2	Compare 2nd and 3rd (Do not Swap)
3 5 8 4 6	3 5 8 4 6
Step 3	Compare 3rd and 4th (Swap)
3 5 8 4 6	3 5 8 4 6
Step 4	Compare 4th and 5th (Swap)
3 5 4 8 6	3 5 4 8 6
Step 5	Repeat Step 1-5 until no more swaps required
3 5 4 6 8	

Merge Sort



Insertion Sort

Each item in the list is inserted into its correct place, until the last item has been inserted and the list is sorted.

Unsorted



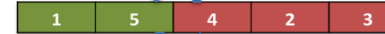
Sorted

Unsorted



Sorted

Unsorted



Sorted

Unsorted



Sorted

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Sorted

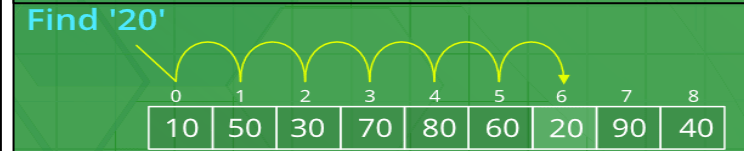


Binary Search

Search 23	0	1	2	3	4	5	6	7	8	9
	2	5	8	12	16	23	38	56	72	91
23 > 16 take 2 nd half	L=0	1	2	3	M=4	5	6	7	8	H=9
	2	5	8	12	16	23	38	56	72	91
23 > 56 take 1 st half	0	1	2	3	4	L=5	6	M=7	8	H=9
	2	5	8	12	16	23	38	56	72	91
Found 23, Return 5	0	1	2	3	4	L=5, M=5	H=6	7	8	9
	2	5	8	12	16	23	38	56	72	91

Binary Search – Find the middle of the list, compare with the value being search, and discard the half of the list that isn't required. List must be sorted.

Linear Search



Linear Search – Checks each item from the beginning to find the search value. List doesn't need to be sorted.

Flowchart Symbols

Terminator	Used to represent the Start and end of a program with the Keywords BEGIN and END.	Decision	Used to split the flowchart sequence into multiple paths in order to represent SELECTION and REPETITION.
Process	An instruction that is to be carried out by the program.	Input / Output	Used to represent data entry by a user or the display of data by the program.
Arrow	Indicates the flow of the algorithm pathways.	Subprogram	References another program within the program.

Helpful websites:

Youtube – Algorithms

BBC Bitesize

<https://www.computerscience.gcse.guru>