BINARY – UNITS – LOGIC GATES

Data

5 types of data that computers can convert to binary:

1) Numbers
2) Images
3) Characters
4) Sound
5) Units

Converting between Binary and Denary

Example – 00010110

4. **Draw out the table below and place the binary value into the table.**

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

5. **Add up the values turned "on".**
   16 + 4 + 2 = 22

Converting between Denary and Binary

Example – 56

1. **Draw out the table below:**

128	64	32	16	8	4	2	1

2. **Fill the table with 1's for values you want to use to make 56 and 0's with those you don't.**

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

3. **Check it (using Bin-Den method)**
   32 + 16 + 8 = 56 ✓

Binary Addition Rules:

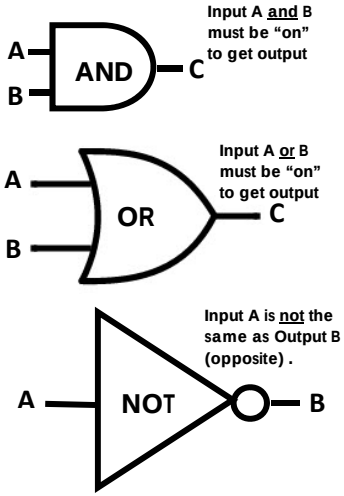
1) 0 + 0 = 0
2) 0 + 1** = 1
3) 1 + 1 = 0 carry 1
4) 1 + 1 + 0** = 0 carry 1
5) 1 + 1 + 1 = 1carry 1

Example

```
 1 0 1 0 1
 1 1 1 1 0
1 1 0 0 1 1
  1 1
```

****Any other combination of them values**

Logic Gates



Truth Tables

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

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

A	B
1	0
0	1

Hex to Binary

4E

1. **Split in half: 4 and E.**
2. **Use below table to calculate binary value of each:**

4 =

8	4	2	1
0	1	0	0

E = (11)

8	4	2	1
1	0	1	1

3. **Combine Answer: 01001011**

Binary to Hex

0110 1110

1. **Split in half 0110 and 1110**
2. **Use below table to calculate hex value for each (follow denary rules)**

0110 =

8	4	2	1
0	1	1	0

= 6

1110 =

8	4	2	1
1	1	1	0

= 14 (E)

3. **Combine Answer: 6E**

Hex

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
										10	11	12	13	14	15

Uses a counting system of 16 values (0-15).
1 hex value = 4 bits of data (nibble).

Binary Multiplication / Division

Multiplying

Multiply 00011 by 2.

1. **Shift the "1"s 2 places to the LEFT.**

0	0	0	1	1
0	1	1	0	0

2. **Fill the empty values with 0.**

Dividing

Divide 1011000 by 3.

1. **Shift the "1"s 3 places to the RIGHT.**

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

2. **Fill the empty values with 0.**

Units of Measurement

Bit	0 or 1
Nibble	0110 (4 bits)
Byte	01100001 (8 bits)
Kilobyte	1000 bytes
Megabyte	1 million bytes
Gigabytes	1 billion bytes
Terabytes	1 trillion bytes

Convert – Higher unit: / 1000

Convert – Lower unit: * 1000

CYBER SECURITY – LEGAL, ETHICAL, ENVIRONMENTAL

Cyber Security

"Processes / technologies used to protect programs and data from attack, damage or unauthorised access."

Threats

Weak and default passwords.
Misconfigured access rights (people accessing things they shouldn't have permission for)
Removable media (memory sticks, SD cards)
Outdated software (not updating regularly)
Social engineering**
Malicious code**

Social Engineering

"Manipulating people to provide information"

Phishing	Sending false emails to gain personal information.
Pharming	Redirects website traffic to fake sites.
Shouldering	Using direct observation to gain confidential information e.g. pin numbers at cash points.
Blagging	Obtaining personal information without someone's consent.

Malicious Code

Malware	A virus installed without the user's permission. Deletes /edit's files and clogs up the storage.
Spyware	Software which tracks the user's movements and gathers information about them without their knowledge.
Adware	Produces adverts based on user's internet movement – some are legal.
Trojan	Falsely disguises itself as something legal.

Cyber Security – Prevention Methods

Biometric Testing – Eye / finger recognition.

Antivirus software.

Automatic software updates.

CAPTCHA
Checks a user is not a "robot" but asking to fill in data a computer could not answer.

Penetration Testing
Used to find weaknesses in a system and reports findings back.
Black box – No prior knowledge about system given.
White box – Some prior knowledge shared.

Environmental Issues

A growing population means more devices are being used (4 devices to one person).

More power consumption and more waste, polluting the environment.

Chemicals in devices (gold, mercury) being released into atmosphere.

Devices taking 100s of years to decompose.

PREVENTION
Recycle
Dispose of items using correct resources
Re use old ink cartridges
Share devices in households

Ethical Issues

Humans replacing machines, meaning a growth in unemployment.

Cyber bullying.

Local shops and businesses closing down as a result of internet buying.

PREVENTION
Monitor of social media sites / stricter punishments for those who bully.

Balance of humans and machines equally.

Legal Issues

Data Protection Act
- 8 principles
- Organisations must protect their customer's data e.g. name, age, bank detailsand address.
- Must use high levels of security and restrict unauthorised access of highly confidential data.

Computer Misuse Act
- Makes it illegal to use a computer for fraudulent purposes e.g. fraud, hacking, viruses etc.

Copyright, Designs and Patents Act
- Cannot use other people's property (images, videos, documents) without their consent.

DATA REPRESENTATION REVISION

Images

File Type	Description
Vector Image	Image made up of lines and shapes with properties e.g. fill colour, line style etc. (Used with basic graphics).
Bitmap Image	"Map of bits". – Image made using bits of data.
Resolution	The total number of pixels in the image. No of pixels across * no of pixels down
Colour depth	The number of bits per pizel.
Meta data	"Data about data". Data about the image / file itself e.g. size, dimensions, resolution etc.

Huffman Coding / Binary Trees

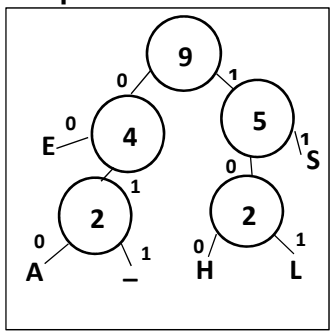
SEA SHELLS

Uncompressed = 8 bits per character:
10 * 8 = 80 characters.

1. **Count the frequencies of each character (how often it appears)**

S	E	A	H	L	_
3	2	1	1	2	1

2. **Create tree starting with lowest values, working up.**



SEA: 1100010
_: 011
SHELLS: 111000010110111
Total compressed: 25 bits

**
1's = right
0's left

Character set

Any characters found on a computer (letters, numbers, symbols).

ASCII Character Set

Uses 7 bits of data to store all characters in a character set.
128 characters in total can be stored.

Extended ASCII Character Set

Increased to 8 bits of data.
Stores up to 256 characters.

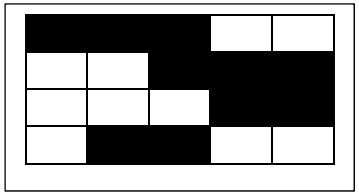
Unicode Character Set

Uses 32 bits of data.
Stores up to 4 billion characters and symbols for all languages in the world.

Run Length Encoding Compression

1 = white

0 = black



Uncompressed = 00011, 11000, 11100,

To Compress using RLE

Pair alike colours together *.g 3 black = 30 (0 meaning the black bit value).*

Compressed: 30 21, 21 30, 31 20, 11 20 21

*Used on simple, small images with basic patterns.

Sound

Sound is **analogue** and it must be converted to a **digital** form for storage and processing in a computer.

Sound waves are **sampled** to create the digital version of sound

Sound file sizes are based on the **sampling rate** and the **sample resolution** (see below)

File size (bits) = rate * resolution * seconds

Data Compression

Compression	Reducing size of a file.
Lossy	Reduces file size by permanently removing data from the file.
Lossless	Reduces file size by creating patterns in the data without deleting it.

File Types

File Type	Description
.png	Graphics which use a transparent background.
.jpeg	Used on large, detailed images e.g. photographs.
.gif	Simple cartoon graphics.
.bmp	Bitmap images.
.mp3	Music / video files
.txt / .doc	Documents e.g. word, notepad
.pdf	Text document that can't be edited.

HARDWARE REVISION

CPU
A piece of hardware that processes instructions.

Factors affecting a CPU's performance

1- Clock speed (measured in hz). Higher the clock speed the faster it will process an instruction.

2- Cores: More cores means more instructions processed simultaneously.

3 – Cache: Fast memory location close to CPU.

CPU – Fetch Execute Cycle

Fetch – Fetches an instruction from an address in memory.

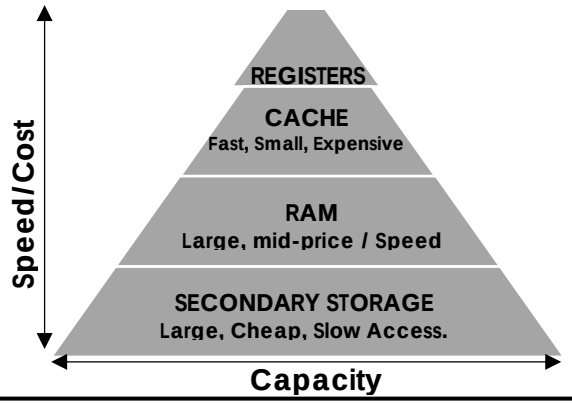
Decode – Uses the ALU to perform any calculations.

Execute – Carries out the instruction.

Computer Systems Definitions

Computer system	Device which contains hardware and software.
Hardware	Physical components.
Software	Programs on a computer.
Inputs	A device which sends data in.
Outputs	A device which receives data coming out of the computer.
Processes	

Types of Memory / Storage



Memory
Hardware that holds programs.

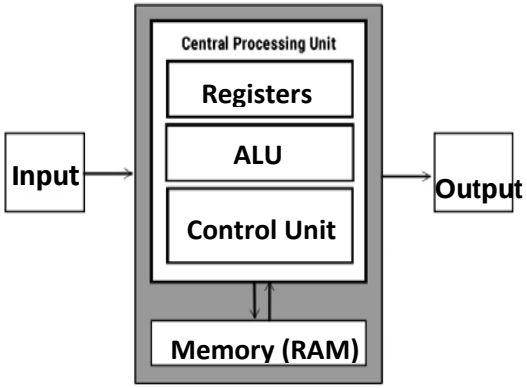
RAM
Volatile
Editable
Contain programs in use.

ROM
Non-volatile.
Not editable.
Contains bootstrap loader.

Secondary Storage
Hardware that permanently stores data.

	Example	Fast?	Large?	Durable?	Cheap?
Magnetic	Hard drive	x	✓	-	-
Optical	Disk	-	x	x	✓
Solid State	Pen drive Solid State drive	✓	✓	✓	x

Von Neumann Architecture
Complete the following diagram using the words given.



CPU Components

Component	Function
Arithmetic Logic Unit (ALU)	Carries out all the arithmetic (+- * /) and logic (AND, OR NOT, >, < <=, >=) operations.
Control Unit	Controls and manages the fetch and executing.
Buses Connections between components	Address Bus carries the address of the next instruction.
	Data Bus carries the data of the address around the CPU.
	Control bus carries out control signals throughout the CPU.
Registers	Small, fast memory locations in the CPU.
Clock	Device which vibrates continually and controls the speed the data is passed through the buses around the CPU.

Cloud Storage
Data stored on a third parties server.

Advantages
Free / Cheap
Back ups
More space on device

Disadvantages
Security
Reliant on server
Need internet access

Embedded Systems
A computer system with a microprocessor, which usually performs specific tasks.

Examples
Microwaves
ATM points
Traffic lights
Vending machines

Difference to Computers
Uses a microprocessor.

Contains just memory (no storage).

NETWORKS REVISION

Networks

Connected devices which communicate / share resources.

Protocols

A set of rules on how devices should communicate.

FTP	File transfer
TCP	Transmission control
IP	Internet
HTTP/S	Hypertext transfer / secure
IMAP	Instant Messaging
POP	Post office

Network Hardware

Hub/ Switch	Connects and sends packets of data to devices within a network.
Router	Sends packets of data across networks.
WAP	Wireless Access Point. Transmits / receives data wireless.
Ethernet	Uses wires to form wired connection.
NIC	Network Interface Card – gives devices the commands to connect to networks.
MAC address	Serial number of the NIC card (device). Stays permanent (never changes)
IP address	ID given when connecting to a network. Changes with different networks.

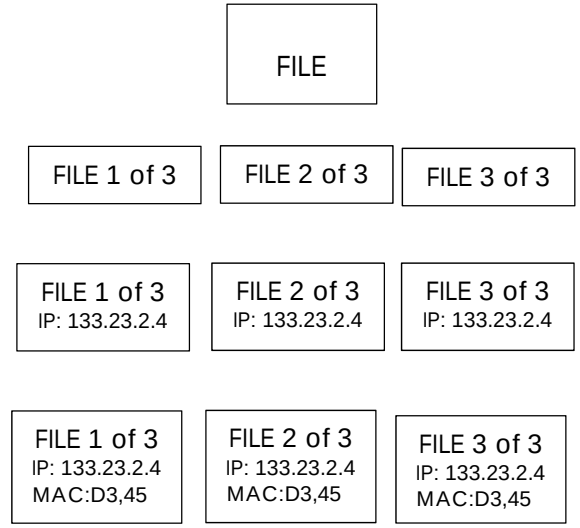
Packets

Packets – Pieces of data broken down before being sent across a network. Each packet contains:

1. **Packet number**
2. **Number of Packets**
3. **Error checking**
4. **IP address (sender / receiver)**
5. **The data itself**

TCP – IP Stack

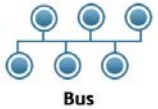
A protocol which sets out the rules of how data should be sent across the internet. This "stack" is broken down into 4 layers. Every layer must be assigned before it is sent.



1. **Application Layer**
   File formatted with necessary protocols.
2. **Transport Layer**
   File broken into packets.
3. **Network Layer**
   IP address assigned to each packet.
4. **Link Layer**
   MAC address assigned to each packet.

Network Topologies

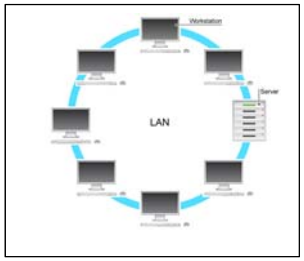
RING
All nodes have equal status.
Cheap to install.
Connections breaks easily.



BUS
Connects nodes together using a backbone link.

START
Connects via a hub.
Fastest topology but most expensive.

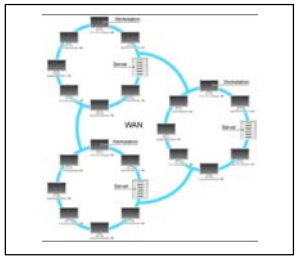
Network Types



Local Area Network

Covers a small geographical area (site) e.g. home, school.

Equipment owned by organisation.



Wide Area Network

Covers a large geographical area (multiple sites) e.g. national shops.

Equipment owned /m managed by 3rd party.

Personal Area Network

Personal devices connected together e.g. a phone with a speaker.

Usually have to be within close range.

Network Security

Firewall	Blocks unauthorised access.
Authentication	Strong username and password. 2 step authentication.
MAC Address Filtering	Blocks MAC addresses from a network ("blacklist")
Encryption	Encodes data, making it unreadable.
Caesar Cipher	A type of encryption which replaces characters with different characters.

SOFTWARE REVISION

Software
Programs on a computer

Types of software

Systems Software – Software that manages the running of the computer.

Applications Software – Software that performs specific tasks.

SDLC Stages
Feasibility study
Analysis
Design
Implementation
Testing – Evaluation
Maintenance

Operating System
Manages all hardware and software on the computer via user interface.

Tasks
- Coordinates input / output devices.
- Manages CPU timings.
- Security
- File management

Utility Programs
Programs that maintain the computer and ensure they are running smoothly.

Examples
Disk defragmentation – Sorting files into order within computer's memory.
Compression – Reducing the size of files.
Antivirus/Firewall – Protecting against unauthorised access.

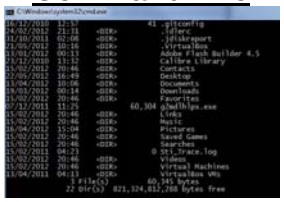
User Interfaces

GUI
Graphical User

Uses icons and graphics to communicate.
WIMP – Windows, icons, menus, pointers.

Simple for less advanced users.
Takes up more storage in memory / slower.

Command Line

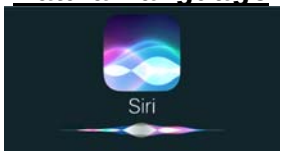


Uses commands to communicate with user.

Faster / takes up less space in storage.

Must know the commands to be able to communicate with it.

Natural Language



Uses the user's speech to communicate.

Very simple – no technical skills needed.

Not always reliable due / interface can't always understand user's demands.

Applications Software

Off the Shelf
Made for the public.
Made in mass.
Cheaper.
Doesn't always cater for user's specific needs.

Bespoke
Created for a specific user.
Tailored to that user's needs.
Expensive.
Time consuming (takes time to build software)

Proprietary
Software owned by a company.
Source code kept secret.

Open Source
Software available to everyone.
Source code shared.

Software Development Life Cycle
The routes programmers / companies take to building a piece of software.

Waterfall

Each step completed one at a time.
Can't go back a step.
Good for large projects but changes are costly.

Cyclical

Similar to waterfall but the process is then repeated to update newer versions of the software.

Spiral

Software is developed in stages which keep being repeated.
Proto type made to check for faults.

Agile

Similar to spiral.
Customer evaluates each proto type and gives feedback.
Small groups work on sections.