Unit 1.1: Binary Systems

1.1.1 BINARY SYSTEMS

Data: numbers, symbols or alphanumeric characters in their raw format before processing

- Information coded in a format ready for processing

Analogue: smooth stream of data that our senses process on a daily basis

- Computers cannot process analogue data

Digital: data represented in the values 1 and 0 that a computer can process

Denary: a system of numbers with a base of 10
Binary: a system of numbers with a base of 2
Byte: a unit of data that is eight binary digits long

- Used to represent a character or hold a string of bits to build an image

Unit of	Abbreviation	Conversion
Byte	B	8 bits
Kilobyte	kB	1024 bytes
Megabyte	MB	1024 kB
Gigabyte	GB	1024 MB
Terabyte	TB	1024 GB

Register: small piece of memory where values can be held

- Built into the CPU where values & instructions are temporarily held
- Read & write faster than primary & secondary storage
- Processor register: used to process data
  - E.g. accumulator, MAR, PC
  - Suitable when small amounts of data need to be accessed quickly
- Hardware register: used to convey a signal
  - E.g. robot arms (raise, grip)

Denary	…	4098	2048	1024	512	256	128	64	32	16	8	4	2	1
Binary	…													

- To convert between denary and binary use the table above ^

1.1.2 HEXADECIMAL

Hexadecimal: a system of numbers with a base of 16

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

- To convert between binary and hex split the binary into sections of 4:
  - 1011 - 1100 - 1001
  - Convey these small sections to denary
  - 11-12-9
  - Convert these to Hex:
  - BC9
  - 101111001001 = BC9
- Do the reverse when converting from hex to denary

Example:
Denary – 1080
Hexadecimal – 438

Binary – 1001001110001010
Hexadecimal – 938A

1.1.3 DATA STORAGE

Character: text, numbers and symbols
Images: analogue
- -Need to be converted into digital for computer to process it
- -Made up of pixels
- -Metadata: tells the computer the dimensions of the grid to create the image

Sampling: recording sound at set time intervals
- -The closer together the time samples, the higher the quality of the recorded sound

Data compression: when the bit structure of a file is manipulated in such a way that the data in a file becomes smaller in size
- -Done by compression algorithms
  - -Algorithm: a step-by-step set of instructions
- -Lossy compression: data that is deemed unnecessary is removed permanently

- Used for multimedia: MP3 (audio), MP4 (video), jpg. (image)
- There will be a loss in quality each time it is saved

- Lossless compression: used when it is essential that no data is lost or discarded during the process
  - Used for multimedia: audio, video, png. images
  - Uses 1 byte for each character and 1 byte for each position the word occurs in the message
- Reduce the size of an image by looking for repeating colour patterns within the image

Musical instrument digital interface (MIDI): uses a series of protocols & interfaces that allow lots of different types of musical instruments to connect and communicate

- A series of instructions for an instrument to carry out

ERROR CHECKING AND CORRECTION

Transmission errors: when data transmitted doesn't arrive in the format it was sent due to electrical interference, power surges etc.

Error checking: methods computers use to check for data transmission errors

- Parity bits: will be set to 1 or 0 to make the total number add up to an odd or even number
  - Odd or even
  - When data is transmitted, the parity bit is set at the transmitting end and parity is checked at the other end. If the wrong number of bits are present an error has occurred. The receiving computer notifies the transmitting end to resend the data
- Check digits: a calculation is performed on the digits and a check digit is added to the end of the digits as a results
  - E.g. the first 12 digits of the barcode is unique and the 13th is the check digit, the receiving computer will perform the same calculation and compare the results to the check digit
  - Can be calculated using Modulus 11
  - Used in ISBN and bank accounts
- Checksums: the number of bits being transmitted is counted up and the numeric count is transmitted with the data
  - Checksum of all bytes in a data transmission is calculated using an algorithm
  - If re-calculated checksum doesn't match up with checksum received, data may have been altered during transmission and is resent
  - Used with credit card numbers
  - There are 4 bytes in every transmission
- Automatic Repeat request (ARQ)
  - When a device receiving data detects an error with a packet, it will send a request for the packet to be resent
  - Happens repeatedly until the packet is error free or a limited amount of resend requests is reached
  - Used to log in to mobile phone