CODING SYSTEMS

Character code

Character code: a binary representation of a particular letter, number or special character

- ASCII: 7 bits, 'A' = 65
- Unicode: 16 bits usually, allows to support others languages

Error checking and correction

- Parity bit

  In ASCII the 8th bit (MSB) were used to spot transmission errors. The parity bit is a method of checking binary codes by counting the number of 0s and 1s in the code, then the parity bit is set to make an even (or odd) parity. This method can only check if there is an odd number of errors. (Extra about the Hamming code)

- Majority voting

  The majority voting is a method of checking for error by producing the same data several times (usually 3) and checking it is the same each time. The major problem is that it takes three or more times longer and if there is more than one error in a row it might misread it.

- Check digits

  A check digit is added to the end of binary data to check the data is accurate. As a check digit set method is often used mod 11 of the some of the previous digits giving different weight to each position. Check digits are used for example in bar codes.

Gray code: different way to count binary number, from one number to the next one change only one bit. It's used in high speed counting operation because uses less electricity, react faster and overcome reading errors.

Images

Pixel: smallest addressable component of an image or smallest controllable area of a computer monitor

Colour Dept: number of bits used to represent different colours for the same pixel. Computer usually use the RGB system, in particular true colour has 24bits (8 each) to these often 8 bits for transparency are added.

Bitmap images

Each pixel in the image is mapped to locations in memory which store binary codes representing the colour of each pixel.

Memory = bytes per pixel x number of pixels

Bit Map images are often too large to use. Compression is the process of reducing the number of bits required to represent the data. Both Lossless & Lossy compression techniques exist.

- *Lossless compression:* e.g. Run Length Encoding, compressed file is as accurate as the original file.
- *Lossy compression:* compressed file has lost some of the information that was present in the original file.

Lossless compression: Run Length Encoding (RLE)

Used in GIF & PNG. Count No of adjacent pixels that have same colour. It's useful in logos or other things but it's not so useful if we have a photo where colours changes almost in every pixel.

- GIF - Graphical Information Format: although lossless only uses 8 bit colour so some colour detail is lost
- PNG – Portable Network Graphic: is lossless and uses 24 bit colour & alpha channel Counting: from bottom left corner, proceed left to right one row at a time

Lossy compression: JPEG – Joint Photographic Experts Group

Considers blocks of pixels for quantization: if there are lots of similar colour, remove data that is unlikely to be detected, if there is a strong contrast, more of the colour data is kept

After quantisation JPEGs use RLE. Extent of quantisation is controlled by the user (Quality %). Quality selected depends on how the image is to be used. Usually 80% is a good middle ground for memory and quality.

Vector graphics

An image made up of object and coordinates. The objects are called primitives are for example points, lines, curves, polygons and letters.

Advantages: smaller size images and perfect rescaling

Disadvantages: not suited for photos and scanning

Sounds

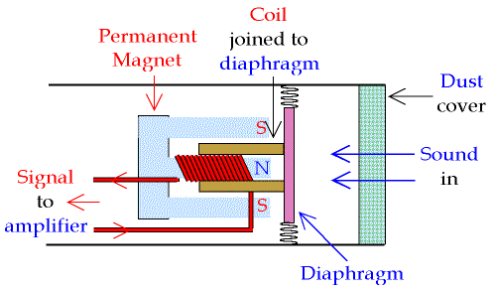
Sound wave

Sound is an air pressure wave. Sound waves are continuously variable.

- *Frequency:* how fast the pressure wave is changing
- *Amplitude:* how high the pressure level reaches

Microphones and speakers

- Microphone
  - Converts wave into electrical voltage / current in proportion to the pressure
  - Electrical signal then transmitted/recorded

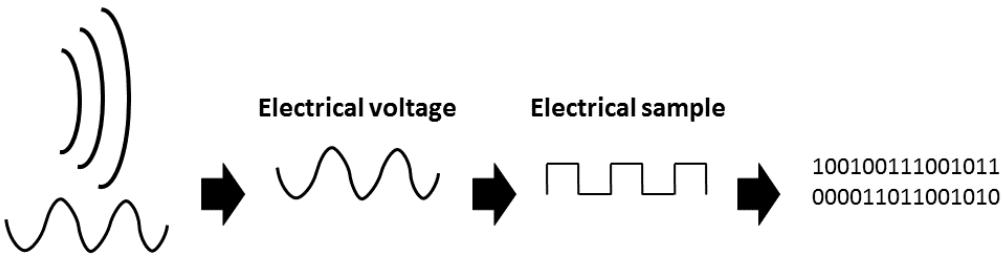


- Speaker: performs the reverse process
  - Electrical signal induces movement in magnets
  - Magnets attached to a diaphragm
  - Diaphragm movement generates a pressure wave

Analogue and digital data

Data: anything collected & submitted for processing

- *Analogue*
  - *Data* Continuously variable data
  - *Signal* Electrical signal that varies continuously
- *Digital*
  - *Data* Discrete data values (not continuous)
  - *Signal* Electrical signal that is in discrete steps



ANALOGUE DATA	ANALOGUE SIGNAL	DIGITAL SIGNAL	DIGITAL DATA
Continuos air pressure sound wave	Varies continuously in proportion to data	Discrete wave	Binary

Sampling Rate & Resolution

Quality (and storage space) increases:

- Higher sampling rate
- Higher sampling resolution

Music CDs:

- Sample 44,100 / second
- Use 16 bits per sample
- 705,600 bits / second
- 88,200 bytes / second

MPEG uses:

- Lower sampling rates
- Compression methods
- Reduce storage

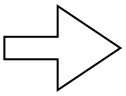
Analogue to Digital Conversion

Process:

- *Sampling* (PAM): analogue signal sampled
- *Quantisation*: PAM values are rounded to an n-bit integer
- *Encoding* (PCM): Quantised values are encoded as binary, sent least significant bit first

Nyquist's Theorem

"Sample at a frequency at least twice the rate of the highest frequency in the sampled signal."



22,000 – 20,000 Hz is the frequency human can hear.

Therefore music CD's sample at 44,100 Hz

Sound Files

- WAV: CD file format → 1 minute of sound = 2.5 Mb
- MPEG: Internet & Portable digital devices, involves compression → 1 minute of sound = 0.25 Mb
- Speech
  - Frequency is limited when compared with music
  - Digital telephones convert at a lowly 8K Hz using 8 bits (64 Kb/s)
- MIDI: Musical Information Digital Interface
  - Doesn't store a sample of the sound played, but event messages detailing information about the music being played. For example: when note started / stopped, what pitch was played, how loud it was played
  - Processor produces sound by applying MIDI record information to a sample sound