Bits and Bytes

COMP 102, lecture 4
Data Representation

- Sound formats
- Image formats
- Movie formats
Data Representation

- sound formats
Sound formats
AIFF Sound format

each sample is a signed 15 (or 23 or 31) bits value

176 samples ≈ 4 ms
(44 100 samples = 1 s)
AIFF Sound format

- 44 100 samples / second
- 16 b = 2 B / sample
  (or 24 b = 3 B / sample
  or 32 b = 4 B / sample)
- stereo = two channels
- $2 \times 2 \times 44 100 = 176.4$ kB/s
- CD $\approx 700$ MB $\approx 75$ minutes
AIFF Sound format

- why 44 100 samples / second?
- because it is in the correct range...
- because 44 100 is divisible by 2, 3, 4, 5, 6, 7, 9, 10
MP3 Sound format

- Based on Fourier transform.
- 576 samples of amplitude / time are converted to 576 samples of distinct frequencies.
In human ears, the cochlea is mechanically performing a process analog to the Fourier Transform. The eardrum vibrates back and forth according to the wave-like representation of the sound. The frequency information stimulates a specific area in the cochlea.
MP3 Sound format

- Frequencies with small coefficients removed
- Waveform reconstructed is close to original
MP3 Sound format

High

Bass

Treble

Low quality
Data Representation

- Image formats
TIFF image format
TIFF image format

- an 8x8 sub-region of a large image:

- each individual pixel uses 24 bytes: 8b for red, 8b for blue, 8b for green.

- total size = number of pixels x 3 Bytes.
Animal eyes focus light on the retina where an image of the environment is produced.

This image is analysed according to 3 types of colour sensitive cones, mostly triggered near the red, green and blue bands.

A perceived colour is a triplet $(x,y,z)$ of excitations of the 3 types of cones.

Two combinations of colours yielding the same triplet $(x,y,z)$ are indistinguishable.
Using a transformation similar to Fourier transform (used for audio), a so called Discrete Cosine Transform is applied to each sub-bloc of size 8x8.

**Notice:** colours are used for abstract data. Dark means small, bright means large.
If no data is removed, the resulting image is nearly identical to the original. Imprecision in the transform causes small errors.
If all data very close to zero is removed, the resulting image is only slightly different from the original.

*Notice:* colours are used for abstract data. Dark means small, bright means large.
If all data close to zero is removed, the resulting image is somewhat different from the original.
If all data of small magnitude is removed, the resulting image is still very similar to the original.

**Notice:** colours are used for abstract data. Dark means small, bright means large.
JPEG image format

- If only data of large magnitude is kept, the resulting image is similar but quite different from the original. Most details are wiped out.
Data Representation

- movie formats
RAW movie format

- 720×576 pixels per frame
- 24 bits (colour) per pixel
- 30 frames per second
- $30 \times 3 \times 720 \times 576 \approx 37 \text{ MB/s} \approx 135 \text{ GB/hour}$
- typically 200 GB per movie !!! ($\approx 50$ DVDs)
MPEG2 Movie Format
MPEG2 Movie Format
MPEG2 Movie Format
MPEG2 Movie Format
MPEG2 format

- Fixed Background images
saving is about 96%
MPEG2 format

- Travelling
Image par image
Image par image
Image par image
Image par image
MPEG2 format

- Each image is encoded with JPEG or similar.
- Sound is encoded with MP3 or similar.
- Most frames use only small amount of info to construct from previous frames.
- A complete frame is displayed every so often to make sure the fix part or travelling part has not substantially changed.