JPEG

Key Ideas
- Frequency Domain (small details are less important)
- Block Transforms (works on 8x8 blocks)
  - Discrete Cosine Transform (DCT)
- Control Quantization of frequency components
  - More quality = use more bits
  - Generally, use less bits for HF
- 2005/2006-09.ppt

Discrete Cosine Transform

- A transformation to convert from the spatial to frequency domain – done on 8x8 blocks
- Why? Humans have varying sensitivity to different frequencies, so it is safe to throw some of them away
- Basis functions:

Quantization

- Reduce the number of bits used to store each coefficient by dividing by a given value
  - If you have an 8 bit number (0-255) and divide it by 8, you get a number between 0-31 (5 bits = 8 bits – 3 bits)
  - Different coefficients are divided by different amounts
  - Perceptual issues come in here
- Achieves the greatest compression, but also quality loss
- "Quality" knob controls how much quantization is done

Entropy Coding

- Standard lossless compression on quantized coefficients
  - Delta encode the DC components
  - Run length encode the AC components
    - Lots of zeros, so store number of zeros then next value
    - Huffman code the encodings
Lossless JPEG With Prediction

- Predict what the value of the pixel will be based on neighbors
- Record error from prediction
  - Mostly error will be near zero
- Huffman encode the error stream
- Variation works really well for fax messages

Video Compression

- Much bigger problem (many images per second)
- Could code each image separately
  - Motion JPEG
  - DV (need to make each image a fixed size for tape)
- Need to take advantage that different images are similar
  - Encode the Changes?

MPEG

- Motion Picture Experts Group
  - Standards organization
- MPEG-1 simple format for videos (fixed size)
- MPEG-2 general, scalable format for video
- MPEG-4 computer format (complicated, flexible)
- MPEG-7 future format
- What about MPEG-3? – it doesn’t exist (?)
  - MPEG-1 Layer 3 = audio format

MPEG Concepts

- Keyframe
  - Need something to start from
  - “Reset” when differences get too far
- Difference encoding
  - Differences are smaller/easier to encode than images
- Motion
  - Some differences are groups of pixels moving around
  - Block motion
  - Object motion (models)

MPEG

Frame 1 (keyframe) Find motion vectors → Frame 2 (keyframe)

Frame 1 (comp) + motion → Frame 2

lossy Jpeg-like compression → Encode vectors → Encode Difference (lossy)