Question

The high-frequency limit of human hearing extends to approximately 20 kHz, but studies have shown that intelligible speech requires frequencies only up to 4 K Hz.

- Justify why the sampling rate for an audio Compact Disc (CD) is 44.1 kHz. What is the Nyquist rate for audible speech communications?
- Why do you sound different on the phone from in person?
- Suppose it requires 7 bits per sample. If the phone system is designed to meet requirements for speech (which is the case), what is the maximum bit rate over telephone lines?
- CDs use 16 bits per sample. What is the bit rate of music coming off a CD? Is a modem connection enough to support streamed CD quality audio?

Question

Consider a discrete time source emitting equiprobable symbols A, B, C.

- What is the entropy of the source (assume $\log_2 3 = 1.585$)
- Encoding the source output symbol by symbol, find the average bit length per symbol. Give the example of a code achieving this.
- Encoding the source output in blocks of two symbols, how many bits/symbol are required on average. Give an example code achieving this.

Question

Both subband coding and Subsampling seem to reduce sample sizes and attain compression.

- What is the main difference between them?
- What would motivate an encoding design to use subband as against subsampling?
- Explain how subband coding is used in MPEG1 audio
- Name the three modes of transmission in JPEG and classify them as closely as you can as being "subband coding" or "subsampling".

Question

- What is the color gamut of a CRT screen?
- Why do most standards use the YCrCb color space instead of the RGB color space?
- Choose the color mode for each of the following types of projects:
  (Your choices are 1-bit, 8-bit grayscale, RGB, and CMYK.)
  a. You want to post a copy of your own artwork on your Web page.
  b. You need to put a copy of your signature on your computer typed report
  c. You need to print the digital photograph of a pencil sketch of the map.

Question

Suppose a camera has 450 lines per frame, 520 pixels per line, and 25 Hz frame rate. The color-subsampling scheme is 4:2:0, and the pixel aspect ratio is 16:9. The camera uses interlaced scanning, and each sample of Y, Cr, Cb is quantized with 8 bits.

- What is the [...] by the camera?
- Suppose w[...] video signal on a hard disk, and, in order to save space, re-c[...]nance (Cr, Cb) signals with only 6 bits per sample. What is th[...]e hard disk required to store 10 minutes of video?

Repeat the exerci[...]suming color subsampling scheme 4:2:2.

Question

- We have studied about constant bit rates (CBR) and variable bit rates (VBR) in class.
- Differentiate between CBR and VBR.
- Which one is normally preferable and why? Give your answer with regards to throughput and quality.
- Classify the following as producing VBR or CBR
  - Huffman coding
  - Lossless Mode of JPEG Compression
  - MPEG1 Video
- A VBR video stream generates 420x320 pixels per frame at 20 frames per second, 8 bits per pixel. Consider a buffering strategy at the receiver with a 10 frame buffer to hold the frames so that they can be displayed at CBR. What is the minimum throughput (in Mbps) required from the network to display a video stream of 4 seconds.

Question

In Video Encoding more compression is achieved by using block-based motion estimation and compensation. Let's called this temporal compression.

- Define I, P and B frames used in MPEG.
- Qualitatively explain how much of compression is achieved for each type of frame.