CS 576 – Assignment 1 Theory
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For practice, not to be submitted
Solutions to be posted later

Question 1:
The following sequence of real numbers has been obtained sampling an audio signal: 1.8, 2.2, 2.2, 3.2, 3.3, 3.3, 2.5, 2.8, 2.8, 2.8, 1.5, 1.0, 1.2, 1.2, 1.8, 2.2, 2.2, 2.2, 1.9, 2.3, 1.2, 0.2, -1.2, -1.2, -1.7, -1.1, -2.2, -1.5, -1.5, -0.7, 0.1, 0.9 Quantize this sequence by dividing the interval [-4, 4] into 32 uniformly distributed levels by placing the level 0 at -3.75, the level 1 at -3.5, and so on and level 31 at 4.00. Also, remember that quantization should result in least error

- Write down the quantized sequence
- How many bits do you need to transmit it?

Question 2:
A high-definition film color camera has 1080 lines per frame, 1920 pixels per line, with a 24 Hz capture frame rate. Each pixel is quantized with 12 bits per channel during the quantization process. The capture pipeline employs the follow sequence

1. YUV 4:2:0 color subsampling scheme
2. An optional feature, to the signal to standard definition CIF (352x288)
3. An obligatory MPEG2 compression phase
4. Disk write with a varying disk write speed (12 to 36 Mbytes per second).

Answer the following questions

- If the second optional feature is off, what minimal compression ratio needs be achieved by the third compression step process?
- If the second optional feature is turned on to produce CIF format, how does your previous answer change?
- If original pixels were square, how do the pixel stretch with the second optional feature turned on.?

Question 3:
Temporal aliasing can be observed when you attempt to record a rotating wheel with a video camera. In this problem, you will analyze such effects. Assume there is a car moving at 36 km/hr and you record the car using a film, which traditionally records at 24 frames per second. The tires have a diameter of 0.4244 meters. Each tire has a white mark to gauge the speed of rotation.

- If you are watching this projected movie in a theater, what do you perceive the rate of tire rotation to be in rotations/sec?
- If you use your camcorder to record the movie in the theater and your camcorder is recording at one third film rate (ie 8 fps), at what rate (rotations/sec) does the tire rotate in your video recording
- The driver decides to participate in race, and buys tires that safely allow a max speed of 180 km/hr. What must be the diameter of the tire if no temporal aliasing needs to be witnessed in the recording?