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CS 576 – Multimedia Systems Design

Assignment 1

Q1.

i) We know,
Pixels per second = lines per frame * pixels per line * frame rate

Which gives us -

= 450 * 520 * 25

= 5850000 pixels per second

The subsampling scheme used is 4:2:0 and thus, the bits to represent a pixel are 12.

We know,

Bitrate = pixels per second * (bits/pixel)

Thus,

Bit rate = 5850000 * 12

= 70200000 bits/s

= **70.2 Mbps** (approximately)

ii) Now, if 6 bits are used to represent Cr and Cb samples, then bits required to represent a pixel will be 11.

Therefore,

Bitrate = 5850000 * 11

= 64350000 bits/s

= 64.3 Mbps (approximately)

If 10 minutes of video is played, the disk space required will be

Bitrate * durationOfVideo = 64350000 * (10*60)

= 38610000000 bits

= **4.82 GB** (approximately)

Q2.

We are given a sequence

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

Let our lower interval start from -3.75, that is, interval 0 = -3.75

The logic used for quantization is rounding to the **nearest interval**.

E.g 4.3 will be quantized to the level = 4.5.

Therefore, our quantized sequence will now be:

22, 24, 24, 28, 28, 28, 25, 26, 26, 26, 21, 19, 20, 20, 22, 24, 24, 24, 23, 24, 20, 16, 10, 10, 8, 11, 6, 9, 9, 12, 15, 19

Further,

If we have to quantize into 32 levels it will need **5 bits** since 2^5 = 32.

Q3.

Speed of car = 36 km/hr

= 36000/3600

= 10 m/s

Diameter of tire = 0.4244 m

Rotation/s = speed of car / circumference

= 10 / (3.14*0.4244)

= 7.5 rps

Frame per second = 24 fps (given)

According to Nyquist's sampling theorem, the sampling frequency (freq_sampling) should be greater than or equal to 2 * max_freq

Here,

freq_sampling = 24, max_freq = 7.5

Hence,

freq_sampling > (2*7.5).

So the perceived speed and direction will be the **same as the actual speed** and direction.

i) The perceived speed of tire rotation will be **7.5 rotation/sec**

ii) In this case, the freq_sampling = 12.
Here, Nyquist theorem is not satisfied since freq_sampling < (2*7.5).
Hence, the freq_sampling will be the 'fold-over frequency'.
Therefore,
Perceived frequency = freq_sampling – [(max_freq)- freq_sampling]
= 12 – [(2 * 7.5) - 12]
= **9 rotations/sec**