CSCI 576 - ASSIGNMENT 1
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Theory Part:

Question 1:
Camera records at 25 frames per second.

- Speed of rotation = 20 rotations per second.

Sampling should be done at 2 * Max frequency = 2 * 20 = 40. But since it is done at 25 frames per second (< 40), there is aliasing effect.
In one second, frame 1 rotates (360 * 20)/ 25 = 288 degrees .
frame 2, it rotates 288 degrees more and is at 216 degrees.
frame 3, it is at 144 degrees.
Counter-clockwise compared to previous frame = 72 degrees.
Ans: Therefore, the observed speed is (72/360)* 25 = **5 rotations per second.**

- Speed of rotation = 10 rotations per second.

Sampling should be done at 2 * Max frequency = 2 * 10 = 20. It is done at 25 frames per second (> 20). Hence no aliasing effect.
In one second, frame 1 rotates (360 * 10)/ 25 = 144 degrees .
frame 2, it rotates 144 degrees more and is at 288 degrees.
frame 3, it is at 72 degrees.
Ans: Therefore, observed speed is (144/360) *25 = **10 rotations per second.**

Question 2:

- The quantized sequence is : 1.75, 2.25, 2.25, 3.25, 3.25, 3.25, 2.5, 2.75, 2.75, 2.75, 1.5, 1.0, 1.25, 1.25, 1.75, 2.25, 2.25, 2.25, 2.0, 2.25, 1.25, 0.25, -1.25, -1.25, -1.75, -1.0, -2.25, -1.5, -1.5, -0.75, 0, 1.0
- Since there are 32 levels (= 2^5). So, it needs **5 bits per signa**l and 32*5 = **160 bits in total.**

Question 3:
N_L = 450 lines per frame
N_P = 520 pixels per line
N_{fps} = 25 Hz
Colo sub-sampling = 4:2:0
Pixel aspect ratio = 16:9
Inter-laced scanning.
Each Y, Cr, Cb is quantized with 8 bits

- Bit rate = $N_L * N_P * N_{fps} * P$

Y: all 4 bits=> 4*8 = 32 bits.
Cr: 2 bits=> 2*8 = 16 bits.
Cb: 0 bits=> 0*8 = 0bits
Total: 48 bits.
Avg: 48/4 = 12 bits per pixel
Ans: Bit rate = 450 * 520 * 25 * 12 = **70.2 Mbits per second.**

- Each Y, Cr, Cb is quantized with 6 bits

Y: all 4 bits=> 4*6 = 24 bits.
Cr: 2 bits=> 2*6 = 12 bits.
Cb: 0 bits=> 0*6 = 0bits
Total: 36 bits.
Avg: 36/4 = 9 bits per pixel
Bit rate = 450 * 520 * 25 * 9 = 52.65 Mbits per second.
Ans: For a 10 min video = 52.56 * 10 *60 = **31590 Mbits.**