CSCI 576 - Assignment 1
Mathias Voelcker

1. Suppose you are recording a rotating wheel with a video camera which records at 25 frames per second. The wheel has a white mark on it to gauge the speed of rotation.
    a. If the speed of rotation is 20 rotations per second, what is the observed speed (rotations/sec) of rotation? (5 points)
    b. What is the observed speed (rotations/sec) of rotation if the actual speed of rotation is 10 rotations per second? (5 points)

a. Rotation per frame = 20/25 = ⅘
Each frame, the wheel will rotate 80%
This will create an illusion that the wheel is rotating ⅕ per frame in the opposite direction
Therefore, the wheel will rotate ⅕ * 25 times per second, which results in **5 rotations per second**.

b. Rotation per frame = 10/25 = 2/5
There is no illusion in this case, since the wheel is moving ⅖ each frame
Each 5 frames, the wheel will rotate 2 times.
⅖ rotations/frame * 25 frames/second = **10 rotations per second**

2. 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 (place the level 0 at -3.75, the level 1 at -3.5, and so on. This should simplify your calculations).
    a. Write down the quantized sequence. (4 points)
    b. How many bits do you need to transmit it? (1 points)

a. The formula created to quantify each number was:

$$(((x + 4) / 8) * 32) - 1 = y$$

Where x is the number of the sequence and y is the integer output, rounded to the nearest integer. The + 4 is to turn the input in a positive scale from 0 to 8 instead of -4 to 4. The division of 8 and product of 32 is to scale to the 32 bits quantization, and the -1 is to move the range from [1 to 32] to [0 to 31].

Quantized signal (in levels): **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**

Quantized signal: 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, 2.25, 1.25, 0.25, -1.25, -1.25, -1.75, -1, -2.25, -1.5, -1.5, -0.75, 0, 1

b. Log 2 (32) = **5 bits**

3.

a) Bits per frame = ((8*4) + (8*1) + (8*1))/ 4 = 12
Bits per second = 12 * 520 * 450 * 25 = **70.2 Mbps**

b) Bits per frame = ((6*4) + (6*1) + (6*1))/ 4 = 9
Bits per second = 9 * 520 * 450 * 25 = 52.6 Mbps
Size requirement = (52.6 Mbps * total seconds)
Size requirement = (52.6 Mbps * 600) = **31.2 Gbits or 3.9 Gbytes**