HACETTEPE UNIVERSITY
Department of Electrical and Electronics Engineering
ELE 409: Digital Signal Processing Laboratory

NAME SURNAME:

STUDENT ID:

EXPERIMENT 3 - QUANTIZATON

- Use the following functions: *audioread, max, min, mean, var, sign, ceil, floor, round, histogram, histcounts*
- **You will not get full credit if you use any type of loop.**

Q1. Zero-Mean Quantizer

- Write a MATLAB function **y** = myQuantizer(**x**,B,X_m) which quantizes input vector **x** with zero-mean, B-bit, uniform, midrise type quantizer of range $[-X_m, X_m]$.
- Write a MATLAB function **y** = mySNR(x,xquan) which calculates input and output SNR values(in dB) where xquan is the quantized version of input **x**. Note that **y** is a 2-by-1 vector.

1. Plot the characteristic of quantizer for $B = 3$ and $X_m = 1$ with appropriate input **x**.
2. Load 's3_1.wav', name this vector **x**.
   (a) Quantize **x** with *myQuantizer* with 3-bits for $X_m = 0.1$. Call the quantized vector **xquan1**. Calculate input and output SNR values and call these values SNRin1 and SNRout1, respectively.
   (b) Quantize **x** with *myQuantizer* with 3-bits for $X_m = \max(|\mathbf{x}|)$. Call the quantized vector **xquan2**. Calculate input and output SNR values and call these values SNRin2 and SNRout2, respectively.
   (c) Quantize **x** with *myQuantizer* with 3-bits for $X_m = 1$. Call the quantized vector **xquan3**. Calculate input and output SNR values and call these values SNRin3 and SNRout3, respectively.
   (d) Plot input-output relationship for three quantized signals on the same figure. Comment on the change from input to output SNR values. Support your reasoning with the comment on the figure.
   (e) Which value of X_m yields maximum output SNR? Show whether it is an optimum value or not for $X_m \in [0.1, 1]$. If not, what is the optimum value for X_m? Comment on the optimal value by investigating the histogram of the input signal. You can use loops for this part (e) **only**.
3. Quantize **x** with *myQuantizer* with 2-bits for $X_m = \max(|\mathbf{x}|)$. Call the quantized vector **xquan4**. Calculate output SNR value and call it SNRout4. Compare your results with 2.b.

Q2. Adaptive Quantization

- Write a MATLAB function **y** = myAdaptiveQuantizer(**x**,B,L) which partitions **x** to segments of L samples and quantizes these segments individually. The quantizer should be B-bit uniform midrise type. For each segment, $\mathbf{x}_l$, the range of the quantizer is chosen as $\max(|\mathbf{x}_l|)$.

  Note: You are going to use the results **xquan2** and SNRout2 from **Q1**.

1. Load 's3_1.wav', name this vector **x**.
   (a) Quantize **x** with *myAdaptiveQuantizer* with 3-bits where the sample size of each segment is $L = 100$. Call the quantized vector **xquan5**.
   (b) Calculate output SNR value for **xquan5** and call it SNRout5. Compare with SNRout2.
   (c) Plot **x**, **xquan2** and **xquan5** on the same figure and comment on the results.