Homework # 3: In-Class Portion # 1

Due Date: Thursday, September 26, 2019 by 11:59PM
Total Points: 25

This assignment provides practical programming experience with computing the speech-to-noise ratio (SNR) and for scaling a noise signal so that the resulting noisy speech signal has a desired SNR. **For the purposes of this assignment, please work individually**. However, feel free to ask basic questions to the instructor and classmates, but complete the assignment on your own. Feel free to search for information (inputs and outputs) about key Python functions, using the internet. From Canvas, go to Files and download all content from the HW#3 folder.

This assignment serves as one of the in-class components of HW# 3. Submit your answers to the questions and Python code to Canvas. **Be sure to include a README that explains each major script/function.** Answer all questions within the code. Feel free to create separate functions as needed. **Be sure to comment your code and to submit all files to Canvas**.

All assignments must be submitted on time to receive credit. No late work will be accepted, unless you have a prior arrangement with the instructor.

The audio files are sampled with a sampling rate of 16 kHz.

Question 1. [10 POINTS]

SNR Calculation. Write a function that computes the speech-to-noise ratio (SNR) between an inputted speech signal and an inputted noise signal. Compute the SNR for the four pairs of signals below.

1. 'speech.wav' and 'noise.wav'
2. 'speech.wav' and 'noise2.wav'
3. 'speech.wav' and 'noise3.wav'
4. 'speech.wav' and 'noise4.wav'

Question 2. [15 POINTS]

Noisy Speech Generation: Write a function that generates noisy speech that has a desired SNR. The input to this function should be a speech signal, a noise signal, and a desired SNR (in decibels).

Hint: The noise signal should be scaled by a value (e.g. 'b'), so that when the scaled noise signal is added to the speech signal, the resulting noisy speech signal has the desired SNR value (in decibels). In other words, if $s[n]$ represents the speech signal, $x[n]$ represents the noise signal, and b is a scalar value, then the SNR of noisy-speech signal, $y[n]$, should be equal to the desired SNR (e.g. dSNR). Find b such that this SNR between $s[n]$ and $b \times x[n]$ is as desired.

$$y[n] = s[n] + b \times x[n] \tag{1}$$

Using this function and the 'speech.wav' and 'noise.wav' signals, generate noisy speech signals at -6, 4.5, and 16 dB SNRs.