Assignment 3

In this assignment, we will dive deeper into audio analysis using Python, specifically focusing on the Short-Time Fourier Transform (STFT). We will also familiarize ourselves with essential libraries that will be used throughout this course. For this assignment, you can use either Google Collab or Kaggle for your coding environment.

You can download the audio dataset from the following link

Assignment Outline

Part 1: Visualization of 'flute.wav'

1. Import the Audio File

   - Load the audio file using 'librosa' and create a playback widget.

2. Plot the Waveform

   - Plot the entire waveform of the audio signal.

   - Select and plot a specific range of the waveform for detailed analysis.

3. Perform STFT and Plot the Spectrogram

   - Compute the STFT of the audio signal.

   - Plot the spectrogram to visualize the frequency content over time.

Part 2: Comparison of 'violin1.wav' and 'violin2.wav'

1. Compute and Plot the Spectrograms

   - Perform STFT and plot the spectrograms for both `violin1.wav` and `violin2.wav`.

2. Analyze and Comment on Differences

   - Compare the spectrograms and comment on the differences observed.

   - Compute the fundamental frequency (F0) for both audio files and plot them on a single graph for comparison.

Part 3: Analysis of Remaining Audio Files

1. Perform STFT and Plot Spectrograms

   - For the remaining audio files, perform STFT and plot the spectrograms.

2. Adjust 'n_fft' Parameter

   - Adjust the `n_fft` parameter to values of 512 (narrowband) and 2048 (wideband) to observe the differences in the resulting spectrograms.

- Comment on the effects of these adjustments on the visibility of harmonics and formants.

3. Gender-Based Analysis

   - Some audio files contain the same speech for male and female voices. Analyze how gender affects the spectrogram for both narrowband and wideband frequencies. Provide commentary on your findings.

Submission Guidelines

- Submit your notebook with all code, plots, and comments included.

- Ensure that your notebook is well-documented with explanations for each step.

- Highlight any interesting findings or observations you make during the analysis.