

Audio Processing Assignment - 1

Deadline: 16th Jan 2025

Objective:

The aim of this assignment is to explore the effects of varying sampling rates and bit depths on the perceptual quality of audio. Additionally, students will visualize the audio signals in both the time and frequency domains to understand how these parameters affect the waveform and spectrum.

Instructions:

1. Record an Original Audio File

- Use software like **WaveSurfer**, **Audacity**, or any audio recording tool to record a high-quality audio file.
- **Specifications:**
 - Sampling rate: **48000 Hz**
 - Bit depth: **16 bits**
- Save the file in WAV format for consistency.

2. Experiment 1: Vary Sampling Rate

- Downsample the original audio file to the following sampling rates while keeping the bit depth fixed at **16 bits**:
 - **16000 Hz**
 - **8000 Hz**
 - **4000 Hz**
- Listen to each audio file and note the perceptual changes (e.g., clarity, frequency range).

3. Experiment 2: Vary Bit Depth

- Change the bit depth of the original audio file to the following values while keeping the sampling rate fixed at **16000 Hz**:
 - **16 bits**
 - **8 bits**
 - **1 bit**
- Listen to each audio file and note the perceptual changes (e.g., dynamic range, noise).

4. Visualization Tasks

- Plot the **time-domain waveform** of the complete original audio file (sampling rate: 48000 Hz, bit depth: 16 bits).
- Select a **short segment** (e.g., 1 second) from the original audio file and perform the following:
 - Plot its **time-domain waveform**.

- Compute and plot its **magnitude spectrum** (frequency domain) using the Fast Fourier Transform (FFT).
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Submission Requirements: Upload all files in Google classroom

1. **Audio Files:**
 - Submit the original audio file (48 kHz, 16-bit) and all modified versions (varying sampling rates and bit depths).
 2. **Plots:**
 - Time-domain waveform of the complete original audio file.
 - Time-domain waveform and magnitude spectrum of the selected segment.
 3. **Observations and Comments:**
 - Compare the perceptual quality of audio at different sampling rates and bit depths.
 - Discuss the changes in waveform and spectrum with varying parameters.
 4. **Code:**
 - Submit the complete code for the assignment in **Python notebook format (.ipynb)**.
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Helpful Tools and Libraries:

1. **Python routine:**
 - a. https://colab.research.google.com/drive/1nX20djsBuHpdy29TNpbDCXc_6TCzyMlo?usp=sharing
1. **Python Libraries:**
 - Use **torchaudio**, **matplotlib**, **numpy**, and **scipy**.
2. **Software for Audio Manipulation:**
 - **Audacity**.
 - **WaveSurfer**.
 - Any other preferred tools.