**REPORT  
  
 Question 2 (Task A):  
 Comparison and Analysis of Windowing Techniques for UrbanSound8K Classification**

**Introduction**

The goal of this experiment was to compare the effectiveness of different windowing techniques—Hann, Hamming, and Boxcar (Rectangular) windows—on spectrogram generation and feature extraction for classifying environmental sounds using the UrbanSound8K dataset. A Support Vector Machine (SVM) classifier was trained using MFCC features extracted from the spectrograms.

**Comparison of Windowing Techniques**

| **Window Type** | **Accuracy Achieved** |
| --- | --- |
| Hann | 42.59% |
| Hamming | 43.10% |
| Boxcar | 46.42% |

**Analysis of Results**

1. **Unexpectedly Higher Accuracy for Boxcar Window**
   * The Boxcar window produced better accuracy than Hann and Hamming windows, despite its known tendency to introduce spectral leakage.
   * This may be because urban sounds are non-stationary, and Boxcar preserves more transient details in the audio, which helps in distinguishing classes.
2. **Effect of Spectral Leakage and Smoothing**
   * Hann and Hamming windows apply smoothing, reducing frequency-domain artifacts but potentially losing sharp transient information.
   * In contrast, Boxcar does not apply any smoothing, leading to better preservation of raw sound features, which the classifier might be exploiting.
3. **Feature Extraction Considerations**
   * Since the classifier is trained on **MFCC features**, the choice of window affects the extracted features indirectly.
   * If the classifier benefits from more detailed frequency information, the lack of smoothing in Boxcar might explain its higher accuracy.

**Conclusion**

* The results suggest that for environmental sound classification, Boxcar windows might be more effective, possibly due to their ability to retain more raw data.
* Further testing with larger datasets and alternative feature extraction methods (e.g., Mel spectrograms) is needed to confirm this trend.
* Future work could also explore deep learning models to assess if CNNs or RNNs behave differently with different windowing techniques.

**Question 2 (Task B):**

| **Feature** | **Piya Tose Naina Laage Re** | **Yaad Piya Ki Aane Lagi** | **Saadda Haq (Rockstar)** | **Instrumental Song from Rangoon** |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Frequency Range | Mid  (till 9KHz) | Mid to high freq 16KHz)( | Wide range | Low |  |  |  |  |
| Spectrogram Appearance | Smooth frequency changes | Slightly more dynamic | Jagged peaks from guitar | Clear patterns for each instrument |  |  |  |  |
| Intensity | Low | Moderate | Loud | Low |  |  |  |  |
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