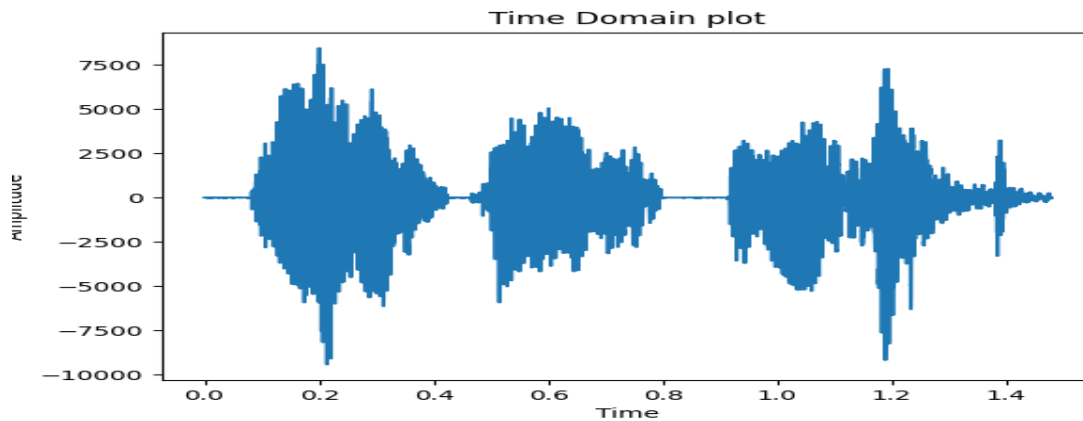Q1.

A time domain plot of the .wav file is plotted. The voiced and unvoiced regions are transcribed using the .lab file provided for the transcriptions. We use **a sampling rate** of **44100** , with a **mono channel** and **Lin16 encoding**.
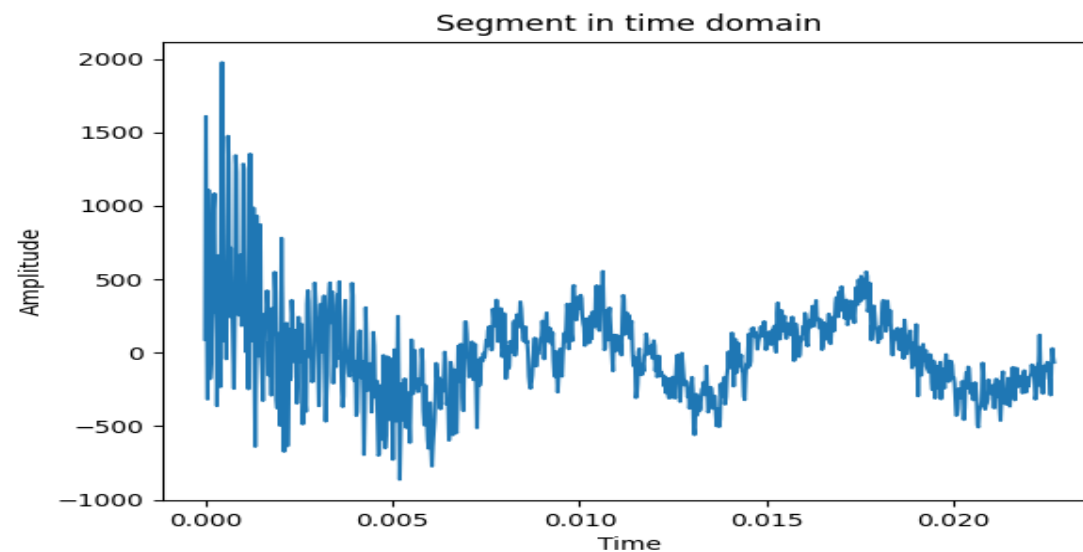

Q2.

In order to select the segment, we use the concept of

No. of Frames= Frame Rate * Time

Thus, we end up with a range of **[61500, 62500**] and a time range of **[1.39 ,1.41**]s. We chose a should contain less noise and can be more characteristic of the sample received.

We now have to analyse the given waveform for voiced or unvoiced based on our analysis:

The given waveform exhibits quasiperiodicity and the spectrogram reveals it doesn't have a regular formant structure like those of voiced regions.

Segment Spectrogram
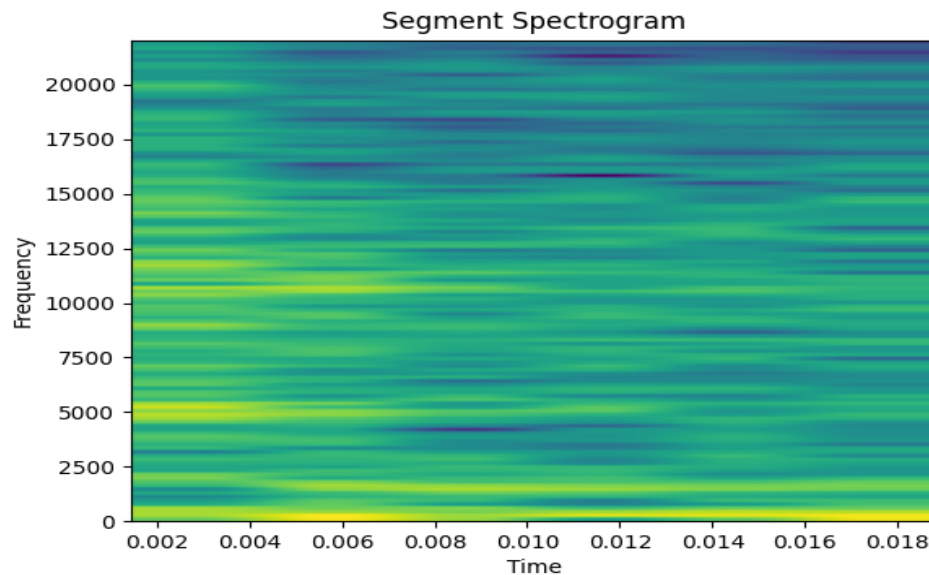
Zero Crossing:

Zero Crossing refers to the number of times the wave crosses the 0 axis and thus , the sound wave changes it's sign. For quasiperiodic signal the zero crossings should be high. An total of 1000 times. This is a characteristic of a unvoiced sound which

Energy:

In, order to find the energy of a wave form we need to find the area under the squared magnitude of the signal. We observe our segment to have a max energy of **32761 joules**. Which is extremely high. We can attribute this to the segment being a part of a **plosive** such as /p/, /t/,/d/ , combined with

background noise which was inherently present in the recording and also hints mainly at being **unvoiced**

..
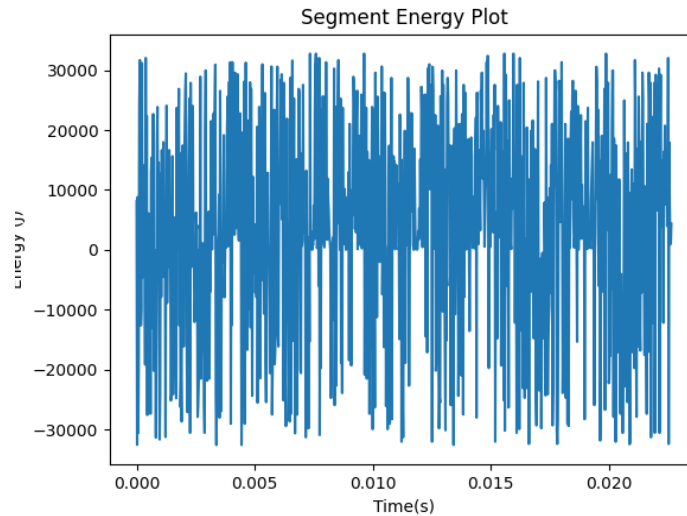
Autocorrelation:

We can finally leverage the autocorrelation metric to find whether the sound segment is voiced or unvoiced. Autocorrelation is used to find repeating patterns of periodicity ,etc. This involves analysing the signal with a lagged version of itself. Voiced regions exhibit high periodicity and thus high autocorrelation, conversely unvoiced regions exhibit low periodicity and this, low autocorrelation.

We see our plot has small spike in correlation with almost no peaks, and very low autocorrelation.
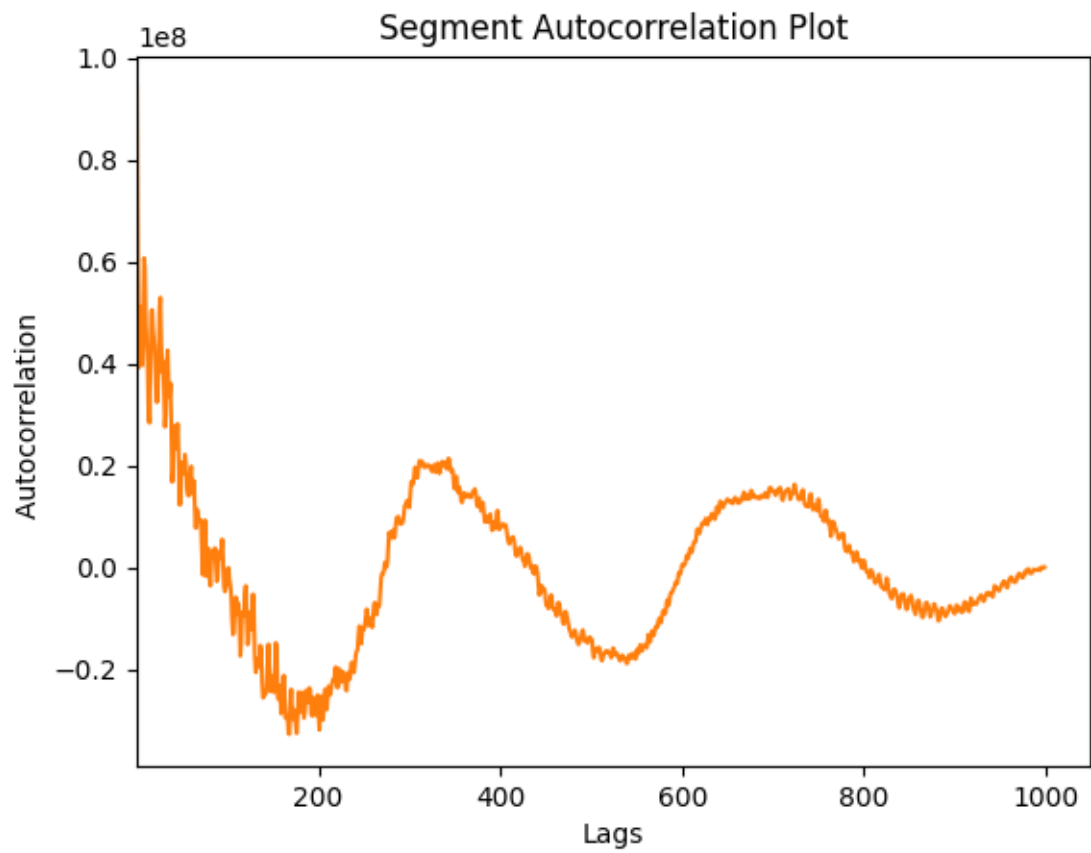
Thus, from the above factors of frequencies at high energies, no regular formant structures, rapid zero crossing's and low autocorrelation we can conclude the **segment is unvoiced.**