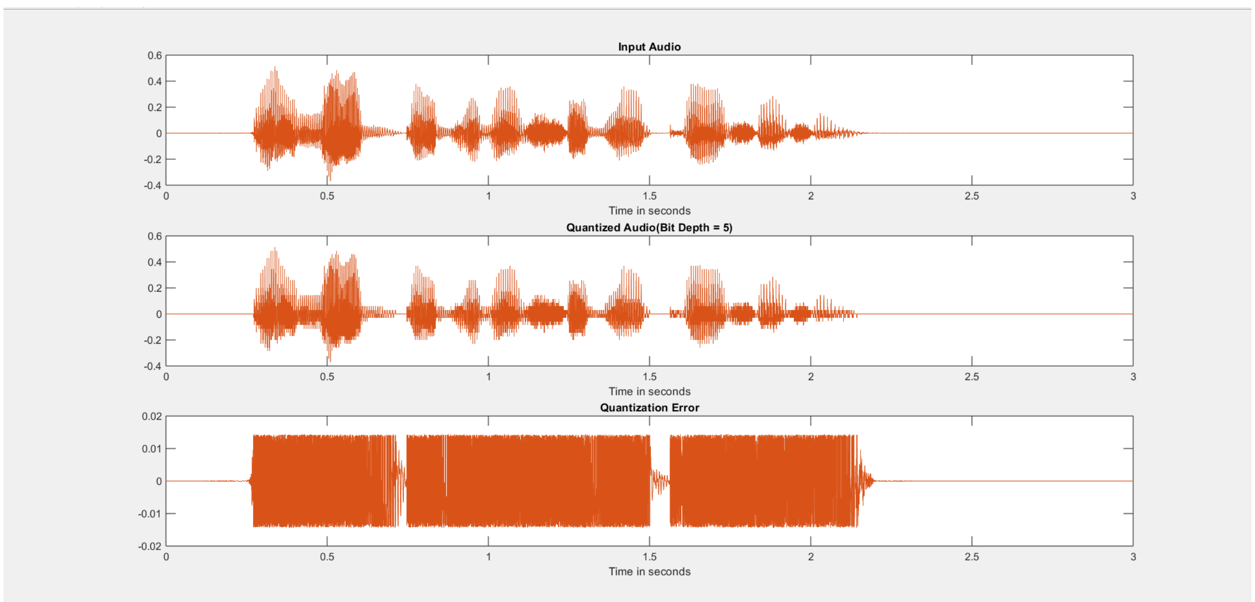
Answers to the MP Questions

Initialization

1) The sampling rate of the audio signal is 44.1 kHz.
2) Attempting to play audio with a lower sampling rate will produce a sound of a lower pitch, which is also the aliasing. This is because the lower the sampling frequency the lower the pitch of the sound. Sampling at a higher frequency than the sampling rate will produce a sound of a higher pitch. Pitch and frequency are directly proportional to each other.

Part 1 Implementation

Answers for 1 and 2



3)

a)

i) Using the 1st SNR formula at N =3 is equal to 4.2594 dB

ii) Using the 2nd SNR formula at N = 3 is equal to 7.6762 dB

iii) As shown in the results of both computations there is a difference in SNR. This is because there is a difference in what you are trying to measure.

The first formula evaluates the signal's strength in terms of power by multiplying the log by 20 and the the second formula measures the signal strength in terms of

Voltage by multiplying the log by 10.

b) Using the 2nd formula provided for SNR, the following SNR values for N = 3 and N = 5 is shown below.

@N = 3

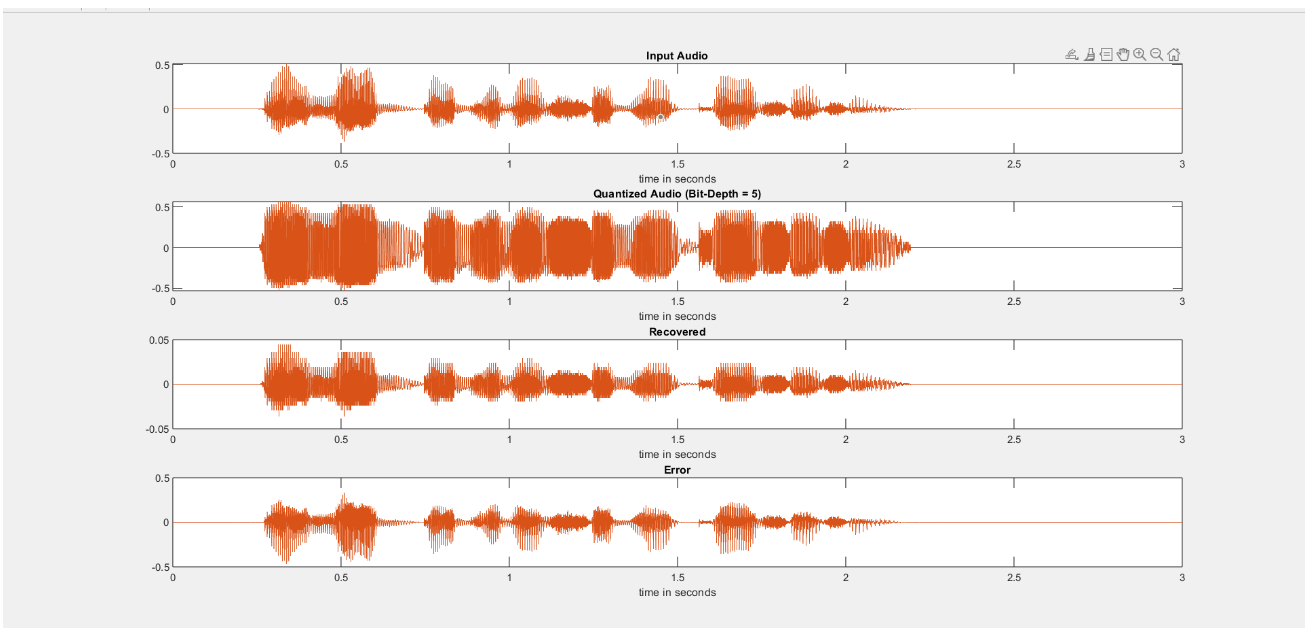
SNR = 7.6762 dB

@N = 5

SNR = 19.3657 dB

Based on the results of the calculations at N = 3 and N = 5, having a higher bit-depth will result in a higher SNR. SNR is the difference between the desired signal and noise, having a higher SNR means that there is more of the desired signal than the noise that can be heard. This is because having a larger bit-depth will result in more precise quantizing of a signal's amplitude.

4)



a) Using the 2nd formula of SNR, the SNR for the recovered signal at N = 3 and N = 5 is shown below.

@ N = 3

SNR = 1.1879 dB

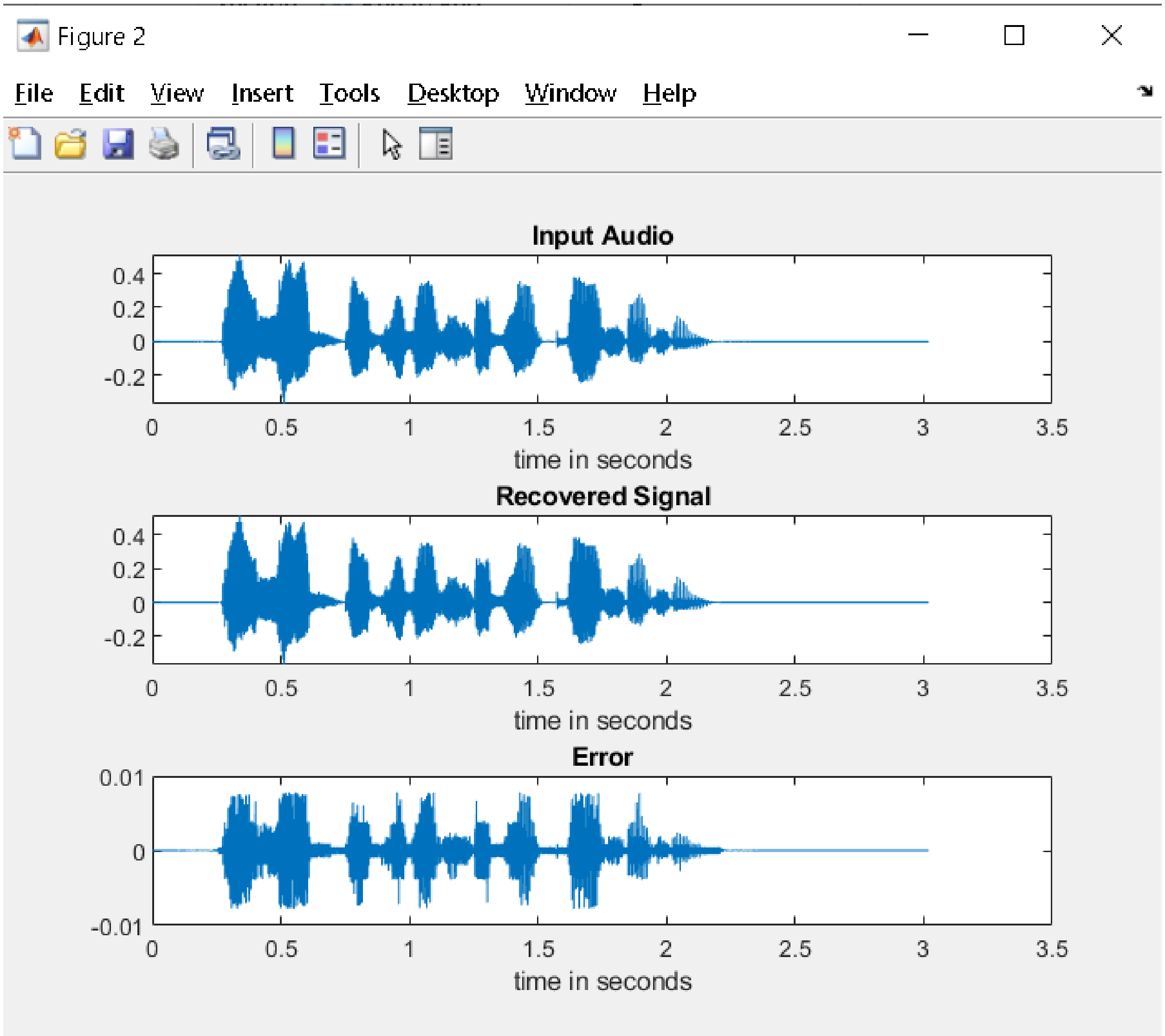
@ N = 5

SNR = 1.1369 dB

As compared to the SNR of the quantized version only, the SNR is higher as compared to the SNR after companding for N = 3, and at N = 5.

b) Comparing the recovered audio at N = 3 and N = 5, the recovered signal is more audible at N = 5 because there are more levels of quantization.

Part 5 Implementation



a)

```
>> myBinaryEncoder(0.75)

ans =

    '111000000000'

>> myBinaryEncoder(-0.75)

ans =

    '011000000000'

>> myBinaryEncoder(-0.645)

ans =

    '010100101000'

>> myBinaryEncoder(0.0125)

ans =

    '100000011001'
```

b)

```
>> compressed8bit = myMuCompressor('100000000101')

compressed8bit =

    '10000101'

>> compressed8bit = myMuCompressor('000011101010')

compressed8bit =

    '01001101'
```

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c)

```
>> expanded12bit = myMuExpander('10000101')

expanded12bit =

    '100000000101'

>> expanded12bit = myMuExpander('01001101')

expanded12bit =

    '000011101100'
```

e)

i) The signal is compressed by a factor of 1.5 after encoding it into a 12-bit format using Mu-law compression. It is compressed further by a factor of 1.5 after encoding the 12-bit signal into an 8-bit format. Therefore, the effective data compression ratio from s(n) to the compressed binary is 1.5:1.

ii) Using the 2nd formula of SNR, the SNR of the recovered signal is 37.4349 dB. The SNR of the recovered signal in Part 5 is significantly higher than the SNR in Part 1 and 2. This indicates that the recovered signal after encoding and decoding has much less noise compared to the original and quantized signals.