**ENGR 1330 – Computational Thinking with Data Science**

**Final Project: Dual Tone Multiple Frequency (DTMF) Signaling**

**Objective:**

Dual Tone Multiple Frequency (DTMF) signaling is used in landline telephones to encore the number dialed. Based on the position of a digit on the 10-digit keypad (row and column), two frequencies are selected and combined to an audible tone that encodes that digit. The two frequencies used per digit are chosen in such a way that the particular combination is unlikely to occur naturally. The reason why the digits are encoded as audible sound is because the plain old telephone service (POTS) limited transmission of signals to audible tones in a range from 300 Hz to 3400 Hz.

For more information on DTMF, please refer to: <https://en.wikipedia.org/wiki/Dual-tone_multi-frequency_signaling>

**Tasks:**

Literature Research:

Describe the DTMF signaling standard. Address topics such as:

1. frequencies used for each keypad digit
2. duration of tone for each keypad digit
3. pause in-between digits

DTMF Encoder:

Design and program a DTMF encoder. Your encoder should ask the user for a telephone number and then create the corresponding tone sequence and store it in an audible audio format (e.g. a .wav file)

DTMF Decoder:

Design a DTMF decoder that reads in the audio file corresponding to a sequence of numbers being dialed. From the sound it should recover the number of digits that were dialed, i.e. the decoder needs to

1. read in an audio file
2. separate the sounds corresponding to the different digits
3. determine the digits they correspond to
4. output the sequence of numbers that was dialed.

Once your decoder works on “clean” signals it will be tested on signals containing varying sources of noise pollution (transmission noise, people speaking in the background, engine noise, etc.). You will be given a set of sound files to work with for this task.

**Deliverables:**

Part 1 (due November 24):

A report that briefly describes the DTMF standard and how you plan to solve the tasks of creating a DTMF encoder and decoder. You need to break down each task into manageable subtasks and describe how you intend to solve the subtasks and how you will test each task. You also need to address the responsibilities of each team member for tasks completed and tasks to be completed until the end of the semester.

Your report should be limited to 4 pages, 12 pt font size, double linespacing. You need to reference all sources you used.

Part 2 (due on Final Exam day):

1. A well-documented Python implementation for the encoder and decoder.
2. A demonstration of correct performance or a description of problems that you were not able to solve.
3. A video (up to 5 minutes) in which you explain how you solved the problem and how you worked as a team.