**Credit Hours System**
Communications and Computer Engineering
**Advanced Topics in Communications I (ELCN 446)**
**Project 1**

## PROJECT DESCRIPTION

It is required to create a GUI-based tool that allows a user to add any **text file** and **results in the entropy** of the text characters written in the file. The GUI can be built using Matlab App Designer or any other software package.

### *Tool Description*

The Tool should do the following:

1) Allow the user **enter the path of a text file** (.txt), in which the text is written in English letters.
2) Based on the added file (composed of English letters, both small (a, b, ..., z) and capital (A, B, ..., Z) in addition to the space ( ), comma (,) the period (.) and the numbers from 1 to 9.):
   - **Read** the .txt file
   - **Extract** characters from the file
   - Find the **PMF** of the characters
   - **Display** a plot showing the **probability distribution** of the characters in the file.
   - **Display the Entropy** of the characters.
   - **Display the Relative Entropy** of the characters in the input text file relative to a reference uniform distribution of the characters.
3) Assume that the characters, $X$, are coded, each using $6$ bits. If the bit sequence representing the file is denoted by $X_{coded}$, assume it is sent over a binary symmetric channel with $p = 5\%$. Let the received bit sequence be denoted by $Y_{decoded}$. Decode the sequence $Y_{decoded}$ back to text characters $Y$.
   *i.e.* $X$ – coded to $X_{coded}$ – received as $Y_{decoded}$ – decoded to $Y$
   Now, it is required to **calculate and display**:
   - The joint entropy, $H(X, Y)$.
   - The conditional entropy, $H(Y|X)$.
   - Verify if $H(X, Y) = H(X) + H(Y|X)$.

### *Testing your Tool*

Test your Tool for the included text file (Sample Text.txt) and report the resulting output. However, your code and GUI will be tested for other text files. So, you must make sure the produced GUI works without errors on arbitrary text files.

### *Deliverable*

Deliver the following:

1) An **executable file** for the GUI Tool
2) All the **source codes** (**.m** files)
3) **Screenshots** for the output of the GUI for the test file.
4) Comments on the results, and whether the **Chain Rule** is always valid.

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## INSTRUCTIONS

- You can work this reports in teams up to **3** members per team.
- Write a full report including all requirements of the deliverable.
- Late submissions are not allowed.
- **All team members should expect to be asked about all the report parts.**
- Teams are not expected to have used the same exact channel codes, nor have similar GUIs.
- Duplicate reports will be penalized with zero grade.
- The grading criteria of the **project** will be as follows:
  - **60%:** Completeness and correctness of every deliverable (as per the .pdf report).
  - **20%:** Clarity of figures, and proper labeling (as per the .pdf report).
  - **20%:** Report writing and organization.