Credit Hours System
Communications and Computer Engineering
Advanced Topics in Communications I (ELCN 446)
Project 3

PROJECT DESCRIPTION

In this project, you are required to build a number of **Universal Source Encoder/Decoder** and user-friendly GUI for using them.

Part I: Adaptive Arithmetic Codes

In this part of the project, you will implement an Adaptive Arithmetic Encoder function and an Adaptive Arithmetic Decoder function. The input of the encoder function would be the data sequence (a vector of symbols), and the output would be the encoded binary sequence (a vector of bits). The decoder function performs the inverse, assuming that the number of encoded symbols is known.

You can start by implementing your functions for the case of an alphabet of 2 symbols ($X = \{A, B\}$). Then, you can generalize your function to an alphabet of M symbols.

It is required to:

1) Implement your **encoder** function, with proper commenting and documentation
2) Implement your **decoder** function, with proper commenting and documentation
3) Test your functions for the following text inputs:
   - The sequence $S_1 =$ [**A B B C A**], assuming $X = \{A, B, C\}$
   - The sequence $S_2 =$ [**A B C A B A C B A B C C A C B A A B B C C A B A A B B**], assuming $X = \{A, B, C\}$
   - The sequence, S_3, of characters in the sentence: "**If Peter Piper picked a peck of pickled peppers, where is the peck of pickled peppers Peter Piper picked?**".
     Assume the $X = \{a, b, c, \cdots, z, \ ',' \ , \ '?' \ , \ ' \ '\}$ (small letters, comma, question mark and space), and **assume the letters are case insensitive**.

   For each of the test sequences:
   a) Encode the sequence
   b) Decode the resulting encoded sequence
   c) Calculate the efficiency of the code.
      Note: The efficiency is defined as the ratio between the coded sequence length to that resulting from using the minimum number of bits in fixed-length coding.

Part II: Lempel-Ziv Codes

In this part, it is required to repeat **Part I** for Lempel-Ziv Coding.
After completing this part, comment on your observations of the efficiencies resulting from **Part II** compared to those resulting from **Part I**.

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Part III

In this part, it is required to:

1) Create a GUI that takes a sequence of symbols as an input, results in binary sequence as an output and calculates the efficiency of the code.
2) The GUI should also has a section in which the user can enter a binary sequence to be decoded to the corresponding sequence of symbols.
3) The GUI should also give the user the option to choose Adaptive Arithmetic Coding or Lempel-Ziv Coding.

Deliverable

Deliver, electronically, a .zip file including:

1) Source code for each part separately, with proper commenting
2) GUI file, ready for use
3) A PDF report summarizing the outcomes of each part, including your comments

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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.**.
- Duplicate reports will be penalized with zero grade.
- Any copied reports, either fully or partially, will receive 0 points. This applies to both the original and the copy.
- The .pdf report is the main document to be evaluated. However, source codes are to be checked against plagiarism.
- Grading will depend on:
  - **50%:** Completeness and correctness of deliverable (as per the .pdf report)
  - **20%:** Clarity of codes, and proper commenting
  - **20%:** Good design of the GUI, and usability without bugs or errors.
  - **10%:** Report writing and organization