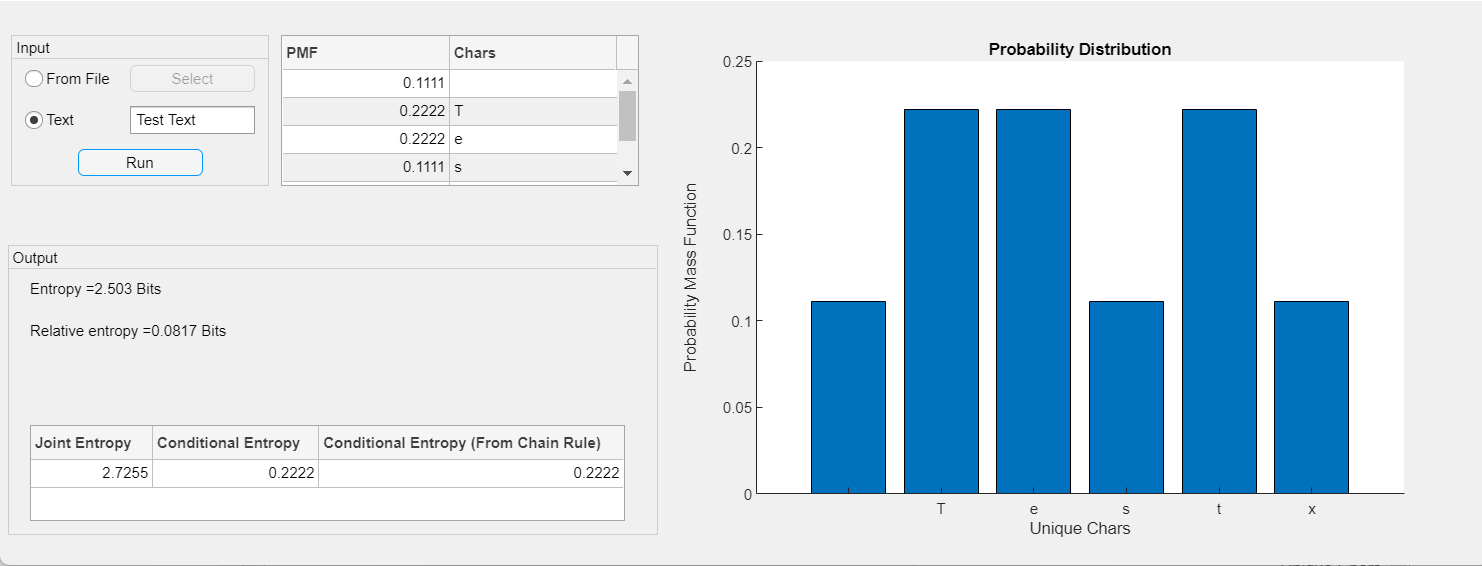
|  |  |  |
| --- | --- | --- |
| **Credit Hours System**  **ELCN446**  **Advanced Topics in Communications I**  **Spring 2020** |  | **Cairo University**  **Faculty of Engineering** |

Project-1

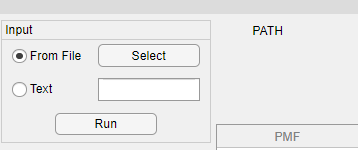
|  |  |
| --- | --- |
| Team Members | ID |
| Hussein Ahmed Ibrahim | 1180594 |
| Omar Tarek Ahmed | 1180004 |

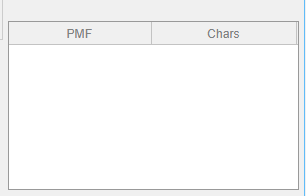
# GUI



# Allow the user **enter the path of a text file** (.txt), in which the text is written in English letters.

1. • Read the .txt file • Extract characters from the file

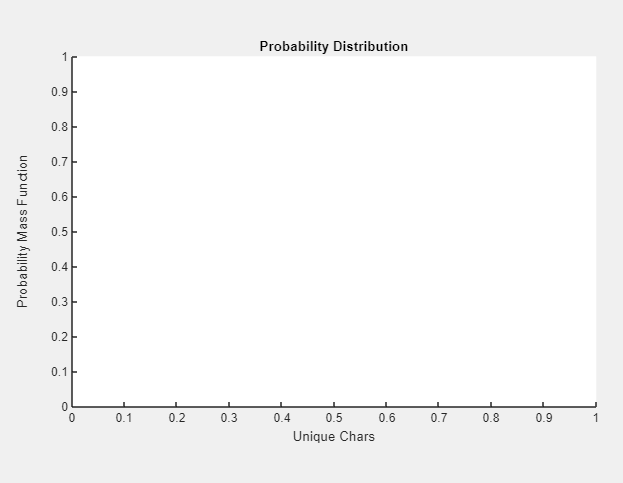
We gave the user 2 options, to select the path of the text file and read it before running the program or choosing the second option text option to write the text. We used the function unique to extract the unique chars in the file or in the text box. If you choose the file, the path of the file will appear beside it.

• Find the PMF of the characters

We Count the number of occurrences of each char and divide it by the total number of chars not the unique chars to get the probability mass function and plot the output in the following table.

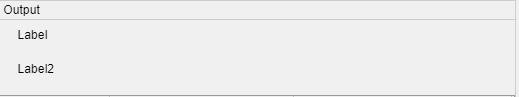
• Display a plot of the probability distribution of the characters in file.

After calculating the PMF, Plot on the graph and the unique chars on the labels.



• Display the Entropy of the characters. • Display the Relative Entropy

From the PMF calculated, we calculate the entropy from its expression and also the relative entropy which is relative to the uniform distribution of unique chars in the text or file. They appear in the output section in label 1 as entropy and label 2 as relative entropy.



1. **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).

Encoding the characters was done by storing all possible 64 characters in an array. Finding the binary code for the character is as simple as converting its index to binary.

Decoding the characters: We take each 6 bits of the file, convert them to their equivalent decimal number, and use this as the index for our character list.

Calculating the joint entropy was done by making a two-column matrix that looks like this:

|  |  |
| --- | --- |
| X | Y­Decoded |

A column for the input text and another for the decoded text after sending.

We then divide this matrix into pairs, where each pair takes the form (char sent, char received).

By counting each pair and dividing by the number of occurrences for all pairs, we get the joint probability.

We apply the formula to get the joint entropy:

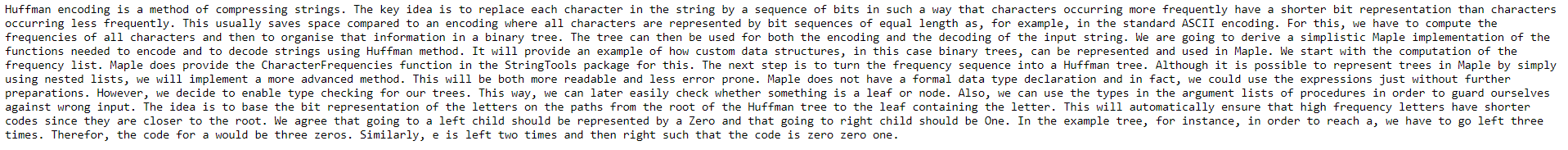
# Getting the conditional entropy was done using Bayes rule:

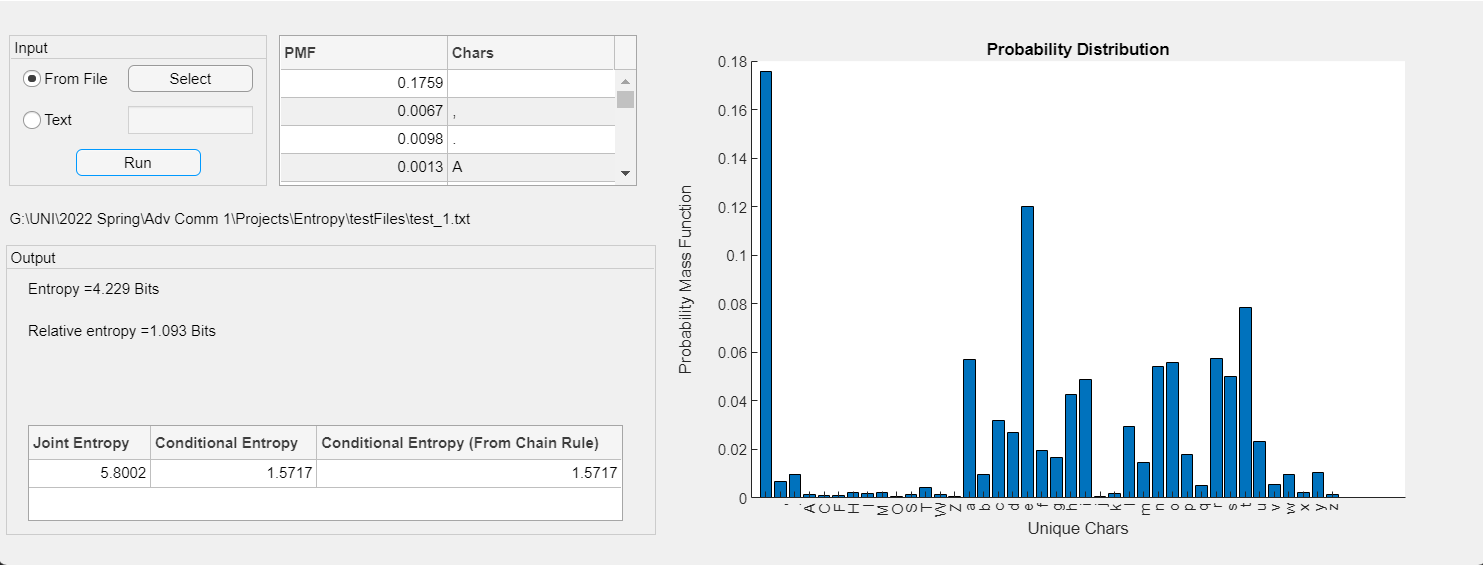
By dividing each element of P(X,Y) by its corresponding element in P(X) , we obtain P(Y|X).

We apply two formulas to get the conditional entropy, we then compare the results to validate the chain rule:

# Test Cases

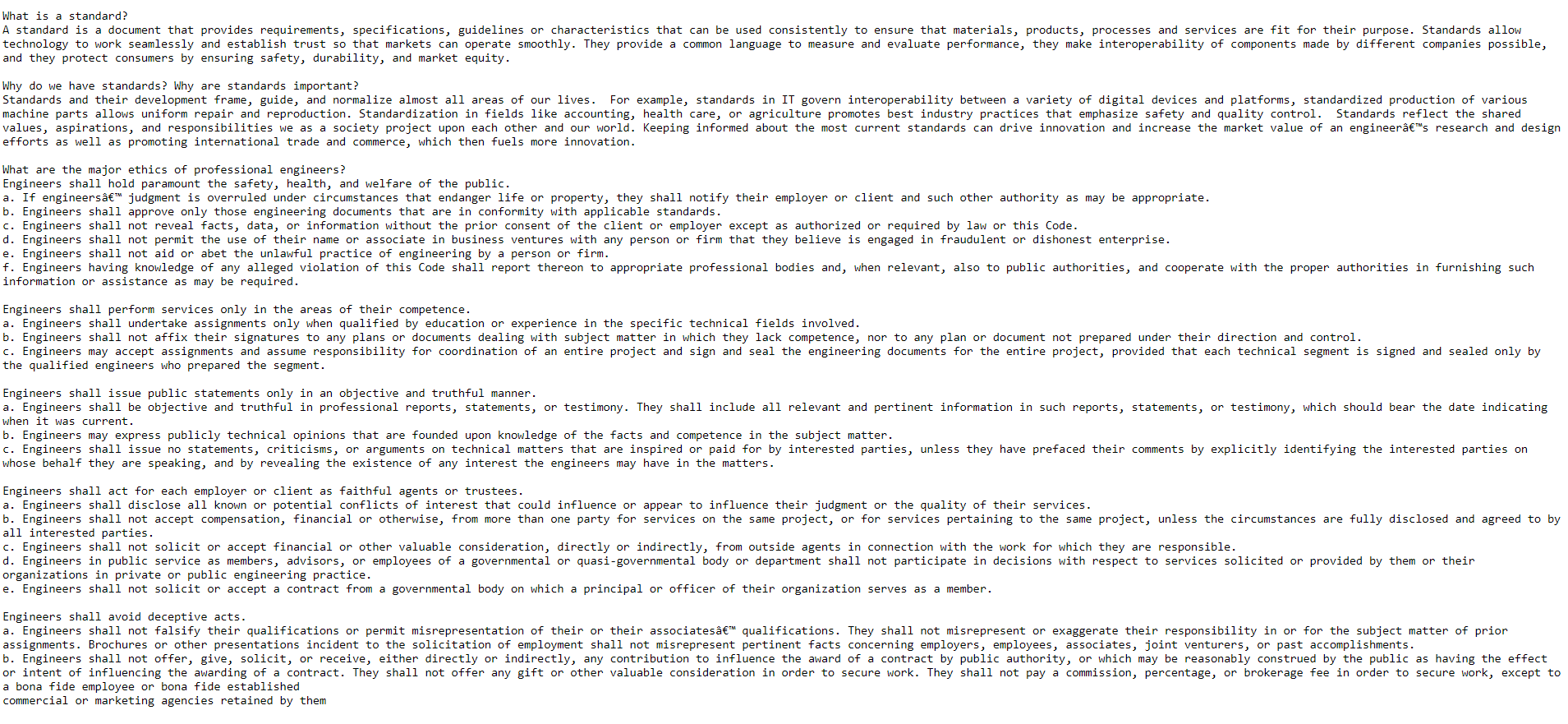
Test Case Sample 1:

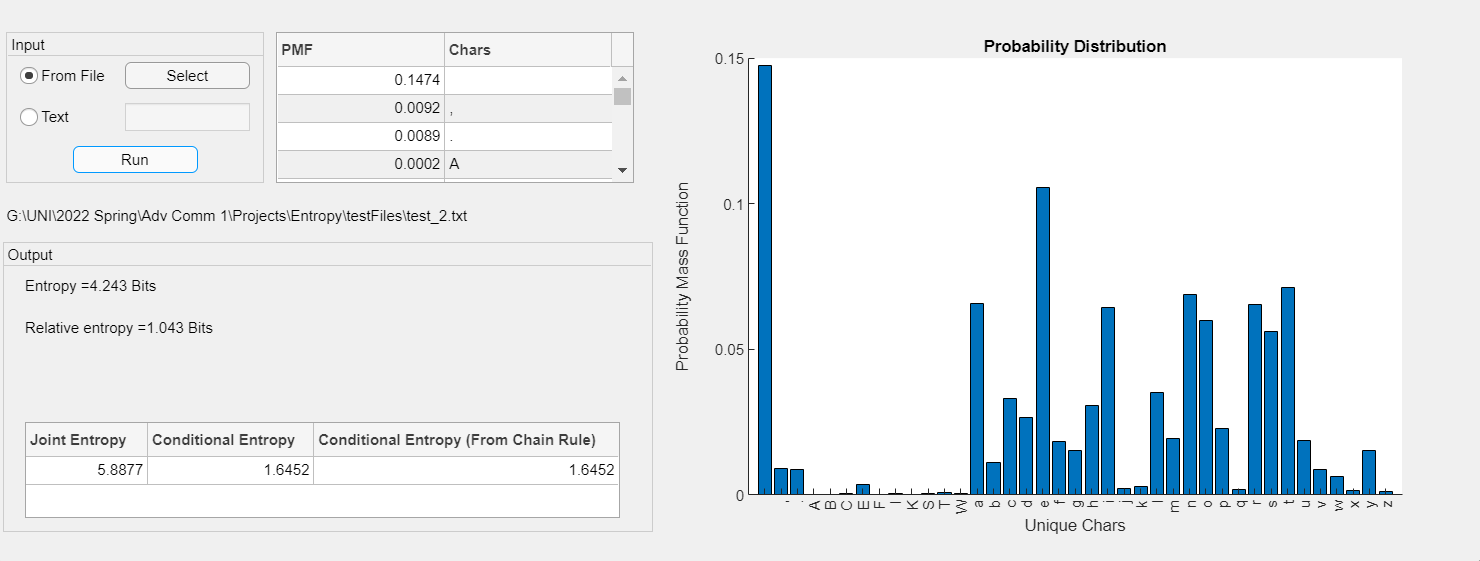
Input: 



Comment: We can see that the chain rule is valid. We also see that the “space” character is the most common character, followed by the letter “e”. This was excepted.

Test Case Sample 2:

Input: 



Comment: We conclude the same conclusion from ­*“test\_1”* as well as the validity of the chain rule.

**We can see that the chain rule is always valid.**

# Appendix