

# Assignment 2: Advanced Cryptography and Cryptanalysis (COSC5196)

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## Introduction

In this assignment, we explore the fundamentals of cryptography using the Caesar Cipher and MATLAB. We begin by setting up your programming environment and familiarizing with basic functions of MATLAB. The first part of this assignment, focuses on applying the Caesar Cipher with a key of 0, allowing us to observe the effects of encryption on text without any actual shifts. We analyze the letter frequencies of both the original and cipher-text, discovering how they remain identical when no shift occurs.

In second part, we adjust the encryption key to 1, generating a cipher-text that reflects a simple character shift. Through visualizations of letter frequencies, we learn how small changes in the key can alter the distribution of letters. Finally, we engage in cryptanalysis by determining the encryption key from a given cipher-text and automating this process through creating MATLAB code. This will deepen our understanding of cryptographic techniques and reinforce your programming skills.

## Part-0: Introduction to MATLAB

We installed the MATLAB on our system. First of all, we go through the some of basic documentation and functions of the MATLAB like, MATLAB environment, Plotting, Numerical methods and programming methods. We will this knowledge for tasks, visualizing the data through the plots and graphs. [1]

## Part-1: Plotting Letter Frequency with k=0

In this part, we have explored the MATLAB Caesar Cipher encryption code to encrypt the content of **PlainText1.txt** and generate an encrypted file called **CipherText1.txt**. For this step, we have used a key of K=0, which means no

shift will be applied. After that, we have compared the letter frequency graphs of both the original (plain-text) and the encrypted text to see how encryption impacts letter distribution.

## Caesar Cipher encryption code (Key K=0)

This code will encrypt the plain-text using encryption key  $k=0$ .

```
1 %% Caesar Cipher encryption
2 % m = plain text string. Contains only a-to-z and space
3 % k = encryption key, ranges from 1 to 26
4 % cipherText = encrypted text k(m).
5
6 clc; clear all; close all;
7
8 m = fileread('PlainText1.txt'); % reading plaintext from text file
9 k = 0; % encryption key
10 ascii_m = double(m);          % ascii values of the string
11
12 %% Finding the locations of special characters
13 characters1 = find(ascii_m < 65);
14 characters2 = find(ascii_m == 96);
15 characters3 = find(ascii_m > 122);
16
17 %% special characters are replaced by space
18 ascii_m(characters1) = 32;
19 ascii_m(characters2) = 32;
20 ascii_m(characters3) = 32;
21
22
23 %% Encryption
24 ascii_cipherText = ascii_m+k;
25 wrap = find(ascii_cipherText>122); % wrapping around if greater than
    'z'
26 ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
27 wrap = find(ascii_cipherText==96); % wrapping around if greater than
    'z'
28 ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
29
30
31 %% restoring spaces
32 ascii_cipherText(characters1) = 32;
33 ascii_cipherText(characters2) = 32;
34 ascii_cipherText(characters3) = 32;
35
36 cipherText = char(ascii_cipherText);
37
38 %% Writing encrypted text in a text file
39 fid = fopen('C:\Users\Administrator\Documents\MATLAB\CipherText1.
    txt','wt');
40 fid = fopen('Task_1_CipherText1.txt','wt');
41 fprintf(fid, '%s', cipherText);
42 fclose(fid);
```

## Letter Frequency Distribution Plot Code

This code will plot the letter frequency distribution graph of the plain-text and cipher-text.

```
1 %% This program plots the letter frequency of the input text
2 clc; close all; clear all;
3
4 %% Reading ciphertext from file
5 cipherText = fileread('Task_1_CipherText1.txt');
6 ascii_cipherText = double(cipherText); %Converting string to
    numeric ASCII values
7
8 %% Reading plaintext from file
9 plainText = fileread('PlainText1.txt');
10 ascii_plainText = double(plainText); % converting string to numeric
    ASCII values
11
12 %% array declaration. Array size 1x26
13 frequency_cipher = zeros(1,26);
14 frequency_plain = zeros(1,26);
15
16 %% Counting frequency for small case letters
17 for i= 97:1:122
18     frequency_cipher(i-96) = length(find(ascii_cipherText==i));
19     frequency_plain(i-96) = length(find(ascii_plainText==i));
20 end
21
22 %% Counting frequency for capital case letters
23 for i= 65:1:90
24     frequency_cipher(i-64) = frequency_cipher(i-64) + length(find(
        ascii_cipherText==i));
25     frequency_plain(i-64) = frequency_plain(i-64) + length(find(
        ascii_plainText==i));
26 end
27
28 %% Normalizing to percentage value
29 frequency_cipher = frequency_cipher/sum(frequency_cipher)*100;
30 frequency_plain = frequency_plain/sum(frequency_plain)*100;
31
32 %% Plotting letter frequency for cipherText
33 subplot(2,1,1)
34 bar(frequency_cipher, 'red')
35 xlabel('Encrypted Alphabets (a to z i.e., 0 to 26)')
36 ylabel('Frequency (in %)')
37 title('Letter Frequency Plot for Ciphertext')
38 grid on
39
40 %% Plotting letter frequency for plaintext
41 subplot(2,1,2)
42 bar(frequency_plain, '')
43 xlabel('Plain Alphabets (a to z i.e., 0 to 26)')
44 ylabel('Frequency (in %)')
45 title('Letter Frequency Plot for Plaintext')
46 grid on
```

## MATLAB interface image

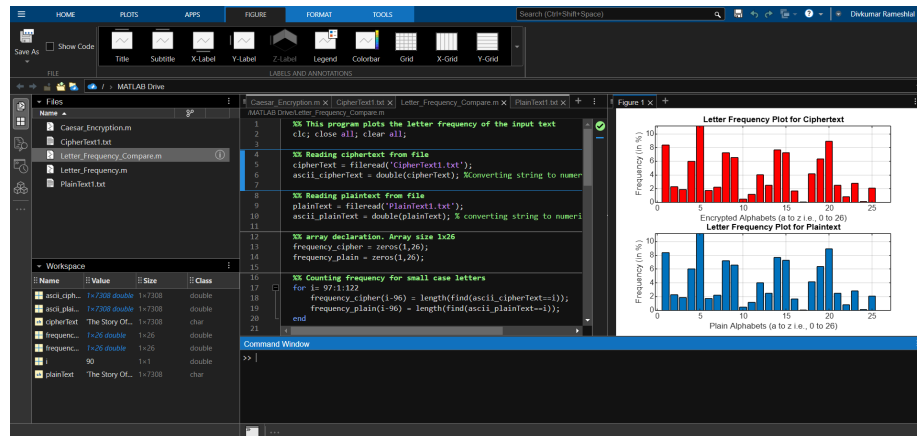


Figure 1: MATLAB interface image for part 1

## Output

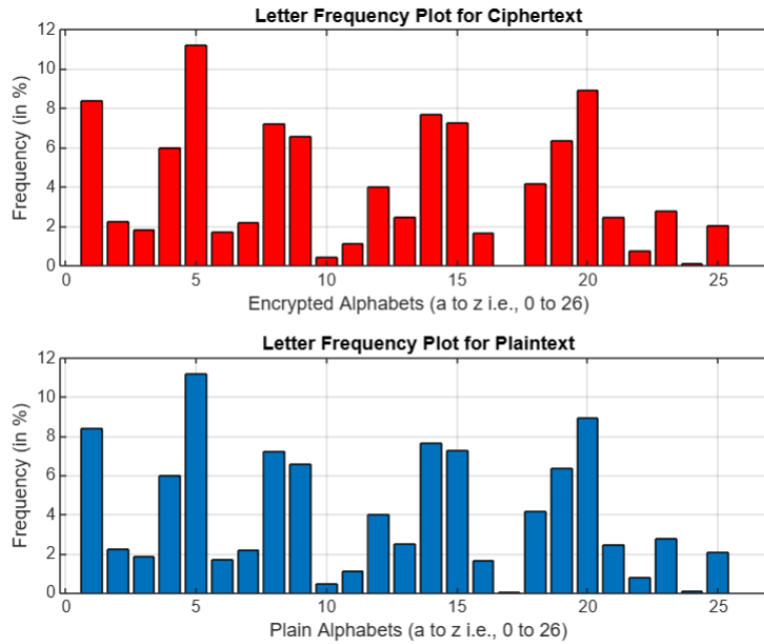


Figure 2: Part 1: plain-text and cipher-text frequency histogram

Here, key  $K=0$  due to that both histogram are identical.

## Part-2: Plotting Letter Frequency with $k=1$

In the second part, we use the same code of part-1 but with different key value  $K=1$ . Then, we will plot letter frequency histogram to compare plain-text and cipher-text letter frequency.

### Caesar cipher encryption code (Key $K=1$ )

This code will encrypt the plain-text using encryption key  $k=1$ .

```
1 %% Caesar Cipher encryption
2 % m = plain text string. Contains only a-to-z and space
3 % k = encryption key, ranges from 1 to 26
4 % cipherText = encrypted text k(m).
5
6 clc; clear all; close all;
7
```

```

8 m = fileread('PlainText1.txt'); % reading plaintext from text file
9 k = 1; % encryption key
10 ascii_m = double(m); % ascii values of the string
11
12 %% Finding the locations of special characters
13 characters1 = find(ascii_m < 65);
14 characters2 = find(ascii_m == 96);
15 characters3 = find(ascii_m > 122);
16
17 %% special characters are replaced by space
18 ascii_m(characters1) = 32;
19 ascii_m(characters2) = 32;
20 ascii_m(characters3) = 32;
21
22
23 %% Encryption
24 ascii_cipherText = ascii_m+k;
25 wrap = find(ascii_cipherText>122); % wrapping around if greater than
    'z'
26 ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
27 wrap = find(ascii_cipherText==96); % wrapping around if greater than
    'z'
28 ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
29
30
31 %% restoring spaces
32 ascii_cipherText(characters1) = 32;
33 ascii_cipherText(characters2) = 32;
34 ascii_cipherText(characters3) = 32;
35
36 cipherText = char(ascii_cipherText);
37
38 %% Writing encrypted text in a text file
39 fid = fopen('C:\Users\Administrator\Documents\MATLAB\CipherText1.
    txt','wt');
40 fid = fopen('Task_2_CipherText1.txt','wt');
41 fprintf(fid, '%s', cipherText);
42 fclose(fid);

```

## Letter frequency distribution plot code

This code will plot the letter frequency distribution graph of the plain-text and cipher-text.

```

1 %% This program plots the letter frequency of the input text
2 clc; close all; clear all;
3
4 %% Reading ciphertext from file
5 cipherText = fileread('Task_2_CipherText1.txt');
6 ascii_cipherText = double(cipherText); %Converting string to
    numeric ASCII values
7
8 %% Reading plaintext from file
9 plainText = fileread('PlainText1.txt');
10 ascii_plainText = double(plainText); % converting string to numeric
    ASCII values

```

```

11
12 %% array declaration. Array size 1x26
13 frequency_cipher = zeros(1,26);
14 frequency_plain = zeros(1,26);
15
16 %% Counting frequency for small case letters
17 for i= 97:1:122
18     frequency_cipher(i-96) = length(find(ascii_cipherText==i));
19     frequency_plain(i-96) = length(find(ascii_plainText==i));
20 end
21
22 %% Counting frequency for capital case letters
23 for i= 65:1:90
24     frequency_cipher(i-64) = frequency_cipher(i-64) + length(find(
25         ascii_cipherText==i));
26     frequency_plain(i-64) = frequency_plain(i-64) + length(find(
27         ascii_plainText==i));
28 end
29
30 %% Normalizing to percentage value
31 frequency_cipher = frequency_cipher/sum(frequency_cipher)*100;
32 frequency_plain = frequency_plain/sum(frequency_plain)*100;
33
34 %% Plotting letter frequency for cipherText
35 subplot(2,1,1)
36 bar(frequency_cipher, 'red')
37 xlabel('Encrypted Alphabets (a to z i.e., 0 to 26)')
38 ylabel('Frequency (in %)')
39 title('Letter Frequency Plot for Ciphertext')
40 grid on
41
42 %% Plotting letter frequency for plaintext
43 subplot(2,1,2)
44 bar(frequency_plain, '')
45 xlabel('Plain Alphabets (a to z i.e., 0 to 26)')
46 ylabel('Frequency (in %)')
47 title('Letter Frequency Plot for Plaintext')
48 grid on

```

## MATLAB interface image

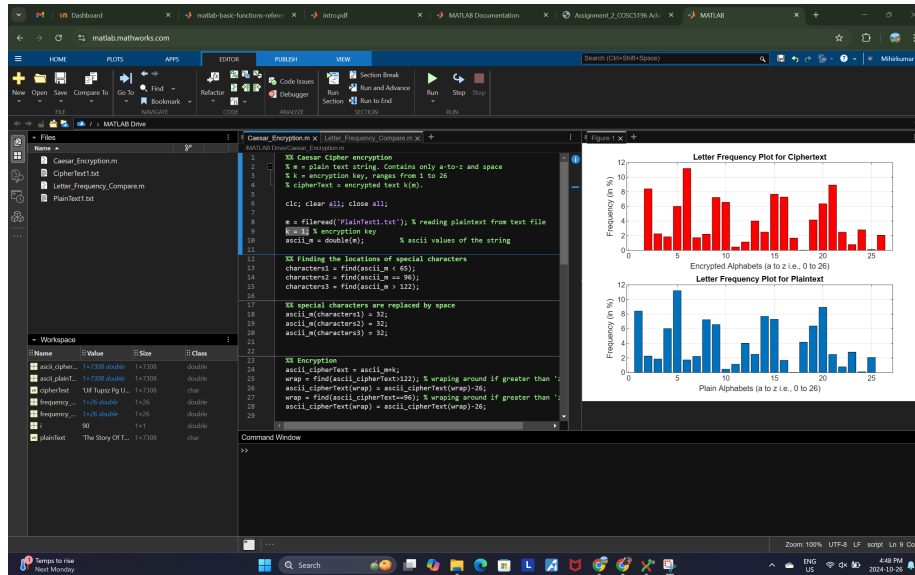


Figure 3: MATLAB interface image for part 2



## Output

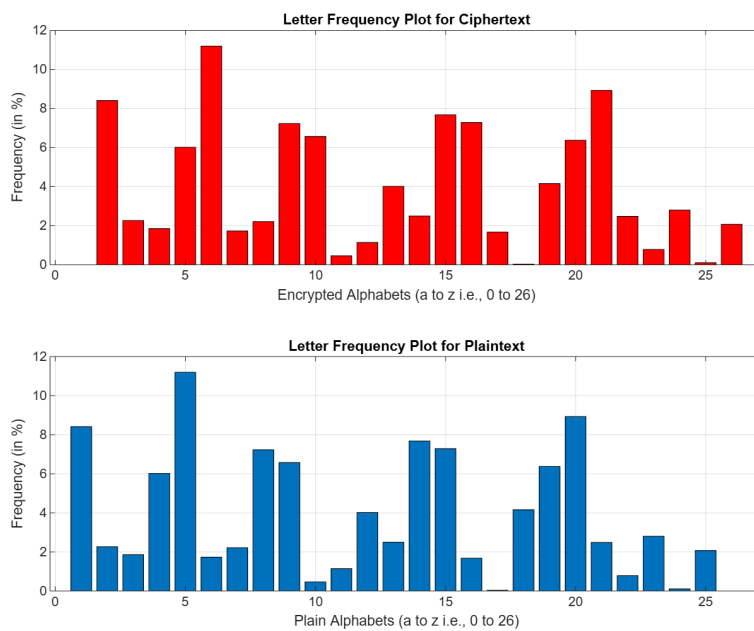


Figure 4: Part 2: plain-text and cipher-text frequency histogram

Here, We can see the difference between the plain-text and cipher-text histogram because of the key value  $K=1$ .

## Part-3: Cryptanalysis

In the third part, we created a histogram displaying the letter frequencies in "CipherText2.txt".

## Histogram of CipherText2.txt

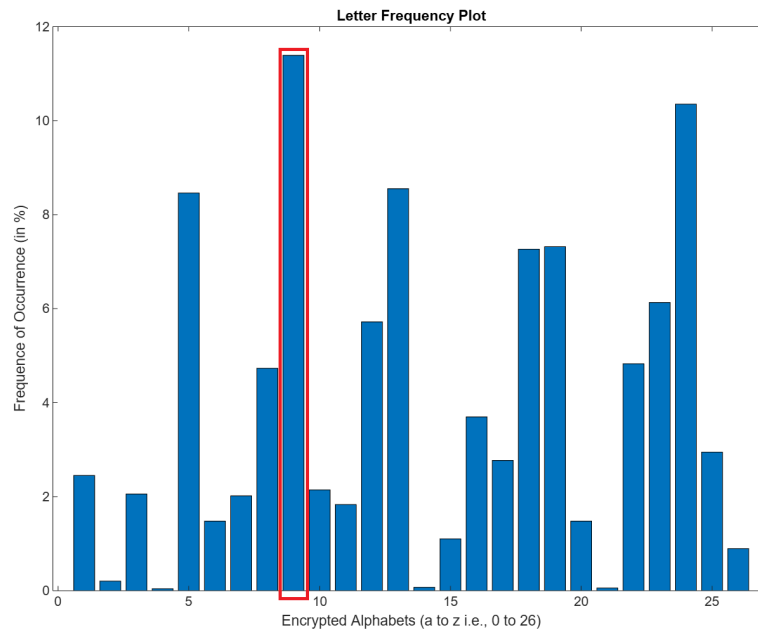


Figure 5: Histogram of CipherText2.txt

To interpret this, we compared the histogram with the typical letter frequency distribution of the English alphabet, where the letter "E" is known to have the highest frequency. By using this as a reference, we identified the letter with the highest frequency in our cipher-text, located in column 9 on the cryptanalysis graph. To calculate the key, we took the index of "E" (position 5 in the alphabet) and subtracted it from the index of the most frequent letter in our cipher-text (position 9). **This gives us a possible key of 4.** [2] Then we use the decryption algorithm from assignment-1 to decrypt the CipherText2.txt using the key value  $K=4$  and we got the following result.

## Caesar cipher decryption code from Assignment 1

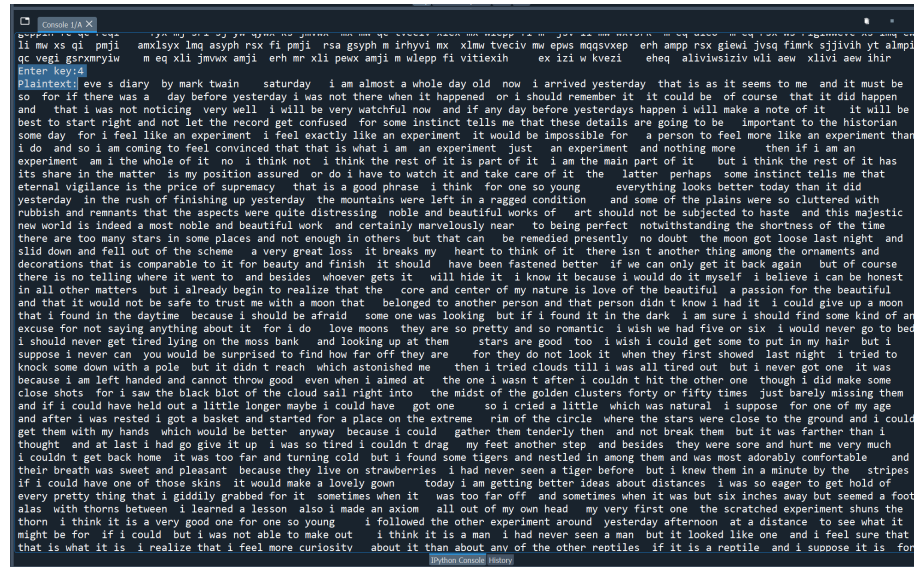
```
1 """
2 Created on Mon Oct 7 00:28:03 2024
3 @author: Mihirkumar Mistry
4 Student ID: 249419480
5 Group Number: 11
6 """
7 # Take cipher text from the user
```

```

8 cipher_text = input('Enter cipher text:')
9 # Take key value from the user
10 key = int(input('Enter key:'))
11
12 # Caesar cipher decryption function
13 def caesar_cipher_decryption(cipher_text, key):
14     plain_text = ""
15
16     for char in cipher_text:
17         # Check if the char is a alphabet or not
18         if char.isalpha():
19             # Get the ASCII value of the base char, based on the
20             case
21             start = ord('A') if char.isupper() else ord('a')
22             # Finding the plaintext using character shifting
23             algorithm
24             decrypted_char = chr((ord(char) - start - key) % 26 +
25             start)
26             # Add the resulting char
27             plain_text += decrypted_char
28         else:
29             # Keep the Non-alphabet character as it is
30             plain_text += char
31
32     return plain_text
33
34 # Call caesar_cipher_decryption with user input
35 print('Plaintext:', caesar_cipher_decryption(cipher_text, key))

```

## Output



```
li mw xs ql pmjl amxlyx lmq asyph rsx fi pmjl rsa gsyph m irhyvi mx xlmv tveciv mw epus mqsxvex erh ampp rsx glewi jvsq fimk sijjihv yt almpi
qc vegi gsrxmryiw m eq xli jmvwx amji erh mr xli peux amji m wlepp fi vitiexih ex izi w kvezi eheq alivivisiziv wli aew xli vi aew ihr
Enter key:4
Plaintext: eve s diary by mark twain saturday i am almost a whole day old now i arrived yesterday that is as it seems to me and it must be
so for if there was a day before yesterday i was not there when it happened or i should remember it it could be of course that it did happen
and that i was not noticing very well i will be very watchful now and if any day before yesterdays happen i will make a note of it it will be
best to start right and not let the record get confused for some instinct tells me that these details are going to be important to the historian
some day for i feel like an experiment i feel exactly like an experiment it would be impossible for a person to feel more like an experiment than
i do and so i am coming to feel convinced that that is what i am an experiment just an experiment and nothing more then if i am an
experiment am i the whole of it no i think not i think the rest of it is part of it i am the main part of it but i think the rest of it has
its share in the matter is my position assured or do i have to watch it and take care of it the latter perhaps some instinct tells me that
eternal vigilance is the price of supremacy that is a good phrase i think for one so young everything looks better today than it did
yesterday in the rush of finishing up yesterday the mountains were left in a ragged condition and some of the plains were so cluttered with
rubbish and remnants that the aspects were quite distressing noble and beautiful works of art should not be subjected to haste and this majestic
new world is indeed a most noble and beautiful work and certainly marvelously near to being perfect notwithstanding the shortness of the time
there are too many stars in some places and not enough in others but that can be remedied presently no doubt the moon got loose last night and
slid down and fell out of the scheme a very great loss it breaks my heart to think of it there isn t another thing among the ornaments and
decorations that is comparable to it for beauty and finish it should have been fastened better if we can only get it back again but of course
there is no telling where it went to and besides whoever gets it will hide it i know it because i would do it myself i believe i can be honest
in all other matters but i already begin to realize that the core and center of my nature is love of the beautiful a passion for the beautiful
and that it would not be safe to trust me with a moon that belonged to another person and that person didn t know i had it i could give up a moon
that i found in the daytime because i should be afraid some one was looking but if i found it in the dark i am sure i should find some kind of an
excuse for not saying anything about it for i do love moons they are so pretty and so romantic i wish we had five or six i would never go to bed
i should never get tired lying on the moss bank and looking up at them stars are good too i wish i could get some to put in my hair but i
suppose i never can you would be surprised to find how far off they are for they do not look it when they first showed last night i tried to
knock some down with a pole but it didn t reach which astonished me then i tried clouds till i was all tired out but i never got one it was
because i am left handed and cannot throw good even when i aimed at the one i wasn t after i couldn t hit the other one though i did make some
close shots for i saw the black blot of the cloud sail right into the midst of the golden clusters forty or fifty times just barely missing them
and if i could have held out a little longer maybe i could have got one so i cried a little which was natural i suppose for one of my age
and after i was rested i got a basket and started for a place on the extreme rim of the circle where the stars were close to the ground and i could
get them with my hands which would be better anyway because i could gather them tenderly then and not break them but it was farther than i
thought and at last i had to give it up i was so tired i couldn t drag my feet another step and besides they were sore and hurt me very much
i couldn t get back home it was too far and turning cold but i found some tigers and nestled in among them and was most adorably comfortable and
their breath was sweet and pleasant because they live on strawberries i had never seen a tiger before but i knew them in a minute by the stripes
if i could have one of those skins it would make a lovely gown today i am getting better ideas about distances i was so eager to get hold of
every pretty thing that i giddily grabbed for it sometimes when it was too far off and sometimes when it was but six inches away but seemed a foot
alas with thorns between i learned a lesson also i made an axiom all out of my own head my very first one the scratched experiment shuns the
thorn i think it is a very good one for one so young i followed the other experiment around yesterday afternoon at a distance to see what it
might be for if i could but i was not able to make out i think it is a man i had never seen a man but it looked like one and i feel sure that
that is what it is i realize that i feel more curious about it than about any of the other reptiles if it is a reptile and i suppose it is for
```

Figure 6: Part 3: Decrypted text using key value 4

## Histogram of plain-text and cipher-text

---

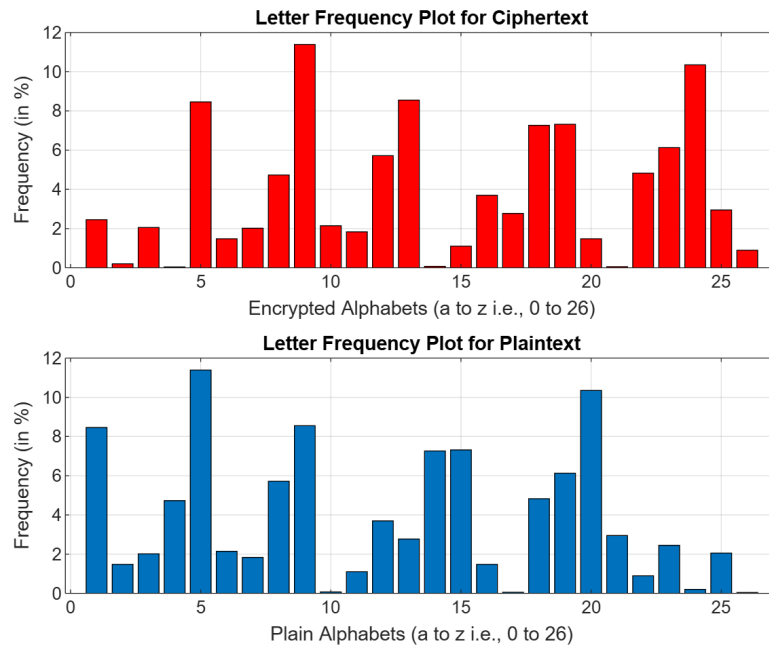


Figure 7: Part 3: Histogram of plain-text and cipher-text

```

Python Console History
li mw xs q1 pmjl amksyx lmq asyph rsx fi pmjl rsa gsyph m irhyvi mx xlmw tveciv mw epus mqsxvexp erh ampp rsx giewi jvsq fimrk sjjivih yt almpi
qc vegi gsrmmxyiw m eq xli jmwvx amjl erh mr xli peux amjl m wlepp fi vitiexih ex izi w kvez1 eheq allivusiziv wli aew xliwi aew ihir
enter key4
Plaintext: eve s diary by mark twain saturday i am almost a whole day old now i arrived yesterday that is as it seems to me and it must be
so for if there was a day before yesterday i was not there when it happened or i should remember it it could be of course that it did happen
and that i was not noticing very well i will be very watchful now and if any day before yesterdays happen i will make a note of it it will be
best to start right and not let the record get confused for some instinct tells me that these details are going to be important to the historian
some day for i feel like an experiment i feel exactly like an experiment it would be impossible for a person to feel more like an experiment than
i do and so i am coming to feel convinced that that is what i am an experiment just an experiment and nothing more then if i am an
experiment am i the whole of it no i think not i think the rest of it is part of it i am the main part of it but i think the rest of it has
its share in the matter is my position assured or do i have to watch it and take care of it the latter perhaps some instinct tells me that
eternal vigilance is the price of supremacy that is a good phrase i think for one so young everything looks better today than it did
yesterday in the rush of finishing up yesterday the mountains were left in a ragged condition and some of the plains were so cluttered with
rubbish and remnants that the aspects were quite distressing noble and beautiful works of art should not be subjected to haste and this majestic
new world is indeed a most noble and beautiful work and certainly marvelously near to being perfect notwithstanding the shortness of the time
there are too many stars in some places and not enough in others but that can be remedied presently no doubt the moon got loose last night and
slid down and fell out of the scheme a very great loss it breaks my heart to think of it there isn t another thing among the ornaments and
decorations that is comparable to it for beauty and finish it should have been fastened better if we can only get it back again but of course
there is no telling where it went to and besides whoever gets it will hide it i know it because i would do it myself i believe i can be honest
in all other matters but i already begin to realize that the core and center of my nature is love of the beautiful a passion for the beautiful
and that it would not be safe to trust me with a moon that belonged to another person and that person didn t know i had it i could give up a moon
that i found in the daytime because i should be afraid some one was looking but if i found it in the dark i am sure i should find some kind of an
excuse for not saying anything about it for i do love moons they are so pretty and so romantic i wish we had five or six i would never go to bed
i should never get tired lying on the moss bank and looking up at them stars are good too i wish i could get some to put in my hair but i
suppose i never can you would be surprised to find how far off they are for they do not look it when they first showed last night i tried to
knock some down with a pole but it didn t reach which astonished me then i tried clouds till i was all tired out but i never got one it was
because i am left handed and cannot throw good even when i aimed at the one i wasn t after i couldn t hit the other one though i did make some
close shots for i saw the black blot of the cloud sail right into the midst of the golden clusters forty or fifty times just barely missing them
and if i could have held out a little longer maybe i could have got one so i cried a little which was natural i suppose for one of my age
and after i was rested i got a basket and started for a place on the extreme rim of the circle where the stars were close to the ground and i could
get them with my hands which would be better anyway because i could gather them tenderly then and not break them but it was farther than i
thought and at last i had go give it up i was so tired i couldn t drag my feet another step and besides they were sore and hurt me very much
i couldn t get back how it was too far and turning cold but i found some tigers and nestled in among them and was most adorably comfortable and
their breath was sweet and pleasant because they live on strawberries i had never seen a tiger before but i knew them in a minute by the stripes
if i could have one of those skins it would make a lovely gown today i am getting better ideas about distances i was so eager to get hold of
every pretty thing that i giddily grabbed for it sometimes when it was too far off and sometimes when it was but six inches away but seemed a foot
alas with thorns between i learned a lesson also i made an axiom all out of my own head my very first one the scratched experiment shuns the
thorn i think it is a very good one for one so young i followed the other experiment around yesterday afternoon at a distance to see what it
might be for if i could but i was not able to make out i think it is a man i had never seen a man but it looked like one and i feel sure that
that is what it is i realize that i feel more curiosity about it than about any of the other reptiles if it is a reptile and i suppose it is for

```

Figure 8: Part 3: Decrypted text using key value 4

Furthermore, We can answer the following questions using the output.

- What is the story name? **Answer: eve s diary**
- Who is the writer? **Answer: mark twain**

## Part-4: Write Your Own Code

In the final part of our analysis, we developed a MATLAB code to perform cryptanalysis on the cipher-text. This code uses the approach we outlined in part 3 to identify the likely key, which it then uses to decrypt the cipher-text. [2]

### Caesar cipher cryptanalysis code

This code will analyses the possible key for the cipher text and generate the text file of the plain-text.[3]

```

1 % This program plots the letter frequency of the input text
2 clc; close all; clear all;
3
4 %text = fileread('EvesDiaryMarkTwain.txt'); % reading text from
   file
5 text = fileread('CipherText2.txt'); % reading text from file
6 ascii_text = double(text); % converting string to numeric ASCII
   values

```

```

7
8 frequency = zeros(1,26); % array declaration. Array size 1x26
9
10 %% Counting frequency for small case letters
11 for i= 97:1:122
12     frequency(i-96) = length(find(ascii_text==i));
13 end
14
15 %% Counting frequency for capital case letters
16 for i= 65:1:90
17     frequency(i-64) = frequency(i-64) + length(find(ascii_text==i));
18 end
19
20
21 % Standard English letter frequencies (approximate)
22 english_freq = [8.167, 1.492, 2.782, 4.253, 12.702, 2.228, 2.015,
23     6.094, ...
24     6.966, 0.153, 0.772, 4.025, 2.406, 6.749, 7.507,
25     1.929, ...
26     0.095, 5.987, 6.327, 9.056, 2.758, 0.978, 2.361,
27     0.150, ...
28     1.974, 0.074];
29
30 % Normalize the frequencies of the ciphertext to compare with
31 % English frequencies
32 total_letters = sum(frequency);
33 normalized_frequency = (frequency / total_letters) * 100;
34
35 % Find the best shift by comparing each possible shift with
36 % standard frequencies
37 best_shift = 0;
38 min_difference = inf; % Start with a large number
39
40 for shift = 0:25
41     % Shift frequencies
42     shifted_frequency = circshift(normalized_frequency, -shift);
43
44     % Calculate the sum of absolute differences for this shift
45     difference = sum(abs(shifted_frequency - english_freq));
46
47     % Update the best shift if this one has a smaller difference
48     if difference < min_difference
49         min_difference = difference;
50         best_shift = shift;
51     end
52 end
53
54 % Decrypt the text using the best shift found
55 plaintext = char(ascii_text); % Initialize with original text
56 structure
57 for i = 1:length(ascii_text)
58     if ascii_text(i) >= 65 && ascii_text(i) <= 90
59         % Uppercase letters
60         plaintext(i) = char(mod(ascii_text(i) - 65 - best_shift,
61             26) + 65);
62     elseif ascii_text(i) >= 97 && ascii_text(i) <= 122

```

```

56         % Lowercase letters
57         plaintext(i) = char(mod(ascii_text(i) - 97 - best_shift,
58             26) + 97);
59     end
60 end
61 % Save the plaintext to a file
62 fileID = fopen('PlainText2.txt', 'w');
63 fprintf(fileID, '%s', plaintext);
64 fclose(fileID);
65
66 % Display the encryption key and success message
67 fprintf('The encryption/decryption key (shift) is: %d\n',
68     best_shift);
69 disp('Decryption complete. Plaintext saved to PlainText2.txt.');
```

## MATLAB interface image

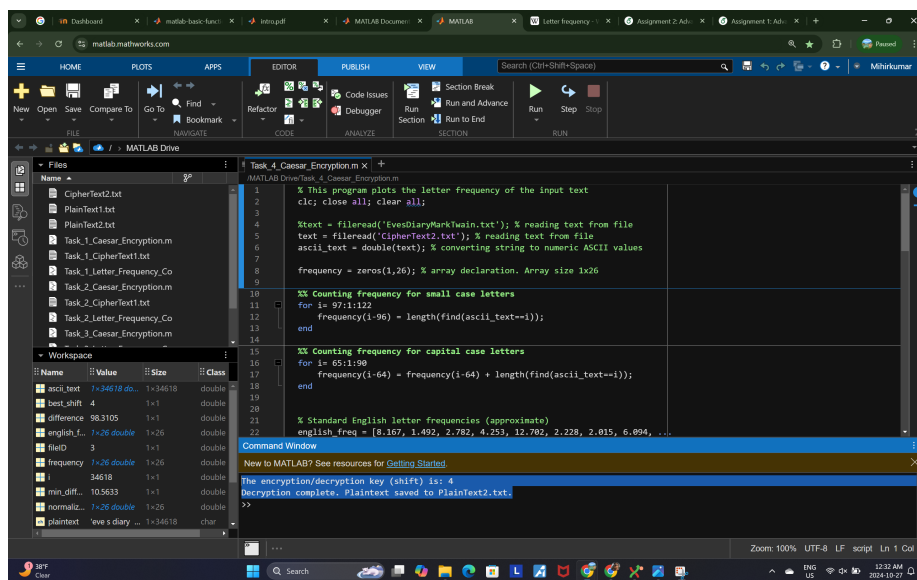
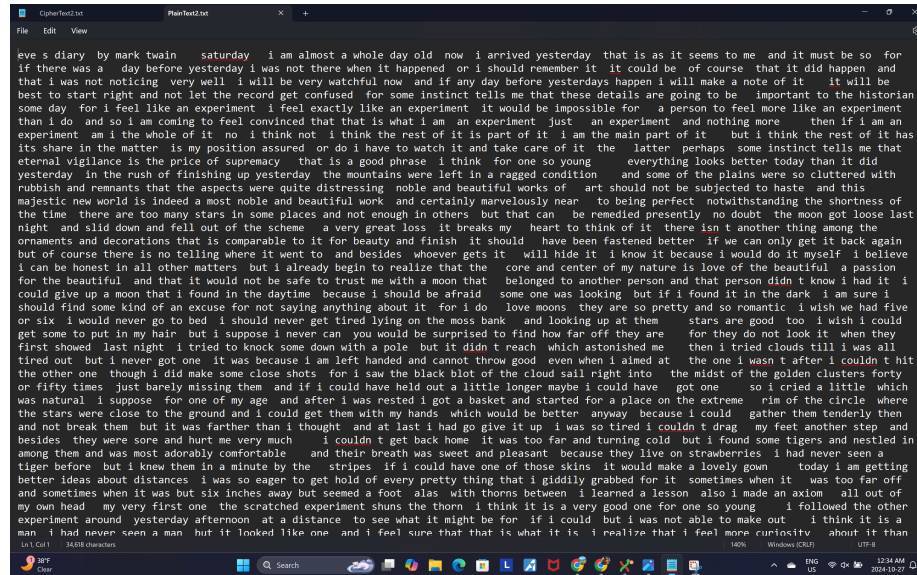


Figure 9: MATLAB interface image for part 4



## Output



```
eve's diary by mark twain  saturday  i am almost a whole day old now  i arrived yesterday  that is as it seems to me  and it must be so  for
if there was a  day before yesterday  i was not there when it happened  or i should remember it  it could be  of course  that it did happen  and
that i was not noticing  very well  i will be very watchful now  and if any day before yesterdays happen i will make a note of it  it will be
best to start right and not let the record get confused  for some instinct tells me that these details are going to be  important to the historian
some day  for i feel like an experiment  i feel exactly like an experiment  it would be impossible for  a person to feel more like an experiment
than i do  and so i am coming to feel convinced that that is what i am  an experiment  just  an experiment  and nothing more  then if i am an
experiment  am i the whole of it  no  i think not  i think the rest of it is part of it  i am the main part of it  but i think the rest of it has
its share in the matter  is my position assured  on do i have to watch it and take care of it  the  latter perhaps  some instinct tells me that
eternal vigilance is the price of supremacy  that is a good phrase  i think  for one so young  everything looks better today than it did
yesterday  in the rush of finishing up yesterday  the mountains were left in a ragged condition  and some of the plains were so cluttered with
rubbish and remnants that the aspects were quite distressing  noble and beautiful works of  art should not be subjected to haste  and this
majestic new world is indeed a most noble and beautiful work  and certainly marvelously near  to being perfect  notwithstanding the shortness of
the time  there are too many stars in some places and not enough in others  but that can  be remedied presently  no doubt  the moon got loose last
night  and slid down and fell out of the scheme  a very great loss  it breaks my  heart to think of it  there isn't another thing among the
ornaments and decorations that is comparable to it for beauty and finish  it should  have been fastened better  if we can only get it back again
but of course there is no telling where it went to  and besides  whoever gets it  will hide it  i know it because i would do it myself  i believe
i can be honest in all other matters  but i already begin to realize that the  core and center of my nature is love of the beautiful  a passion
for the beautiful  and that it would not be safe to trust me with a moon that  belonged to another person and that person didn't know i had it  i
could give up a moon that i found in the daytime  because i should be afraid  some one was looking  but if i found it in the dark  i am sure i
should find some kind of an excuse for not saying anything about it  for i do  love moons  they are so pretty and so romantic  i wish we had five
or six  i would never go to bed  i should never get tired lying on the moss bank  and looking up at them  stars are good  too  i wish i could
get some to put in my hair  but i suppose i never can  you would be surprised to find how far off they are  for they do not look it  when they
first showed  last night  i tried to knock some down with a pole  but it didn't reach  which astonished me  then i tried clouds till i was all
tired out  but i never got one  it was because i am left handed and cannot throw good  even when i aimed at  the one i wasn't after i couldn't hit
the other one  though i did make some close shots  for i saw the black blot of the cloud sail right into  the midst of the golden clusters forty
or fifty times  just barely missing them  and if i could have held out a little longer maybe i could have  got one  so i cried a little  which
was natural  i suppose  for one of my age  and after i was rested i got a basket and started for a place on the extreme  rim of the circle  where
the stars were close to the ground and i could get them with my hands  which would be better  anyway  because i could  gather them tenderly then
and not break them  but it was farther than i thought  and at last i had to give it up  i was so tired i couldn't drag  my feet another step  and
besides  they were sore and hurt me very much  i couldn't get back home  it was too far and turning cold  but i found some tigers and nestled in
among them and was most adorably comfortable  and their breath was sweet and pleasant  because they live on strawberries  i had never seen a
tiger before  but i knew them in a minute by the  stripes  if i could have one of those skins  it would make a lovely goon  today i am getting
better ideas about distances  i was so eager to get hold of every pretty thing that i giddily grabbed for it  sometimes when it  was too far off
and sometimes when it was but six inches away but seemed a foot  alas  with thorns between  i learned a lesson  also i made an axiom  all out of
my own head  my very first one  the scratched experiment shuns the thorn  i think it is a very good one for one so young  i followed the other
experiment around yesterday afternoon  at a distance to see what it might be for  if i could  but i was not able to make out  i think it is a
man  i had never seen a man  but it looked like one  and i feel sure that that is what it is  i realize that i feel more curiosity about it than
```

Figure 10: Part 4: Cryptanalysis output

## Acknowledgment

- **Part-0: Introduction to MATLAB**
  - Divkumar Patel (Student Id: 249417620)
  - Mihirkumar Mistry (Student Id: 249419480)
- **Part-1: Plotting Letter Frequency with  $k=0$** 
  - Divkumar Patel (Student Id: 249417620)
- **Part-2: Plotting Letter Frequency with  $k=1$** 
  - Mihirkumar Mistry (Student Id: 249419480)
- **Part-3: Cryptanalysis**
  - Divkumar Patel (Student Id: 249417620)
  - Mihirkumar Mistry (Student Id: 249419480)
- **Part-4: Write Your Own Code**
  - Divkumar Patel (Student Id: 249417620)

- Mihirkumar Mistry (Student Id: 249419480)

- **Assignment Report:**

- Divkumar Patel (Student Id: 249417620)

- Mihirkumar Mistry (Student Id: 249419480)

## Conclusion

In conclusion, this assignment provided a hands-on exploration of cryptography fundamentals through the Caesar Cipher and MATLAB. Starting with basic encryption using a key of 0, we observed the unchanged letter frequency, reinforcing our understanding of how shifts affect text. Increasing the key to 1 showed how even small adjustments impact letter distribution. Finally, by developing MATLAB code for cryptanalysis, we applied these principles to decrypt unknown cipher-text, gaining insights into key discovery and decryption techniques. Overall, this exercise strengthened both our understanding of cryptographic concepts and our MATLAB programming skills.

## References

- [1] MATLAB. Matlab documentation.
- [2] Wikipedia contributors. Letter frequency - wikipedia.
- [3] GeeksforGeeks given i=G. Caesar cipher in cryptography.