Assignment 2: Advanced Cryptography and Cryptanalysis (COSC5196)

Mihirkumar Mistry (Student ID: 249419480)
Divkumar Patel (Student ID: 249417620)
Group Number: 11

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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.

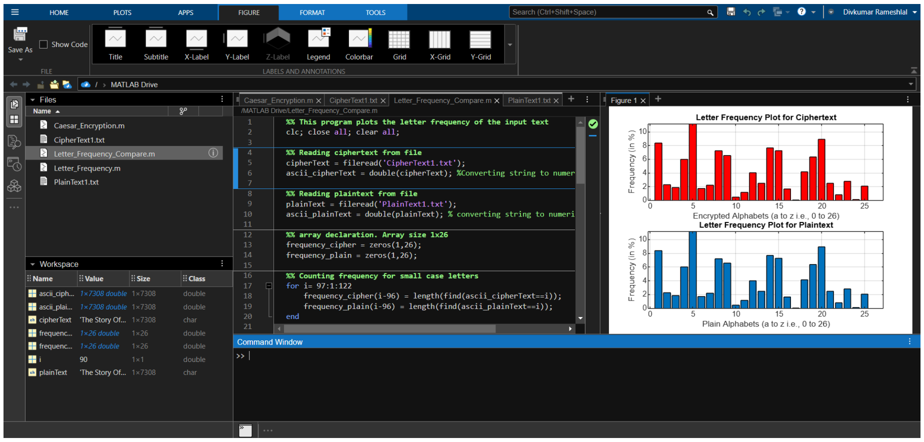
```matlab
%% Caesar Cipher encryption
% m = plain text string. Contains only a-to-z and space
% k = encryption key, ranges from 1 to 26
% cipherText = encrypted text k(m).

clc; clear all; close all;

m = fileread('PlainText1.txt'); % reading plaintext from text file
k = 0; % encryption key
ascii_m = double(m);          % ascii values of the string

%% Finding the locations of special characters
characters1 = find(ascii_m < 65);
characters2 = find(ascii_m == 96);
characters3 = find(ascii_m > 122);

%% special characters are replaced by space
ascii_m(characters1) = 32;
ascii_m(characters2) = 32;
ascii_m(characters3) = 32;


%% Encryption
ascii_cipherText = ascii_m+k;
wrap = find(ascii_cipherText>122); % wraping around if greater than 'z'
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
wrap = find(ascii_cipherText==96); % wraping around if greater than 'z'
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;


%% restoring spaces
ascii_cipherText(characters1) = 32;
ascii_cipherText(characters2) = 32;
ascii_cipherText(characters3) = 32;

cipherText = char(ascii_cipherText);

%% Writing encrypted text in a text file
%fid = fopen('C:\Users\Administrator\Documents\MATLAB\CipherText1.txt','wt');
fid = fopen('Task_1_CipherText1.txt','wt');
fprintf(fid, '%s', cipherText);
fclose(fid);
```

Letter frequency distribution plot code

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

```
%% This program plots the letter frequency of the input text
clc; close all; clear all;

%% Reading ciphertext from file
cipherText = fileread(’Task_1_CipherText1.txt’);
ascii_cipherText = double(cipherText); %Converting string to numeric ASCII values

%% Reading plaintext from file
plainText = fileread(’PlainText1.txt’);
ascii_plainText = double(plainText); % converting string to numeric ASCII values

%% array declaration. Array size 1x26
frequency_cipher = zeros(1,26);
frequency_plain = zeros(1,26);

%% Counting frequency for small case letters
for i= 97:1:122
    frequency_cipher(i-96) = length(find(ascii_cipherText==i));
    frequency_plain(i-96) = length(find(ascii_plainText==i));
end

%% Counting frequency for capital case letters
for i= 65:1:90
    frequency_cipher(i-64) = frequency_cipher(i-64) + length(find(ascii_cipherText==i));
    frequency_plain(i-64) = frequency_plain(i-64) + length(find(ascii_plainText==i));
end

%% Normalizing to percentage value
frequency_cipher = frequency_cipher/sum(frequency_cipher)*100;
frequency_plain = frequency_plain/sum(frequency_plain)*100;

%% Ploting letter frequency for ciphrtext
subplot(2,1,1)
bar(frequency_cipher, ’red’)
xlabel(’Encrypted Alphabets (a to z i.e., 0 to 26)’)
ylabel(’Frequency (in %)’)
title(’Letter Frequency Plot for Ciphertext’)
grid on

%% Ploting letter frequency for plaintext
subplot(2,1,2)
bar(frequency_plain, ’’)
xlabel(’Plain Alphabets (a to z i.e., 0 to 26)’)
ylabel(’Frequency (in %)’)
title(’Letter Frequency Plot for Plaintext’)
grid on
```

MATLAB interface image



```
%% This program plots the letter frequency of the input text
clc; close all; clear all;

%% Reading ciphertext from file
cipherText = fileread('CipherText1.txt');
ascii_cipherText = double(cipherText); %Converting string to numer

%% Reading plaintext from file
plainText = fileread('PlainText1.txt');
ascii_plainText = double(plainText); % converting string to numeri

%% array declaration. Array size 1x26
frequency_cipher = zeros(1,26);
frequency_plain = zeros(1,26);

%% Counting frequency for small case letters
for i= 97:1:122
    frequency_cipher(i-96) = length(find(ascii_cipherText==i));
    frequency_plain(i-96) = length(find(ascii_plainText==i));
end
```

```
>> |
```

Name	Value	Size	Class
ascii_ciph...	1×7308 double	1×7308	double
ascii_plai...	1×7308 double	1×7308	double
cipherText	'The Story Of...	1×7308	char
frequenc...	1×26 double	1×26	double
frequenc...	1×26 double	1×26	double
i	90	1×1	double
plainText	'The Story Of...	1×7308	char

Figure 1: MATLAB interface image for part 1

Output

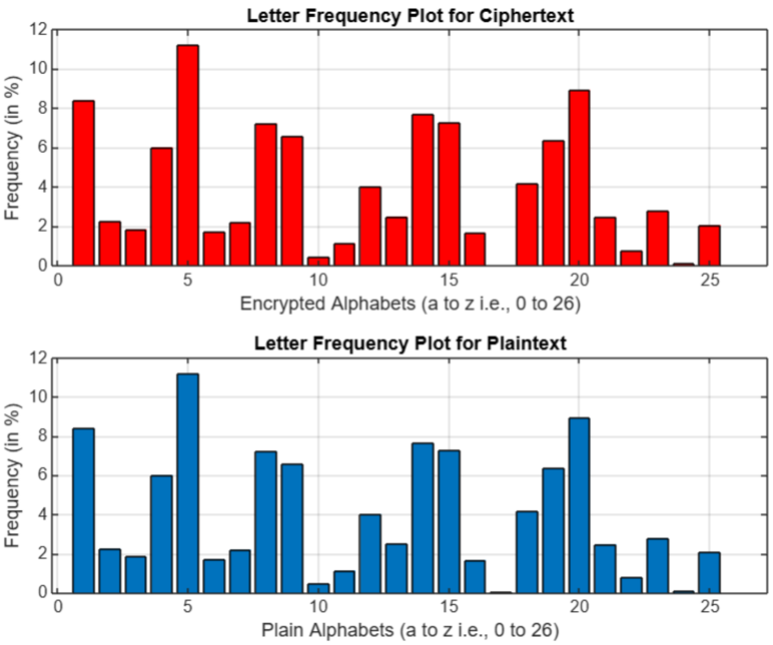


Figure 2: Part 1: plain-text and cipher-text frequency histogram

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.

```
%% Caesar Cipher encryption
% m = plain text string. Contains only a-to-z and space
% k = encryption key, ranges from 1 to 26
% cipherText = encrypted text k(m).

clc; clear all; close all;

```

```
m = fileread('PlainText1.txt'); % reading plaintext from text file
k = 1; % encryption key
ascii_m = double(m);         % ascii values of the string

%% Finding the locations of special characters
characters1 = find(ascii_m < 65);
characters2 = find(ascii_m == 96);
characters3 = find(ascii_m > 122);

%% special characters are replaced by space
ascii_m(characters1) = 32;
ascii_m(characters2) = 32;
ascii_m(characters3) = 32;


%% Encryption
ascii_cipherText = ascii_m+k;
wrap = find(ascii_cipherText>122); % wraping around if greater than 'z'
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
wrap = find(ascii_cipherText==96); % wraping around if greater than 'z'
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;


%% restoring spaces
ascii_cipherText(characters1) = 32;
ascii_cipherText(characters2) = 32;
ascii_cipherText(characters3) = 32;

cipherText = char(ascii_cipherText);

%% Writing encrypted text in a text file
%fid = fopen('C:\Users\Administrator\Documents\MATLAB\CipherText1.txt','wt');
fid = fopen('Task_2_CipherText1.txt','wt');
fprintf(fid, '%s', cipherText);
fclose(fid);
```

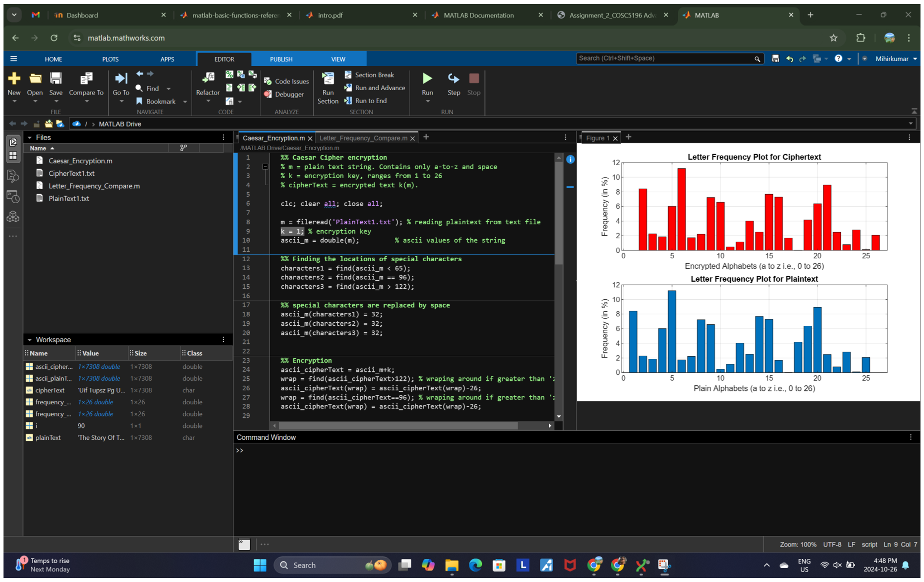
Letter frequency distribution plot code

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

```
%% This program plots the letter frequency of the input text
clc; close all; clear all;

%% Reading ciphertext from file
cipherText = fileread('Task_2_CipherText1.txt');
ascii_cipherText = double(cipherText); %Converting string to numeric ASCII values

%% Reading plaintext from file
plainText = fileread('PlainText1.txt');
ascii_plainText = double(plainText); % converting string to numeric ASCII values
```

```matlab

%% array declaration. Array size 1x26
frequency_cipher = zeros(1,26);
frequency_plain = zeros(1,26);

%% Counting frequency for small case letters
for i= 97:1:122
    frequency_cipher(i-96) = length(find(ascii_cipherText==i));
    frequency_plain(i-96) = length(find(ascii_plainText==i));
end

%% Counting frequency for capital case letters
for i= 65:1:90
    frequency_cipher(i-64) = frequency_cipher(i-64) + length(find(ascii_cipherText==i));
    frequency_plain(i-64) = frequency_plain(i-64) + length(find(ascii_plainText==i));
end

%% Normalizing to percentage value
frequency_cipher = frequency_cipher/sum(frequency_cipher)*100;
frequency_plain = frequency_plain/sum(frequency_plain)*100;

%% Ploting letter frequency for ciphrtext
subplot(2,1,1)
bar(frequency_cipher, 'red')
xlabel('Encrypted Alphabets (a to z i.e., 0 to 26)')
ylabel('Frequency (in %)')
title('Letter Frequency Plot for Ciphertext')
grid on

%% Ploting letter frequency for plaintext
subplot(2,1,2)
bar(frequency_plain, '')
xlabel('Plain Alphabets (a to z i.e., 0 to 26)')
ylabel('Frequency (in %)')
title('Letter Frequency Plot for Plaintext')
grid on
```

MATLAB interface image



Letter Frequency Plot for Ciphertext
Frequency (in %)
Encrypted Alphabets (a to z i.e., 0 to 26)
Letter Frequency Plot for Plaintext
Frequency (in %)
Plain Alphabets (a to z i.e., 0 to 26)
0
2
4
6
8
10
12
5
10
15
20
25

/MATLAB Drive/Caesar_Encryption.m

```
%% Caesar Cipher encryption
% m = plain text string. Contains only a-to-z and space
% k = encryption key, ranges from 1 to 26
% cipherText = encrypted text k(m).

clc; clear all; close all;

m = fileread('PlainText1.txt'); % reading plaintext from text file
k = 1; % encryption key
ascii_m = double(m);         % ascii values of the string

%% Finding the locations of special characters
characters1 = find(ascii_m < 65);
characters2 = find(ascii_m == 96);
characters3 = find(ascii_m > 122);

%% special characters are replaced by space
ascii_m(characters1) = 32;
ascii_m(characters2) = 32;
ascii_m(characters3) = 32;


%% Encryption
ascii_cipherText = ascii_m+k;
wrap = find(ascii_cipherText>122); % wraping around if greater than 'z
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
wrap = find(ascii_cipherText==96); % wraping around if greater than 'z
ascii_cipherText(wrap) = ascii_cipherText(wrap)-26;
```

Files:

- Caesar_Encryption.m
- CipherText1.txt
- Letter_Frequency_Compare.m
- PlainText1.txt

Workspace

Name	Value	Size	Class
ascii_cipher...	1×7308 double	1×7308	double
ascii_plainT...	1×7308 double	1×7308	double
cipherText	'Uif Tupsz Pg U...	1×7308	char
frequency_...	1×26 double	1×26	double
frequency_...	1×26 double	1×26	double
i	90	1×1	double
plainText	'The Story Of T...	1×7308	char

```
>>
```

Figure 3: MATLAB interface image for part 2

Output

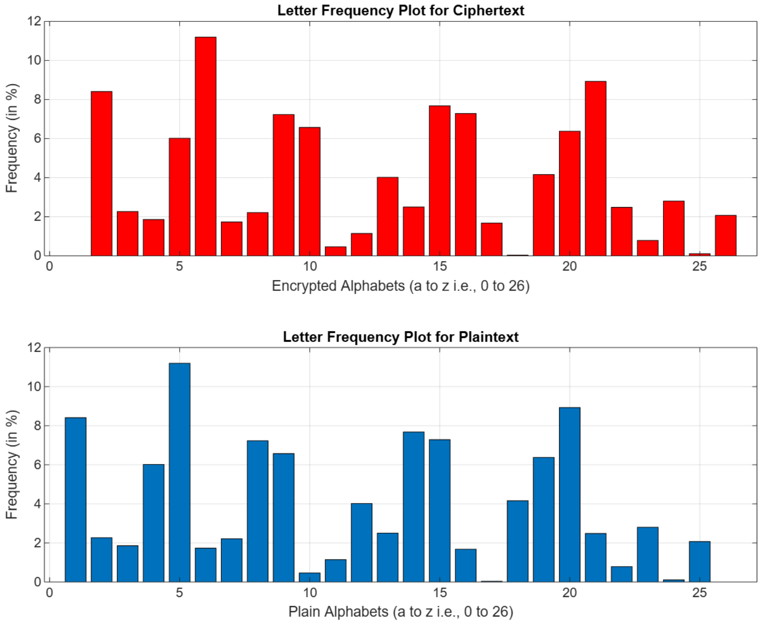


Figure 4: Part 2: plain-text and cipher-text frequency histogram

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

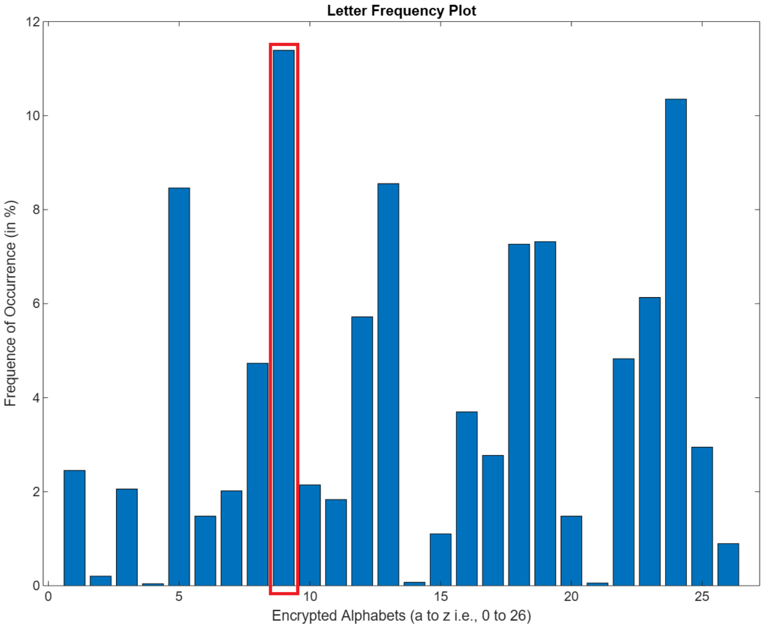


Figure 5: Histogram of CipherText2.txt

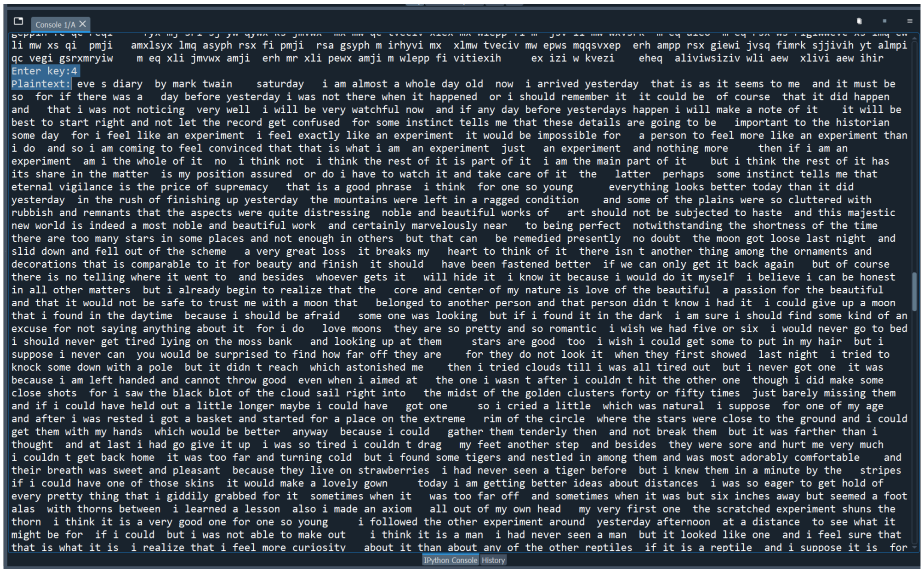
To interpret this, we compared the histogram with the typical letter frequency distribution of the English alphabet, where the letter **”E”** is known to have the highest frequency. By using this as a reference, we identified the letter with the highest frequency in our cipher-text, located in column 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

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

```
cipher_text = input(’Enter cipher text:’)
# Take key value from the user
key = int(input(’Enter key:’))

# Caesar cipher decryption function
def caesar_cipher_decryption(cipher_text, key):
    plain_text = ""

    for char in cipher_text:
        # Check if the char is a alphabet or not
        if char.isalpha():
            # Get the ASCII value of the base char, based on the case
            start = ord(’A’) if char.isupper() else ord(’a’)
            # Finding the plaintext using character shifting algorithm
            decrypted_char = chr((ord(char) - start - key) % 26 + start)
            # Add the resulting char
            plain_text += decrypted_char
        else:
            # Keep the Non-alphabet character as it is
            plain_text += char

    return plain_text

# Call caesar_cipher_decryption with user input
print(’Plaintext:’,caesar_cipher_decryption(cipher_text, key))
```

Output



```
li mw xs qi  pmji   amxlsyx lmq asyph rsx fi pmji  rsa gsyph m irhyvi mx  xlmw tveciv mw epws mqqsvxep  erh ampp rsx giewi jvsq fimrk sjjivih yt almpi
qc vegi gsrxmryiw    m eq xli jmvwx amji  erh mr xli pewx amji m wlepp fi vitiexih     ex izi w kvezi    eheq  aliviwsiziv wli aew  xlivi aew ihir
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 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 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 curiosity   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

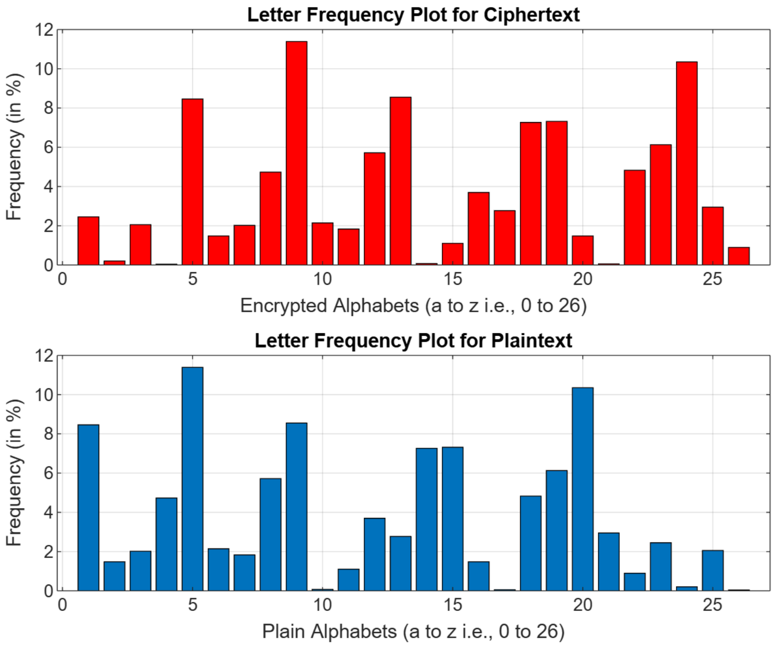


Figure 7: Part 3: Histogram of plain-text and cipher-text

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]

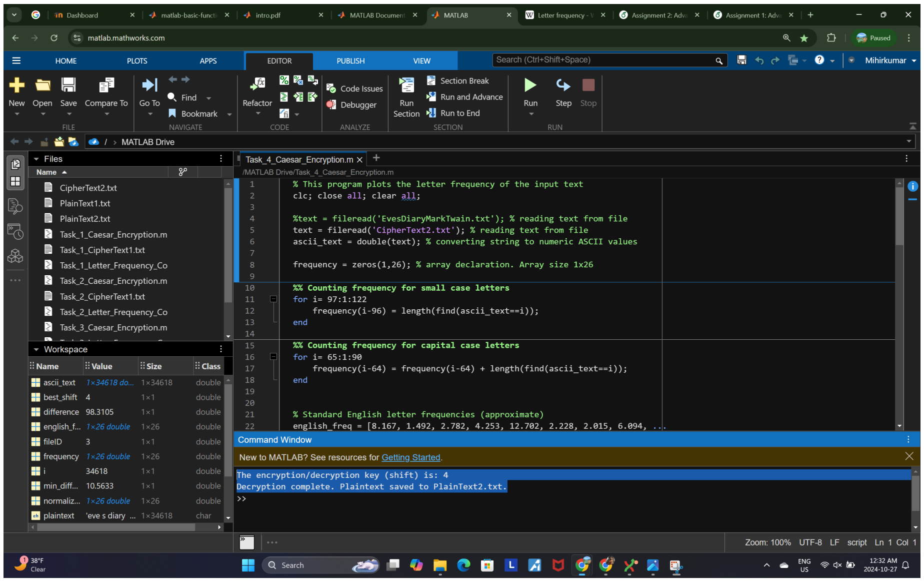
Caesar cipher cryptanalysis code

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

```matlab
% This program will find the key and decript the cipher text
clc; close all; clear all;

text = fileread('CipherText2.txt'); % reading text from file
ascii_text = double(text); % converting string to numeric ASCII values

frequency = zeros(1,26); % array declaration. Array size 1x26

%% Counting frequency for small case letters
for i= 97:1:122
    frequency(i-96) = length(find(ascii_text==i));
end

%% Counting frequency for capital case letters
for i= 65:1:90
    frequency(i-64) = frequency(i-64) + length(find(ascii_text==i));
end


% Standard English letter frequencies (approximate)
english_freq = [8.167, 1.492, 2.782, 4.253, 12.702, 2.228, 2.015, 6.094, ...
                6.966, 0.153, 0.772, 4.025, 2.406, 6.749, 7.507, 1.929, ...
                0.095, 5.987, 6.327, 9.056, 2.758, 0.978, 2.361, 0.150, ...
                1.974, 0.074];

% Normalize the frequencies of the ciphertext to compare with English frequencies
total_letters = sum(frequency);
normalized_frequency = (frequency / total_letters) * 100;

% Find the best shift by comparing each possible shift with standard frequencies
best_shift = 0;
min_difference = inf; % Start with a large number

for shift = 0:25
    % Shift frequencies
    shifted_frequency = circshift(normalized_frequency, -shift);

    % Calculate the sum of absolute differences for this shift
    difference = sum(abs(shifted_frequency - english_freq));

    % Update the best shift if this one has a smaller difference
    if difference < min_difference
        min_difference = difference;
        best_shift = shift;
    end
end

% Decrypt the text using the best shift found
plaintext = char(ascii_text); % Initialize with original text structure
```

```
for i = 1:length(ascii_text)
    if ascii_text(i) >= 65 && ascii_text(i) <= 90
        % Uppercase letters
        plaintext(i) = char(mod(ascii_text(i) - 65 - best_shift, 26) + 65);
    elseif ascii_text(i) >= 97 && ascii_text(i) <= 122
        % Lowercase letters
        plaintext(i) = char(mod(ascii_text(i) - 97 - best_shift, 26) + 97);
    end
end

% Save the plaintext to a file
fileID = fopen('PlainText2.txt', 'w');
fprintf(fileID, '%s', plaintext);
fclose(fileID);

% Display the encryption key and success message
fprintf('The encryption/decryption key (shift) is: %d\n', best_shift);
disp('Decryption complete. Plaintext saved to PlainText2.txt.');
```

MATLAB interface image



Workspace

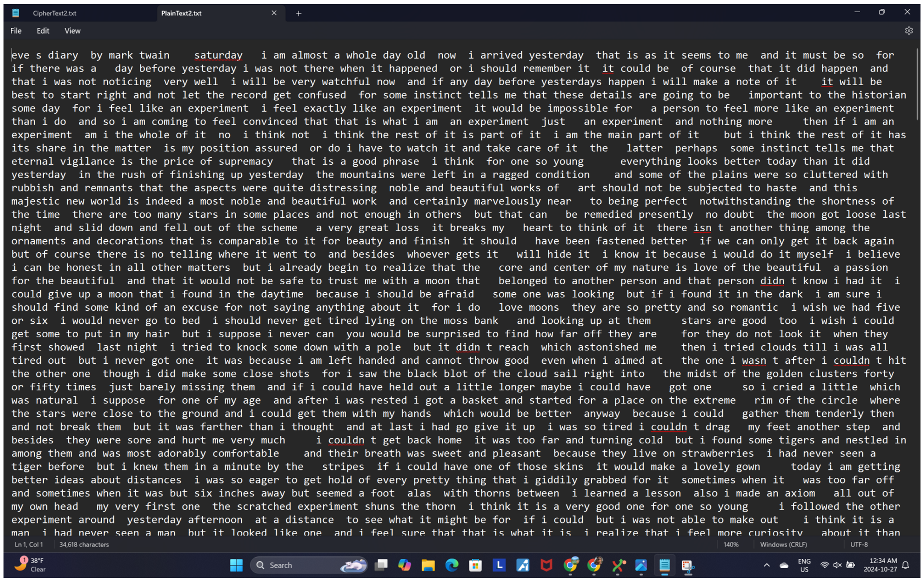
Name	Value	Size	Class
ascii_text	1×34618 do...	1×34618	double
best_shift	4	1×1	double
difference	98.3105	1×1	double
english_f...	1×26 double	1×26	double
fileID	3	1×1	double
frequency	1×26 double	1×26	double
i	34618	1×1	double
min_diff...	10.5633	1×1	double
normaliz...	1×26 double	1×26	double
plaintext	'eve s diary ...	1×34618	char

```
% This program plots the letter frequency of the input text
clc; close all; clear all;

%text = fileread('EvesDiaryMarkTwain.txt'); % reading text from file
text = fileread('CipherText2.txt'); % reading text from file
ascii_text = double(text); % converting string to numeric ASCII values

frequency = zeros(1,26); % array declaration. Array size 1x26

%% Counting frequency for small case letters
for i= 97:1:122
    frequency(i-96) = length(find(ascii_text==i));
end

%% Counting frequency for capital case letters
for i= 65:1:90
    frequency(i-64) = frequency(i-64) + length(find(ascii_text==i));
end


% Standard English letter frequencies (approximate)
english_freq = [8.167, 1.492, 2.782, 4.253, 12.702, 2.228, 2.015, 6.094, ...
```

```
The encryption/decryption key (shift) is: 4
Decryption complete. Plaintext saved to PlainText2.txt.
>>
```

Figure 8: MATLAB interface image for part 4

Output



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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 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 curiosity  about it than
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Figure 9: 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.