

Week 1 - Classical Cryptosystems

MAT260: Cryptology

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Introduction:

The assigned computer problems this week are from Chapter 2, Problems 1, 2, 4, and 9.

Make sure to review the example computer problems in "Appendix C.2 Examples for Chapter 2" that work similar problems to those you are assigned.

Make sure to run your code so all relevant computations/results are displayed and then export your work as a PDF file for submission.

Chapter 2 Problems:

Problem 1: I ran ciphertexts and used the command allshift to get all possible shifts. So, the correct plaintext is "watch out for Brutus"

```
%ciphertexts
%allshift(ycve)
```

Problem 2: I ran ciphertexts and used the command allshift to get all possible shifts. So, the correct plaintext is "Eve expect eggs for breakfast"

```
allshift(lcll)
```

```
lcllewljazlnnzmvyiylhrmhza
mdmmfxmkbamooanwzjzmisniab
nenngynlcbnppboxakanjtojbc
ofohzomdcoqqcpyblbokupkcd
pgppiapedprdqzcmclvqlde
qhqqjbbqofeqsseradndqmwrmef
rirkcrpgfrttfsbeoernxsnfg
sjssldsqhgsuugtcfpfsoytogh
tkttmetrihtvvhudgggtpzuphi
uluunfusjiuwwivehrhugavqij
vmvovgvtkjvxxjwfisivrbrjrk
wnwwphwulkwyykxgjtjwscxskl
xoxqxixvmlxzzlyhkukxtdytlm
ypyyrjywnmyaamzilvlyuezumn
zqzzskzxonzbbnajmwmzvfavno
araatlappoaccobknxnawgbwop
bsbbumbzqpbddpclloyobxhcxpq
ctccvncarqceeqdmpzpcyidyqr
```

```
duddwodbsrdffrenqagdzejzrs
eveexpectseggsforbreakfast
fwffyyqfdutfhhtgpscscfblgbtu
gxggzrgevugiiuhqtdtgcmhcu
hyhhashfwvhjjvirueuhdnidvw
iziibtigxwikkwjsvfvieojewx
jajjcujhyxjllxktwgwjfpkfx
kbbkdvkizykmmyluxhxxkgqlgyz
```

Problem 4:

```
% if i -> e & f -> d
% then E(8) = 4 and E(5) = 3
% so, a * 8 + b = 4 mod 26 & a * 5 + b = 3 mod 26
% (8a+b) - (5a+b) ≡ 4-3 mod 26 = 3 * a = 1 mod 26
% Since 27 = 1 mod 26 & 3 * 9 = 27 => a = 9
a = 9;
% so, 9 * 8+b = 4 mod 26 => 72 + b = 4 mod 26
% so, b = 4-72 = -68 mod 26
% -68 + 26 = -42
% -42 + 26 = -16
% -16 + 26 = 10 so, b = 10
b = 10;
% Since, 9 * a^-1 = 1 mod 26
% 9 * 3 = 27 = 1 mod 26 => a^-1 = 3
a_inv = 3; % inverse of 9 mod 26
%convert letters to numbers
disp(edsg);
```

```
edsgickxhuklzveqzvkwkzucvuh
```

```
y = text2int(edsg);
disp(y);
```

```
4      3      18      6      8      2      10      23      7      20      10      11      25      21      4      16      25
```

```
plaintext_nums = mod(a_inv * (y - b), 26);
disp(plaintext_nums);
```

```
8      5      24      14      20      2      0      13      17      4      0      3      19      7      8      18      19
```

```
% convert numbers to letters
plaintext = int2text(plaintext_nums);
disp(plaintext);
```

```
ifyoucanreadthisthankateacher
```

Problem 9:

```
% Problem 9 Code Here

% Vigenère Cipher Decryption using frequency correlation
% Based on Appendix C.2 style

% Define normalized English letter frequencies (a to z)
```

```

freqs = [0.08167 0.01492 0.02782 0.04253 0.12702 0.02228 0.02015 0.06094 ...
         0.06966 0.00153 0.00772 0.04025 0.02406 0.06749 0.07507 0.01929 ...
         0.00095 0.05987 0.06327 0.09056 0.02758 0.00978 0.02360 0.00150 ...
         0.01974 0.00074];

% Set the key length
m = 6;

% Initialize the key vector
key = zeros(1, m);

% For each position modulo m, compute the shift with best correlation
for i = 1:m
    max_corr = -inf;
    best_shift = 0;

    % Try all 26 shifts and compute correlation with English frequency
    for shift = 0:25
        vec = circshift(vigvec(ocwy, m, i), -shift);
        c = corrcoef(vec, freqs);
        if c(1,2) > max_corr
            max_corr = c(1,2);
            best_shift = shift;
        end
    end

    % Store the negative shift for decryption
    key(i) = -best_shift;
end

```

```

a 3
b 4
c 2
d 0
e 0
f 1
g 0
h 5
i 2
j 1
k 3
l 4
m 0
n 3
o 4
p 4
q 0
r 1
s 1
t 2
u 7
v 1
w 2
x 0
y 1
z 1

```

a	3
b	4
c	2
d	0
e	0
f	1
g	0
h	5
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n	0
o	1
p	0
q	0
r	0
s	2
t	0
u	4
v	0
w	4
x	0
y	0
z	1

```
% Decrypt using the computed key
plaintext = vigenere(ocwy, key);

% Decrypted Plaintext:
disp(plaintext);
```

holmeshadbeenseatedforsomehoursinsilencewithhislongthinbackcurvedoverachemicalvesselinwhichhewasbrewingapa

```
% Decryption Key (letters):
disp(int2text(mod(-key, 26)));
```

holmes

```
% Decryption Key (numeric):
disp(key);
```

-7 -14 -11 -12 -4 -18