**Theory:**

In cryptography, hill cipher is a polygraphic cipher based on linear algebra. Invented by Lester S. Hill in 1929 and thus got its name. It was the first cipher that was able to operate on 3 symbols at once.

Encryption: The given message string and key string is represented in the form of matrix. Then the key and message matrix are multiplied. Finally, modulo 26 is taken for each element of matrix obtained by multiplication. The key matrix that we take here should be invertible, otherwise decryption will not be possible. Encryption is given by:

c = E(k,p) = kp mod 26

Decryption: The encrypted message matrix is multiplied by the inverse of key matrix and finally its modulo 26 is taken to get the original message. Decryption is given by:

p = D(k,c) = ck-1 mod 26

**Programming Language: C**

**IDE: VS-Code**

**Code :**

#include<stdio.h>

#include<math.h>

float encrypt[3][1], decrypt[3][1], a[3][3], b[3][3], mes[3][1], c[3][3];

void encryption(); //encrypts the message

void decryption(); //decrypts the message

void getKeyMessage(); //gets key and message from user

void inverse(); //finds inverse of key matrix

void main() {

getKeyMessage();

encryption();

decryption();

}

void encryption() {

int i, j, k;

for(i = 0; i < 3; i++)

for(j = 0; j < 1; j++)

for(k = 0; k < 3; k++)

encrypt[i][j] = encrypt[i][j] + a[i][k] \* mes[k][j];

printf("\nEncrypted string is: ");

for(i = 0; i < 3; i++)

printf("%c", (char)(fmod(encrypt[i][0], 26) + 97));

}

void decryption() {

int i, j, k;

inverse();

for(i = 0; i < 3; i++)

for(j = 0; j < 1; j++)

for(k = 0; k < 3; k++)

decrypt[i][j] = decrypt[i][j] + b[i][k] \* encrypt[k][j];

printf("\nDecrypted string is: ");

for(i = 0; i < 3; i++)

printf("%c", (char)(fmod(decrypt[i][0], 26) + 97));

printf("\n");

}

void getKeyMessage() {

int i, j;

char msg[3];

printf("Enter 3x3 matrix for key (It should be inversible):\n");

for(i = 0; i < 3; i++)

for(j = 0; j < 3; j++) {

scanf("%f", &a[i][j]);

c[i][j] = a[i][j];

}

printf("\nEnter a 3 letter string: ");

scanf("%s", msg);

for(i = 0; i < 3; i++)

mes[i][0] = msg[i] - 97;

}

void inverse() {

int i, j, k;

float p, q;

for(i = 0; i < 3; i++)

for(j = 0; j < 3; j++) {

if(i == j)

b[i][j]=1;

else

b[i][j]=0;

}

for(k = 0; k < 3; k++) {

for(i = 0; i < 3; i++) {

p = c[i][k];

q = c[k][k];

for(j = 0; j < 3; j++) {

if(i != k) {

c[i][j] = c[i][j]\*q - p\*c[k][j];

b[i][j] = b[i][j]\*q - p\*b[k][j];

}

}

}

}

for(i = 0; i < 3; i++)

for(j = 0; j < 3; j++)

b[i][j] = b[i][j] / c[i][i];

printf("\n\nInverse Matrix is:\n");

for(i = 0; i < 3; i++) {

for(j = 0; j < 3; j++)

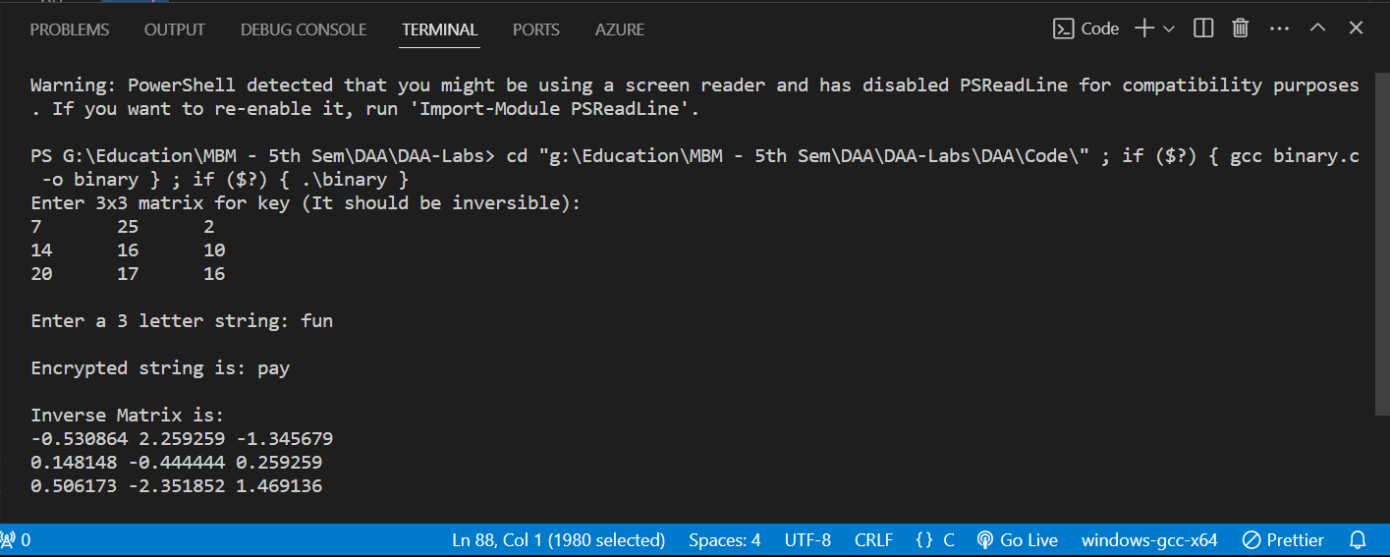
printf("%f ", b[i][j]);

printf("\n");

}

}

**Output**

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