Experiment 1

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Aim: Study and implement playfair Cipher.

Theory: The playfair cipher was the first practical diagraph substitution cipher. In playfair cipher, unlike traditional cipher we encrypt a pair of alphabets (diagraph) instead of a single alphabet.

Encryption technique - The algorithm consists of two steps:-

1) Generate the key square (5x5): This grid acts as the key for encrypting the plaintext. Each of the 25 alphabets must be unique and on letter of the alphabet (usually J) is ommitted from the table. If the plaintext contains J, then it is replaced by I.

2) Algorithm to encrypt the plain text: If there is an odd no. of letters a Z is added to last letter. Pair canno be made with same letter. Break the letter in single and add a bogus letter to the previous letter. If the letter is standing in the process of pairing, then add a extra bogus letter with the old letter.

'hello' → he lx lo

'helloe' → he lx lo ex

Rules for Encryption

1) If both the letters are in the same column, take the lette below each one (going back to the top if at the bottom).

2) If both the letters are in the same row, take the letter right of each one (going back to the leftmost if at the rightmost position) "st" → 'tl'

3) If neither is true form a rectange with the two letters and take the letters on horizontal opposite corners of the rectangle. 'nt' → 'rq'

Eg. Key = monarchy

plaintext - instruments.

M	O	N	A	R
C	H	Y	B	D
E	F	G	I/J	K
L	P	Q	S	T
U	V	W	X	Z

in st ru me nt sx

1) i → g   ga

n → a

2) s → t   tl

t → l

3) r → m   mz

v → z

4) m → c   cl

e → l

5) n → r   rq

t → q

6) s' → t   tz

z → x

Encrypted text = gatlmzclrqtz

Conclusion: Hence, we studied and implemented playfair cipher

EXPERIMENT 1

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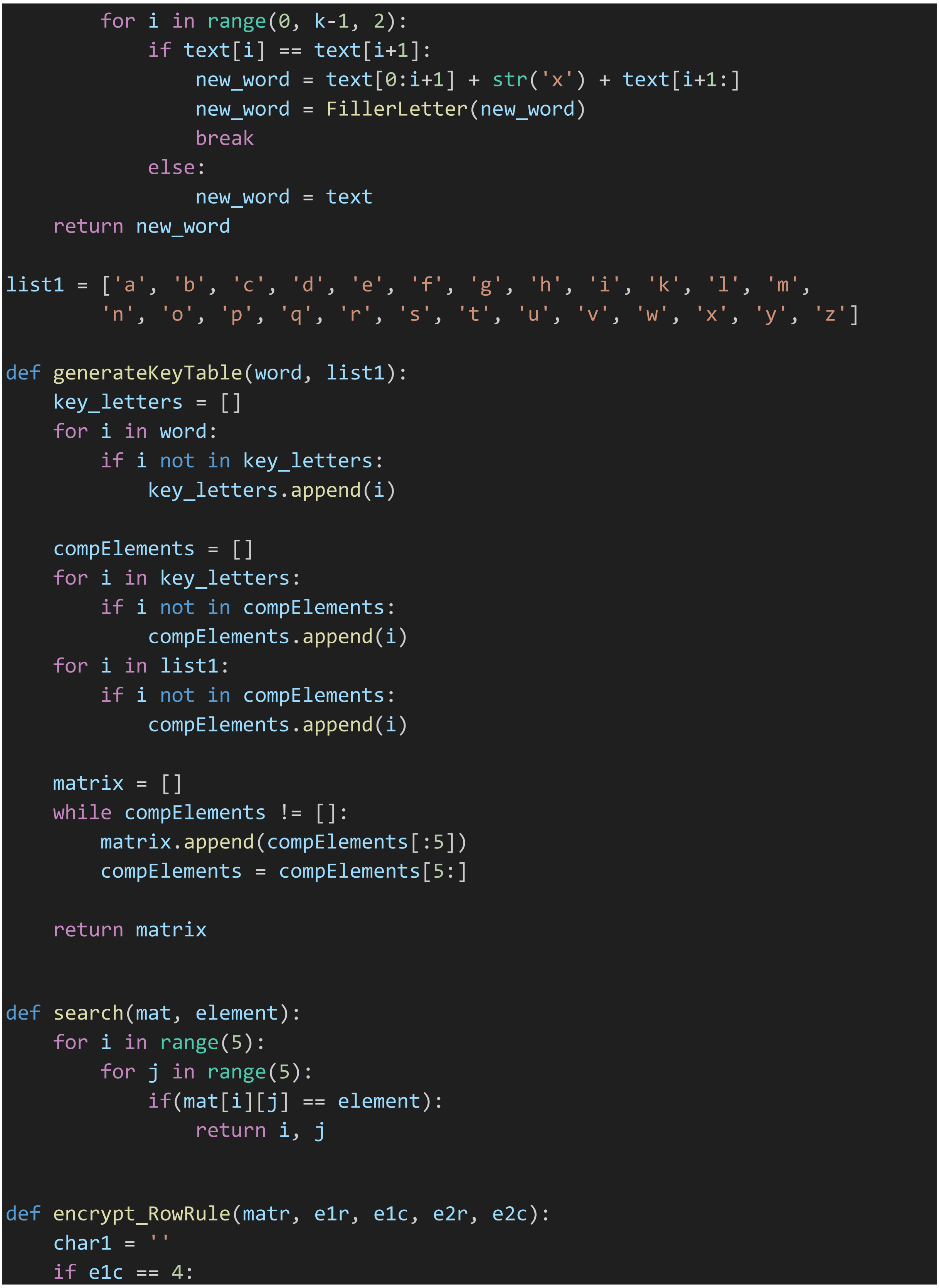
AIM: Study and Implement Playfair Cipher.

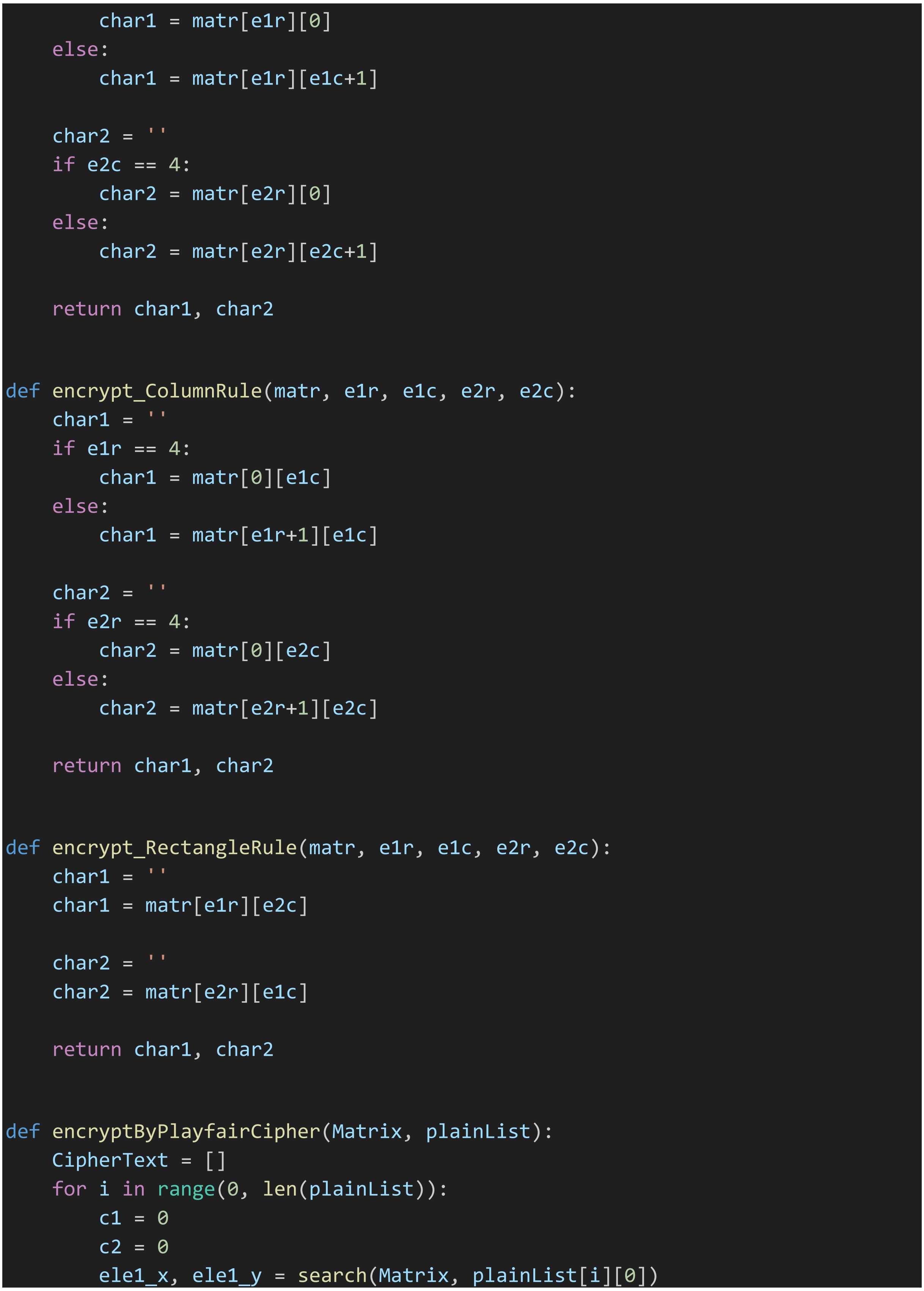
ENCRYPTION:

CODE:

```
def toLowerCase(text):
    return text.lower()

def removeSpaces(text):
    newText = ""
    for i in text:
        if i == " ":
            continue
        else:
            newText = newText + i
    return newText

def Diagraph(text):
    Diagraph = []
    group = 0
    for i in range(2, len(text), 2):
        Diagraph.append(text[group:i])

        group = i
    Diagraph.append(text[group:])
    return Diagraph

def FillerLetter(text):
    k = len(text)
    if k % 2 == 0:
        for i in range(0, k, 2):
            if text[i] == text[i+1]:
                new_word = text[0:i+1] + str('x') + text[i+1:]
                new_word = FillerLetter(new_word)
                break
            else:
                new_word = text
    else:
```

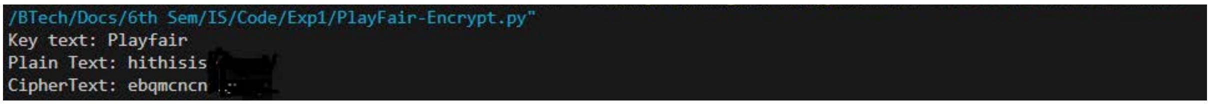


```
        for i in range(0, k-1, 2):
            if text[i] == text[i+1]:
                new_word = text[0:i+1] + str('x') + text[i+1:]
                new_word = FillerLetter(new_word)
                break
            else:
                new_word = text
    return new_word

list1 = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'k', 'l', 'm',
        'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z']

def generateKeyTable(word, list1):
    key_letters = []
    for i in word:
        if i not in key_letters:
            key_letters.append(i)

    compElements = []
    for i in key_letters:
        if i not in compElements:
            compElements.append(i)
    for i in list1:
        if i not in compElements:
            compElements.append(i)

    matrix = []
    while compElements != []:
        matrix.append(compElements[:5])
        compElements = compElements[5:]

    return matrix


def search(mat, element):
    for i in range(5):
        for j in range(5):
            if(mat[i][j] == element):
                return i, j


def encrypt_RowRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    if e1c == 4:
```



```
        char1 = matr[e1r][0]
    else:
        char1 = matr[e1r][e1c+1]

    char2 = ''
    if e2c == 4:
        char2 = matr[e2r][0]
    else:
        char2 = matr[e2r][e2c+1]

    return char1, char2


def encrypt_ColumnRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    if e1r == 4:
        char1 = matr[0][e1c]
    else:
        char1 = matr[e1r+1][e1c]

    char2 = ''
    if e2r == 4:
        char2 = matr[0][e2c]
    else:
        char2 = matr[e2r+1][e2c]

    return char1, char2


def encrypt_RectangleRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    char1 = matr[e1r][e2c]

    char2 = ''
    char2 = matr[e2r][e1c]

    return char1, char2


def encryptByPlayfairCipher(Matrix, plainList):
    CipherText = []
    for i in range(0, len(plainList)):
        c1 = 0
        c2 = 0
        ele1_x, ele1_y = search(Matrix, plainList[i][0])
        ele2_x, ele2_y = search(Matrix, plainList[i][1])

        if ele1_x == ele2_x:
            c1, c2 = encrypt_RowRule(Matrix, ele1_x, ele1_y, ele2_x, ele2_y)
            # Get 2 letter cipherText
        elif ele1_y == ele2_y:
            c1, c2 = encrypt_ColumnRule(Matrix, ele1_x, ele1_y, ele2_x,
ele2_y)
        else:
            c1, c2 = encrypt_RectangleRule(
                Matrix, ele1_x, ele1_y, ele2_x, ele2_y)

        cipher = c1 + c2
        CipherText.append(cipher)
    return CipherText


text_Plain = 'Hello world'
text_Plain = removeSpaces(toLowerCase(text_Plain))
PlainTextList = Diagraph(FillerLetter(text_Plain))
if len(PlainTextList[-1]) != 2:
    PlainTextList[-1] = PlainTextList[-1]+'z'

key = "Playfair"
print("Key text:", key)
key = toLowerCase(key)
Matrix = generateKeyTable(key, list1)

print("Plain Text:", text_Plain)
CipherList = encryptByPlayfairCipher(Matrix, PlainTextList)

CipherText = ""
for i in CipherList:
    CipherText += i
print("CipherText:", CipherText)
```

OUTPUT:

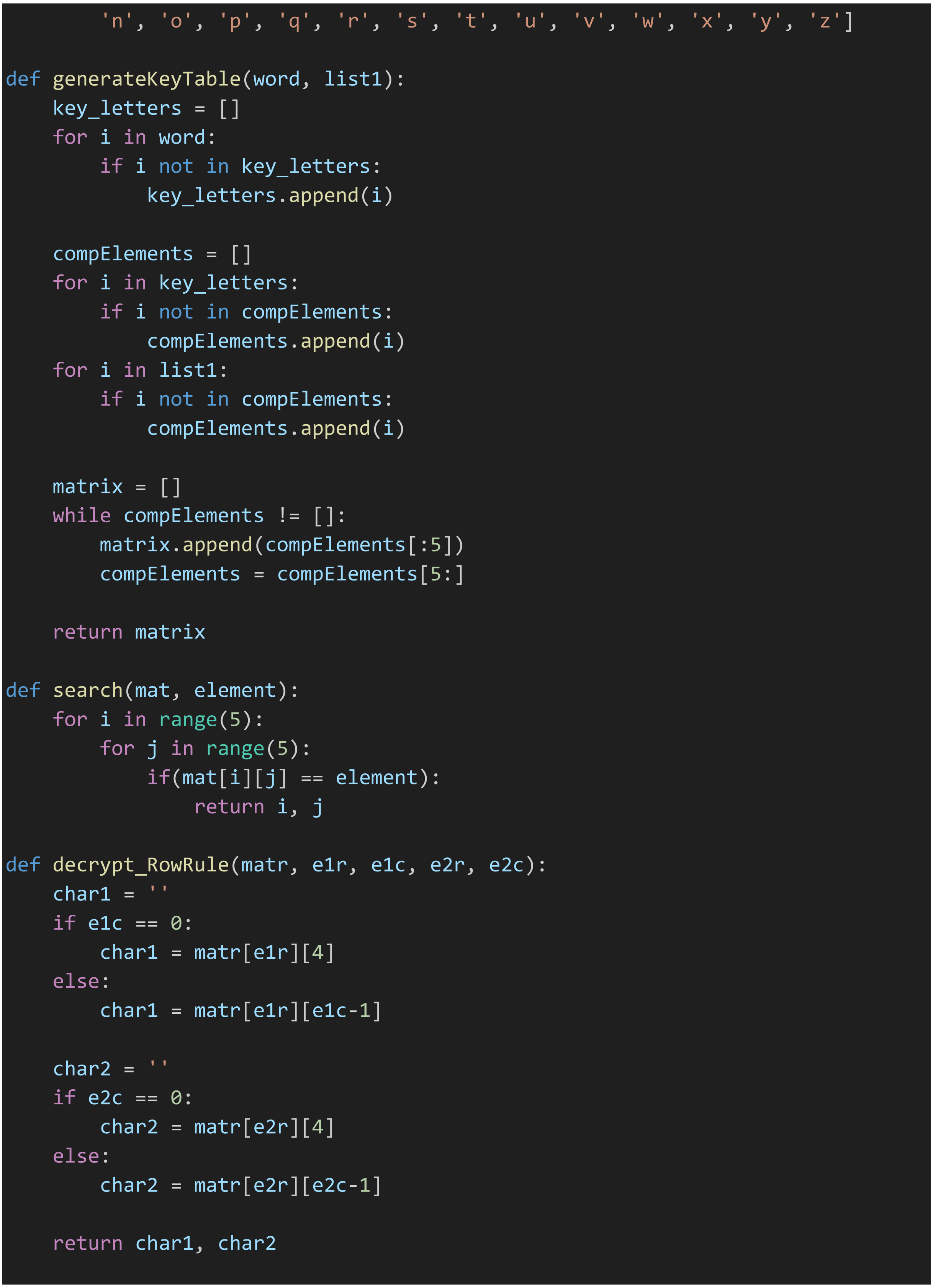


```
/BTech/Docs/6th Sem/IS/Code/Exp1/PlayFair-Encrypt.py"
Key text: Playfair
Plain Text: hithisis [redacted]
CipherText: ebqmcncn
```

DECRYPTION:

CODE:

```
def toLowerCase(text):
    return text.lower()

def removeSpaces(text):
    newText = ""
    for i in text:
        if i == " ":
            continue
        else:
            newText = newText + i
    return newText

def Diagraph(text):
    Diagraph = []
    group = 0
    for i in range(2, len(text), 2):
        Diagraph.append(text[group:i])
        group = i
    Diagraph.append(text[group:])
    return Diagraph

def FillerLetter(text):
    k = len(text)
    if k % 2 == 0:
        for i in range(0, k, 2):
            if text[i] == text[i+1]:
                new_word = text[0:i+1] + str('x') + text[i+1:]
                new_word = FillerLetter(new_word)
                break
            else:
                new_word = text
    else:
        for i in range(0, k-1, 2):
            if text[i] == text[i+1]:
                new_word = text[0:i+1] + str('x') + text[i+1:]
                new_word = FillerLetter(new_word)
                break
            else:
                new_word = text
    return new_word

list1 = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'k', 'l', 'm',
```

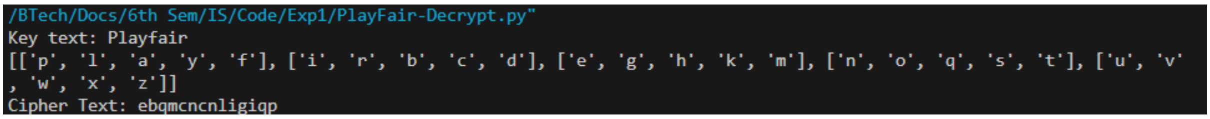


```
        'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z']

def generateKeyTable(word, list1):
    key_letters = []
    for i in word:
        if i not in key_letters:
            key_letters.append(i)

    compElements = []
    for i in key_letters:
        if i not in compElements:
            compElements.append(i)
    for i in list1:
        if i not in compElements:
            compElements.append(i)

    matrix = []
    while compElements != []:
        matrix.append(compElements[:5])
        compElements = compElements[5:]

    return matrix

def search(mat, element):
    for i in range(5):
        for j in range(5):
            if(mat[i][j] == element):
                return i, j

def decrypt_RowRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    if e1c == 0:
        char1 = matr[e1r][4]
    else:
        char1 = matr[e1r][e1c-1]

    char2 = ''
    if e2c == 0:
        char2 = matr[e2r][4]
    else:
        char2 = matr[e2r][e2c-1]

    return char1, char2
```

```
def decrypt_ColumnRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    if e1r == 0:
        char1 = matr[4][e1c]
    else:
        char1 = matr[e1r-1][e1c]

    char2 = ''
    if e2r == 0:
        char2 = matr[4][e2c]
    else:
        char2 = matr[e2r-1][e2c]

    return char1, char2

def decrypt_RectangleRule(matr, e1r, e1c, e2r, e2c):
    char1 = ''
    char1 = matr[e1r][e2c]

    char2 = ''
    char2 = matr[e2r][e1c]

    return char1, char2

def decryptByPlayfairCipher(Matrix, cipherList):
    PlainText = []
    for i in range(0, len(cipherList)):
        c1 = 0
        c2 = 0
        ele1_x, ele1_y = search(Matrix, cipherList[i][0])
        ele2_x, ele2_y = search(Matrix, cipherList[i][1])

        if ele1_x == ele2_x:
            c1, c2 = decrypt_RowRule(Matrix, ele1_x, ele1_y, ele2_x, ele2_y)
        elif ele1_y == ele2_y:
            c1, c2 = decrypt_ColumnRule(Matrix, ele1_x, ele1_y, ele2_x,
ele2_y)
        else:
            c1, c2 = decrypt_RectangleRule(Matrix, ele1_x, ele1_y, ele2_x,
ele2_y)

        plaintext = c1 + c2
        PlainText.append(plaintext)
    return PlainText
```

```
text_Cipher = 'ebqmcncnligiqp'
text_Cipher = removeSpaces(toLowerCase(text_Cipher))

# Pad the ciphertext if its length is odd
if len(text_Cipher) % 2 != 0:
    text_Cipher += 'x'

CipherTextList = Diagraph(text_Cipher)

key = "Playfair"
print("Key text:", key)
key = toLowerCase(key)
Matrix = generateKeyTable(key, list1)
print(Matrix)

print("Cipher Text:", text_Cipher)
PlainTextList = decryptByPlayfairCipher(Matrix, CipherTextList)

PlainText = ""
for i in PlainTextList:
    PlainText += i
print("PlainText:", PlainText)
```

OUTPUT:



```
/BTech/Docs/6th Sem/IS/Code/Exp1/PlayFair-Decrypt.py"
Key text: Playfair
[['p', 'l', 'a', 'y', 'f'], ['i', 'r', 'b', 'c', 'd'], ['e', 'g', 'h', 'k', 'm'], ['n', 'o', 'q', 's', 't'], ['u', 'v'
, 'w', 'x', 'z']]
Cipher Text: ebqmcncnligiqp
```