Cryptography and Network Security Lab

Assignment 1

Student Details

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Code:

```python
# Sample Text : once upon a time there was a little girl named goldilocks she went
for a walk in the forest pretty soon she came upon a house she knocked and when no
one answered she walked right in at the table in the kitchen there were three bowls
of porridge goldilocks was hungry she tasted the porridge from the first bowl


THEORETICAL_FREQUENCY = {"e": 12.7, "t": 9.06, "a": 8.17, "o": 7.51, "i": 6.97, "n":
6.75, "s": 6.33, "h": 6.09, "r": 5.99, "d": 4.25, "l": 4.02, "c": 2.78,
                         "u": 2.76, "m": 2.41, "w": 2.36, "f": 2.23, "g": 2.01, "y":
1.97, "p": 1.93, "b": 1.49, "v": 0.99, "k": 0.77, "j": 0.15, "x": 0.15, "q": 0.09,
"z": 0.07}
FREQUENCY_ANALYSIS_ALPHABETS = ["a", "b", "c", "d", "e", "f", "g", "h", "i", "j",
                                "k", "l", "m", "n", "o", "p", "q", "r", "s", "t", "u",
"v", "w", "x", "y", "z"]



def encrypt(text: str, key: int) -> str:
    """
    Encrypts text by shifting characters by key
    Text contains only alphabetical characters and spaces
    """
    ciphertext = ""
    for char in text:
        if char.isalpha():
            ciphertext += (
                chr((ord(char) - ord("a") + key) % 26 + ord("a"))
                if ord(char) >= ord("a")
                else chr((ord(char) - ord("A") + key) % 26 + ord("A"))
            )
        else:
            ciphertext += char
    return ciphertext
```

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def decrypt(text: str, key: int) -> str:
    """
    Decrypts text by shifting characters by key towards the left
    Text contains only alphabetical characters and spaces
    """
    ciphertext = ""
    for char in text:
        if char.isalpha():
            ciphertext += (
                chr((ord(char) - ord("a") - key + 26) % 26 + ord("a"))
                if ord(char) >= ord("a")
                else chr((ord(char) - ord("A") - key + 26) % 26 + ord("A"))
            )
        else:
            ciphertext += char
    return ciphertext


def frequency_analysis_decrypt(text: str) -> str:
    """
    Runs frequency analysis decryption on text to find out valid key and decrypted
text
    Returns tuple (key,decrypted_text)
    """
    TEXT_LENGTH = len(text)
    final_error = 100000000
    final_key = 0
    for key in range(0, 26):
        actual_frequency = {}
        decrypted_text = decrypt(text, key)
        for character in decrypted_text:
            if character == " " or character not in FREQUENCY_ANALYSIS_ALPHABETS:
                if character == " ":
                    continue
                raise Exception(
                    "Invalid character found in given encrypted text!")
            actual_frequency[character] = actual_frequency.get(
                character, 0) + 1

        error = sum([(THEORETICAL_FREQUENCY.get(character, 0) -
(100*(actual_frequency.get(
            character, 0)/TEXT_LENGTH)))**2 for character in
FREQUENCY_ANALYSIS_ALPHABETS])
        if error < final_error:
            final_key = key
            final_error = error
```

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        return final_key, decrypt(text, final_key)


def run_encrypt_dialog():
    """
    Runs menu for encryption dialog
    """
    text = input("Please enter a text to encrypt: ")
    key = int(input("Please enter a key: "))
    if key <= 0 and key >= 26:
        raise Exception("Please enter a key between 1 and 25 only!")
    print("Your encrypted text is: " + encrypt(text, key))


def run_decrypt_dialog():
    """
    Runs menu for decrypt dialog
    """
    text = input("Please enter a text to decrypt: ")
    try:
        key = int(input("Please enter a key: "))
    except:
        raise Exception("Please enter a valid key!")
    if key <= 0 or key >= 26:
        raise Exception("Please enter a key between 1 and 25 only!")
    print("Your decrypted text is: " + decrypt(text, key))


def run_brute_force_decrypt_dialog():
    """
    Prints result after using all the possible values of Key for given decrypted text
    """
    text = input("Please enter a text to decrypt: ")

    for key in range(0, 26):
        print(f"Key #{key}: {decrypt(text,key)}")


def run_frequency_analysis_decrypt_dialog():
    """
    Prints key and decrypted text after using frequency analysis for given decrypted
text
    """
    text = input(
```

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        "Please enter a text to decrpyt( Only Lowercase Alphabets and Space allowed)
:")

    key, decrypted_text = frequency_analysis_decrypt(text)

    print(f"Expected Key #{key} : {decrypted_text}")



def run_menu_loop():
    """
    Runs menu loop
    """
    try:
        choice = -1
        try:
            choice = int(
                input("1. Encrypt\n2. Decrypt\n3. Brute Force Attack\n4. Frequency
Analysis Decryption\n0. Exit\nPlease enter your choice: ")
            )
        except:
            raise Exception("Please enter a valid Integer Choice!")
        if choice == 1:
            run_encrypt_dialog()
        elif choice == 2:
            run_decrypt_dialog()
        elif choice == 3:
            run_brute_force_decrypt_dialog()
        elif choice == 4:
            run_frequency_analysis_decrypt_dialog()
        elif choice == 0:
            return
        else:
            print("Invalid choice!")
    except Exception as e:
        print(e)

if __name__ == "__main__":
    run_menu_loop()
```

Sample Output:

```
krhero@arc-warden:/media/krhero/0FB812900FB81290/BTech/Assignments/4th_Year/CNS/Assignment_1$ python3 ./1.py
1. Encrypt
2. Decrypt
3. Brute Force Attack
4. Frequency Analysis Decryption
0. Exit
Please enter your choice: 1
Please enter a text to encrypt: once upon a time there was a little girl named goldilocks she went for a walk in the forest pre
tty soon she came upon a house she knocked and when no one answered she walked right in at the table in the kitchen there were
three bowls of porridge goldilocks was hungry she tasted the porridge from the first bowl
Please enter a key: 3
Your encrypted text is: rqfh xsrq d wlph wkhuh zdv d olwwoh jluo qdphg jroglorfnv vkh zhqw iru d zdon lq wkh iruhvw suhwwb vrrq
 vkh fdph xsrq d krxvh vkh nqrfnhg dqg zkhq qr rqh dqvzhuhg vkh zdonhg uljkw lq dw wkh wdeoh lq wkh nlwfkhq wkhuh zhuh wkuhh er
zov ri sruulgjh jroglorfnv zdv kxqjub vkh wdvwhg wkh sruulgjh iurp wkh iluvw erzo
```

```
krhero@arc-warden:/media/krhero/0FB812900FB81290/BTech/Assignments/4th_Year/CNS/Assignment_1$ python3 ./1.py
1. Encrypt
2. Decrypt
3. Brute Force Attack
4. Frequency Analysis Decryption
0. Exit
Please enter your choice: 2
Please enter a text to decrypt: rqfh xsrq d wlph wkhuh zdv d olwwoh jluo qdphg jroglorfnv vkh zhqw iru d zdon lq wkh iruhvw suh
wwb vrrq vkh fdph xsrq d krxvh vkh nqrfnhg dqg zkhq qr rqh dqvzhuhg vkh zdonhg uljkw lq dw wkh wdeoh lq wkh nlwfkhq wkhuh zhuh
wkuhh erzov ri sruulgjh jroglorfnv zdv kxqjub vkh wdvwhg wkh sruulgjh iurp wkh iluvw erzo
Please enter a key: 3
Your decrypted text is: once upon a time there was a little girl named goldilocks she went for a walk in the forest pretty soon
 she came upon a house she knocked and when no one answered she walked right in at the table in the kitchen there were three bo
wls of porridge goldilocks was hungry she tasted the porridge from the first bowl
```

```
krhero@arc-warden:/media/krhero/0FB812900FB81290/BTech/Assignments/4th_Year/CNS/Assignment_1$ python3 ./1.py
1. Encrypt
2. Decrypt
3. Brute Force Attack
4. Frequency Analysis Decryption
0. Exit
Please enter your choice: 4
Please enter a text to decrpyt( Only Lowercase Alphabets and Space allowed) :rqfh xsrq d wlph wkhuh zdv d olwwoh jluo qdphg jro
glorfnv vkh zhqw iru d zdon lq wkh iruhvw suhwwb vrrq vkh fdph xsrq d krxvh vkh nqrfnhg dqg zkhq qr rqh dqvzhuhg vkh zdonhg ulj
kw lq dw wkh wdeoh lq wkh nlwfkhq wkhuh zhuh wkuhh erzov ri sruulgjh jroglorfnv zdv kxqjub vkh wdvwhg wkh sruulgjh iurp wkh ilu
vw erzo
Expected Key #3 : once upon a time there was a little girl named goldilocks she went for a walk in the forest pretty soon she c
ame upon a house she knocked and when no one answered she walked right in at the table in the kitchen there were three bowls of
 porridge goldilocks was hungry she tasted the porridge from the first bowl
```