

THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Deemed to be University)

Patiala, Punjab



A Mini Project On

“Secure Network Configuration”

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Under the supervision of

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ABSTRACT

This project focuses on the implementation of cryptographic algorithms, including Caesar Cipher, Playfair Cipher, and Hill Cipher, to explore the principles of data encryption and decryption. The main objective of this project is to analyze the computational efficiency and security of these algorithms when applied to text-based data.

The developed Python program provides functionality to encrypt and decrypt text using these algorithms, measures their execution time, and visualizes the results through comparative graphs. Additionally, the program includes a user-friendly interface for managing encryption keys and processing files.

The project demonstrates the trade-offs between encryption speed and security, highlighting scenarios where different algorithms may be preferred based on application requirements. Caesar Cipher offers simplicity and speed but limited security, while Hill Cipher ensures robust security at the cost of higher computational overhead. Playfair Cipher serves as a balanced approach, offering moderate security and performance.

This project not only provides valuable insights into cryptography but also equips students with hands-on experience in implementing encryption algorithms, benchmarking their performance, and applying them to practical use cases. Future improvements could include expanding the scope to cover more advanced cryptographic techniques and incorporating modern encryption standards for real-world applications.

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Encryption Algorithms: Analysis and Results

1. Codes for the Mentioned Algorithms

Caesar Cipher Code

```
def caesar_encrypt(text, shift):
    encrypted = ""
    for char in text:
        if char.isalpha():
            shift_base = 65 if char.isupper() else 97
            encrypted += chr((ord(char) - shift_base + shift) % 26 + shift_base)
        else:
            encrypted += char
    return encrypted

def caesar_decrypt(text, shift):
    return caesar_encrypt(text, -shift)
```

Playfair Cipher Code

```
import numpy as np
def to_lower_case(text):
    return text.lower()
def remove_spaces(text):
    return text.replace(" ", "")
def generate_key_table(key):
    key = remove_spaces(to_lower_case(key))
    key = key.replace('j', 'i') # Treat 'j' as 'i'
    key = ".join(dict.fromkeys(key)) # Remove duplicate letters
    alphabet = "abcdefghijklmnopqrstuvwxyz" # 'j' is excluded
    key_table = [c for c in key if c in alphabet]
    for char in alphabet:
        if char not in key_table:
            key_table.append(char)
    key_table = np.array(key_table).reshape(5, 5)
    return key_table
def search(key_table, a, b):
    if a == 'j': a = 'i'
    if b == 'j': b = 'i'
    p1 = p2 = None
```

```

for i in range(5):
    for j in range(5):
        if key_table[i, j] == a:
            p1 = (i, j)
        elif key_table[i, j] == b:
            p2 = (i, j)
    return p1, p2
def encrypt(plain_text, key):
    plain_text = remove_spaces(to_lower_case(plain_text))
    plain_text = plain_text.replace('j', 'i')
    i = 0
    while i < len(plain_text) - 1:
        if plain_text[i] == plain_text[i + 1]:
            plain_text = plain_text[:i + 1] + 'x' + plain_text[i + 1:]
            i += 2
    if len(plain_text) % 2 != 0:
        plain_text += 'z'
    key_table = generate_key_table(key)
    cipher_text = []
    for i in range(0, len(plain_text), 2):
        p1, p2 = search(key_table, plain_text[i], plain_text[i + 1])
        if p1[0] == p2[0]:
            cipher_text.append(key_table[p1[0], (p1[1] + 1) % 5])
            cipher_text.append(key_table[p2[0], (p2[1] + 1) % 5])
        elif p1[1] == p2[1]:
            cipher_text.append(key_table[(p1[0] + 1) % 5, p1[1]])
            cipher_text.append(key_table[(p2[0] + 1) % 5, p2[1]])
        else:
            cipher_text.append(key_table[p1[0], p2[1]])
            cipher_text.append(key_table[p2[0], p1[1]])
    return ".join(cipher_text)
def decrypt(cipher_text, key):
    key_table = generate_key_table(key)
    deciphered = []
    for i in range(0, len(cipher_text), 2):
        p1, p2 = search(key_table, cipher_text[i], cipher_text[i + 1])
        if p1[0] == p2[0]:
            deciphered.append(key_table[p1[0], (p1[1] - 1) % 5])
            deciphered.append(key_table[p2[0], (p2[1] - 1) % 5])
        elif p1[1] == p2[1]:
            deciphered.append(key_table[(p1[0] - 1) % 5, p1[1]])
            deciphered.append(key_table[(p2[0] - 1) % 5, p2[1]])
        else:
            deciphered.append(key_table[p1[0], p2[1]])

```

```

        deciphered.append(key_table[p2[0], p1[1]])
    return ''.join(deciphered)

```

Hill Cipher Code

```

import numpy as np
def hill_encrypt(text, key_matrix):
    text = ''.join(filter(str.isalpha, text.upper()))
    n = len(key_matrix)
    while len(text) % n != 0:
        text += 'A'
    text_vector = [ord(char) - 65 for char in text]
    text_matrix = np.array(text_vector).reshape(-1, n).T
    cipher_matrix = np.dot(key_matrix, text_matrix) % 26
    return ''.join(chr(num + 65) for num in cipher_matrix.T.flatten())
def hill_decrypt(ciphertext, key_matrix):
    det = round(np.linalg.det(key_matrix))
    inv_det = pow(int(det), -1, 26)
    adj_matrix = np.round(np.linalg.inv(key_matrix) * det).astype(int) % 26
    inv_key_matrix = (inv_det * adj_matrix) % 26
    ciphertext_vector = [ord(char) - 65 for char in ciphertext]
    ciphertext_matrix = np.array(ciphertext_vector).reshape(-1, key_matrix.shape[0]).T
    plain_matrix = np.dot(inv_key_matrix, ciphertext_matrix).round().astype(int) % 26
    return ''.join(chr(num + 65) for num in plain_matrix.T.flatten())

```

Driver File: Main Function

```

import time
import numpy as np
import matplotlib.pyplot as plt
from playfairCipher import encrypt as playfair_encrypt, decrypt as playfair_decrypt
from hillCipher import hill_encrypt, hill_decrypt, generate_key_matrix
from ceaserCipher import caesar_encrypt, caesar_decrypt

# Function to measure encryption/decryption time
def measure_time(func, *args):
    start_time = time.time()
    result = func(*args)
    end_time = time.time()
    return result, end_time - start_time

# Main Function
if __name__ == "__main__":

```

```

try:
    # Read the text file
    with open("Text_To_Be_Encrypted.txt", "r") as file:
        text = file.read().strip()

    caesar_shift = 3
    playfair_key = "SMPK"
    hill_key="GYBNQKURP"
    hill_key_matrix = generate_key_matrix(hill_key,3)
    # Encrypt and Decrypt with Caesar Cipher
    caesar_encrypted, caesar_enc_time = measure_time(caesar_encrypt, text, caesar_shift)
    caesar_decrypted, caesar_dec_time = measure_time(caesar_decrypt, caesar_encrypted,
caesar_shift)

    # Encrypt and Decrypt with Playfair Cipher
    playfair_encrypted, playfair_enc_time = measure_time(playfair_encrypt, text,
playfair_key)
    playfair_decrypted, playfair_dec_time = measure_time(playfair_decrypt,
playfair_encrypted, playfair_key)

    # Encrypt and Decrypt with Hill Cipher
    hill_encrypted, hill_enc_time = measure_time(hill_encrypt, text, hill_key_matrix)
    hill_decrypted, hill_dec_time = measure_time(hill_decrypt, hill_encrypted,
hill_key_matrix)

    # Write the decrypted texts to files
    with open("DecryptedText/caesar_decrypted.txt", "w") as file:
        file.write(caesar_decrypted.upper())
    with open("DecryptedText/playfair_decrypted.txt", "w") as file:
        file.write(playfair_decrypted.upper())
    with open("DecryptedText/hill_decrypted.txt", "w") as file:
        file.write(hill_decrypted.upper())

    # Write the Encrypted texts to files
    with open("EncryptedText/caesar_encrypted.txt", "w") as file:
        file.write(caesar_encrypted.upper())
    with open("EncryptedText/playfair_encrypted.txt", "w") as file:
        file.write(playfair_encrypted.upper())
    with open("EncryptedText/hill_encrypted.txt", "w") as file:
        file.write(hill_encrypted.upper())

    # Verification (Match Texts)
    print("Verification Results:")

```



```

print(f"Caesar Cipher Match: {text == caesar_decrypted}")
print(f"Playfair Cipher Match: {text.replace(' ', '').lower() == playfair_decrypted}")
print(f"Hill Cipher Match: {text.upper() == hill_decrypted}")

# Plot encryption/decryption times
algorithms = ["Caesar Cipher", "Playfair Cipher", "Hill Cipher"]
encryption_times = [caesar_enc_time, playfair_enc_time, hill_enc_time]
decryption_times = [caesar_dec_time, playfair_dec_time, hill_dec_time]

x = np.arange(len(algorithms))
plt.figure(figsize=(10, 6))

# Plot bars for encryption/decryption times
bars1 = plt.bar(x - 0.2, encryption_times, width=0.4, label="Encryption Time",
color="skyblue")
bars2 = plt.bar(x + 0.2, decryption_times, width=0.4, label="Decryption Time",
color="salmon")

# Add the time taken on top of each bar
for bar in bars1:
    plt.text(bar.get_x() + bar.get_width() / 2, bar.get_height(),
             f"{bar.get_height():.7f}s", ha="center", va="bottom", fontsize=10)

for bar in bars2:
    plt.text(bar.get_x() + bar.get_width() / 2, bar.get_height(),
             f"{bar.get_height():.7f}s", ha="center", va="bottom", fontsize=10)

# Add labels and grid
plt.xticks(x, algorithms)
plt.ylabel("Time (seconds)")
plt.title("Comparison of Encryption and Decryption Times")
plt.legend()
plt.grid(axis="y", linestyle="--", alpha=0.7)
plt.tight_layout()
plt.show()

except FileNotFoundError:
    print("The file 'Text_To_Be_Encrypted.txt' was not found. Please ensure it exists in the
script's directory.")

```

2. Encryption Keys

Caesar Cipher: Shift = 3

Playfair Cipher: Key = "SMPK"

Hill Cipher: key="GYBNQKURP"

Key Matrix = [[6, 24, 1], [13, 16, 10], [20, 17, 15]]

3. Generated Ciphertexts by Each Algorithm

Caesar Cipher:

TCMKEAGSLZBVQHRXFJWPYONUTSDIKGCPAHXRUQEJOMBNFDZWLYTCSPARVO
MFBEUQNIDJKWHYSGLOXCPAHBTMUSKRQVDZNFJOFGIEWXRLCSOPTUBKQMNHJ
VGIREZAWDLFYQCXOMKPUNBJRHGSFTZEQVYADJOXWMS PUBNGKIROFLHCTAQ
XEWJZNDMSVGO PUFYBEKWJQLRICZXHDNPAUSOGMFKBETCJWYQDVRHNZLXIP
UOASGBMKETFQYJWCZNOPAXHRMDUGSELYIBCQVTJKWFMDNUZQROPJYHXAEG
SLVCIWTMKFQPUDOYZBXNRJCSLMEGKAFIPTBNUSORQXWYHDJZOMVGQCEALW
PRUKNFYTSGBHJIMOQVALZNRDGEKPTYXUFCSABQLWJOMNGKVRDEZSHQYP
TFBUANIWXCISOQREJZKGDHYMPUFXTVBSAWILCONJRGKQEUYZDHXTMPBAIWY
FONSLUVGCRJQKEPAZOHBTXSWNGMFYUQKVPDCILJOZRGTESHBXUNQYAWMPC
FDIKRHEOZSLJUXTAGBQVPYNWMKUFDIZSHOJLBTAXCGRNPWEQUYMVFKTOSAI
ZBLCNRJPMWDGQXVYEUOKSFTBRCQHINJWPAZGMKULSXOVEYDFROQBHTNMW
JCZXGAPSKEUNLTBVMQHYDICOJFZEGSRWQKPABUINXMOYCHRFATLQDJWKEGS
UPZVMNIBXROYLFCTDAQUJKSPMRWNOXHVEBYGZFIQTBCDNXUPWKMYHJEALS
ROZFTVQXUGBAOWNYDJMPIECLSKRFGZUHAOPBTVQXMWYNDIJRGLBECOKFSZ
UAPQTHVNYMIEJWRXOSKCDUBLGQPZFMWJTNHVSBUOCEQKARFZPXWTSND
GJMV LHCUBQEIAOKZRWPYUNSXJMGFCLBETZDKVROAIXPHYBFWQEJMCUNGSO
LTZKDRQYVBAXFMCELIJUGNPOWSTHBVKRZDXYQAIPOMNCLWFUJVYSBETGRK
ZUOAMHPWFNIQSDXCTBGJKYVLQROPUAEWMBZXHCNLYQSOVIPGBETJKWDUXR
MAFCIZNOHSQYWAVBDLKCPEJUTGNMXOIRQFSYAZKLHRWBUBVMEXCJDAOIPNT
ZBLUSQGCYHMKFRVWEGXAQPOSCJMNULTYDKIBHZVFOQEWRMACXNPSYZGOJ
VQFTRUBHCIKLMOXDNA YPSFWQVTMGBJZUOEDLINASKPXYRQCGMOZWYLVXFT
JNBUDCSKHERPAOQZTGMNIWFSJVXLUYAPHCBRTWOQKMFZGDCUYXNJRLSAP
QHBZVKMTGEOWIDFNSYCRPVOXUJBQLKATZMWFYHGRNDIBOEVPQSKJCXUZMR
LHNFWBIO SAYDPUGTQKJNV LZREOXC BYWFTIGMSPKUAHQJLVROECZNDXWYSU
TBOQAPIGMFELNCJVURZKWH SXBTDYFPAUZIOVQGKSJCWMTLEXNBRHAYPIZCM
GDOKFXUSQWLJTNVBAREHOQZIDKMCUYTJPWNVBGLSFHXNEMORQKUIBDYWJA
XTSVQPCLZUIGRYBHNETMKPZSOJVBWCIDQXULRAYFMOZKNKSTPJWCHIGQELVY
RBATWFM DXOU CJPSEINKQGYZBVLHFOMRTDNWXSKAJCUIREBPZOIMGSTLAWX
VFKHQUOZINRPJDMGKCELT SWBYAHNPVFE XUOIJRQMAWXTDCPVSBFMKUONWZ
AYLTGKJREBIQMOCYHUPZSDNVXQFAWIKGTELMOJRUSNBZDPQYHOWAFVXMGE
UCSKIJPRTZDNYLMQHABGX SOCUWETKPVFOINCQYBAWDMZRJTHGESXP UOKBF
MLZQIWRNAY TJVGBDUPCFEHSKXLZOWAGMNR YDJUIBQTFVSKARWPCOUNHMB
YGXZJDQLEWIFOC SVAKTUPXMRNJTGDZQYBAWSECVOPLUJWPYONUTSDIKGCPA
HXRUQEJOMBNFDZWLYTCSPARVOMFBEUQNIDJKWHYSGLOXCPAHBTMUSKRQV
DZNFJOFGIEWXRLCSOPTUBKQMNHJVGIREZAWDLFYQCXOMKPUNBJRHGSFTZEQV
YADJOXWMS PUBNGKIROFLHCTAQXEWJZNDMSVGO PUFYBEKWJQLRICZXHDNPA
USOGMFKBETCJWYQDVRHNZLXIPUOASGBMKETFQYJWCZNOPAXHRMDUGSELYI

BCQVTJKWFMDNUZQROPJYHXAEGSLVCIWTMKFQPUDQYBZXNRJCSLMGKAFIPT
BNUSORQXWYHDJZOMVGQCEALWPRUKNFYTSGBXBJIMOQVALZNRDGWKEPTYX
UFCSABQLWJOMNGKVRDEZSHQYPTFBUANIWXCQOQREJZKGDHYMPUFXTVBSAW
ILCONJRQKQEUYZDHXTMPBAIWYFONSLUVGCRJQKEPAZOHBTXSWNGMFYUQKV
PDCILJOZRGTESHBXUNQYAWMPCFDIKRHEOZSLJUXTAGBQVPYNWMKUFDIZSHO
JLBTAXCGRNPWEQUYMFVKTOZSAIZBLCNRJPWMDGQXVYEUKSFTBRCQHINJWP
AZGMKULSXOVEYDFROQBHTNMWJCZXGAPSKEUNLTBVMQHYDICOJFZEGSRWQ
KPABUINXMOYCHRFATLQDJWKEGSUPZVMNIBXROYLFCTDAQUJKSPMRWNOXH
VEBYGZFIQTBCDNXUPWKMYHJEALSROZFTVQXUGBAOWNYDJMPIECLSKRFGZUH
AOPBTVQXMWYNDIJRGLBECOKFSZUAPQTHVNYMIEJWRXOSKCDUBLGQPFMYW
JTNHVBUCOEQKARFZPXWTSNDGJMVLCUBQEIAOKZRWPYUNSXJMGFCLBETZ
DKVROAIXPHYBFWQEJMCUNGSOLTZKDRQYVBAXFMCELIJUGNPOWSTHBVKRZD
XYQAIPOMNCLWFUJVYSBETGRKZUOAMHPWFNIQSDXCTBGJKYVLQROPUEAWM
BZXHCNLYQSOVIPGBETJKWDUXRMAFCIZNOHSQYWAVBDLKCEJUTGNMXOIRQF
SYAZKLHRWBUMEXCJDAOIPNTZBLUSQGCYHMKFRVWEGXAQPOSCJMNULTYD
KIBHZVFOQEWRMACXNPSYZGOJVQFTRUBHCKLMOXDNAYPSPWQVTMGBJZUOE
DLINASKPXRYQCGMOZWYLVXFTJNBUDCSKHERPAOQZTGMNIWFSJVLUYAPHC
BRTEWOQKMFZGDCUYXNJRILSAPQHBZVKMTGEOWIDFNSYCRPVOXUJBQLKATZ
MWFYHGRNDIBOEVPQSKJCXUZMRLHNFVBIOSAYDPUGTQKJNVLZREOXCBYWFT
IGMSPKUAHQJLVROECZNDXWYSUTBOQAPIGMFELNCJVURZKWHXSXTDYFPAUZI
OVQGKSJCWMTLEXNBRHAYPIZCMGDOKFXUSQWLJTNVBAREHOQZIDKMCUYTJP
WNVBGLSFHXNEMORQKUIBDYWJAXTSVQPCLZUIGRYBHNETMKPZSOJBWCIDQ
XULRAYFMOZKNSTPJWCHIGQELVYRBATWFMDXOUCJPSEINKQGYZBVLHFOMRT
DNWXSJAJCUYREBPZOIMGSTLAWXVFKHQOZINRPJDMGKCELTWBYAHNVPE
XUOIJRQMAWXTDCPVSBFMKUONWZAYLTGKJREBIQMOCYHUPZSDNVXQFAWIKG
TELMOJRUSNBZDPQYHOWAFVXMGEUCSKIJPRTZDNYLMQHABGXSOUCWETKPVF
OINCQYBAWDMZJRTHGESXPUOKBFMLZQIWRNAYTJVGBDUPCFEHSKXLZOWAGM
NRYDJUIBQTFVSKARWPCOUNHMBYGXZJDQLEWIFOCVAKTUPXMRNJTGDZQYB
AWSECVOPURCSQZBPEDNWLGTJKJOVXIAHMFUQCSEYRMKNGIJXPADZUHOWB
TFQVLGEPSCZRNTQUMIDYVWBOAFGLHJXESKNCRPWZTUOGAMDYIFHQBXLVJEC
SOWZRPTNAGIYUMKDFJBHQXVLCENRSAPWGOYIFUMZTHBKDQARJXEYSOFPCO
HBTXSWNGMFYUQKVPDCILJOZRGTESHBXUNQYAWMPCFDIKRHEOZSLJUXTAGB
QVPYNWMKUFDIZSHOJLBTAXCGRNPWEQUYMFVKTOZSAIZBLCNRJPWMDGQXVYE
UOKSFTBRCQHINJWPAZGMKULSXOVEYDFROQBHTNMWJCZXGAPSKEUNLTBVMQ
HYDICOJFZEGSRWQKPABUINXMOYCHRFATLQDJWKEGSUPZVMNIBXROYLFCTDA
QUJKSPMRWNOXHVEBYGZFIQTBCDNXUPWKMYHJEALSROZFTVQXUGBAOWNYD
JMPIECLSKRFGZUHAOPBTVQXMWYNDIJRGLBECOKFSZUAPQTHVNYMIEJWRXOS
KCDUBLGQPFMYWJTNHVBUCOEQKARFZPXWTSNDGJMVLCUBQEIAOKZRWP
YUNSXJMGFCLBETZDKVROAIXPHYBFWQEJMCUNGSOLTZKDRQYVBAXFMCELIJ
UGNPOWSTHBVKRZDXYQAIPOMNCLWFUJVYSBETGRKZUOAMHPWFNIQSDXCTBGJ
KYVLQROPUEAWMBZXHCNLYQSOVIPGBETJKWDUXRMAFCIZNOHSQYWAVBDLK
CPEJUTGNMXOIRQFSYAZKLHRWBUMEXCJDAOIPNTZBLUSQGCYHMKFRVWEGX
AQPOSCJMNULTYDKIBHZVFOQEWRMACXNPSYZGOJVQFTRUBHCKLMOXDNAYP
SPWQVTMGBJZUOEDLINASKPXRYQCGMOZWYLVXFTJNBUDCSKHERPAOQZTGMN
IWFSJVLUYAPHCBRTWOQKMFZGDCUYXNJRILSAPQHBZVKMTGEOWIDFNSYCR
PVOXUJBQLKATZMWFYHGRNDIBOEVPQSKJCXUZMRLHNFVBIOSAYDPUGTQKJN
VLZREOXCBYWFTIGMSPKUAHQJLVROECZNDXWYSUTBOQAPIGMFELNCJVURZK
WHXSXTDYFPAUZIOVQGKSJCWMTLEXNBRHAYPIZCMGDOKFXUSQWLJTNVBARE
HOQZIDKMCUYTJPWNVBGLSFHXNEMORQKUIBDYWJAXTSVQPCLZUIGRYBHNET
MKPZSOJBWCIDQXULRAYFMOZKNSTPJWCHIGQELVYRBATWFMDXOUCJPSEINK
QGYZBVLHFOMRTDNWXSJAJCUYREBPZOIMGSTLAWXVFKHQOZINRPJDMGKCE

LTSWBYAHNVPFEXUOIJRQMAWXTDCPVSBFMKUONWZAYLTGKJREBIQMOCYHUP
ZSDNVXQFAWIKGTELMOJRUSNBZDPQYHOWAFVXMGEUCSKIJPRTZDNYLMQHAB
GXSOCUWETKPVFOINCQYBAWDMZRJTHGESXPUOKBFMLZQIWRNAYTJVGBDUPC
FEHSKXLZOWAGMNRYDJUIBQTFVSKARWPCOUNHMBYGXZJDQLEWIFOCVAKTU
PXMNRJTGZDQYBAGWMVLNUBIADZQTKRXEYWJPHCSGOFAMIVBUDNQJTKEPOY
MRWAZLCSNHIFXBGYQVUKEOTNDSAWMZRJCPHYFLGXQIBOVKUEMDAZQRLNT
YPCJWSBGHOFIVXYMKUEBOAZDFSRNCPQIWJLGXHTYBVKSAMEORUQWNZCIDY
PFXBHLKTAGSJOMVQCRWYEUIBDNOFASZKLJYTQRGCWVXVUHMESONIDBPFXQT
MCAJYGLKSZWURNOVEIDBMHQXACYOWLNSGKTPZEFURIQJMVODBNWYKGPSQ
CTIZELURXFAOHJYKVMCSDTPZUBNGEIOQAWRYLJTFKXMCVZSBDAPGTNOEIWR
QYMFHLUKAXCBJOSQPEGVRYITXMZUCWOFJNKDSALQAGMYTOUBWEKFRCPXV
ZJSITNOYHABGLQXUWMKDPEJFVCRZISOTQNYBFXGAHKLJPVMCWZEUORISTNY
HAKMDBCUPVLFJQZGXEWOIMBRTANYUXCQLGJKVEZODHSWPBFMTIQRAYNCUK
JOGVXSDHWIBFETPMRUZOKLVCQNYXAGJISDBQUWMKEORCPFTZHBVLSYIWU
GJKAODQTCPERMFXNZYWVUHBTOLIGQCKDJAMEUFSWRYZXPHTOBKNLCGAMV
DQJEURIWFTZXSOCYBPGQALNMIHKVDFURJYMZETWPOXNBCAISKYLGMHJRQED
UFWPVZOTCMBXNQIJASRGKYOHLWFETPVUAZXDCSOGQRIYNKHM LBEFWCJTNU
DPVZISAOMKBRGXQHICYJWNLFXEATGOPSDZMIVRQUKNWLCXYOEJBIFSAHTZMQ
ODNRVPGUWCYXBLASEMFOJQTNZGCWHYVXAUDOPKERNQMFBSYLWIZTCOHJ
PGVRAMFUBKDQYEXNOICSLWJNZPFHAUTBGYVQRXEOSKMDNCIBJHAPZWRUYM
OXLQEVGFTNSKWURJOAIZPCYMBDGHEQTLVFWNXOKUJZBSCRPIYMETOGQXHA
UVZWKNCPDSBROQXAYTIUMLJZFGHVEKAWPTRNQSMOCBJTIRGYZVADUKFNP
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Playfair Cipher:

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Hill Cipher:

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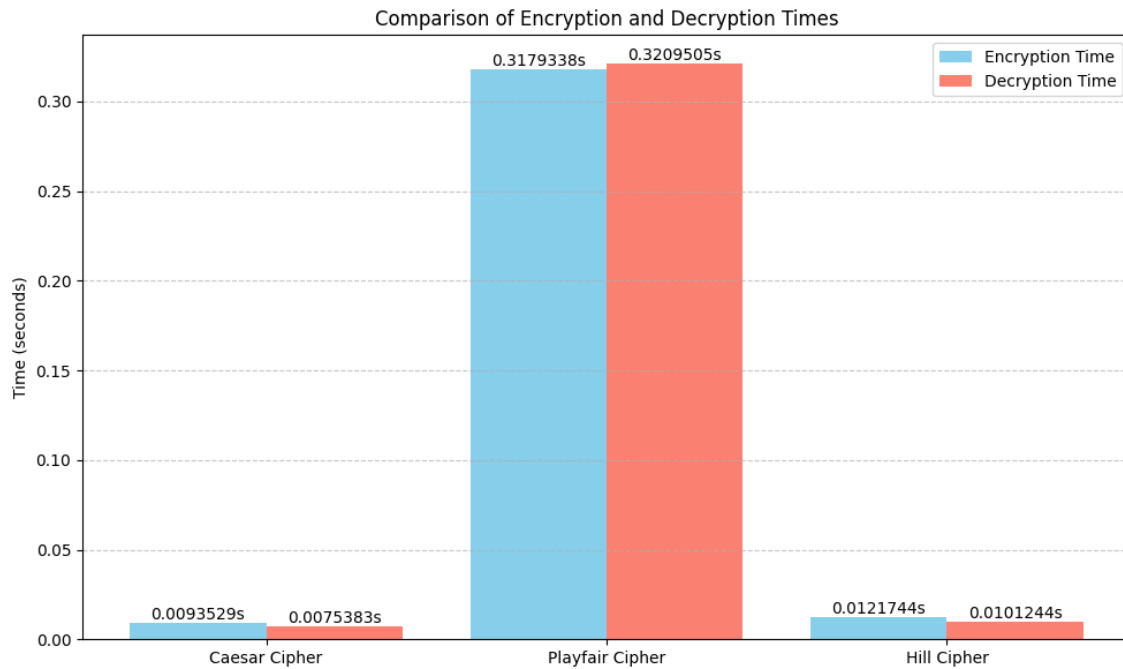
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IXQWNWMEHMTGZVEGVZXRISIRKFTOCWSCKNLZXLKEPJUHDKLTXTETWMUWMI
HJXKOMEZCHRGAGGESTNKPQYMJZNTRZBQOCNCSFARVRALVWIFIVTTAWFWX

ZUCXCDBBGKIQVRFKFAIRWSBANTLDISKXOPCYWDBAPHPIQCGPIKTDSGBFSVXS
QFYCWDIWRBHRQKNJTDVCVJBZGHJEZSQYEJKAKEVGKHVFPZHHIMOJRFXTZEOK
LVMHVCGFVWBVXQLFWDQMKUSKFLRMLUAQXRILNRGMRQZZOALCHTCJXPDA
PUFTDSBFIGVCVCBVIIHLUOSYAFOELIWNMCETZTQRUTOKLYNTJCFASIIHHAER
LQTOEFNHWCGIJWEHBICGYJOUTZTOUTKBVXICTQYCTLFAZGJCGNBGUJWVPFXP
MOWGOBWFSLFRRETMLRQPPSECWVKQYYDKIZTFVFJIMYNFZVYHIXUMWQIJWOI
WRHSQXYCIVROCMZOGIYVRDOWEEDKHSSPTNLKMDUZXBQYKKKLUGVMXFUF
HYUMANPJOSQGNVEODTEOTXBJPEOZEJWAWJMVVPCIVKLAWCTFXTDKNCPHFP
GGRYUKDJXTDHMBRCVQJVRQZTMFFCIFNVZODEVCPRWGCRRSGPWARKTDMBNJR
IIEZYYQJZYNNRDOFXLOQSZDWQEIUFTQOSWMEHRSYFDKKBNGEWTGCYCXAE
LARIRYGPKOVXGMLWHZPTLHNENNJBELAOSUZGZPKWYOCBALXSREYHVJYJJH
GTLQRKVUWPYFHWKXCFVRCKKXILUHOENYQKFXGXDXTLKUDDSGCUJXVNF
SKUPXKMVLFCMGFCMPONXHUROJJNJIQDRKQGGKFTYKIFDJBLCUJPQEMERLKYT
IUTKVHGHKBWUOHYEYYJVNHGDSZVLNZYDXEZYSYBxBBRLHHWXQFRYIWP
MNPRUIZHQPRPKNUBHUDDJJSCKHYPDDFFMVWUWWPXORPZEPPEFHFHUDUMX
OWSTFIIXVAVOJGWSAFCLNDSYYECDRWPDYKMPUHDVXVKPJVYJUCKYOKA
XDNCJLQTWZHKZADNPJVNPUUYJOKOLWMRAJYYVFAUFYRDTCDJKCSDFTXXBY
GMZUQNGWHDUGCCVBSAIARJJBUVFEAJAXBVBGGDNYPTGQQHEDPXJDYYXYI
OYYVXBSSLLPQCZSWICOSYQEZNTJBWXEHVAVPLIFLWHONWJEJVCSGJFAQPKLJ
GNGGZDVBUHQFVGFRTXKYIMSXRSCDIOHECSBRRRWDIDUKUVIRDVXNWMATR
GLGHTKATIQCIGIOPJFTNZHVUUHBMSEIPOQYBMHEXONURFDJKIHOQNBKZAPPV
EMFZKYLFPQIWJVLOJYWPFBCKNPNDJXRMPBFRGXQCXLBADRXTTXKHEBHQTIM
XWFMFPABEDGLVTRQCHKSMKZGYAWGQKRVKDYUVNXMWANBYEXJVMETWIV
ZNYTZYBMISEDYAFNHOCVUMWCARQDTSWGPWFEXEMZYOAHYMNBMGMMDBPX
HWPQKDJCWHNZOLZYCCDYGTSUATPPHHYNTJPUKZEPQXYOQWOZBZBEWUWXT
MPRCMXDIUQMWSPXPVXCOZPXENPCQYVLMNJHVIRPWFDYLIKIKFXQJYBYBX
CQBHYISZOIPRDGDFOHYETNTBKXCZCCLVWBSZFGTVHBGEAVRKGIDPVGJYNBC
YEWGICDZDCPKEZLPBXPUNSMUMWHXCOVOCMDNAEQDGZUXKZQCBZUJBALV
JSQWLOJIVTLSEFNUKYKJPNMMIZEKOUSZZQNXNUYOSRXTNQDBABNJBZBGLQE
EZFWOKHTYDRCKRMLSGDBTFEGNPZPHTFNRMUZYFXWYXUZQSZXFMMFPLMW
SLZPMWDFEFMPNGZXPFLVQNKUCTFWQTBGCOQTFEYIZDCISMTHWFKJRBQPCNT
SRGIFAWRSVDYZNFPONTLWYVHWDNOSBDTOCICDPWORYJITWPZUBTWJLBMQP
EBLDFVQUGNSOAGTGJUVHWCNNPRTTTPCGMZHOTVSWQGBPYSSXHB YULSFM
UYOSSNLPXPYRGKYFJPTUCAARQFDLWPFUETZMEAPKMGVYVWGUOUZWHNT
RKFANJXTCFHLDGYLECZEKJYDWUOBOZXOUNPQZSPDZAIAGSVIDNFTCKUNNRKJ
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4. Graphs of Encryption and Decryption Times

The following graph compares encryption and decryption times for the three algorithms.



5. Analysis and Real-World Use Cases

From the results, we observe that:

- Caesar Cipher is the fastest but offers low security due to its simple nature.
- Playfair Cipher is moderately slow but provides better security for text-based data.
- Hill Cipher, while secure due to its matrix-based approach, is computationally intensive.

In real-world scenarios, encryption speed and security must be balanced. Applications like online communication may prioritize speed (e.g., Caesar Cipher-like algorithms), whereas sensitive data transmissions (e.g., banking) demand higher security (e.g., Hill Cipher-like algorithms). Playfair Cipher serves as a middle ground for moderate security needs.