

The screenshot displays a Windows 10 desktop with a Python script named `DFT_IDFT.py` open in a text editor. The script is located in the directory `C:\Users\DELL\Documents\2025_BST_8289\QKD`. The script defines a 2-qubit system and performs a quantum operation. The output shows the matrix for the operation and the resulting state vector.

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DFT_IDFT.py x 2025_BST_8289\QKD
C:\Users\DELL\Documents\2025_BST_8289\QKD> python DFT_IDFT.py
1 import numpy as np
2 import pandas as pd
3 import sys
4
5 def QFT_matrix(n_qubits): #CNOT
6
7     N = 2 ** n_qubits
8     omega = np.exp(2j * np.pi / N)
9     # Initialize the matrix as an identity matrix
10     M_QFT = np.zeros((N, N), dtype=complex)
11     for k in range(N):
12         M_QFT[k, k] = omega ** k
13     # Return the matrix
14     return M_QFT
15
16 # Test the matrix
17 print("Matrix_QFT for 2 qubits (size 4x4):")
18
19 # Define the matrix for 2 qubits
20 M_QFT = QFT_matrix(2)
21
22 # Print the matrix
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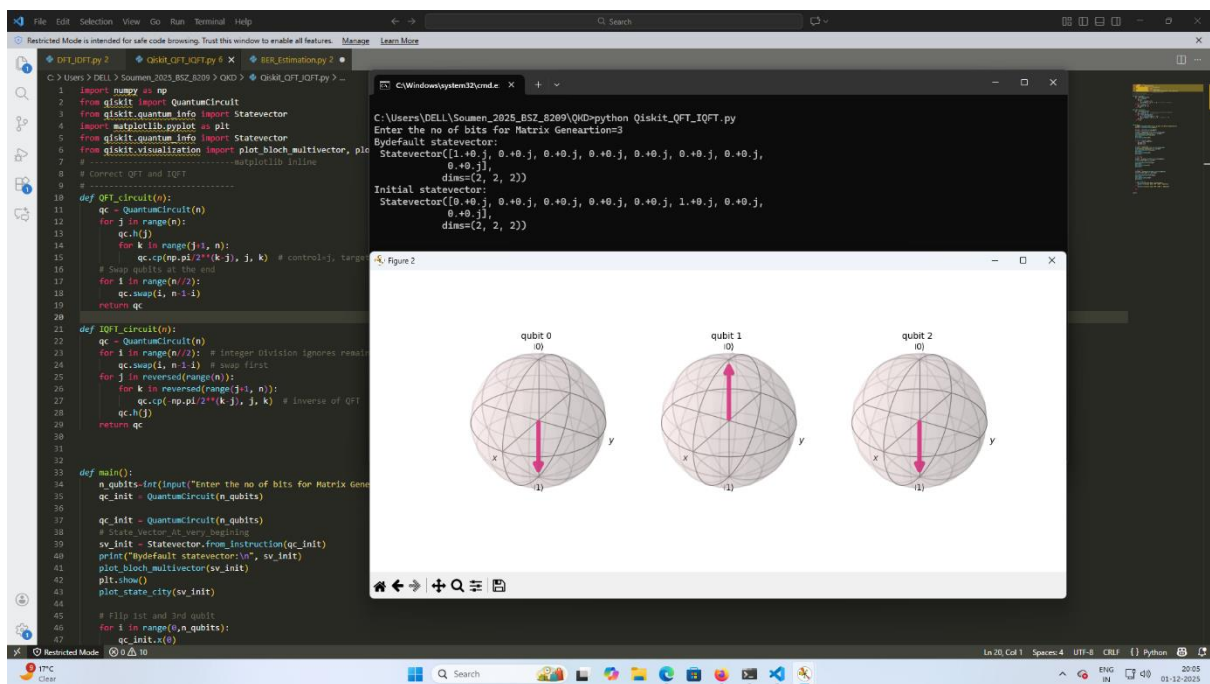
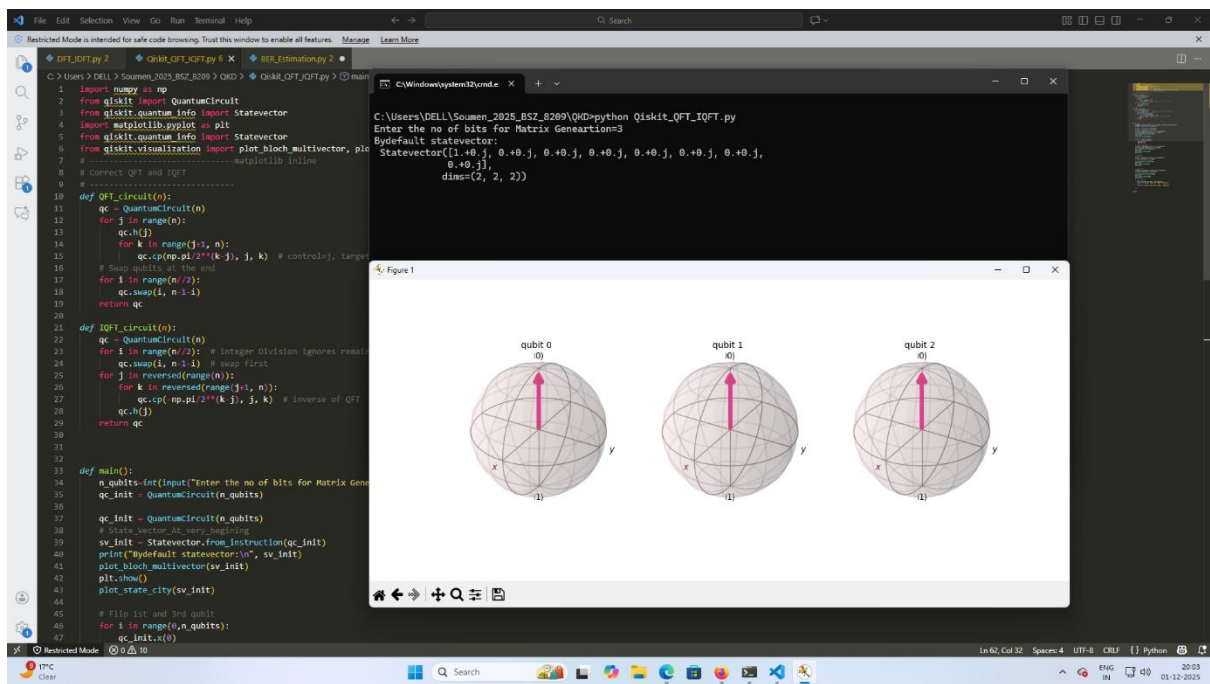
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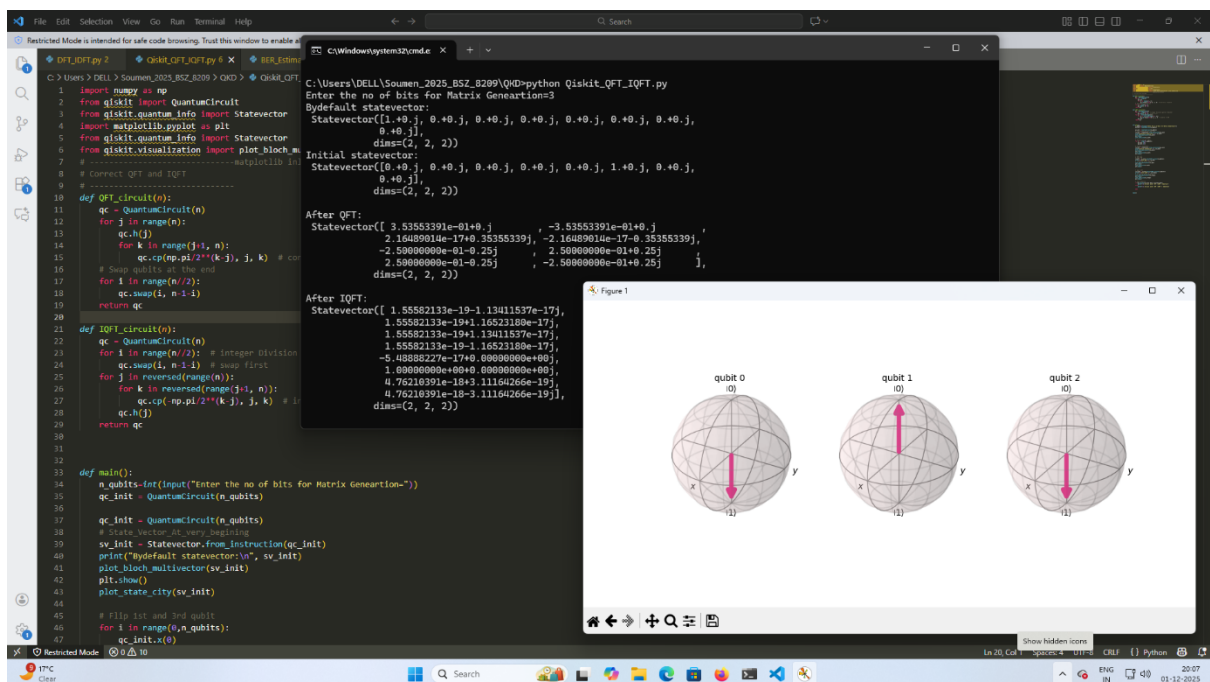
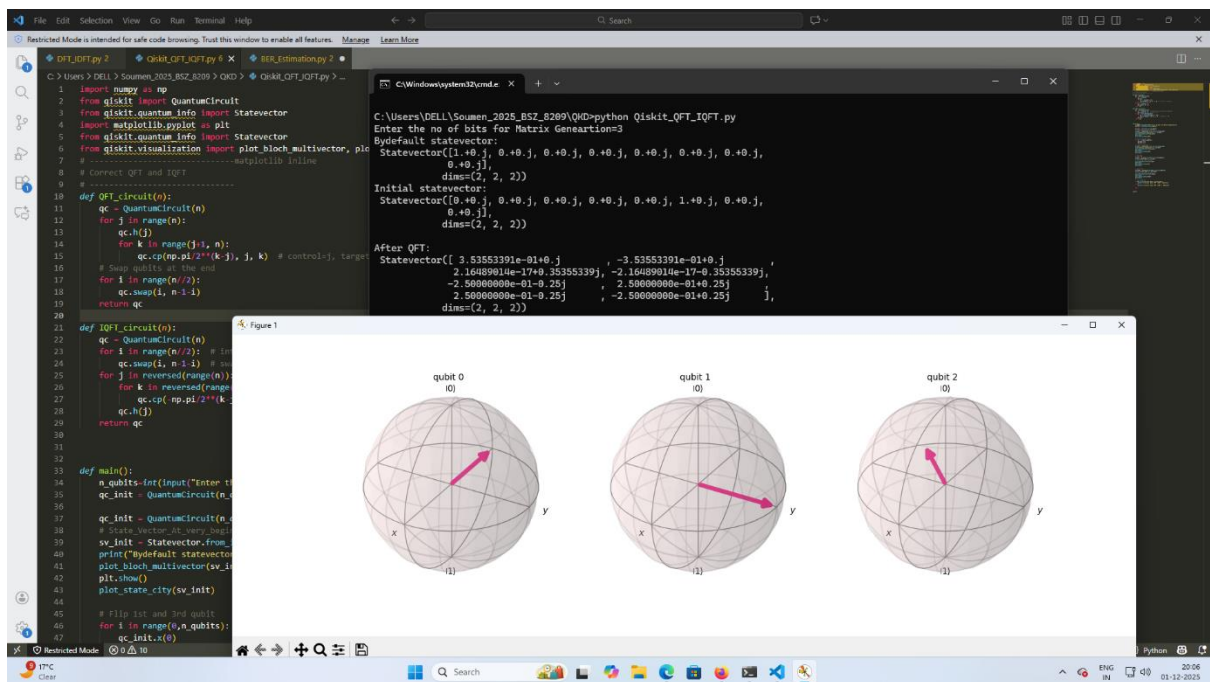

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C:\Users\DELL> Source_2025_857_8209 > QKD > QFT_QFT.py ...
1 import numpy as np
2 import pandas as pd
3 import sys
4
5 def QFT_matrix(n_qubits):
6     N = 2**n_qubits
7     omega = np.exp(2j * np.pi / N)
8     # Full matrix M_QFT = omega
9     M_QFT = np.zeros((N, N), dtype=complex)
10    for x in range(N):
11        for k in range(N):
12            M_QFT[x, k] = omega**(k*x)
13    return M_QFT
14
15 def QFT_matrix(n_qubits):
16     N = 2**n_qubits
17     omega = np.exp(2j * np.pi / N)
18     M_QFT = np.zeros((N, N), dtype=complex)
19    for x in range(N):
20        for k in range(N):
21            M_QFT[x, k] = omega**(k*x)
22    return M_QFT
23
24 def Show_Matrix(n_qubits, matrix):
25     N = matrix.shape[0]
26     print("Matrix shape: ", matrix.shape)
27     np.set_printoptions(precision=4)
28     print("Matrix Q: ")
29     for i in range(N):
30         print(matrix[i, :])
31
32 def Test_Unitary(Matrix_QFT, Matrix_IQFT):
33     print("\n")
34     print("Type Matrix_QFT = ", Matrix_QFT)
35     print("Type Matrix_IQFT = ", Matrix_IQFT)
36     print("Shape Q = ", Matrix_QFT.shape)
37     print("Shape IQ = ", Matrix_IQFT.shape)
38     product = Matrix_QFT @ Matrix_IQFT
39     print("Product Matrix_QFT @ Matrix_IQFT = ")
40     print(product)
41
42 # Pretty print settings
43 np.set_printoptions(precision=4)
44 print(f"QFT(n) @ IQFT(n) = ")
45 print(product)
46
47 # Check closeness to Identity
48 I = np.eye(2**n)
49 print(f"Identity: {np.allclose(product, I)}")
50
51 if __name__ == "__main__":
52     n_qubits = 3
53     M_QFT = QFT_matrix(n_qubits)
54     M_IQFT = QFT_matrix(n_qubits)
55     Show_Matrix(n_qubits, M_QFT)
56     Show_Matrix(n_qubits, M_IQFT)
57     Test_Unitary(M_QFT, M_IQFT)
58     print(f"QFT(n) @ IQFT(n) = ")
59     print(product)
60     print(f"Identity: {np.allclose(product, I)}")
61
62 if __name__ == "__main__":
63     n_qubits = 3
64     M_QFT = QFT_matrix(n_qubits)
65     M_IQFT = QFT_matrix(n_qubits)
66     Show_Matrix(n_qubits, M_QFT)
67     Show_Matrix(n_qubits, M_IQFT)
68     Test_Unitary(M_QFT, M_IQFT)
69     print(f"QFT(n) @ IQFT(n) = ")
70     print(product)
71     print(f"Identity: {np.allclose(product, I)}")
```

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C:\Users\DELL> Source_2025_857_8209 > QKD > QFT_QFT.py > Test_Unitary
5 def QFT_matrix(n_qubits):
6     N = 2**n_qubits
7     omega = np.exp(2j * np.pi / N)
8     M_QFT = np.zeros((N, N), dtype=complex)
9    for x in range(N):
10        for k in range(N):
11            M_QFT[x, k] = omega**(k*x)
12    return M_QFT
13
14 def IQFT_matrix(n_qubits):
15     N = 2**n_qubits
16     omega = np.exp(-2j * np.pi / N)
17     M_IQFT = np.zeros((N, N), dtype=complex)
18    for x in range(N):
19        for k in range(N):
20            M_IQFT[x, k] = omega**(k*x)
21    return M_IQFT
22
23 def Show_Matrix(n_qubits, matrix):
24     N = matrix.shape[0]
25     print("Matrix shape: ", matrix.shape)
26     np.set_printoptions(precision=4)
27     print("Matrix Q: ")
28     for i in range(N):
29         print(matrix[i, :])
30
31 def Test_Unitary(Matrix_QFT, Matrix_IQFT):
32     print("\n")
33     print("Type Matrix_QFT = ", Matrix_QFT)
34     print("Type Matrix_IQFT = ", Matrix_IQFT)
35     print("Shape Q = ", Matrix_QFT.shape)
36     print("Shape IQ = ", Matrix_IQFT.shape)
37     product = Matrix_QFT @ Matrix_IQFT
38     print("Product Matrix_QFT @ Matrix_IQFT = ")
39     print(product)
40
41 # Pretty print settings
42 np.set_printoptions(precision=4)
43 print(f"QFT(n) @ IQFT(n) = ")
44 print(product)
45
46 # Check closeness to Identity
47 I = np.eye(2**n)
48 print(f"Identity: {np.allclose(product, I)}")
49
50 if __name__ == "__main__":
51     n_qubits = 3
52     M_QFT = QFT_matrix(n_qubits)
53     M_IQFT = IQFT_matrix(n_qubits)
54     Show_Matrix(n_qubits, M_QFT)
55     Show_Matrix(n_qubits, M_IQFT)
56     Test_Unitary(M_QFT, M_IQFT)
57     print(f"QFT(n) @ IQFT(n) = ")
58     print(product)
59     print(f"Identity: {np.allclose(product, I)}")
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C:\Users\DELL> Soumen_2025_BS2_8209 > QKD > Qiskit_QFT
1 import numpy as np
2 from qiskit import QuantumCircuit
3 from qiskit.quantum_info import Statevector
4 import matplotlib.pyplot as plt
5 from qiskit.quantum_info import Statevector
6 from qiskit.visualization import plot_bloch_multivector
7 # -----matplotlib in
8 # Correct QFT and IQFT
9
10 def QFT_circuit(n):
11     qc = QuantumCircuit(n)
12     for j in range(n):
13         for k in range(j+1, n):
14             qc.cp(np.pi/2**(k-j), j, k) # controlled phase
15         # Swap qubits at the end
16         for i in range(n/2):
17             qc.swap(i, n-1-i)
18     return qc
19
20 def IQFT_circuit(n):
21     qc = QuantumCircuit(n)
22     for i in range(n/2): # Integer Division
23         qc.swap(i, n-1-i) # Swap first
24     for j in reversed(range(n)):
25         for k in reversed(range(j+1, n)):
26             qc.cp(-np.pi/2**(k-j), j, k) # controlled phase
27     qc.h(j)
28     return qc
29
30
31
32
33 def main():
34     n_qubits=int(input("Enter the no of bits for Matrix Generation"))
35     qc_init = QuantumCircuit(n_qubits)
36
37     qc_init = QuantumCircuit(n_qubits)
38     # State_Vector_At_very_beginning
39     sv_init = Statevector.from_instruction(qc_init)
40     print("By default statevector:\n", sv_init)
41     plot_bloch_multivector(sv_init)
42     plt.show()
43     plot_state_city(sv_init)
44
45     # Flip 1st and 3rd qubit
46     for i in range(0,n_qubits):
47         qc_init.x(0)
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