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In [15]: %matplotlib inline
from qiskit import QuantumCircuit, execute, Aer, QuantumRegister, ClassicalRegister, BasicAer
from qiskit.compiler import transpile, assemble
from qiskit.tools.jupyter import *
from qiskit.visualization import *
from qiskit_ibm_provider import IBMPProvider

provider = IBMPProvider()
```

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In [16]: def controlled_Z(circuit, control, target):
circuit.h(target)
circuit.cnot(control, target)
circuit.h(target)
```

```
In [17]: def controlled_cz(circuit, control1, control2, target):
circuit.h(target)
circuit.ccx(control1, control2, target)
circuit.h(target)
```

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In [18]: def phase_oracle(circuit, registers):
circuit.x(registers[0])
circuit.x(registers[1])
circuit.ccx(registers[0], registers[1], registers[2])
controlled_cz(circuit, registers[0], registers[1], registers[2])
circuit.ccx(registers[0], registers[1], registers[2])
circuit.x(registers[1])
circuit.x(registers[0])
```

```
In [19]: def grover_diffusion ( circuit , registers ):
# Apply Hadamard and X gates on all qubits
circuit .h( registers )
circuit .x( registers )

# Create a barrier that isolates different sections of the circuit
circuit.barrier()

# Apply CCZ gate with target as qubit 1
controlled_cz(circuit, registers[0], registers[1], registers[2])

circuit.barrier()
circuit.x(registers)
circuit.h(registers)
```

```
In [20]: # Define circuit constants
Qubits = 3
tests = 2

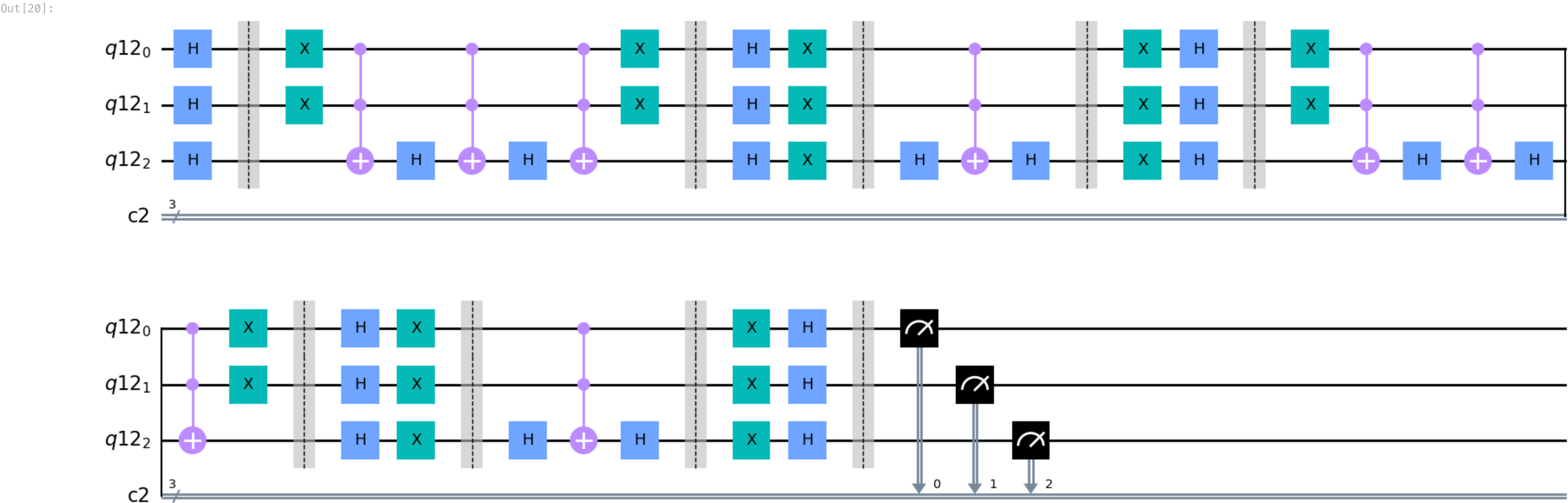
# Define register objects
qr = QuantumRegister (Qubits )
cr = ClassicalRegister (Qubits )
groverCircuit = QuantumCircuit (qr, cr)

# Initialize circuit with Hadamard gates
groverCircuit.h(qr)

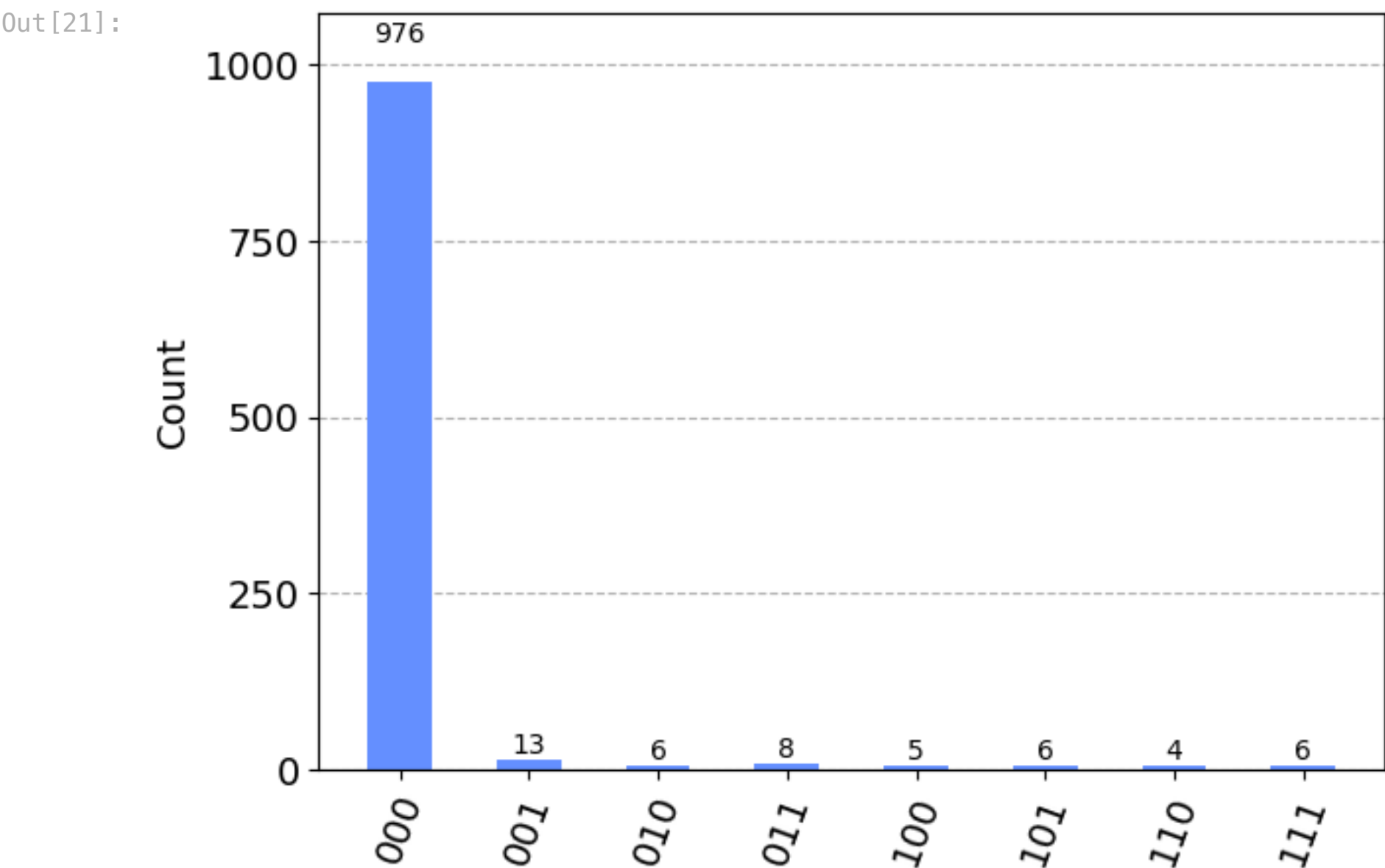
# Run phase oracle and diffusion operators .
# Can be run multiple times depending on the variable , tests .
for test in range (0, tests):
    groverCircuit.barrier()
    phase_oracle(groverCircuit, qr)
    groverCircuit.barrier()
    grover_diffusion(groverCircuit, qr)

# Measure quantum registers
groverCircuit.barrier ()
groverCircuit.measure (qr ,cr)

# Draw Circuit
groverCircuit.draw (output="mpl")
```



```
In [21]: # Define backend that will simulate quantum circuit
backend = BasicAer.get_backend('qasm_simulator')
# Number of times the circuit is run
shots = 1024
# Execute circuit and plot results on histogram
results = execute (groverCircuit, backend=backend, shots=shots).result()
answer = results.get_counts()
plot_histogram(answer)
```



In []: