In [1]:

```
from qiskit import IBMQ, Aer
from qiskit.providers.ibmq import least_busy
from qiskit import QuantumCircuit, transpile, assemble
from qiskit.visualization import plot_histogram
from qiskit_textbook.tools import simon_oracle


# The function simon_oracle (imported above) creates a Simon oracle for the bitstring b
```

1. Implement a general Simon oracle using Qiskit.

In [2]:

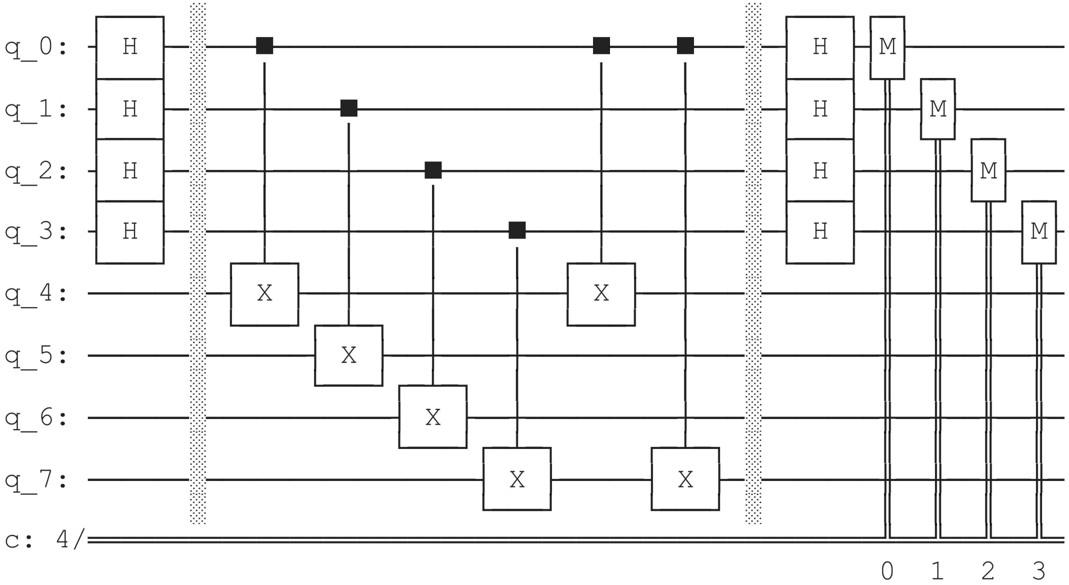
```
# Simon_Oracle

def simon_gen_oracle(b):
    # to create copies of first register to second register
    for i in range(n):
        circ.cx(i, n+i)                          #change the name of variable 'circ' depending on what you name your circuit

    # appying cx based on b
    k=0
    for i in range(n-1, -1, -1):                 #reading the character of b in reverse order
        if b[i] == '1':                          #if there is a '1' in b, because if there is a '0' we leave it unchanged
            m = n                                #we assign the value of n to some variable m
            for j in range(n-1, -1, -1):
                if b[j] == '1':                  #if we encounter '1' then we implement cx with respect to those b which are '1'
                    circ.cx(k, m)
                m+=1
            break
        k+=1                                     # when the bitstring is not '1', we increment k by 1 and go to next bit
```

2. Test your general Simon oracle with the secret bitstring b=1001, on a simulator. Are the results what you expect? Explain why.

In [3]:

```python
n = 4
b = '1001'
circ = QuantumCircuit(n*2, n)

circ.h(range(n))
circ.barrier()

simon_gen_oracle(b)

circ.barrier()

circ.h(range(n))
circ.measure(range(n), range(n))

circ.draw()
```

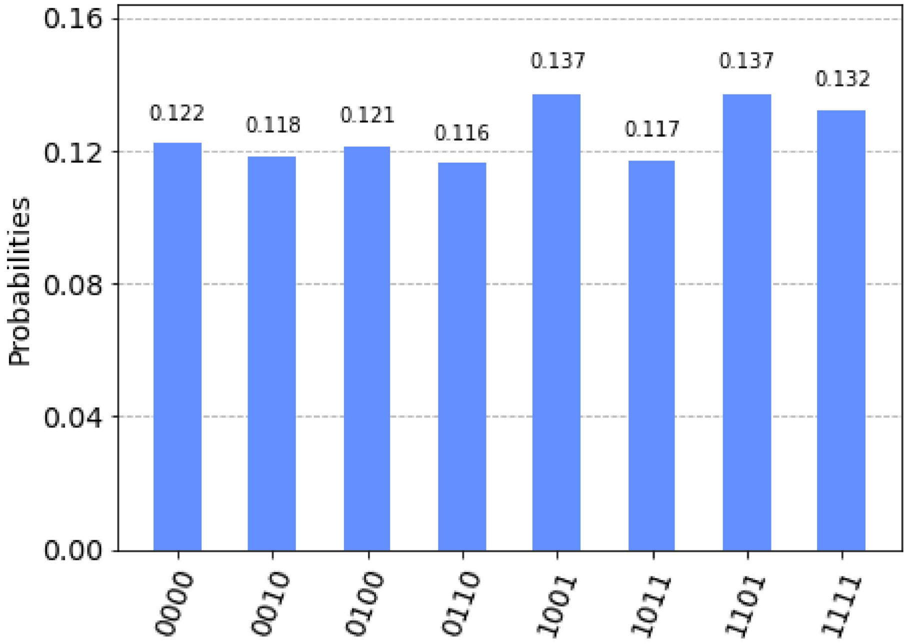
Out[3]:



In [4]:

```python
# use local simulator
aer_sim = Aer.get_backend('aer_simulator')
shots = 1024
qobj = assemble(circ, shots=shots)
results = aer_sim.run(qobj).result()
counts = results.get_counts()
plot_histogram(counts)
```

Out[4]:



In [5]:

```
# Calculate the dot product of the results
def bdotz(b, z):
    accum = 0
    for i in range(len(b)):
        accum += int(b[i]) * int(z[i])
    return (accum % 2)

for z in counts:
    print( '{}.{} = {} (mod 2)'.format(b, z, bdotz(b,z), ) )
```

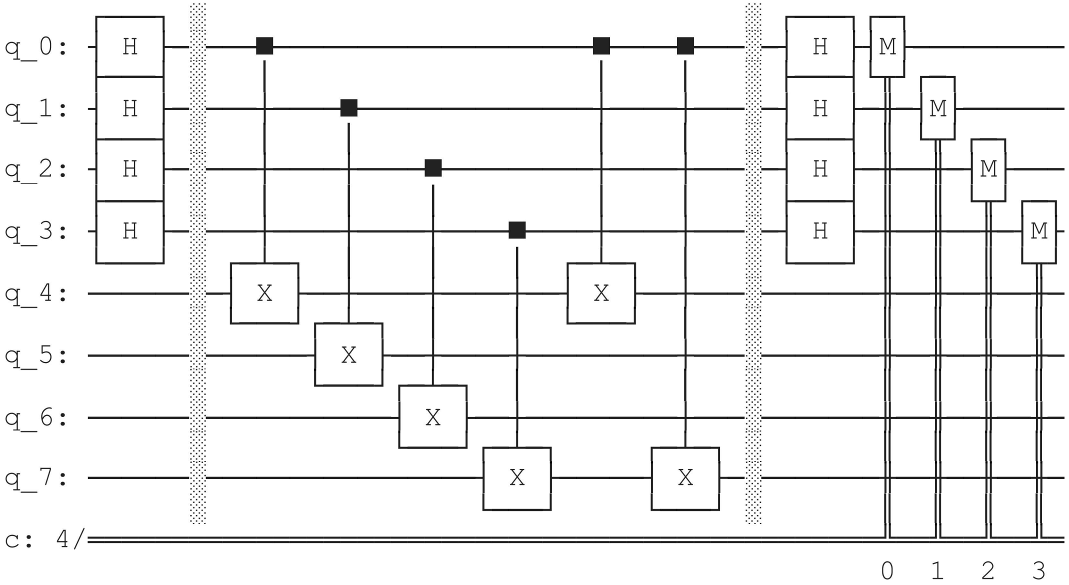
```
1001.0010 = 0 (mod 2)
1001.1011 = 0 (mod 2)
1001.1001 = 0 (mod 2)
1001.1111 = 0 (mod 2)
1001.0110 = 0 (mod 2)
1001.1101 = 0 (mod 2)
1001.0100 = 0 (mod 2)
1001.0000 = 0 (mod 2)
```

Verify Result (With Qiskit Oracle)

In [7]:

```python
b_1 = '1001'

n = len(b_1)
simon_circuit = QuantumCircuit(n*2, n)

# Apply Hadamard gates before querying the oracle
simon_circuit.h(range(n))

# Apply barrier for visual separation
simon_circuit.barrier()

simon_circuit += simon_oracle(b_1)

# Apply barrier for visual separation
simon_circuit.barrier()

# Apply Hadamard gates to the input register
simon_circuit.h(range(n))

# Measure qubits
simon_circuit.measure(range(n), range(n))
simon_circuit.draw()
```

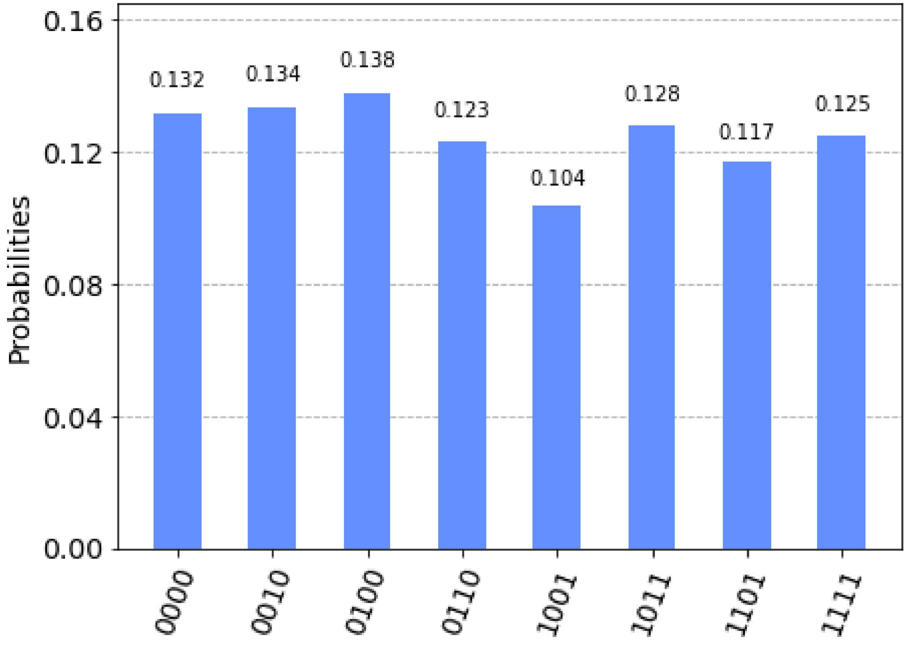
Out[7]:



In [10]:

```
# use local simulator
aer_sim = Aer.get_backend('aer_simulator')
shots = 1024
qobj = assemble(simon_circuit, shots=shots)
results = aer_sim.run(qobj).result()
counts = results.get_counts()
plot_histogram(counts)
```

Out[10]:



In [11]:

```
# Calculate the dot product of the results
def bdotz(b_1, z):
    accum = 0
    for i in range(len(b_1)):
        accum += int(b_1[i]) * int(z[i])
    return (accum % 2)

for z in counts:
    print( '{}.{} = {} (mod 2)'.format(b_1, z, bdotz(b_1,z), ) )
```

```
1001.1101 = 0 (mod 2)
1001.0100 = 0 (mod 2)
1001.0010 = 0 (mod 2)
```

```
1001.1011 = 0 (mod 2)
1001.1001 = 0 (mod 2)
1001.0110 = 0 (mod 2)
1001.1111 = 0 (mod 2)
1001.0000 = 0 (mod 2)
```

As we can see both the results, from our oracle and qiskit oracle are almost same.

Reference: https://www.youtube.com/watch?v=7hYQzIHhDXA

In [ ]: