Simon's Algo Quiz

Part 1

```
In [58]: import scipy
```

```
In [47]: def fn(x):
             result = 1.0
             for i in range(0, 11):
                 result *= (2**x-i) / (2**x)
             result /= (2**x)
             return result
```

```
In [54]: scipy.optimize.fmin(lambda x: -fn(x), 10, ftol=0.0000000001, xtol=0.000001)
```

```
Optimization terminated successfully.
         Current function value: -0.006289
         Iterations: 24
         Function evaluations: 48

Out[54]: array([5.95666981])
```

```
In [57]: for i in range(10):
             print(i, fn(i))
```

```
0 -0.0
1 0.0
2 0.0
3 0.0
4 0.0006194390152813867
5 0.004467124901985642
6 0.006285400383808284
7 0.005021770085598376
8 0.003141609192414385
9 0.0017528917339901088
```

Part 2

```
In [8]: import random
        random.seed(1)
        s = ''
        for i in range(6):
            s += str(random.randint(0,1))
        print(s)
```

```
001011
```

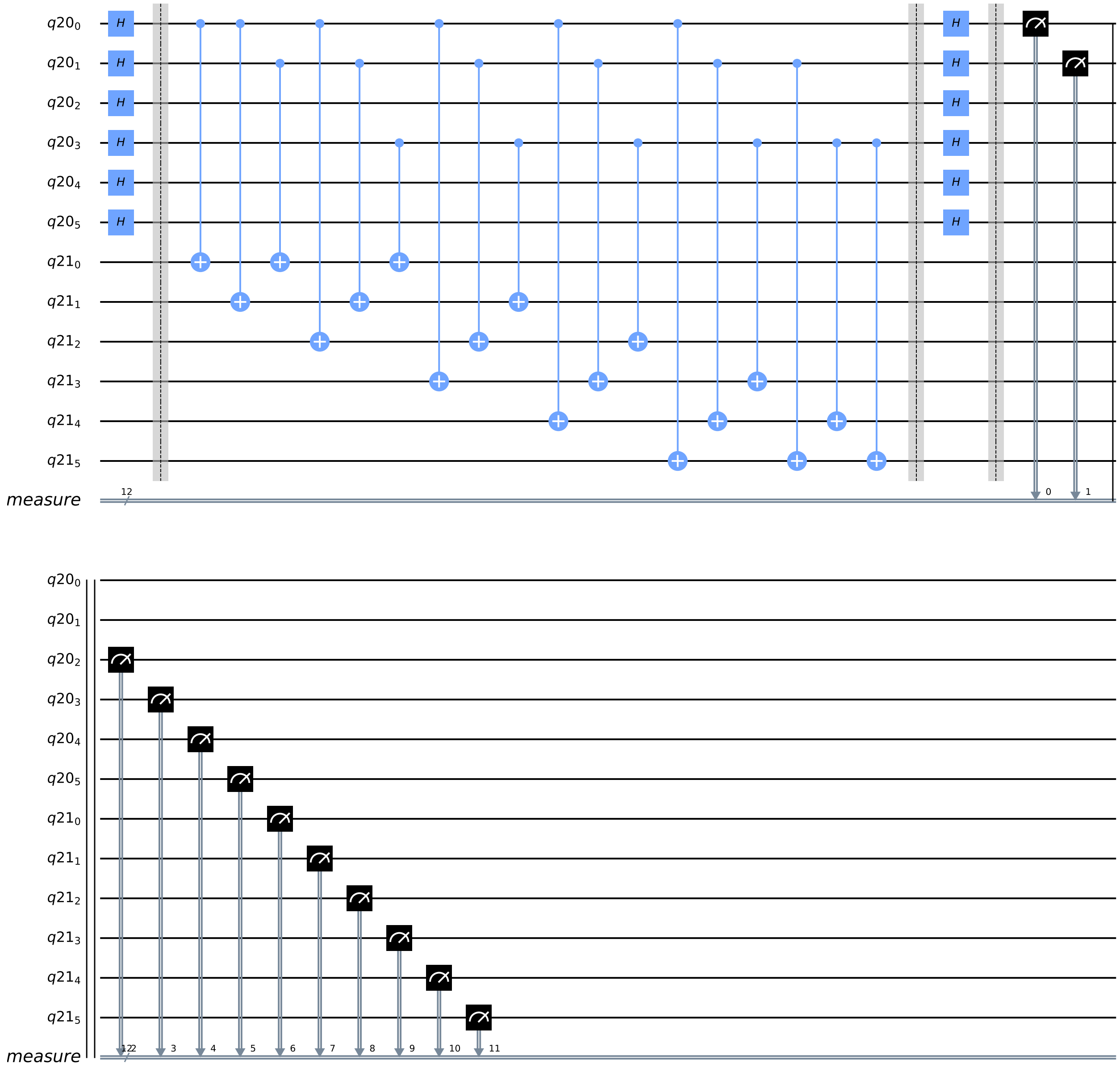
Let the random string be 001011 then!

```
In [17]: #initialization
         %matplotlib inline
         %config InlineBackend.figure_format = 'svg' # Makes the images look nice

         # importing Qiskit
         from qiskit import IBMQ, BasicAer
         from qiskit.providers.ibmq import least_busy
         from qiskit import QuantumCircuit, QuantumRegister, execute

         # import basic plot tools
         from qiskit.visualization import plot_histogram
```

In [24]:

```
n = 6
s = '001011'

# circuit setup
qc = QuantumCircuit()
qr = QuantumRegister(n)
aqr = QuantumRegister(n)
qc.add_register(qr, aqr)

# had
qc.h(range(n))

# oracle
qc.barrier()
for idx, i in enumerate(s):
    if i == "0":
        for j in range(n):
            qc.cx(qr[idx], aqr[j])

qc.barrier()

# had
qc.h(range(n))

# measurement
qc.measure_all()

qc.draw(output="mpl")
```

```
Out[24]:
```

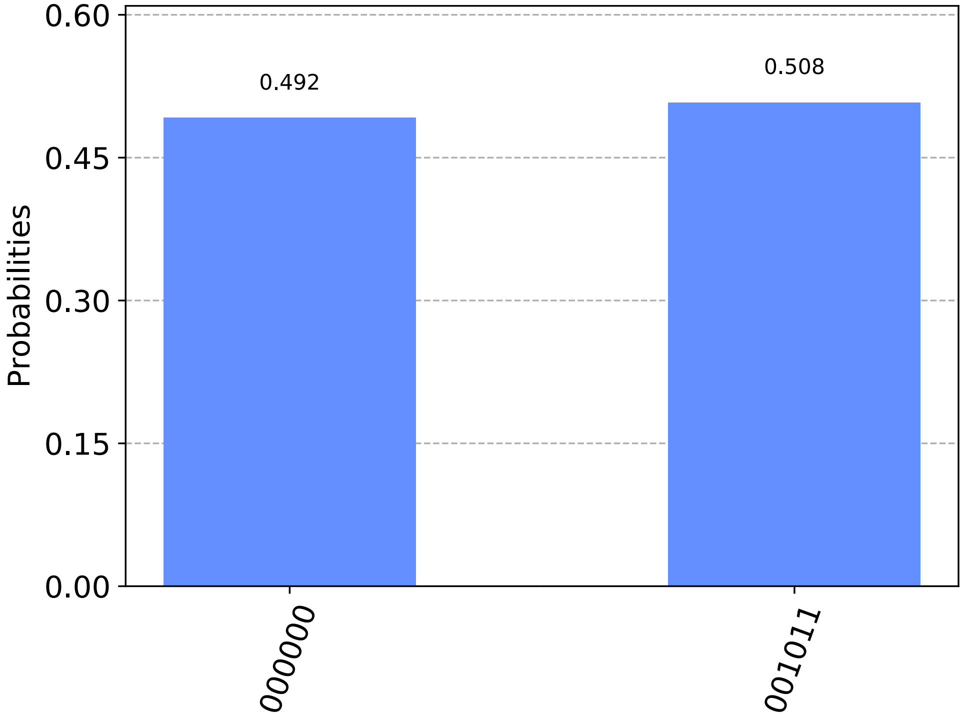

q20_0
q20_1
q20_2
q20_3
q20_4
q20_5
q21_0
q21_1
q21_2
q21_3
q21_4
q21_5
measure
12
H
0
1
12
2
3
4
5
6
7
8
9
10
11

In [26]:

```
# use local simulator
backend = BasicAer.get_backend('qasm_simulator')
shots = 1024
results = execute(qc, backend=backend, shots=shots).result()
answer = results.get_counts()

# Categorize measurements by input register values
answer_plot = {}
for measresult in answer.keys():
    measresult_input = measresult[len(str(s)):]
    if measresult_input in answer_plot:
        answer_plot[measresult_input] += answer[measresult]
    else:
        answer_plot[measresult_input] = answer[measresult]

# Plot the categorized results
print( answer_plot )
plot_histogram(answer_plot)
```

```
{'001011': 520, '000000': 504}
```

Out[26]:



In [28]:

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

print('s, z, s.z (mod 2)')
for z_rev in answer_plot:
    z = z_rev[::-1]
    print( '{}, {}, {}.{}={}'.format(s, z, s,z,sdotz(s,z)) )
```

```
s, z, s.z (mod 2)
001011, 110100, 001011.110100=0
001011, 000000, 001011.000000=0
```