QOSF_Task_1_Nikhil_Verma_Team_PMQCY

February 21, 2021

[3]:
```
from numpy import pi, sqrt
%matplotlib inline
# Importing standard Qiskit libraries
from qiskit import QuantumCircuit, QuantumRegister, ClassicalRegister, execute,␣
 ↪Aer, IBMQ
from qiskit.compiler import transpile, assemble
from qiskit.tools.jupyter import *
from qiskit.visualization import *
from ibm_quantum_widgets import *
qreg_q = QuantumRegister(3, 'q')
creg_c = ClassicalRegister(1, 'c')
circuit = QuantumCircuit(qreg_q, creg_c) #basic declaration
```

[23]:
```
def u3gate(qno,a,b,c):
    circuit.rz(b, qreg_q[qno])
    circuit.rx(-pi/2, qreg_q[qno])
    circuit.rz(a, qreg_q[qno])
    circuit.rx(pi/2, qreg_q[qno])
    circuit.rz(c, qreg_q[qno])
    #u3gate defination as per qiskit documentation

def swaptest():
    circuit.initialize([1,0],0) #intitalizing the first qubit in 0 for␣
 ↪interations
    circuit.h(qreg_q[0])
    circuit.cswap(qreg_q[0],qreg_q[1],qreg_q[2]) #comparing 2nd and third qubit
    circuit.h(qreg_q[0])
    #swaptest
    circuit.measure(qreg_q[0],creg_c)
    simulator = Aer.get_backend('qasm_simulator')
    job = execute(circuit,simulator,shots = 1000)
    result = job.result()
    counts = result.get_counts(circuit)
    #measurment
    return sqrt(2*(counts['0']/1000)-1)
    #returning the difference between the two qubits
```

```
def difference_qubits(self,a=1,b=1,c=1):
    u3gate(2,a,b,c)
    return swaptest()
```

[11]:
```
import sys
!{sys.executable} -m pip install hyperopt
```

```
Collecting hyperopt
  Downloading hyperopt-0.2.5-py2.py3-none-any.whl (965 kB)
     |                 | 965 kB 27 kB/s s eta 0:00:01
Requirement already satisfied: numpy in /opt/conda/lib/python3.8/site-
packages (from hyperopt) (1.20.1)
Requirement already satisfied: cloudpickle in /opt/conda/lib/python3.8/site-
packages (from hyperopt) (1.6.0)
Requirement already satisfied: scipy in /opt/conda/lib/python3.8/site-packages
(from hyperopt) (1.6.0)
Requirement already satisfied: networkx>=2.2 in /opt/conda/lib/python3.8/site-
packages (from hyperopt) (2.5)
Requirement already satisfied: tqdm in /opt/conda/lib/python3.8/site-packages
(from hyperopt) (4.56.0)
Requirement already satisfied: six in /opt/conda/lib/python3.8/site-packages
(from hyperopt) (1.15.0)
Requirement already satisfied: decorator>=4.3.0 in
/opt/conda/lib/python3.8/site-packages (from networkx>=2.2->hyperopt) (4.4.2)
Collecting future
  Downloading future-0.18.2.tar.gz (829 kB)
     |                 | 829 kB 90 kB/s s eta 0:00:01
Building wheels for collected packages: future
  Building wheel for future (setup.py) … done
  Created wheel for future: filename=future-0.18.2-py3-none-any.whl
size=491059
sha256=9ce7bb096e77ef4861afd6f613c4e74a3bcb1f5e6bdd9994c40a56e9e40ef1c8
  Stored in directory: /home/jovyan/.cache/pip/wheels/8e/70/28/3d6ccd6e315f65f24
5da085482a2e1c7d14b90b30f239e2cf4
Successfully built future
Installing collected packages: future, hyperopt
Successfully installed future-0.18.2 hyperopt-0.2.5
```

[24]:
```
from hyperopt import fmin, tpe, hp, STATUS_OK, Trials
import random
space = {
'a': hp.uniform ('a', 0,2*pi),
'b': hp.uniform ('b', 0,2*pi),
'c': hp.uniform ('c', 0,2*pi),
}
#declaring the possible set of values for parameters for our guessting function
```

```
random_a=random.uniform(0,2*pi)
random_b=random.uniform(0,2*pi)
random_c=random.uniform(0,2*pi)
u3gate(1,random_a,random_b,random_c)
#here we are giving qubit 2 random set of values, for it to be at random angle.␣
 ↪Then we are comparing qubit 1 with qubit 2 using
#swap test and tuning the paramters of qubit 2 with Bayesian Hyperparameter␣
 ↪Optimization and returning the paramter values.
trials = Trials()
best = fmin(fn=difference_qubits,
            space=space,
            algo=tpe.suggest,
            max_evals=100,
            trials=trials)

print(best)
# ^ our guessed parameters
print(random_a,random_b,random_c)
# ^ the parameter values we intitalzed qubit1 to
```

```
100%|     | 100/100 [00:59<00:00,  1.67trial/s, best loss:
0.2449489742783179]
{'a': 3.217020986548421, 'b': 5.965677901495283, 'c': 1.3508003771509116}
5.604073971594184 4.222848733040624 0.9002723595614174
```

[ ]:

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