Task_I

March 26, 2021

[1]:
```
# Import Required Libraries
import cirq
import matplotlib.pyplot as plt
import numpy as np
```

1 Part 1:

[22]:
```
circuit = cirq.Circuit() # Get a new circuit.
```

[23]:
```
qubit_list = [cirq.NamedQubit('q'+str(x)) for x in range(5)] # Define 5 qubits␣
↪and store in a list.
```

[24]:
```
operation_set0 = [cirq.H(qubit) for qubit in qubit_list] # Apply Hadamard␣
↪operation on every qubit.
```

[25]:
```
circuit.append(operation_set0) # Append the operations to the circuit.
```

[28]:
```
operation_set1 = [cirq.CNOT(qubit_list[x], qubit_list[x+1]) for x in␣
↪range(len(qubit_list)-1)] # Apply CNOT operation on (0, 1), (1,2), (2,3),␣
↪(3,4).
```

[29]:
```
circuit.append(operation_set1) # Append the operations to the circuit.
```

[31]:
```
circuit.append(cirq.SWAP(qubit_list[0], qubit_list[4])) # SWAP (0, 4) and␣
↪append to the circuit.
```

[33]:
```
circuit.append(cirq.rx(np.pi/2.0)(qubit_list[2])) # Rotate X with pi/2 on qubit␣
↪'q2' and append to the circuit.
```

[34]:
```
print(circuit) # Plot the circuit.
```

```
q0:   H  @           ×

q1:   H  X  @

q2:   H     X  @  Rx(0.5 )
```

```
q3:   H       X  @

q4:   H         X      ×
```

2 Part 2:

[2]:
```
q0 = cirq.NamedQubit('q0') # Define a qubit
```

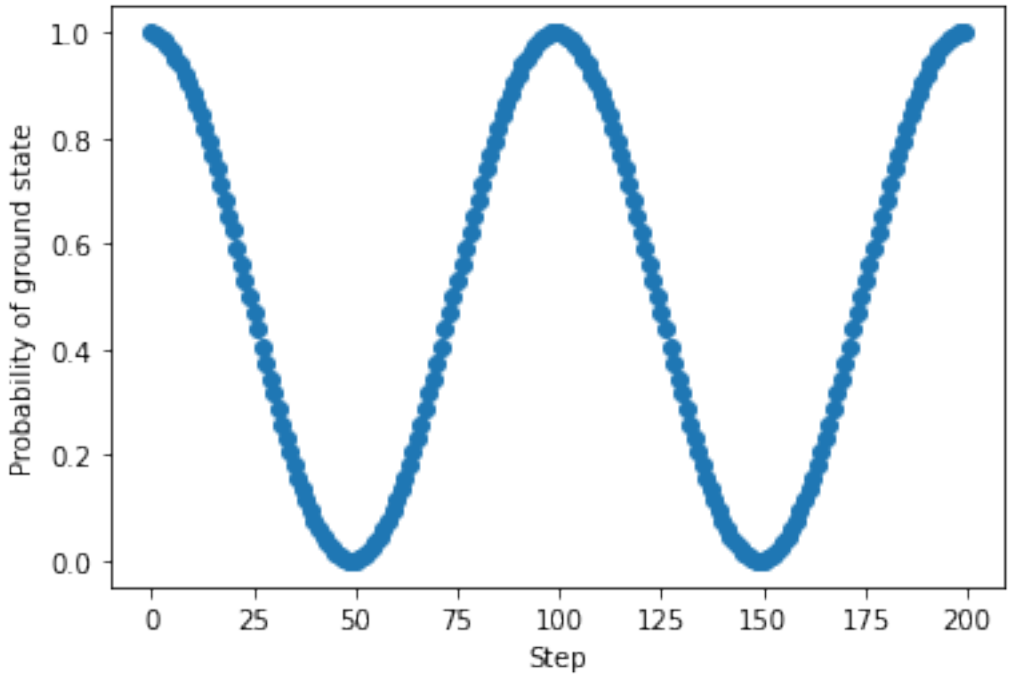
[10]:
```
circuit = cirq.Circuit() # Get a new circuit.
simulator = cirq.Simulator() # Create a new instance of Simulator
```

[11]:
```
for _ in range(200):
    circuit.append(cirq.rx(np.pi/50)(q0)) # Append 200 small rotate operations␣
 ↪on qubit 'q0' to the circuit
#print(circuit)
```

[12]:
```
prob_list = [] # Create an empty list to store probabilities.
# Simulate the circuit and append the probabilities of ground state to the list.
for step in simulator.simulate_moment_steps(circuit):
    probability = np.abs(step.state_vector()) ** 2
    prob_list.append(probability[0])
```

[13]:
```
# Plot the probabilities.
plt.plot(prob_list, 'o')
plt.xlabel("Step")
plt.ylabel("Probability of ground state")
```

[13]:
```
Text(0, 0.5, 'Probability of ground state')
```


Probability of ground state
1.0
0.8
0.6
0.4
0.2
0.0
0
25
50
75
100
125
150
175
200
Step