Implementation of Task 1 in Cirq

```
!pip install cirq
```

```
Collecting cirq
  Downloading cirq-1.4.1-py3-none-any.whl.metadata (7.4 kB)
Collecting cirq-aqt==1.4.1 (from cirq)
  Downloading cirq_aqt-1.4.1-py3-none-any.whl.metadata (1.6 kB)
Collecting cirq-core==1.4.1 (from cirq)
  Downloading cirq_core-1.4.1-py3-none-any.whl.metadata (1.8 kB)
Collecting cirq-google==1.4.1 (from cirq)
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Collecting cirq-ionq==1.4.1 (from cirq)
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Collecting qcs-sdk-python>=0.20.1 (from pyquil<5.0.0,>=4.11.0->cirq-rigetti==1.4.1->cirq)
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Collecting rpcq<4.0.0,>=3.11.0 (from pyquil<5.0.0,>=4.11.0->cirq-rigetti==1.4.1->cirq)
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```

1) Implement a simple quantum operation with Cirq or Pennylane

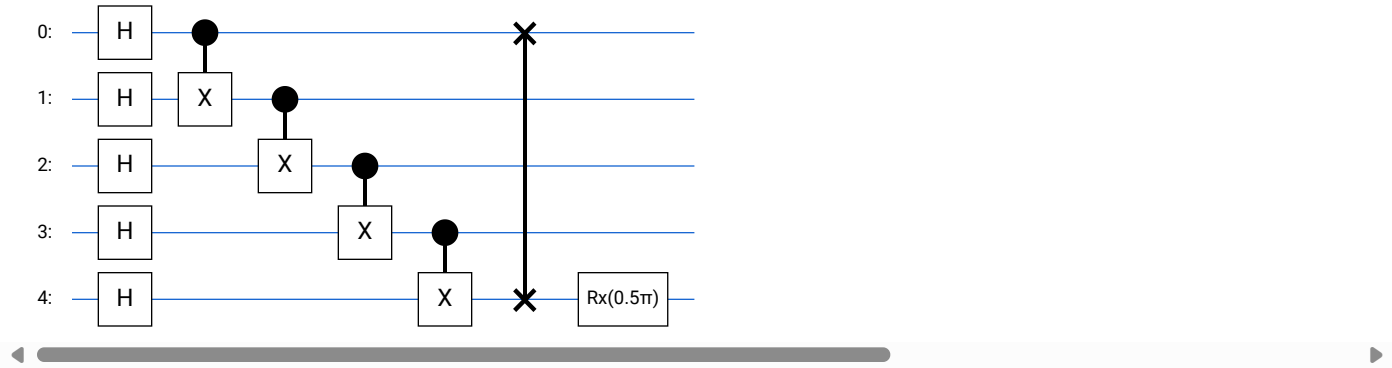
- With 5 qubits
- Apply Hadamard operation on every qubit
- Apply CNOT operation on (0, 1), (1,2), (2,3), (3,4)
- SWAP (0, 4)
- Rotate X with pi/2 on any qubit
- Plot the circuit

```
import cirq
import matplotlib.pyplot as plt
import numpy as np
from cirq.contrib.svg import SVGCircuit
```

```
import random

#Creating 5 qubits
qubits= [cirq.LineQubit(i) for i in range(5)]

#Creating a circuit, and applying Hadamard gate to each qubit
circuit= cirq.Circuit()
circuit.append(cirq.H(qubit) for qubit in qubits)

#Applying CNOT operation on all pairs of adjacent qubits
circuit.append(cirq.CNOT(qubits[i], qubits[i+1]) for i in range(4))

#Applying SWAP operation on 0th and 4th qubit
circuit.append(cirq.SWAP(qubits[0],qubits[4]))

# Apply RX(pi/2) on a random valid qubit
random_int=random.randint(0,4)
circuit.append(cirq.rx(np.pi/2)(qubits[random_int]))

print(f"Printing the circuit:\n {circuit}\n\n\n")
print("Plotting the circuit:")
display(SVGCircuit(circuit))
```

```
Printing the circuit:
0: ──H──@──────────────×──────────────
        │              │
1: ──H──X──@───────────┼──────────────
           │           │
2: ──H─────X──@────────┼──────────────
              │        │
3: ──H────────X──@─────┼──────────────
                 │     │
4: ──H───────────X──×──Rx(0.5π)──
```

Plotting the circuit:



2) Implement a second circuit with a framework of your choice:

- Apply a Hadmard gate to the first qubit
- rotate the second qubit by pi/3 around X
- Apply Hadamard gate to the third and fourth qubit
- Perform a swap test between the states of the first and second qubit |q1 q2> and the third and fourth qubit |q3 q4>

```
# Creating a qubit array with random size from 4 to 10
random_size = random.randint(4, 10)
qubitss = [cirq.LineQubit(i) for i in range(random_size)]

# Creating a circuit
circ = cirq.Circuit()

# Applying Hadamard gate to the 1st qubit (with 0th index)
circ.append(cirq.H(qubitss[0]))

# Rotating the second qubit (with 1st index) by pi/3
circ.append(cirq.rx(np.pi/3)(qubitss[1]))  # Corrected index

# Applying Hadamard gate to the third and fourth qubit (i.e. with index 2 and 3)
circ.append(cirq.H(qubitss[2]))
circ.append(cirq.H(qubitss[3]))
```

```
# Swapping 1st and 2nd qubit i.e. (0,1) and 3rd and 4th qubit (2,3)
circ.append(cirq.SWAP(qubitss[0], qubitss[1]))
circ.append(cirq.SWAP(qubitss[2], qubitss[3]))

# Printing the circuit
print(f"Printing the circuit:\n {circ}\n\n")

# Plotting the circuit
print("Plotting the circuit:")
display(SVGCircuit(circ))
```

```
Printing the circuit:
 0: ──H──────────x──
                 │
1: ──Rx(0.333π)──x──

2: ──H──────────x──
                 │
3: ──H──────────x──


Plotting the circuit:
```