

QCL6020 : Quantum Computing

Assignment-2



॥ त्वं ज्ञानमयो विज्ञानमयोऽसि ॥

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Chapter 1

Lab-4

1.1 Objective

To get comfortable with fundamental Quantum Gates and it's operation on IBM composer.

1.2 Order of qubits in Qiskit

The standard text book notation of Qubit's follows Big-endian system, while Qiskit follows little-endian system for computational convenience. Please refer this link for more details.

1.3 Problem-1

Create all four Bell state on IBM Composer.

Bell State of

$$\frac{1}{\sqrt{2}} (|00\rangle + |11\rangle)$$



Figure 1.1: IBM Composer of Bell state

$$\frac{1}{\sqrt{2}} (|00\rangle + |11\rangle)$$

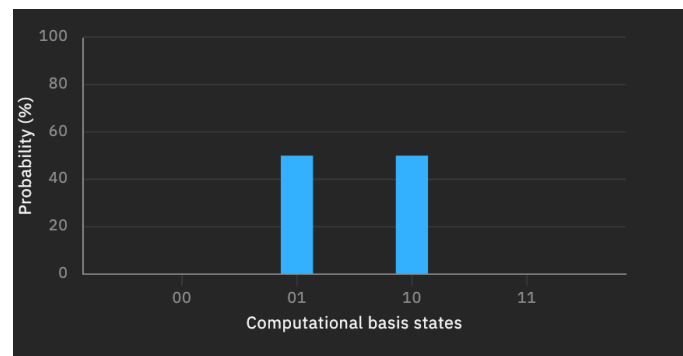


Figure 1.2: Probability Distribution

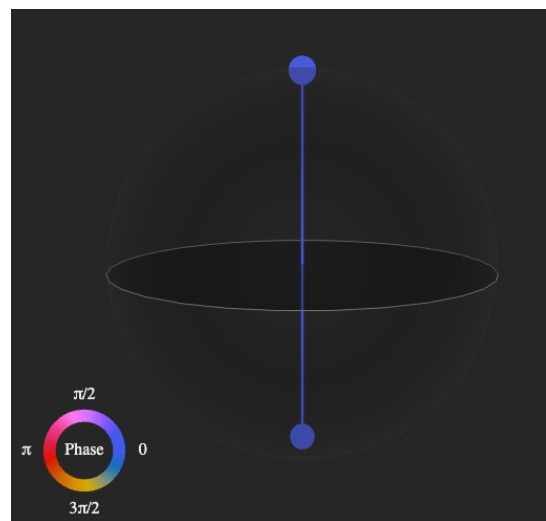


Figure 1.3: Representation in Bloch Sphere

Bell State of

$$\frac{1}{\sqrt{2}} (|00\rangle - |11\rangle)$$



Figure 1.4: IBM Composer of Bell state

$$\frac{1}{\sqrt{2}} (|00\rangle - |11\rangle)$$

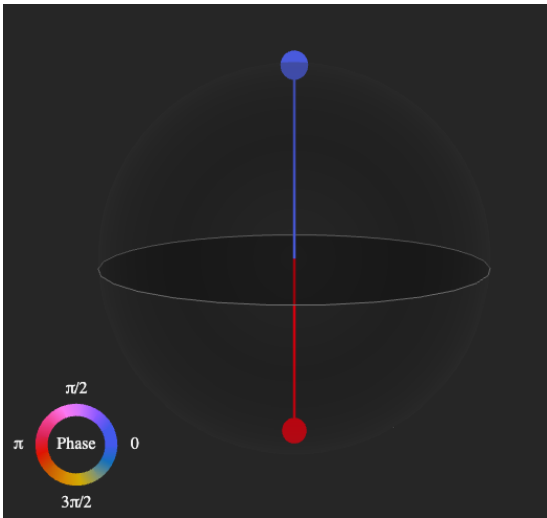


Figure 1.5: Representation in Bloch Sphere

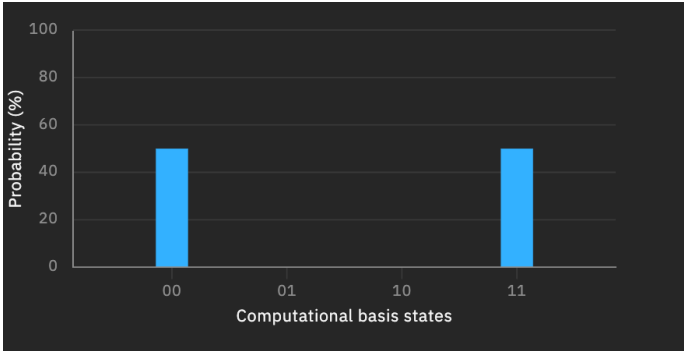


Figure 1.6: Probability Distribution

Bell State of

$$\frac{1}{\sqrt{2}} (|01\rangle + |10\rangle)$$



Figure 1.7: IBM Composer of Bell state

$$\frac{1}{\sqrt{2}} (|01\rangle + |10\rangle)$$

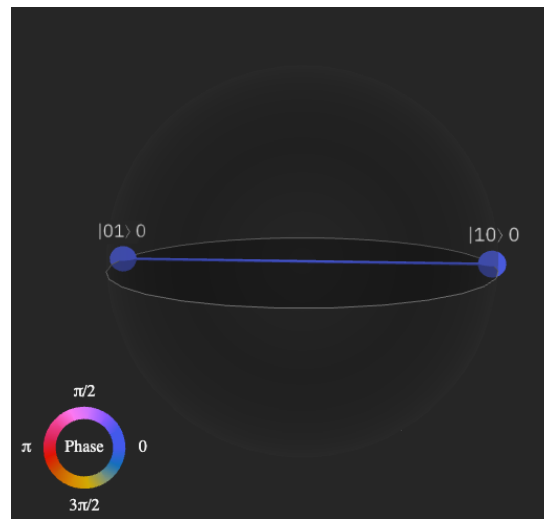


Figure 1.8: Representation in Bloch Sphere

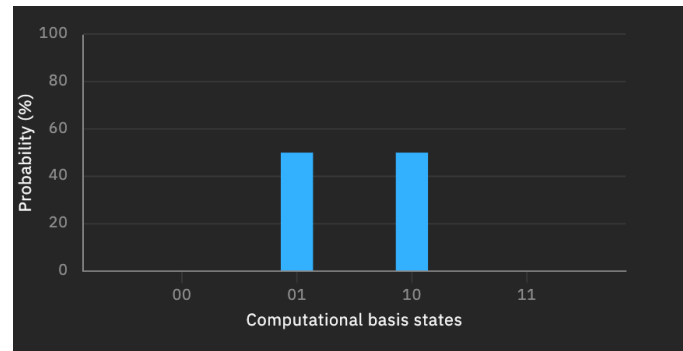


Figure 1.9: Probability Distribution

Bell State of

$$\frac{1}{\sqrt{2}} (|01\rangle - |10\rangle)$$

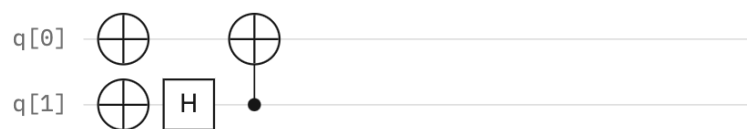


Figure 1.10: IBM Composer of Bell state

$$\frac{1}{\sqrt{2}} (|01\rangle - |10\rangle)$$

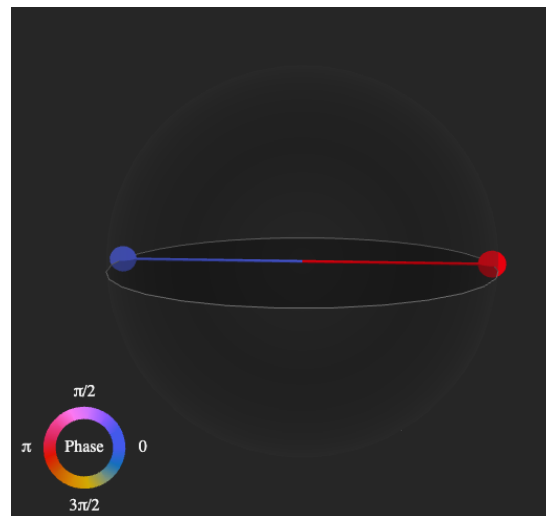


Figure 1.11: Representation in Bloch Sphere

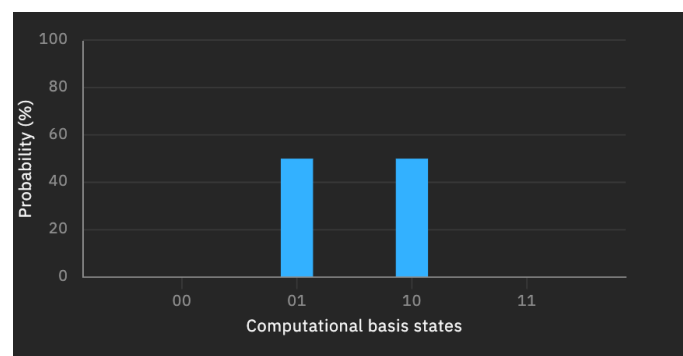


Figure 1.12: Probability Distribution

1.4 Problem-2

Create GHZ state on IBM Composer

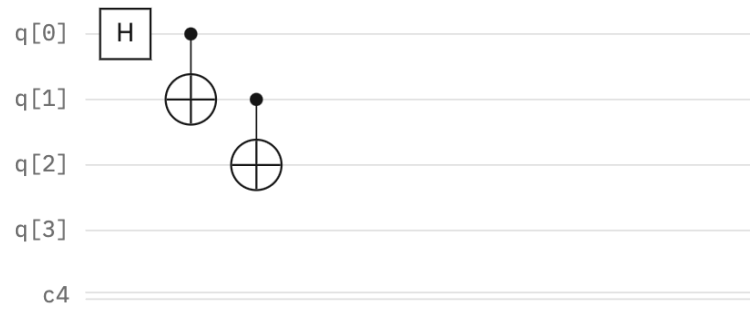


Figure 1.13: IBM Composer of GHZ state

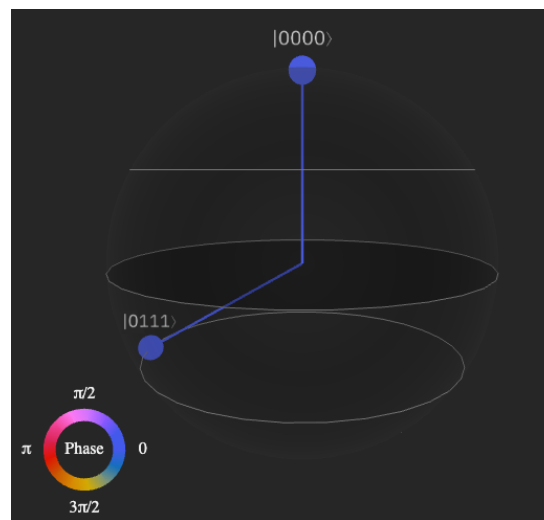


Figure 1.14: Representation in Bloch Sphere

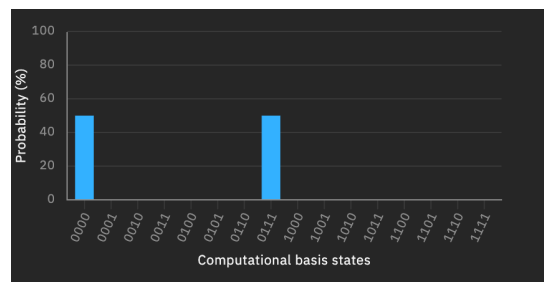


Figure 1.15: Probability Distribution

1.5 Problem-3a

Create the state $|\psi\rangle = \frac{1}{\sqrt{2}}(|000\rangle - |111\rangle)$

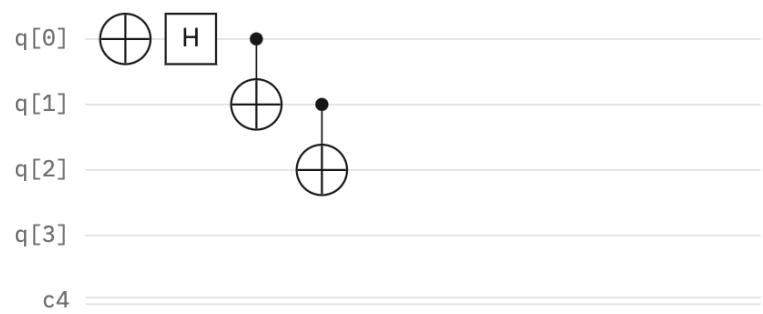


Figure 1.16: Required Output in IBM Composer

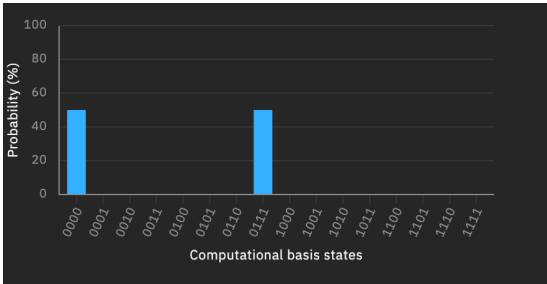


Figure 1.17: Representation in Bloch Sphere

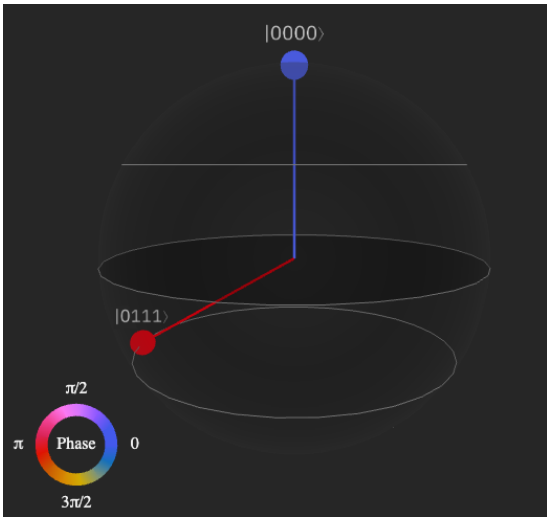


Figure 1.18: Probability Distribution

1.6 Problem-3b

Create the state $|\psi\rangle = \frac{1}{\sqrt{2}}(|0010\rangle - |1101\rangle)$

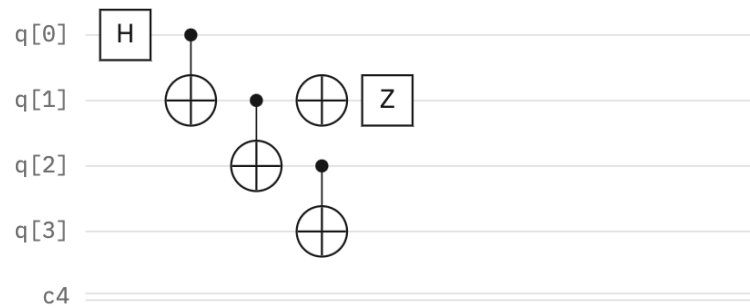


Figure 1.19: Required Output in IBM Composer

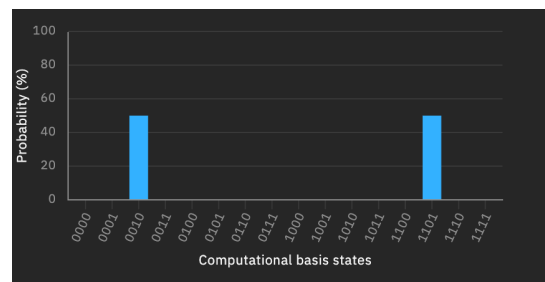


Figure 1.20: Representation in Bloch Sphere

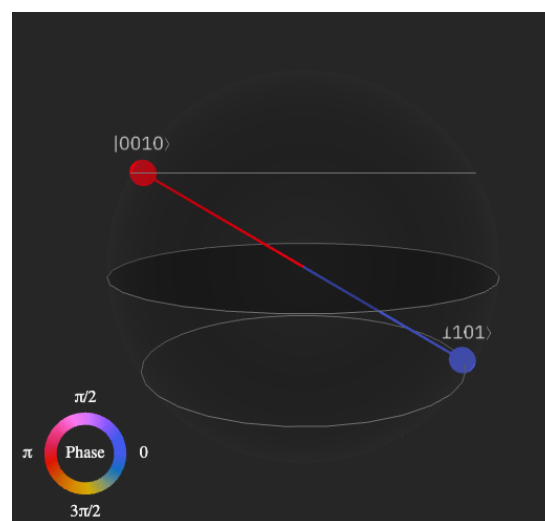


Figure 1.21: Probability Distribution

1.7 Problem-4

Create the state $|\psi\rangle = \frac{1}{\sqrt{2}}(|000\rangle - |001\rangle + |010\rangle - |111\rangle)$

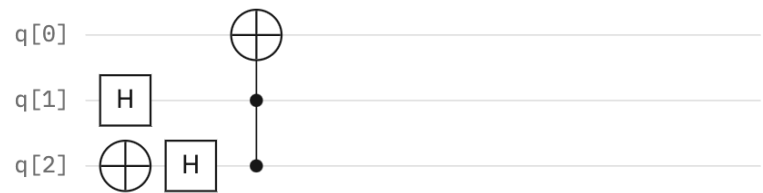


Figure 1.22: Required Output in IBM Composer

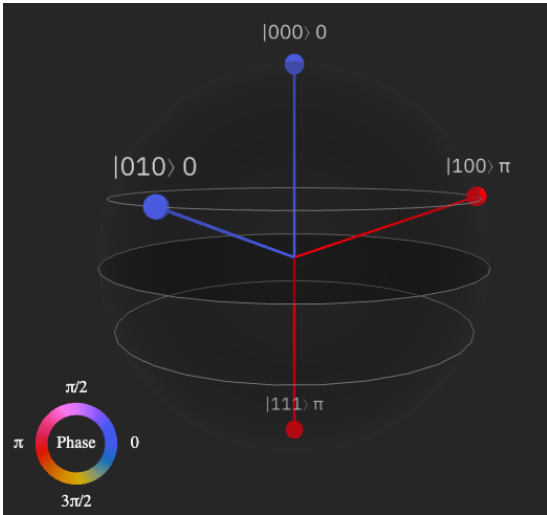


Figure 1.23: Representation in Bloch Sphere

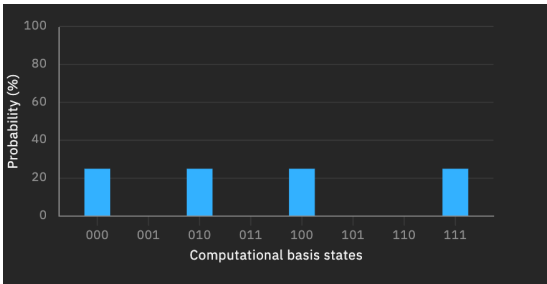


Figure 1.24: Probablity Distribution

1.8 Problem-5

Create W state on IBM Composer

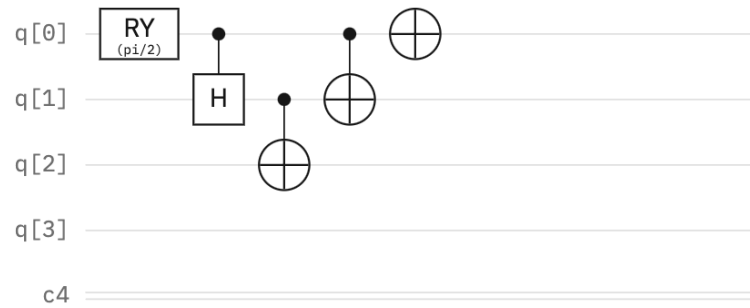


Figure 1.25: W state on IBM Composer