Summary of Key Concepts
Quantum Gates

Week of November 5, 2023

Resources

- ∞ QXQ YLC Week 7 Lab Notebook [SOLUTIONS].ipynb
- ∞ QXQ YLC Week 7 Homework [SOLUTIONS].ipynb

Key Terms

Key Term	Definition
Basis	A basis is the specific point of view or frame of reference you are using to look at a state.
X Gate	An X gate is a quantum gate that does a 180 degree rotation about the x-axis.
Z Gate	A Z gate is a quantum gate that does a 180 degree rotation about the z-axis.
H Gate	An H gate is a quantum gate that does a 90 degree rotation about the y-axis **then** a 180 degree rotation about the x-axis.

Lecture

Learning Objectives

1. *Recognize* what a quantum gate is.
2. *Recognize* how quantum gates affect our different representations of qubit states.
3. *Recognize* the X, Z, and H gates.

Key Ideas

1. Quantum gates are a way to change the state of a qubit on a quantum circuit.

2. The order in which we apply quantum gates matters.

3. A measurement on a qubit will force the qubit to assume a classical state, destroying whatever superposition it may have been in.

Lab

Learning Objectives

1. *Understand* how to represent qubits and their states in Cirq.

2. *Recognize* how to apply quantum gates in Cirq.

3. *Recognize* how to create superposition in Cirq.

Key Ideas

1. Using Cirq, you can apply quantum gates in any order you would like, changing the state of the qubit you are working with.
2. A qubit can be in any state while on the circuit depending on the quantum gates applied to it. These states can be represented using kets, vectors, and the Bloch Sphere in Cirq.
3. Once you add a measurement to a circuit, the qubit will **always** end in either the 0 or 1 state.