Quantum Threats and Defenses: Encryption for Future Generation Telecommunications

ANI_711c | Expert-Led Live | Custom | Expanded
Course Duration: 2 days

Learn about the transformative potential of quantum computing, addressing challenges like secure communication. Explore quantum effects such as superposition and entanglement that redefine writing computer code. This training is crafted to be practical and engaging, with exercises reinforcing how quantum ideas can be harnessed in various computational contexts. Developed and delivered by an Award Solutions partner.

Intended Audience

This course is tailored for computer and engineering professionals new to quantum programming and seeking an intuitive, visual pathway to grasp quantum concepts and how they apply to quantum encryption.

Objectives

After completing this course, the learner will be able to:

- Learn a visually intuitive way to work with quantum bits
- Compare and contrast quantum computing and classic computing
- Explain how quantum effects are applied to quantum encryption
- Summarize key developments in the field of quantum encryption

Course Prerequisites

- Keep an open mind; quantum computing defies intuition and traditional concepts.
- Learners must let go of their common sense and usual ways of thinking to embrace quantum thinking.

Outline

1. Foundations of Quantum Computing Hardware
1.1 How Quantum Computers Operate
1.2 Components of a Quantum Computer
1.3 Physically Realizing Qubits and Quantum Gates
1.4 Gate vs. Annealing Quantum Computers
1.5 Quantum Software and Algorithms
2. From Bits to Qubits
2.1 Qubits (quantum bits) vs. classical bits
2.2 Intuitive and visual ways to represent qubits
2.3 Pure vs. Mixed (or Blended) States
2.4 Amplitude and Probability of Quantum States
2.5 Measuring Quantum States
2.6 Exercises on Mixed Quantum States
3. Quantum Logic Gates for Boolean Operations
3.1 NOT (X) Gate
3.2 Controlled NOT (CNOT) Gate
3.3 Controlled Controlled NOT (CCNOT) Gate
3.4 Quantum Circuits - Formulating Logic Constraints
Exercise: Exercises on Setting up Logic Constraints
4. Quantum Gates for Quantum Effects
4.1 Operating on Qubits
4.2 Hadamard (H) Gates
4.3 Putting Qubits in Mixed States
4.4 Quantum Superposition
4.5 Quantum States Containing All Possible Solutions
4.6 Google's 2021 Quantum Computer Claims Over Supercomputers
4.7 Quantum Advantage and Quantum Supremacy
Exercise: Exercises with Mixed State Quantum Circuits
5. Quantum Tagging and Entanglement
5.1 Tagging Specific Quantum States
5.2 Intuition Behind Entanglement
5.3 Entanglement in Quantum Computing
Exercise: Exercises with Multi-Qubit Quantum States
6. More Quantum Gates
6.1 Universal Quantum Gates
6.2 S and T Gates
6.3 Rx, Ry and Rz Gates
Exercise: Exercises with Quantum Circuits using these Gates
7. Quantum Threatens Current Encryption
7.1 Classical Encryption Foundations
7.2 Shor’s Algorithm Breaks Current Encryption
8. Quantum Key Exchange Mechanism
8.1 Merkle's Ideas for RSA and Quantum Cryptography
8.2 Superposition-based Cryptography: BB84 Protocol
8.3 Entanglement-based Cryptography: E91