



ACEHACKER

Write Great Code

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ACE HACKER

Learn to write great code through immersive & hands-on classes. Sharpen your skills with programming competitions & hackathons. Connect & Collaborate with fellow coders, founders, and investors.

COURSES



Ace Hacker **Courses** are crafted to convey the most complex **STEM** concepts through engaging stories. Participate in these stories by engaging your thoughts, emotions, and imagination as you enter the narrative world and react to it. Tinker with the code in every story, push boundaries without fear of failure, build meaningful solutions to tackle real-world problems, and have fun along the way.



COMPETITIONS



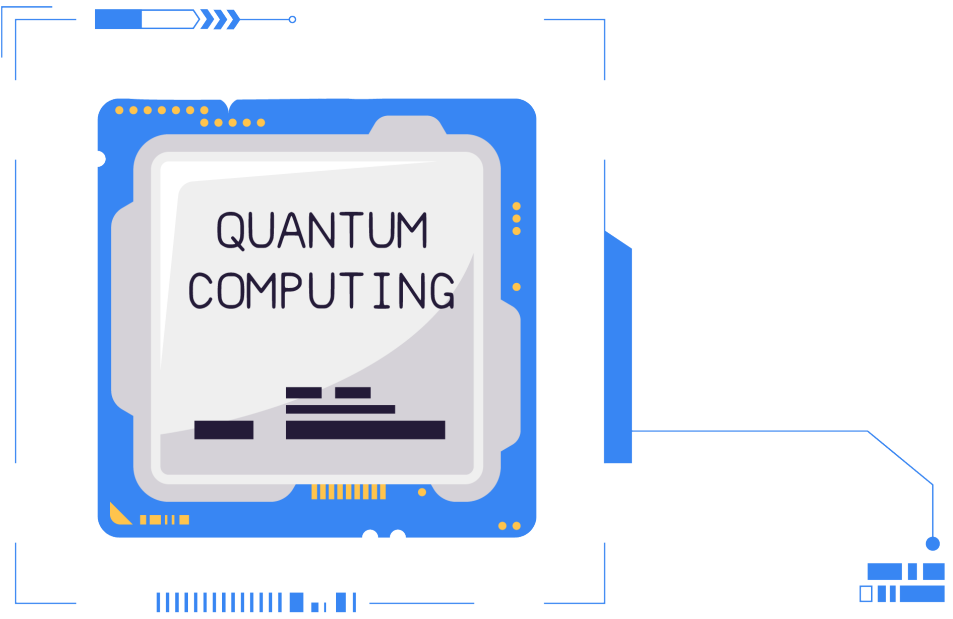
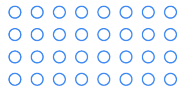
Hack that code. Enhance your skills by participating in sprint **Programming Competitions** or marathon **Hackathons**. Beyond the intellectual growth, the thrill of competition adds an electrifying edge, giving you the chance to showcase your coding finesse and claim well-deserved bragging rights. The skills you hone and the memories you create will serve as lasting assets in your academic and professional pursuits.

CONVENTIONS



Ace Hacker orchestrates **Colloquiums** and **Conferences** serving as a nexus for academicians, scholars, scientists, CXOs, and other luminaries in intellectual pursuits across diverse fields such as Artificial Intelligence, Quantum Computing, Blockchain, Cybersecurity, AR, VR, and Robotics, to name a few, with a mission to foster collaboration and knowledge exchange by bringing together the brightest minds to share their insights and research findings.





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Quantum Computing is a rapidly-emerging technology that harnesses the laws of quantum mechanics to solve problems too complex for classical computers.

In this course, **Vivek Shangari** (<https://acehacker.com/whois/vivek>) offers insights in to quantum computing and how to leverage quantum computational principles such as superposition, measurement, and entanglement by running experiments in Quantum Computing on a quantum computing simulator and a real quantum computer via IBM Quantum Experience systems.

The course is available in two formats:

FUNDAMENTALS OF QUANTUM COMPUTING



This is a **No-Code** course ideal for Executives, Decision-makers, Researchers, or anyone interested in exploring the possibilities of quantum computing without the need to engage in programming tasks.



Learn the theory, principles, and applications of quantum computing without writing computer programs for quantum computers.

PROGRAMMING A QUANTUM COMPUTER



This is a **Hands-on** course ideal for Software Developers, Researchers, or anyone who want to go beyond theory and learn practical aspects of writing & running quantum programs on quantum computers.



Learn to engage with quantum computing tools & platforms like IBM Quantum Experience, and write your own quantum programs with Quantum Computing.





SYLLABUS

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Step into this Ace Hacker course where we unravel the mysteries of Quantum Computing without the quantum headaches! We've concocted a magical mix of mind-boggling topics and wizardry-level concepts, served in Qubit-sized portions with a side of quantum humour. Don't worry about complexity; we'll break it down in a way that you will be spouting quantum theory at the next family dinner.

FUNDAMENTALS OF QUANTUM COMPUTING

Spin

- The Quantum Clock
- Measurements in the Same Direction
- Measurement in Different Directions
- Measurements
- Randomness
- Photons and Polarization

Linear Algebra

- Complex Numbers versus Real Numbers
- Vectors
- Diagrams of Vectors
- Length of Vectors
- Scalar Multiplication
- Vector Addition
- Orthogonal Vectors
- Multiplying a Bra by a Ket
- Bra-Kets and Lengths
- Bra-Kets and Orthogonality
- Orthonormal Bases
- Vectors as Linear Combinations of Basis Vectors
- Ordered Bases
- Length of Vectors
- Matrices
- Matrix Computations
- Orthogonal and Unitary Matrices
- Linear Algebra Toolbox

Spin & Qubits

- Probability
- Mathematics of Quantum Spin
- Equivalent State Vectors
- The Basis associated with a given Spin Direction
- Rotating the Apparatus through 60°
- The Mathematical Model for Photon Polarization
- The Basis associated with a given Polarization Direction
- The Polarized Filters Experiment
- Qubits
- Vijay, Vijaylakshmi, Vivek
- Probability Amplitudes and Interference
- Vijay, Vijaylakshmi, Vivek, and the BB84 Protocol

Entanglement

- Vijay & Vijaylakshmi's Qubits are not entangled
- Unentangled Qubits calculation
- Entangled Qubit calculation
- Superluminal Communication
- The Standard Basis for Tensor Products
- Categorizing the Standard Types
- How do you entangle Qubits?
- Using the CNOT Gate to Entangle Qubits
- Entangled Quantum Clocks

Bell's Inequality

- Entangled Qubits in different Bases
- Proof that

$$\frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 0 \end{bmatrix} \otimes \begin{bmatrix} 1 \\ 0 \end{bmatrix} + \frac{1}{\sqrt{2}} \begin{bmatrix} 0 \\ 1 \end{bmatrix} \otimes \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

equals

$$\frac{1}{\sqrt{2}} |b_0\rangle \otimes |b_0\rangle + \frac{1}{\sqrt{2}} |b_1\rangle \otimes |b_1\rangle$$

- Einstein and Local Realism
- Einstein and Hidden Variables
- A classical explanation of Entanglement
- Bell's Inequality
- The Answer of Quantum Mechanics
- The Classical Answer
- Measurement
- The Ekert Protocol for Quantum Key Distribution

Classical Logic, Gates, Circuits

- Logic
- Boolean Algebra
- Functional Completeness
- Gates
- Circuits
- NAND is a Universal Gate
- Gates and Computation
- Memory
- Reversible Computation
- Billiard Ball Computing

Continues...





SYLLABUS

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...In continuation

FUNDAMENTALS OF QUANTUM COMPUTING

Quantum Gates and Circuits

- Qubits
- The CNOT Gate
- Quantum Gates
- Quantum Gates acting on one Qubit
- Are there Universal Quantum Gates
- No Cloning theorem
- Quantum Computation versus Classical Computation
- The Bell Circuit
- Superdense Coding
- Quantum Teleportation
- Error Correction

Quantum Algorithms

- The Complexity Classes P and NP
- Are Quantum Algorithms faster than Classical ones?
- Query Complexity
- Deutsch's Algorithm
- The Kronecker Product of Hadamard Matrices
- The Deutsch-Jozsa Algorithm
- Simon's Algorithm
- Complexity Classes
- Quantum Algorithms

Impact of Quantum Computing

- Shor's Algorithm and Crypto-analysis
- Grover's Algorithm and Searching Data
- Chemistry and Simulation
- Hardware
- Quantum Supremacy and Parallel Universes
- Computation

Continues...





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PROGRAMMING A QUANTUM COMPUTER

Everything in Fundamentals of Quantum Computing, plus additional subjects as highlighted below:

Exploring the IBM Quantum Experience

- Understanding the Technical requirements
- Navigating the IBM Quantum Experience
- Registering to the IBM Quantum Experience
- Understanding the Personal profile tab
- Getting started with IBM Quantum Experience
- Learning about your backends
- Learning about pending and latest results
- Exploring **My Account**

Circuit Composer - Creating a Quantum Circuit

- Understanding the Technical requirements
- Creating a Quantum Circuit using the Composer
- Creating your first Quantum Circuit
- Building a Quantum Coin-Flipper

Using Quantum Lab Notebooks

- Understanding the Technical requirements
- Creating a Quantum Circuit using Quantum Lab Notebooks
- Reviewing results

Programming Basic Quantum Computing Principles

- Understanding Quantum Computing from a Programmer's perspective
- Understanding Superposition from a Programmer's perspective
- Creating a Quantum Teleportation Circuit

Programming the Quantum Bit (Qubit)

- Understanding the Technical requirements
- Re-visiting Qubits
- Visualizing the state vector of a Qubit
- Creating Bloch Sphere representation of a Qubit
- Understanding Multi-Qubits
- Learning about Superconducting Qubits
- Coupling the Qubit together

Introducing Qiskit and it's Elements

- Understanding the Technical requirements
- Understanding Quantum & Classical system interconnections
- Reviewing the Quantum Programming process
- Understanding how to organize and interact with Qiskit
- Terra
- Aer
- Ignis
- Aqua
- Installing and configuring Qiskit on your machine
- Preparing the installation
- Installing Anaconda
- Installing Qiskit
- Configuring your local Qiskit environment
- Introducing the Qiskit community
- Getting support from the Qiskit community
- Contributing to the Qiskit community

Programming with Qiskit Terra

- Understanding the Technical requirements
- Understanding Quantum Circuits
- Creating a Quantum Circuit
- Obtaining Circuit properties and analysis
- Customizing and parameterizing Circuit libraries
- Generating Pulse Schedules on hardware
- Learning about Instructions
- Understanding Pulses and Pulse libraries
- Generating and executing Schedules
- Scheduling existing Quantum Circuits
- Leveraging Provider information
- Learning about the IBM Quantum Experience components

Continues...





SYLLABUS

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PROGRAMMING A QUANTUM COMPUTER

Everything in Fundamentals of Quantum Computing, plus additional subjects as highlighted below:

Monitoring & Optimizing Quantum Circuits

- Understanding the Technical requirements
- Monitoring and Tracking Jobs
- Optimizing Circuits using the Transpiler
- Transformation of a Quantum Circuit
- Optimizing the Circuit by leveraging the Layout Optimizer
- Learning about Backend Configuration and Optimization
- Understanding Passes and Pass Managers
- Visualizing and enhancing Circuit Graphs
- Learning about customized Visual Circuits
- Drawing the DAG of a Circuit

Executing Circuits using Qiskit Aer

- Understanding the Technical requirements
- Understanding the difference between Aer simulators
- Viewing all available backends
- Running Circuits on the Qasm simulator
- Adding parameters to the backend options
- Initializing the Qubits on a Circuit
- Running Circuits on the Statevector simulator
- Running Circuits on the Unitary simulator
- Generating Noise models
- Understanding Decoherence (T1 and T2)
- Understanding single-gate, multi-gate, and readout errors
- Building your own Noise model
- Executing Quantum Circuits with custom Noise models
- Adding custom Noise models to your Circuits

Mitigating Quantum Errors using Ignis

- Understanding the Technical requirements
- Generating Noise effect of Relaxation
- How to test Circuits
- Estimating T1 Decoherence times
- Generating the Noise effects of Dephasing
- Generating and executing T2 Circuits
- Estimating T2 Decoherence times
- Generating and executing T2* Test Circuits
- Estimating the T2* Dephasing time
- Mitigating Readout Errors

Learning about Qiskit Aqua

- Understanding the Technical requirements
- Understanding the Components and their usability
- Initializing a Fixed Quantum State
- Creating a Neural Network Discriminator
- Implementing State Function Operators
- Using Aqua utilities to simplify work
- Familiarizing yourself with Quantum Algorithms in Aqua
- Implementing the Logical Expression Oracle
- Implementing a Truth Table Oracle
- Creating your first Classical/Quantum application (Simon's)
- Implementing Simon's Algorithm

Programming Quantum Algorithms

- Understanding Technical requirements
- Understanding the meaning of Outperforming Classical Systems
- Understanding the Bell States Algorithm
- Learning about Deutsch's Algorithm
- Understanding the Deutsch-Jozsa Algorithm
- Learning about the foundational Oracle-based Quantum Algorithm
- Learning about the Bernstein-Vazirani Algorithm

Applying Quantum Algorithms

- Understanding Technical requirements
- Understanding Periodic Quantum Algorithms
- Learning Simon's Algorithm
- Learning about the Quantum Fourier Transform Algorithm
- Understanding Shor's Algorithm
- Understanding Grover's Search Algorithm
- Implementing Grover's Search Algorithm

Continues...





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SHARPEN YOUR AXE

Use Lab Exercises, Projects, Coding Competitions, and Hackathons as opportunities to practice and apply your programming skills in real-world scenarios.

To augment your proficiency in **Quantum Computing**, you will be regularly challenged with various assignments like coding challenges, algorithmic puzzles, trick logical, analytical, and mathematical problems - designed to enable you to think creatively and outside the box.

Expect 4 levels of difficulty in these assignments:

- **Beginner:** Exercises that test your understanding of the subject.
- **Intermediate:** Exercises that add new and thought-provoking information to the subject.
- **Advanced:** Exercises that are intended to challenge you.
- **Expert:** Exercises that are extremely difficult by comparison with most others.

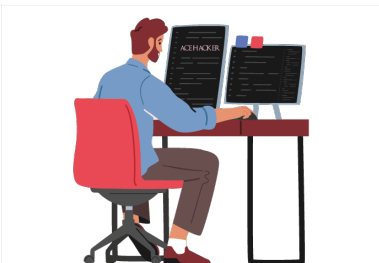
The projects are designed to ensure that you not only understand the theoretical concepts of **Quantum Computing** but also gain hands-on experience in applying those concepts to real-world scenarios. You'll be required to collaborate as a team to attempt some projects while working as a Lone Wolf / individual contributor on others.

- **Four Cornerstone projects** that will reinforce in you the strong foundational knowledge of Cybersecurity & Cyber Warfare.
- **Two Keystone projects** will be more challenging, building on the knowledge you have gained through the Cornerstone projects.
- **One Capstone project**, which will be the culmination of your learning experience in this course.

Competitions and Hackathons are a great way to reinforce your learning and to challenge you to apply your skills to real-world scenarios. By participating in these events, you will gain practical experience and develop your problem-solving skills. You will be participating in a variety of events, including but not limited to:

- **Sprint Coding Competitions**
- **Marathon Hackathons**
- **Catch-the-Flag (CTF) challenges**
- **War Games**

In some competitions, you will collaborate as a team, which will aid you in developing your teamwork skills. In other competitions, you will participate as a Lone Wolf, which will challenge you to think independently and to rely on your own skills and knowledge.



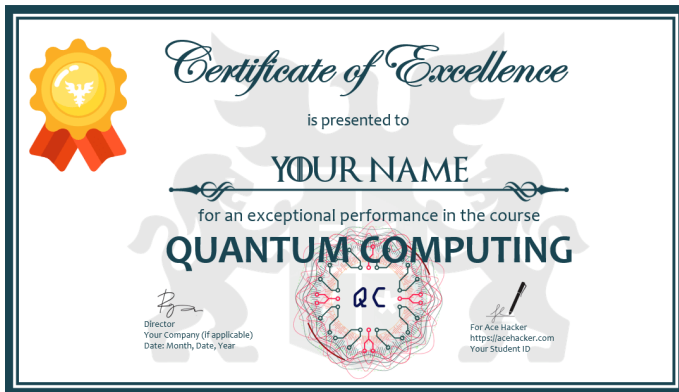


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CERTIFICATE IN QUANTUM COMPUTING

Based on your performance you either get a **Certificate of Excellence** or **Certificate of Completion** after successful completion of the course.



CERTIFICATE OF EXCELLENCE



CERTIFICATE OF COMPLETION

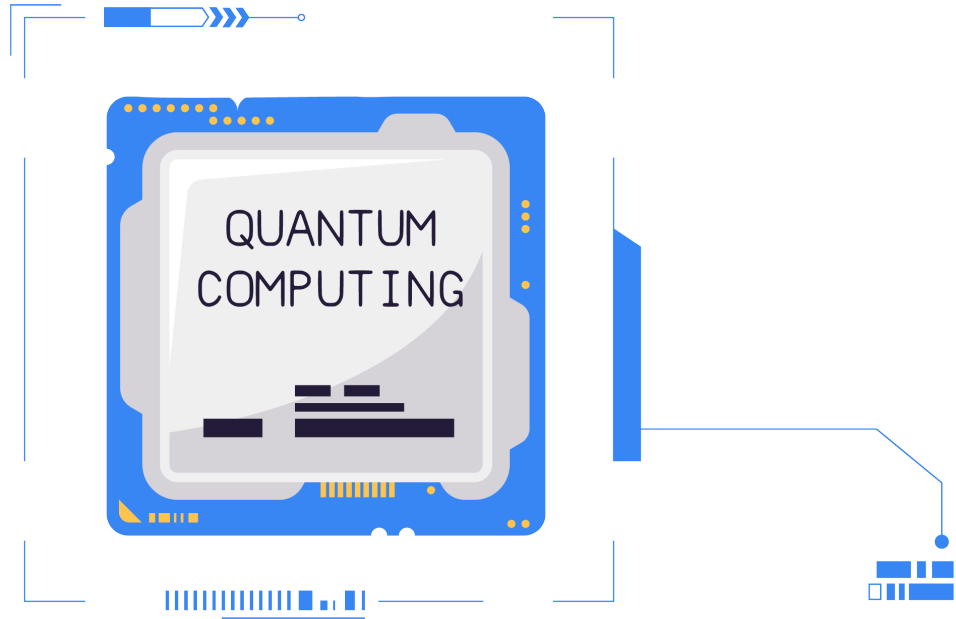


ACE THAT CODING INTERVIEW

As a part of this course, you'll learn to crack a Quantum Computing interview. You'll be thoroughly trained using:

- **Mock Interviews:** We'll simulate the pressure and format of a real Quantum Computing interview, allowing you to practice and improve your technical, communication, and presentation skills under similar conditions.
- Through **Whiteboarding**, you'll learn to visually represent your thought process on a physical or a digital whiteboard.
- We put a lot of emphasis on you having a strong understanding of **Data Structures, Quantum & Classical Algorithms, and Algorithm Analysis** to efficiently solve complex problems and optimize solutions during an interview. which are key factors that interviewers evaluate to assess a candidate's technical competence.
- You'll learn how to handle **Impossible Questions & Kobayashi Maru situations** which are essential during an interview to show adaptability, creativity, and resilience under pressure.
- Learn to solve **Algorithmic, and Mathematical and Puzzles** using Quantum Computing and develop a creative and analytical mindset, logical reasoning, and problem-solving skills that are crucial in cracking an interview.





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Need more information?

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