Quantum Computing: Beginner's Guide

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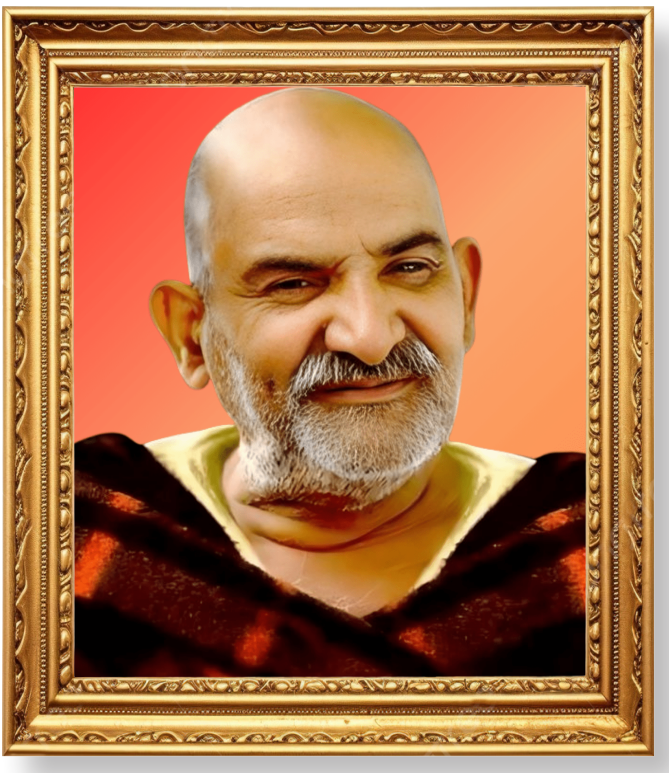

Until some miracles are performed by saints in your life, you cannot believe, believers faith

Preface

At present scenario is study of Quantum Computing is an unavoidable aspect of today's Artificial Intelligent world. Quantum computing is still in its early stages, often referred to as the "Noisy Intermediate-Scale Quantum" (NISQ) era. Yet, rapid advancements suggest that practical, scalable quantum computers may become a reality sooner than expected. Still, the concept and practical application of Quantum Computing rises many interesting questions and offering a radically new approach to computation.

The text book "Quantum computing: Beginner's Guide" serves as an introduction to the foundational principles, potential applications, and current state of quantum computing. It is intended for readers with a basic understanding of linear algebra and classical computing, but it also aims to be accessible to curious learners from a variety of backgrounds. Also, it encompasses a wide range of disciplines and applications, including but not limited to:

- **Foundational Concepts:** Introduction to qubits, superposition, entanglement, quantum gates, and quantum circuits.
- **Quantum Algorithms:** Exploration of notable algorithms such as Shor's algorithm for factoring and Grover's algorithm for search, showcasing the potential for quantum speedup.
- **Quantum Hardware:** Overview of different physical implementations of qubits, including superconducting circuits, trapped ions, and topological qubits.
- **Error Correction & Decoherence:** Discussion on quantum error correction techniques and the challenge of maintaining coherence in fragile quantum systems.
- **Applications:**
  - **Cryptography:** Quantum key distribution and the potential for breaking current cryptographic systems.
  - **Optimization:** Solving complex optimization problems in logistics, finance, and AI.

- **Current Developments:** A look at the current state of quantum computing platforms, cloud-accessible quantum processors, and quantum programming frameworks like Qiskit, Cirq, and others.

We designed this book after referring to university syllabuses from around the world. In my opinion, it will cover at least sixty percentage of the common syllabus from all over the country. This text book aims to provide readers with both the foundational knowledge and forward-looking insight needed to understand and engage with this exciting frontier of technology.

Editors

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We are grateful to Almighty God for giving us the strength, knowledge, and understanding to complete this book. Writing this book, *Quantum Computing*, has been both a challenging and deeply rewarding journey. It would not have been possible without the support, inspiration, and guidance of many individuals and institutions.

First and foremost, I would like to express my sincere gratitude to my colleagues **Dr. Mahamad Ahamad Mohiddon, Dr. Sahil Kumar, Dr. Nithya Rekha Sivakumar, Dr. Indu Sharma, Mr. Sahil Sherawat, Sridevi PC,** who have shared their contribution and encouraged my exploration of this fascinating field. Their expertise and feedback have been invaluable in shaping the direction and depth of this work.

A special thank you goes to my friends and family for their unwavering support and patience throughout the writing process. Their encouragement provided the motivation I needed during the most demanding phases of this project. I also acknowledge the academic institutions, open-source communities, and technology platforms—particularly those involved in the development of quantum programming frameworks.

I extend my heartfelt gratitude to my previous institution, **SRM University-Delhi**, where my idea for the Quantum book was lovingly nurtured and developed. I'm incredibly thankful to my current institution, **DVR & Dr. HS MIC College of Technology, Vijayawada** for allowing me the wonderful opportunity to finish the book and for creating a supportive atmosphere that promotes creative thinking and academic progress.

This book would not have been possible without the support of the New Delhi publisher, **Chanchal Mukherjee** and **Deepanjan Mukherjee**, who provided valuable support for its beautiful publication.

Finally, to the readers—whether you're a student, researcher, or simply curious about the quantum world—I hope this book serves as a valuable guide and ignites your own journey into the possibilities of quantum computation.

Dedicated to

Kavi-Mythu-Surya

&

Family

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