

Quantum Computing

by Jozef Gruska

In quantum computing, we witness an exciting and very promising merging of two of the deepest and most successful scientific and technological developments of this century: quantum physics and computer science. In spite of the fact that its experimental developments are in their infancy, there have already been a variety of concepts, models, methods and results obtained at the theoretical level that clearly have lasting value and these form the main subject of the book. Knowledge from two areas is of importance for understanding the basic developments in quantum computing: namely, quantum physics and theoretical computer science. The book provides elements of both, and concentrates on the presentation of concepts, models, methods and results mainly from a computing point of view. No previous knowledge of quantum mechanics is required.

Supporting material for the book can be found on the author's website:
<http://www.mcgraw-hill.co.uk/gruska>

Who should read this text?

Quantum Computing is suitable for advanced undergraduate and postgraduate courses in computer science and physics. It will also be essential reading for researchers and professionals.

Key features:

- ❖ By making no assumption of previous knowledge of quantum mechanics, the book explains the principles and also the mysteries of the basic physical phenomena behind quantum computing. It allows a computer scientist to understand all of the relevant aspects of quantum information processing.
- ❖ By making minimal assumptions of theoretical computer science results, the book allows a physicist to understand all of the relevant aspects of quantum computing from a computer science point of view.
- ❖ The large number of examples, figures and, especially, exercises provide ample opportunity for students and readers to practice the material learned.
- ❖ An extensive Appendix provides a concentrated presentation of some of the basic frameworks within which quantum computing develops; quantum mechanics, Hilbert spaces and computational complexity theory.



About the author:

Jozef Gruska is Professor of Computer Science at Masaryk University, Brno, The Czech Republic. He has held visiting professorships in many universities in North America and Europe and has been a member of many international organisations in computer science. He was the author of *Foundations of Computing* (1997). His many achievements have included the post of Founding Chair (1989–1997) of the IFIP Specialist Group on Foundations of Computer Science and being the recipient of the IEEE Computer Pioneer Award (1997).

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<p>FUNDAMENTALS: Why quantum computing; Prehistory of quantum computing; From randomized to quantum computation; Hilbert space basics; Quantum experiments; Quantum principles; Classical reversible gates and computing.</p> <p>ELEMENTS: Quantum bits and registers; Quantum entanglement; Quantum circuits.</p> <p>ALGORITHMS: Quantum parallelism and simple algorithms; Shor's algorithms; Quantum searching and counting; Methodologies to design quantum algorithms; Limitations of quantum algorithms.</p> <p>AUTOMATA: Quantum finite automata; Quantum Turing machines; Quantum cellular automata.</p> <p>COMPLEXITY: Universal quantum Turing machines; Quantum computational complexity; Quantum communication complexity; Computational power of quantum non-linear mechanics.</p>	<p>CRYPTOGRAPHY: Prologue; Quantum key generation; Quantum cryptographic protocols; Quantum teleportation and superdense coding.</p> <p>PROCESSORS: Early quantum computers ideas; Impacts of imperfections; Quantum computation and memory stabilization; Quantum error-correcting codes; Fault-tolerant quantum computation; Experimental quantum processors.</p> <p>INFORMATION: Quantum entropy and information; Quantum channels and data compression; Quantum entanglement; Quantum information processing principles and primitives.</p> <p>APPENDIX: Quantum Theory; Hilbert space framework for quantum computing; Deterministic and randomized computing; Exercises; Historical and bibliographical references.</p> <p>LITERATURE:</p> <p>INDEX</p>
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