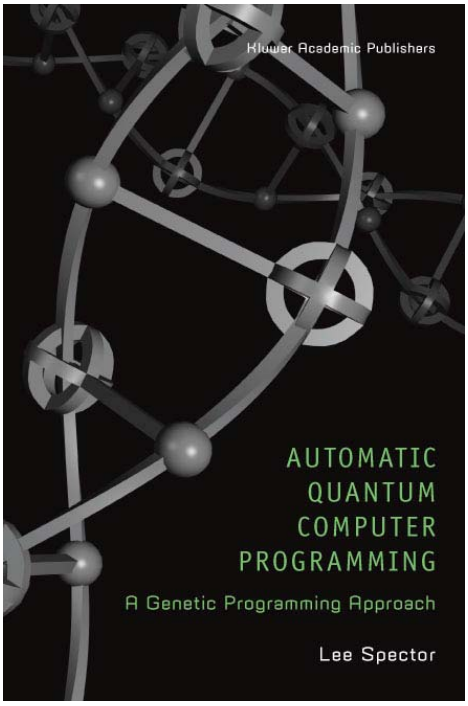
Automatic Quantum Computer Programming

A Genetic Programming Approach



Lee Spector

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'I thoroughly enjoyed this book. It not only introduces quantum computing, but also genetic programming and the author's original genetic programming system "PushGP" which is used to evolve the quantum algorithms discussed in later chapters. The book is comprehensive, with wonderfully clear illustrations and comes with a Lisp-based quantum simulator program. Truly recommended for readers interested in gaining knowledge about exciting frontiers of computer science.'

— ***Wolfgang Banzhaf, Memorial University of Newfoundland***

Computer science will be radically transformed if ongoing efforts to build large-scale quantum computers eventually succeed and if the properties of these computers meet optimistic expectations. Nevertheless, computer scientists still lack a thorough understanding of the power of quantum computing, and it is not always clear how best to utilize the power that is understood. This dilemma exists because quantum algorithms are difficult to grasp and even more difficult to write. Despite large-scale international efforts, only a few important quantum algorithms are documented, leaving many essential questions about the potential of quantum algorithms unanswered.

These unsolved problems are ideal challenges for the application of automatic programming technologies. Genetic programming techniques, in particular, have already produced several new quantum algorithms and it is reasonable to expect further discoveries in the future. These methods will help researchers to discover how additional practical problems can be solved using quantum computers, and they will also help to guide theoretical work on both the power and limits of quantum computing.

Automatic Quantum Computer Programming provides an introduction to quantum computing for non-physicists, as well as an introduction to genetic programming for non-computer-scientists. The book explores several ways in which genetic programming can support automatic quantum computer programming and presents detailed descriptions of specific techniques, along with several examples of their human-competitive performance on specific problems. Source code for the author's QGAME quantum computer simulator is included as an appendix, and pointers to additional online resources furnish the reader with an array of tools for automatic quantum computer programming.

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