



# Elements of Programming

By Alexander A. Stepanov, Paul McJones

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—Martin Newell, Adobe Fellow

“The book contains some of the most beautiful code I have ever seen.”

—Bjarne Stroustrup, Designer of C++

“I am happy to see the content of Alex’s course, the development and teaching of which I strongly supported as the CTO of Silicon Graphics, now available to all programmers in this elegant little book.”

—Forest Baskett, General Partner, New Enterprise Associates

“Paul’s patience and architectural experience helped to organize Alex’s mathematical approach into a tightly-structured edifice—an impressive feat!”

—Robert W. Taylor, Founder of Xerox PARC CSL and DEC Systems Research Center

*Elements of Programming* provides a different understanding of programming than is presented elsewhere. Its major premise is that practical programming, like other areas of science and engineering, must be based on a solid mathematical foundation. The book shows that algorithms implemented in a real programming language, such as C++, can operate in the most general mathematical setting. For example, the fast exponentiation algorithm is defined to work with any associative operation. Using abstract algorithms leads to efficient, reliable, secure, and economical software.

This is not an easy book. Nor is it a compilation of tips and tricks for incremental

improvements in your programming skills. The book's value is more fundamental and, ultimately, more critical for insight into programming. To benefit fully, you will need to work through it from beginning to end, reading the code, proving the lemmas, and doing the exercises. When finished, you will see how the application of the deductive method to your programs assures that your system's software components will work together and behave as they must.

The book presents a number of algorithms and requirements for types on which they are defined. The code for these descriptions—also available on the Web—is written in a small subset of C++ meant to be accessible to any experienced programmer. This subset is defined in a special language appendix coauthored by Sean Parent and Bjarne Stroustrup.

Whether you are a software developer, or any other professional for whom programming is an important activity, or a committed student, you will come to understand what the book's experienced authors have been teaching and demonstrating for years—that mathematics is good for programming, and that theory is good for practice.

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### **Elements of Programming By Alexander A. Stepanov, Paul McJones Bibliography**

- Sales Rank: #665911 in Books
- Published on: 2009-06-19
- Original language: English
- Number of items: 1
- Dimensions: 9.20" h x 1.10" w x 6.70" l, 1.21 pounds
- Binding: Hardcover
- 288 pages

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## Editorial Review

### Review

"A wise manager will make copies available free to any members of her programming staff who commit to read it. The training budget could hardly be better spent...Elements of Programming has the power to change the readers professional life." Martyn Thomas FREng, Components in Eletronics

### From the Back Cover

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## About the Author

**Alexander Stepanov** studied mathematics at Moscow State University from 1967 to 1972. He has been programming since 1972: first in the Soviet Union and, after emigrating in 1977, in the United States. He has programmed operating systems, programming tools, compilers, and libraries. His work on foundations of programming has been supported by GE, Brooklyn Polytechnic, AT&T, HP, SGI, and, since 2002, Adobe. In 1995 he received the Dr. Dobbs' Journal Excellence in Programming Award for the design of the C++ Standard Template Library.

**Paul McJones** studied engineering mathematics at the University of California, Berkeley, from 1967 to 1971. He has been programming since 1967 in the areas of operating systems, programming environments, transaction processing systems, and enterprise and consumer applications. He has been employed by the University of California, IBM, Xerox, Tandem, DEC, and, since 2003, Adobe. In 1982 he and his coauthors received the ACM Programming Systems and Languages Paper Award for their paper "The Recovery Manager of the System R Database Manager."

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