


# Technical Java: Applications for Science and Engineering

*By Grant Palmer*

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Advanced Java for Engineers and Scientists gives the reader all the information needed to use Java to create powerful, versatile, and flexible scientific and engineering applications. The book is full of practical example problems and valuable tips. Grant Palmer, a research scientist himself, goes in-depth into advanced technical programming concepts applicable to scientific-oriented applications, such as solving differential equations, data modeling, integration of functions, and creating generic class libraries. The last section of the book shows readers how Java can be used to develop GUI or Web-based front-ends to scientific or engineering programs.

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## Editorial Review

From the Back Cover

# TechnicalJava™

## Developing Scientific and Engineering Applications

## Grant Palmer

### The practical, example-rich guide to Java technical programming

If you want to use Java todevelop scientific or engineering programs, Technical Java is the Java guide you've vebeen searching for. Using real-life examples, expert scientific programmerGrant Palmer shows how to build powerful, versatile, and flexible software forvirtually any technical application. Whether you're moving from FORTRAN,C, or C ++, or learning Java as your first language, Palmer covers all you needto know—

- Java, FORTRAN, C, and C ++, similarities, differences, and migration issues
- Java 1.4 syntax, objects, classes, methods, interfaces, variables, arrays, exceptions, packages, I/O, and more
- Working with java.math and creating your own math functions—including detailed trigonometric and transcendental examples
- Data modeling, in depth: class hierarchies, generic class libraries, least-squares fit, fitting to non-polynomial equations, and more
- Solving differential equations and systems of equations, including Gauss-Jordan and Gaussian elimination, lower-upper decomposition, and matrix inversion
- Solving integral equations with both proper and improper integrals
- Working with Fourier transforms (DFT and FFT)
- Building Web and GUI-based technical applications with Swing/AWT and servlets

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About the Author

## About the Author

**GRANT PALMER**, a scientific programmer at NASA Ames Research Centerin Moffett Field, CA, specializes in computational fluid dynamics programmingto predict friction-related heat in reentering space vehicles. He has writtenor contributed to five Java books, including Java Event Handling (Prentice HallPTR). Palmer resides in Chandler, Arizona.

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# Preface

This book was inspired by the following premise—Javais a great language for developing scientific and engineering applications.It's more powerful and versatile than Fortan or C. It's easier tolearn, less redundant, and less prone to error than C++. I have been ascientific programmer at a NASA research center for 18 years. You would thinksuch a place would be on the cutting edge of programming technology, but thatis not the case. Most of the technical programmers there still program in Fortranor C. The reason is largely one of inertia. Those languages are what they havealways used and they are comfortable with them. Some people have moved over toC++, and slowly but surely people are moving to Java as their technicalprogramming language of choice.

The book is designed to break through the inertia andmisconceptions that may have kept you from using Java for your scientific andengineering programming work. It will give you a good foundation in the basicsof Java and demonstrate how Java can be applied to solve a number ofmathematical analysis problems. The book will discuss migration issues fromother languages to Java and provide an introduction to developing GUI-orweb-based technical applications.

## Why Is Java a Good Technical Programming Language?

There are many features of Java that make it a good choicefor your technical programming work. For one thing, Java is an object-orientedlanguage. Because of this, it provides a structured framework for developingyour programs. When a code is written in an object-oriented manner, it becomeseasier to read and more modular. You can write programs that extend thecapabilities of existing programs. When an analysis procedure is written as anobject it can be easily incorporated into any number of different applications.

One of the design goals of the developers of Java was thatthe language be easy to learn and use. It borrows much of its basic syntax fromC and C++, but the developers of Java simplified the language by removingredundancies that exist in C and C++, as well as removing potentially dangerouselements—such as multiple inheritance—that were of marginal value.It is much easier to learn and apply Java, for example, than it is to learn andapply C or C++.

Another powerful feature is Java's portability. Javaprograms are designed so that you can "compile once, run anywhere."You can develop a scientific application on a UNIX workstation, transfer it toan Apple or Windows-based laptop, and the application will run without havingto recompile it. Java's portability opens up the power of the Internet toyour technical programming work. You can easily develop your scientific orengineering applications as web-based programs.

There is a global support network for Java. You can getonline support and documentation from the Sun Microsystems website and manyother sources as well. There are Java User Groups (JUGs) pretty much

anywhereyou live in just about every country. These groups are very useful for solvingproblems and discussing programming techniques and issues.

It also is easy to develop code in Java. You can leverageexisting classes and methods to develop new ones. In this book, we willdemonstrate how simple it is to create user-defined mathematical functions. Theobject-oriented structure of aJava makes the code easy to read. A program that is easy to read is easier tomaintain or modify.

# The Structure of This Book

Think of this book in four parts. The first includes ageneral introduction to Java and its development history. Following this arechapters that discuss migration issues from Fortan, C, or C++ to Java. You willfind that much of the basic syntax is the same between C, C++, and Java. Thereare some important differences, though, that these chapters will bring tolight.

The second part goes over the basic elements of the Javalanguage with an emphasis on topics pertinent to technical programming.Following a discussion of basic object-oriented programming concepts, there arechapters that discuss classes, methods, and variables. Interfaces, packages,and JAR files are also covered. There are chapters that discuss how Java treatsarrays and strings. Finally, there are chapters on the math capability ofJava—both the intrinsic functionality that comes with the Java API and a discussionof how to create user-defined math libraries.

Once we have a good understanding of the key elements of theJava language, we are ready to do some serious technical programming. The thirdpart of this book discusses how Java can be applied to such tasks as solvingsystems of equations, differential equations, integral functions, and Fouriertransforms. These chapters not only provide Java source code and real-lifemodel problems, but also delve into the theory behind the solution techniques.This section of the book also includes chapters on developing data curve fitsand generic class libraries.

The final part consists of three chapters covering importantfeatures you will probably make use of in your technical programming. Chapter25 discusses the input/output capability of Java. The Java API provides apowerful and versatile I/O functionality for reading and writing both byte andcharacter data. Java also gives you the ability to write GUI front ends to yourtechnical programs. An introduction to how this is done is provided in Chapter26. Another great feature of Java is that it gives you access to the power ofthe Internet. The final chapter of this book provides an introduction to howyou can turn a program into a web-based application using Java servlets.

# What This Book Is Not

This book will teach you the basic tools you will need tostart writing technical programs in Java, but it will not cover every possibleaspect of scientific or engineering programming. The book is not an exhaustivetreatise on solving differential equations, integral functions, or Fouriertransforms. Each of those topics is a book unto itself. This book will presentthe most commonly used techniques to solve those mathematical problems, butwon’t go into many specialized or super-advanced techniques.

The book also does not give a comprehensive description ofall of the classes, methods, interfaces, and fields from the Java API. The Javalibraries are enormous and a detailed look at even the Standard Editionlibraries would take many hundreds of pages. This book does cover some Java APIelements that are particularly relevant to technical programming. For adetailed look at the rest of the Java API, the reader is referred to the SunJava doc pages.

## Users Review

**From reader reviews:**

**Katherine Belcher:**

Have you spare time to get a day? What do you do when you have considerably more or little spare time? That's why, you can choose the suitable activity to get spend your time. Any person spent their particular spare time to take a stroll, shopping, or went to the Mall. How about open or even read a book called Technical Java: Applications for Science and Engineering? Maybe it is to get best activity for you. You know beside you can spend your time with your favorite's book, you can cleverer than before. Do you agree with their opinion or you have various other opinion?

**Mary Blackwell:**

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