Programming with Objects

A Comparative Presentation of Object-Oriented Programming with C++ and Java

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Preface

This book presents object-oriented programming with C++ and Java, which are today’s two dominant languages for such programming. The presentation format is mostly comparative, all the way from the basic language constructs to application-level issues dealing with graphics programming, network programming, and database programming. This book is intended for a reader who is well-conversant with the important features of C: pointers, strings, arrays, and structures.

The author strongly believes in the notion that, in addition to the syntax, it is essential to also show a programming language through its applications to fully establish its beauty and power. Teaching a programming language divorced from its applications – not uncommon in many educational programs – would be like teaching English through just its grammar.

This book grew out of an attempt to meet a specific academic need for a comprehensive educational program in object-oriented programming. We wanted a program that would not be too indoctrinating with regard to any one style (or any one language, since language often dictates style) of object-oriented programming. While programming skill could have been taught by focusing on a single language, education in its larger sense demanded that we provide a broader menu of styles and concepts. The result was what the reader sees in this book: An integrated presentation of C++ and Java. There is educational value in comparing and contrasting the two languages, from basic language constructs to how the languages are used in application-level programming. Such comparisons may even inspire an enterprising student to think of new and more powerful object-oriented languages of the future. To further enhance
the educational value of this comparative approach, this book also includes treatment
of simulated object-orientation in plain C, with GNOME/GTK+ presented as a major
example of this approach.

This book is based on the philosophy that learning by comparison is very efficient
and can be a lot of fun. Sometimes we find it easier to remember and learn things if we
can anchor our memory and comprehension in interesting differences and similarities
between supposedly similar objects, structures, and situations. Learning C++ and
Java together can exploit this aspect of human cognition. Students find it interesting
to compare C++ and Java programming constructs for doing the same thing.

Teaching and learning C++ and Java together have some unique advantages. First,
because both C++ and Java were born out of C, they have much in common at the
level of basic language structures. Teaching these structures together saves time. For
example, once the concept of a vector in C++ is made clear and some of the more
useful functions associated with C++ vectors are elucidated, the discussion of the Java
ArrayList takes hardly any time. The Java discussion consists mostly of pointing out
the Java functions that do the same thing as the previously discussed C++ functions.

Then there is also the unique process of learning by coding up a program in C++
that does the same thing as a given program in Java, or vice versa. My experience is
that this approach enables the students to tackle more difficult projects in both C++
and Java than would otherwise be the case under the time constraints of a course.

Learning two large languages together does have its down side. One can get
confused as to what feature belongs to which language. Fortunately, this difficulty
is minimized by the modern programming practice of keeping one eye on the on-
line documentation in one terminal window while programming in another terminal
window. Both Java and C++ have become so large that it would be impossible for
anyone to commit to memory all of the classes and all of the functions and attributes
defined for the classes. So even if one were not learning two languages simultaneously,
one would still need to refer to documentation while writing programs.

The book contains more material than can be accommodated in a typical one-
semester course. In my experience, the book works well for a sequence of two
back-to-back courses, the first focusing on the basic language constructs as presented
in the first fifteen chapters, and the second focusing on application- and design-level
issues. For the second course, I complement the material in the last five chapters with
a book on design patterns.

It would be naive of me to assume that a manuscript as large as this would be
free of errors. I’d be much grateful to the readers who would bring the errors to
my attention at kak@purdue.edu. All corrections will be made available online at
www.programming-with-objects.com, and the authors of the corrections will be
duly acknowledged. The same applies to any slip-ups on my part in giving proper
attributions to authors. Where my example programs were inspired directly by what
I saw in other sources, I have acknowledged their authors in the “Credits and Sug-
gestions for Further Reading” section at the end of each chapter.
The author will be glad to make available to the prospective instructors the solutions to the homework problems.

Finally, the book should also be useful to those who are transitioning from C++ to Java, or vice versa.

Purdue University                      Avinash Kak
Acknowledgments

Whatever merit this book has should go in large measure to the stalwarts of the object-oriented programming movement, to those who created C++ and Java, and to those who have been the chief expositors of these two languages over the last several years (see the references at the end of the book).

This book would not have been possible without the help of the following people:

- Guilherme DeSouza, a man with insights that are as deep as they are broad and for whom Linux is a religion to which he has converted many, this author included. Guilherme’s insights in multiprocessing and multithreading played an important role in the revamping of Chapter 18.
- Elvia Suryadi, who can spot from a mile the slightest flaw in a logical argument, the minutest weakness in an explanation. Her constant feedback helped with the cleanup of many sections of the book, too numerous to be listed here individually. The homework problems in Chapters 13 and 20 are by Elvia.
- Malcolm Slaney, with an uncanny eye for rigor and precision, for providing critical feedback on the first five chapters.
- Carl Crawford, never a man to mince words, who insisted that my earlier version of the front matter did not do justice to the rest of the book.
- Susan Gottschlich, with deep insights in the software development cycles of industry, for her careful reading and feedback of the first 11 chapters.
Robert Cromwell, who has always had his ear to the ground for the latest happenings in the world of software and hardware, for looking carefully at the C-related material in the book and suggesting improvements.

Sarah Sellke, with many years of object-oriented software design and development experience for telecom and other applications, for her feedback on Chapter 19.

Christina Pavlopoulou, as a source of great help in the early stages of my putting together this book.

Prathima Venkatesan, who proofread and caught many errors in the draft copies of Chapters 4, 5, 6, and 7.

Bob Mulvey, for helping me better understand the various shortcomings associated with the use of setjmp–longjmp macros for achieving multilevel return in C.

Brett Maden, for creating the final versions of the figures in Chapters 15 and 17. He also contributed to the homework section of Chapter 17; the Qt and GNOME/GTK+ problems were supplied by him.

Kheng Tan, for many of the final production figures for Chapters 14 and 16. Kheng also supplied the problems for the homework section of Chapter 14.

Thanks also go to the anonymous reviewers of the book; many of the comments I received through the review process helped in the revision of much material. Of the publisher reviews received nonanonymously, I wish to thank Simon Gray in particular for catching many errors in Chapter 2, 8, 10, 14, and 19 and suggesting improvements.

Many additional sources of help and information that proved important to the writing of this book are acknowledged near the end of each chapter in a section entitled “Credits and Suggestions for Further Reading,” or sometimes just “Suggestions for Further Reading.” Occasionally, I have also used a footnote for the same purpose.

I am also grateful to Subhash Kak, whose powers of exposition border on the lyrical, for his many wonderful suggestions for smoothing out the text at various places.

Finally, and most importantly, many thanks go to Carla for her loving friendship, support, and understanding, all things that give true meaning to life. Thanks also go to Carla for her direct contributions to the book by way of critical reading of its various sections.

A.C.K.
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Object-oriented programming (OOP) is a programming paradigm based on the concept of "objects", which can contain data, in the form of fields (often known as attributes or properties), and code, in the form of procedures (often known as methods). A feature of objects is an object's procedures that can access and often modify the data fields of the object with which they are associated (objects have a notion of "this" or "self"). In OOP, computer programs are designed by making them out of objects that Teaching object-oriented programming has clearly become an important part of computer science education. We agree with many others that the best place to teach it is in the CS1 introductory course. Many problems with this have been reported in the literature.