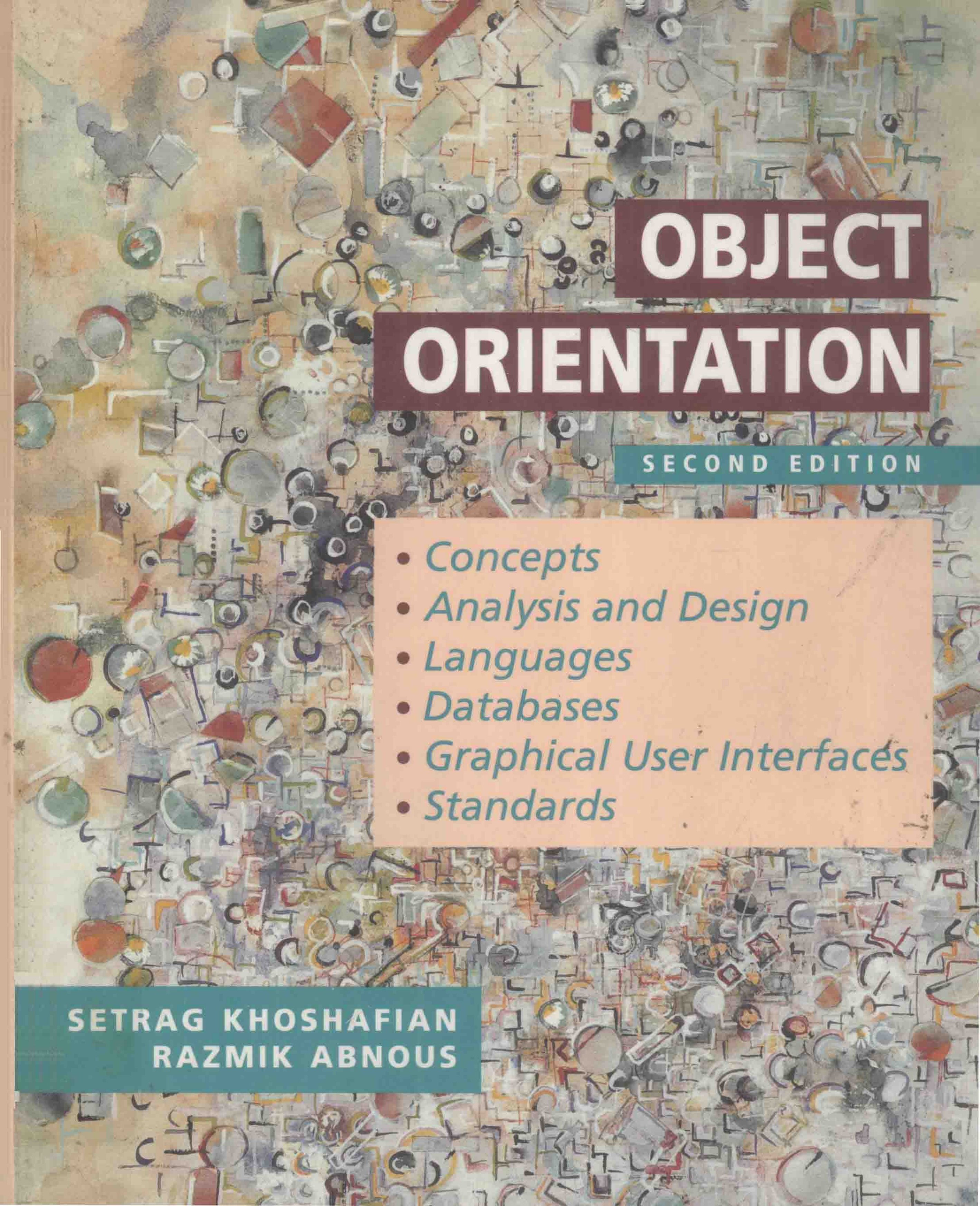
OBJECT ORIENTATION

SECOND EDITION

- *Concepts*
- *Analysis and Design*
- *Languages*
- *Databases*
- *Graphical User Interfaces*
- *Standards*

SETRAG KHOSHAFIAN
RAZMIK ABNOUS



Object Orientation
Second Edition

CONCEPTS • ANALYSIS & DESIGN • LANGUAGES • DATABASES • GRAPHICAL USER INTERFACES • STANDARDS

Setrag Khoshafian
Razmik Abnous

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Object Orientation
Second Edition

To our wives
Silva Khoshafian and
Suzanne M. Abnous

and children
Nishan, Jonathan, Shahan, and Nareg Khoshafian,
Sevan, Haig, and Armen Abnous

Preface

Application environments are becoming increasingly fast-paced and complex. There is great diversity in the way information is accessed, manipulated, and presented. Information is no longer centralized; it is distributed on networks of heterogeneous environments. Different generic products and tools attempt to simplify a user's interactions with information systems. Unfortunately, the diversity and the lack of integration among these products often force users to learn multiple-user interface paradigms, obtuse operating system scripts, and different key-stroke commands.

There is an enormous need for integration, simplicity, and ease of use across all products. But simplicity and ease of use come at a price. The simpler and more intuitive the environment, the more complex the underlying software system must be to support and implement it. To meet the computational needs of emerging applications, software must be modular, extensible, maintainable, and robust. It must be manageable. This means the model of the real world and its implementation in the system should not be too far off.

Object orientation is an enabling software technology that attempts to fulfill these increasingly demanding computational needs. The potential of object technology stems from:

1. The proficiency of its higher-level object-oriented model, which also reduces software cost and provides the designer with real-world programmable components.
2. Its capability to share and reuse code with object-oriented engineering techniques, reducing the time required to develop an application.

3. Its capability to localize and minimize the effects of modifications through object-oriented programming abstractions, allowing the software to encompass more diverse algorithms and technologies.

This book clarifies the basic concepts associated with object orientation. It provides a clear yet comprehensive exposure to the fundamental ideas in object orientation. This is important since object orientation is often confused with certain languages, such as Smalltalk, or particular user-interface paradigms, such as windows and icons. Furthermore, a clear understanding of object-oriented concepts will allow the reader to use object-oriented constructs in *any* programming language (including conventional ones).

The book will give the reader a basic understanding of the main concepts of popular object-oriented systems: languages, databases, and user interfaces. It also elucidates object-oriented analysis and design methodologies and shows how the object-oriented concepts manifest themselves in object-oriented software development. Object orientation is above all a programming *style* that allows better organization and modularization of large application programs. The book emphasizes the concepts and the ideas for improving programming style, regardless of whether the programmer uses an object-oriented programming language. Special emphasis is given to C++ and to the newly emerging fields of object-oriented analysis and design, object-oriented databases, and user interfaces.

Many programming languages are labeled or claim to be "object-oriented." We felt it was important to show how object-oriented concepts are reflected in these languages. Simula and Smalltalk have played a historic role in the evolution of object-oriented systems and concepts. Nevertheless, we believe the most popular system development languages of the 1990s will be C++. Hence we devote an entire chapter to it.

The book also demonstrates the object-oriented concepts that manifest themselves in database applications. We felt the need to present a clear exposure of the emerging field of object-oriented databases. These databases constitute the next evolutionary step after relational databases; post–relational database management systems will all have object-oriented features. This book demonstrates both the object-oriented characteristics and database characteristics of several systems that claim to be object-oriented databases.

As the emergence of Windows 95 and the popularity of graphical user interfaces (GUI) in other platforms (MacOS, Windows X, and OS/2 Warp) indicate, user interaction with computing systems is becoming more intuitive. Given the explosion in multimedia information management systems and graphical information displays, we decided to analyze the object-oriented capabilities of graphical user interfaces. These GUI environments provide direct object manipulation features. They allow users to represent and interact with visual objects using familiar physical metaphors. This book uncovers the object-oriented characteristics of the most popular GUI systems.

This book is intended for a wide variety of audiences. At small and large corporations, MIS managers and professionals can use the book to understand the impact of object orientation on their end users. The book will serve the needs of software engineers and computer scientists who are interested in object-oriented systems and want a global perspective on the subject. At universities, it could be a supplementary text for programming languages and software engineering courses, or a graduate course dedicated to object-oriented systems. The book is also suitable for short courses, continuing education, and professional self-study. Prerequisites in data structures, compilers, operating systems, performance evaluation, and databases will be useful.

Chapter 1 gives a brief introduction to object-oriented concepts. It examines the evolution of object orientation in languages, databases, and user interfaces. It also presents examples used commonly throughout the book.

The key object-oriented concepts covered in this book are abstract data typing, inheritance, and object identity.

Chapters 2 through 4 provide detailed and self-contained exposure to all the aspects of these foundational concepts.

Chapter 2 discusses the concept of abstract data typing. It describes in detail the mechanisms of hiding the implementation of an object's interface routines. Abstract data typing enhances code extensibility and reusability. The chapter also clarifies and differentiates commonly used object-oriented terms, such as *classes, instances, methods,* and *messages.*

Chapter 3 discusses the concept of inheritance. Through inheritance, one can build new classes or software modules on top of an existing, less specialized hierarchy of classes, instead of redesigning everything from scratch. The new classes can inherit both the behavior and the representation of existing classes. Inheritance enhances software extensibility, reusability, and code sharing.

Chapter 4 surveys the concept of object identity. Object identity allows the objects in an application to be organized in arbitrary graph-structured object spaces. The chapter shows the superiority and generality of the strong notion of object identity when compared to the conventional techniques of referencing objects in programming languages and databases. Three disciplines have been most influential in the evolution of object-oriented technologies; object-oriented languages, object-oriented databases, and object-oriented user interfaces.

Chapter 5 provides an overview of object-oriented analysis and design methodologies. The chapter demonstrates how a step-by-step software design and implementation methodology can be used to construct powerful applications with object technology. It also provides brief descriptions of a number of popular OOA×OOD methodologies, including Booch, Rumbaugh, and Shlaer/Mellor.

Throughout Chapters 2, 3, and 4 are numerous illustrative examples in some of the most common object-oriented languages, such as Smalltalk. However, we dedicate two chapters to popular object-oriented languages. Chapter 6 discusses languages such as Smalltalk, Ada, and Eiffel. We have chosen Smalltalk since it started the object-oriented revolution, Ada because of its popularity in government, and Eiffel since it represents a modern object-oriented language. Chapter 7 concentrates on C++, describing its main features through illustrative examples. C++ already is *the* system development language of the 1990s. The chapter, which is self-contained, will provide the reader with a firm grasp of the language.

Chapter 8 covers the emerging field of object-oriented databases, which combine the object-oriented concepts of abstract data typing, inheritance, and object identity with database capabilities. These database capabilities include the support of persistent object spaces, transactions, recovery, querying, and versioning of objects. The chapter discusses the object-oriented features of several object-oriented database management systems from both research and industry.

Chapter 9 illustrates the enormous impact of object orientation on the design and presentation of the modern user interfaces. This chapter covers such concepts as the direct manipulation of objects and the application of predefined class hierarchy libraries for user-interface components. It also discusses some of the modern graphical user interfaces in use today and describes the object-oriented interface layers presented to both end users and application developers.

Chapter 10 presents an overview of standardization efforts in object technologies. In this chapter we examine standardization in the areas of object sharing and interoperability and databases. Object sharing and interoperability have become very hot topics in the 1990s. We examine Microsoft OLE2, CILab's OpenDoc, and Object Management Group's CORBA. In the area of databases, we examine the ODMG-93 standard, which provides a framework for interoperability and sharing among object-oriented database vendors.

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Walnut Creek, California
Danville, California
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SETRAG KHOSHAFIAN
RAZMIK ABNOUS

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