大学计算机教育国外著名教材、教参系列（影印版）

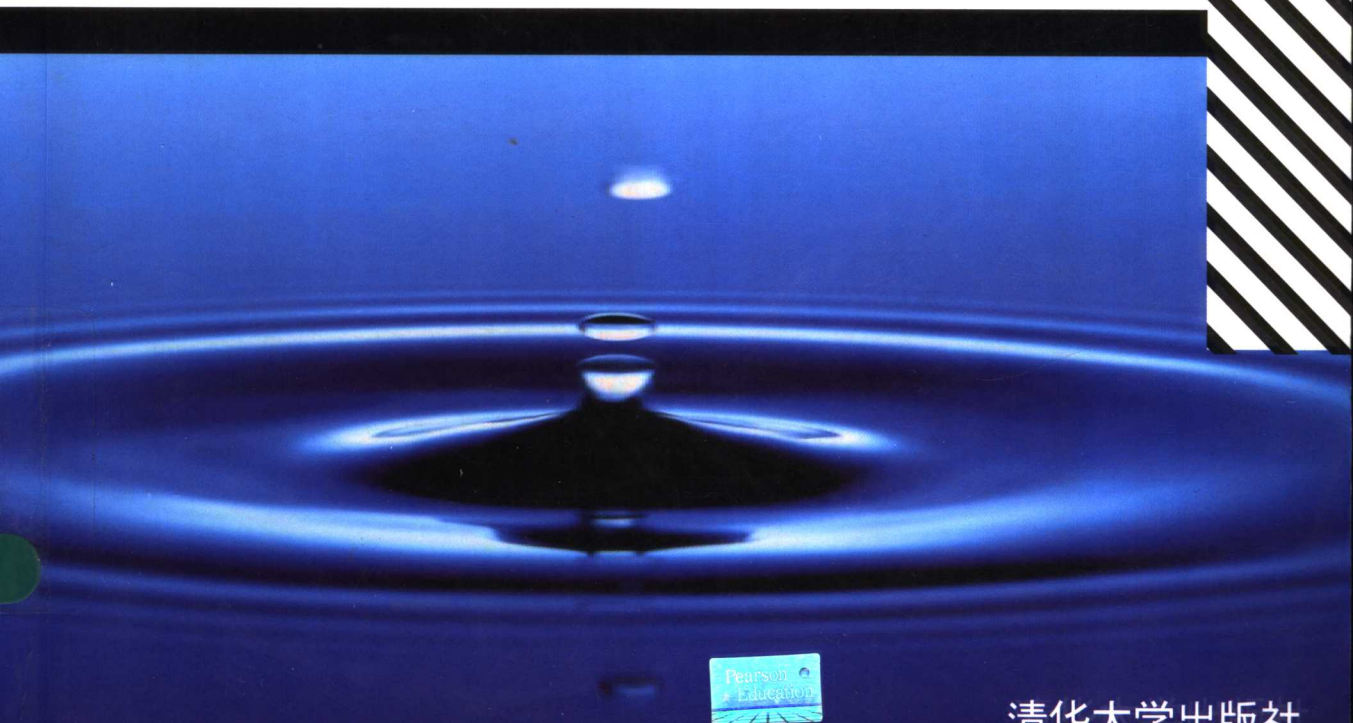
# Data Structures with C++ Using STL

Second Edition

William Ford
William Topp

# 数据结构
# C++语言描述——
## 应用标准模板库（STL）

第2版



清华大学出版社

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清 华 大 学 出 版 社

EISBN 0-13-085850-1
Data Structures with C++ Using STL Second Edition
William Ford, William Topp


北京市版权局著作权合同登记号：图字：01-2002-3020

**图书在版编目(CIP)数据**

数据结构 C++语言描述. 英文：应用标准模板库（STL）：第 2 版 /（美）福特，（美）托普著. —影印本. —北京：清华大学出版社，2003
（大学计算机教育国外著名教材、教参系列）
ISBN 7-302-06259-5

Ⅰ. 数… Ⅱ. ①福… ②托… Ⅲ. ①数据结构－高等学校－教材－英文 ②算法分析－高等学校－材料－英文 ③C 语言－程序设计－高等学校－教材－英文 Ⅳ. TP311.12

中国版本图书馆 CIP 数据核字（2003）第 004205 号

**出版者**：清华大学出版社（北京清华大学学研大厦，邮编 100084）
http:// www.tup.tsinghua.edu.cn
**印刷者**：北京牛山世兴印刷厂
**发行者**：新华书店总店北京发行所
**开　本**：787×960 1/16　印张：66.5
**版　次**：2003 年 1 月第 1 版　2003 年 1 月第 1 次印刷
**书　号**：ISBN 7-302-06259-5/TP・3745
**印　数**：0001～5000
**定　价**：86.00 元

# Preface

This book is designed to present the fundamentals of data structures from an object-oriented perspective. The focus is on data structures that efficiently store large collections of data. The structures, called containers, feature operations to access, insert, and remove items from the collection. The study of data structures is core to a computer science curriculum. This curriculum has had a rich and storied tradition. Computer researchers and practioners have evolved a wide range of container structures to meet different problem situations. Initially, the focus was on implementation issues so that programs could efficiently store and access large data sets within the limited physical resources of the computer system. As computers developed greater CPU power and increased memory and storage capabilities, researchers and practioners were free to give more consideration to the abstract design of the containers. The efforts were greatly aided by an emerging emphasis on object-oriented programming. Object technology provides a means of viewing containers as objects with designated operations to handle the data. A class declaration defines the structure of a container. The public member functions describe a programming interface that allows a container to be used in applications.

Researchers at AT&T Bell Laboratories and Hewlett-Packard Research Labs combined the principles of generic and object-oriented programming to create a unified approach to the study of data structures and algorithms. The result is the Standard Template Library (STL), which is now part of the standard C++ library. STL provides a modern approach to data structures. It categories the structures as sequence and associative containers, along with adapter classes. By using templates and iterators, the STL library allows a programmer to execute a broad range of algorithms that apply to each of the container classes.

This is, however, not a book on STL. It draws on the design structure of STL to create a unifying study of data structures. The reader will be introduced to the basics

of STL and become familiar with the essential elements of the library. The result will be an appreciation of the power, simplicity, and usefulness of STL. With this background, the reader can easily read a technical book on STL to learn more of its many features. While this book is designed as a textbook, a computer professional could use it as a self-study guide to data structures.

### Approach to Data Structures

This book uses a very careful and systematic approach in the development of each data structure. The reader first views a structure informally as an ADT that provides a description of how the container stores elements. Text, figures, and examples provide a detailed understanding of the key operations for the data structure, without reference to any implementation. The reader is then introduced to a second view of the structure using a formal C++ class declaration or an API. The latter refers to an Application Programming Interface format that is the industry-wide standard for presenting class operations. The API format includes the function prototype, a description of its action, and a listing of its preconditions and postconditions. We use the API format to describe the STL container classes and the class declaration to describe the other data structures that are developed in the book.

Once the reader is familiar with a formal represention of a data structure, the book provides a series of applications, which illustrate problem-solving situations that effectively use the structure. Having the reader understand the implemantion of a data structure is a key feature of the book. Corresponding to each STL container class, the book presents a "miniContainer" class that uses the STL interface but offers a straight forward implementation of the operations. The text clearly presents the design and coding of the key operations. The supplemental software supplies a complete listing of the class, with well-documented code.

### Ins and Outs of the Book

This book assumes the reader has completed a first course in C++ object-oriented programming. The authors assume that the concepts of object composition, operator overloading, pointers and dynamic memory, and inheritance are covered briefly, if at all, in a first course. These concepts are carefully developed in this book in the context of their application to data structures. Periodically the book introduces only the essentials of a programming concept, and makes available a Web Tutorial that develops the concept in greater depth. The tutorials include examples and programs and provide the reader with enrichment that is not critical to understanding the text. The existence of a tutorial is clearly marked with an icon in the margin.

Chapters 1 through 10 cover sequence containers (array, vector, list, deque), the adapter classes (stacks, queues, and priority queues), and an introduction to associative tree containers. The material, along with a development of pointers, dynamic memory, and linked lists contains the topics usually covered in a first course in data structures (CS2).

Chapters 11 through 16 introduce more advanced containers that include sets, maps, balanced trees, heaps, hash tables and graphs. The chapters also include a study of applied searching and sorting algorithms, advanced recursion, and graph algorithms. The material is appropriate for a followup course in advanced data structures and applied algorithms (CS7).

### Supplemental Resources

Readers may access the complete source code listings for all classes and programs in the book from the authors' website at **http://www.uop.edu/fordtopp** or **http://www.fordtopp.com**, and from Prentice Hall at **http://www.prenhall.com**. The C++ source code has been tested and run in the Windows environment using Microsoft Visual C++ and Borland C++ Builder, and in the UNIX environment using GNU C++. The graphics library is implemented in each of these environments.

To successfully compile and run the programs in the book using the Microsoft Visual C++ 6.0 compiler, the reader must install the latest Service Pack. Instructions for obtaining and loading the service pack are available on the authors' and Prentice Hall web sites. The same sites include the Web tutorials and Powerpoint slides that present the key topics from each chapter.

An Instructor's Resource CD (IRCD) is available to instructors and provides answers to all of the written exercises and a solution to all of the programming exercises and programming projects. The IRCD also has sample tests with questions in a variety of formats. All of these elements are provided in Word format (".doc") to enable the selection and modification of individual items. For printing only, the IRCD also supplies the materials in Acrobat Reader (".pdf") and postscript (".ps") format. In addition, it provides individual source files of all the programs (*.cpp) and classes (*.h) that are developed in the exercises. The IRCD is available upon request by Professors and Instructors from your local Prentice Hall sales representative.

### Acknowledgments

The authors have been supported by friends, students, and colleagues throughout the preparation of the second edition of *Data Structures with C++ using STL*. The University of the Pacific has generously provided resources and support to complete the project. Prentice Hall offered a dedicated team of professionals who handled the book design and production. We are especially grateful to our acquisitions editor, Petra Recter and to the production editor, AudriAnna Bazlen. We also appreciate the efforts of Sara Burrows, assistant editor, who worked with us on the compilation of the supplements, and the work of Jennie Burger, who is doing the active marketing of the book.

Students have offered valuable criticism of the manuscript by giving us explicit feedback. Our reviewers offered guidance during the design of the new edition and then followed up with detailed comments on both the content and the pedagog-

ical approach. We took most of their recommendations into account. Thanks go to Carol Roberts, University of Maine; Ken Bosworth, Idaho State University; Ralph Ewton, University of Texas, El Paso. Special thanks go to James Slack at Minnesota State University, Mankato, who made extensive and detailed suggestions. His insights and support were invaluable to the authors and greatly improved the final design and content of the book.

*William Ford*
*William Topp*

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