21.1 Introduction

This chapter shows how to build **dynamic data structures** that grow and shrink at execution time. **Linked lists** are collections of data items “linked up in a chain”—insertions and deletions can be made *anywhere* in a linked list. **Stacks** are important in compilers and operating systems; insertions and deletions are made only at one end of a stack—its **top**. **Queues** represent waiting lines; insertions are made at the back (also referred to as the **tail**) of a queue and deletions are made from the front (also referred to as the **head**). **Binary trees** facilitate high-speed searching and sorting of data, eliminating duplicate data items efficiently, representing file-system directories, compiling expressions into machine language and many other interesting applications.

We discuss each of these major data-structure types and implement programs that create and manipulate them. We use classes and composition to create them for reusability and maintainability. We also explain how to organize classes into your own packages to promote reuse. We include this chapter for computer-science and computer-engineering students who need to know how to build linked data structures.

Software Engineering

Observation 21.1

The vast majority of software developers should use the predefined generic collection classes that we discussed in Chapter 16, rather than developing customized linked data structures.

“Building Your Own Compiler” Project

If you feel ambitious, you might want to attempt the major project described in the Building Your Own Compiler special exercise section. You’ve been using a Java compiler to translate your Java programs to bytecodes so that you could execute these programs. In this project, you’ll build your own compiler. It will read statements written in a simple, yet powerful high-level language similar to early versions of the popular language BASIC and translate these statements into Simpletron Machine Language (SML) instructions—SML is the language you learned in the Chapter 7 special section, Building Your Own Computer. Your Simpletron Simulator program will then execute the SML program produced by your compiler! Implementing this project by using an object-oriented approach will give you an opportunity to exercise most of what you’ve learned in this book. The special section carefully walks you through the specifications of the high-level language and describes the algorithms you’ll need to convert each high-level language statement into machine-

language instructions. If you enjoy being challenged, you might attempt the enhancements to both the compiler and the Simpletron Simulator suggested in the exercises.