Summary

In this chapter:

- We have introduced the idea of an algorithm, illustrating the idea with a variety of algorithms of historical interest, and distinguishing between algorithms and programs.
- We have introduced the idea of a data structure, distinguishing between static and dynamic data structures.
- We have introduced the idea of an abstract data type, distinguishing between the separate concerns of the programmer who implements an abstract data type and the programmers who use it.

In Chapters 2 and 5 we shall study algorithm and abstract data type concepts in greater detail. In other chapters, we shall study a variety of data structures in conjunction with the algorithms that operate on them, and we shall study a variety of abstract data types showing which data structures can be used to implement them.

Exercises

1.1 Use Euclid's algorithm, given in Algorithm 1.3, to find the GCD of the following pairs of numbers: 6 and 9, 12 and 18, 15 and 21, and 11 and 15.

1.2 Consider Newton's algorithm, given in Algorithm 1.6, to calculate the square root of a number.
(a) Use this algorithm to calculate the square roots of the following numbers: 4, 6, 8 and 9. In each case calculate your answer to an accuracy of 0.01, i.e., the absolute difference between a and r^2 is less than 0.01.
(b) Write a Java program to implement the algorithm and use it to check your answers to part (a) above.
(c) What would happen if step 2 of the algorithm were as follows?

2. Until $r^2=a$, repeat:

1.3 Give some examples of algorithms used in everyday life, not requiring a calculator or computer.

1.4 Write an algorithm to perform each of the following tasks:
(a) Use an automated bank teller to withdraw cash from your account.
(b) Set the current time on your watch.
(c) Cook a frozen meal in a microwave oven.
(d) Match the pairs of socks in a bundle of freshly laundered socks.

1.5 Try to find further examples of early algorithms like the ones given in this chapter.

1.6 Devise an algorithm, similar to Algorithm 1.4, to find the roots of the general quadratic equation $ax^2 + bx + c = 0$. The roots are the two values of the formula $(-b \pm \sqrt{(b^2-4ac)})/2a$.

1.7 Consider the algorithms you wrote in Exercise 1.4. How easy would it be for each of these algorithms to be performed by a human? by a suitable machine?