CHAPTER 2

A Simple Lisp Program

Certum quod factum.
(One is certain of only what one builds.)
—Giovanni Battista Vico (1668–1744)
Italian royal historiographer

You will never become proficient in a foreign language by studying vocabulary lists. Rather, you must hear and speak (or read and write) the language to gain proficiency. The same is true for learning computer languages.

This chapter shows how to combine the basic functions and special forms of Lisp into a complete program. If you can learn how to do that, then acquiring the remaining vocabulary of Lisp (as outlined in chapter 3) will be easy.

2.1 A Grammar for a Subset of English

The program we will develop in this chapter generates random English sentences. Here is a simple grammar for a tiny portion of English:

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Sentence ⇒ Noun-Phrase + Verb-Phrase
Noun-Phrase ⇒ Article + Noun
Verb-Phrase ⇒ Verb + Noun-Phrase
Article ⇒ the, a, . . .
Noun ⇒ man, ball, woman, table. . .
Verb ⇒ hit, took, saw, liked. . .
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To be technical, this description is called a context-free phrase-structure grammar, and the underlying paradigm is called generative syntax. The idea is that anywhere we want a sentence, we can generate a noun phrase followed by a verb phrase. Anywhere a noun phrase has been specified, we generate instead an article followed by a noun. Anywhere an article has been specified, we generate either "the," "a," or some other article. The formalism is "context-free" because the rules apply anywhere regardless of the surrounding words, and the approach is "generative" because the rules as a whole define the complete set of sentences in a language (and by contrast the set of nonsentences as well). In the following we show the derivation of a single sentence using the rules:

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To get a Sentence, append a Noun-Phrase and a Verb-Phrase
  To get a Noun-Phrase, append an Article and a Noun
    Choose "the" for the Article
    Choose "man" for the Noun
  The resulting Noun-Phrase is "the man"
  To get a Verb-Phrase, append a Verb and a Noun-Phrase
    Choose "hit" for the Verb
    To get a Noun-Phrase, append an Article and a Noun
      Choose "the" for the Article
      Choose "ball" for the Noun
    The resulting Noun-Phrase is "the ball"
  The resulting Verb-Phrase is "hit the ball"
The resulting Sentence is "The man hit the ball"
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2.2 A Straightforward Solution

We will develop a program that generates random sentences from a phrase-structure grammar. The most straightforward approach is to represent each grammar rule by a separate Lisp function: