Figure 10.1 Fractal patterns in nature. Clockwise from top left: a nautilus shell [61], the coastline of Norway [62], a closeup of a leaf [63], branches of a tree, a rock outcropping, and lightning [64]. The insets in the bottom two images show how smaller parts resemble the whole.
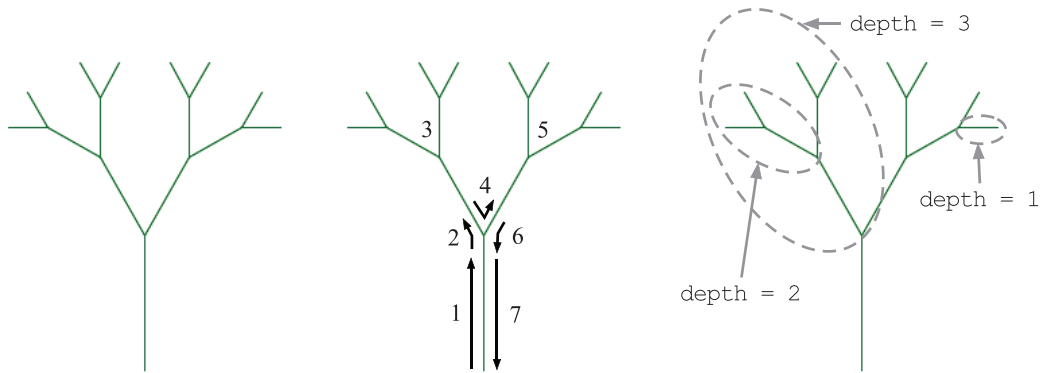
Figure 10.2 A tree produced by tree(george, 100, 4). The center figure illustrates what is drawn by each numbered step of the function. The figure on the right illustrates the self-similarity in the tree.
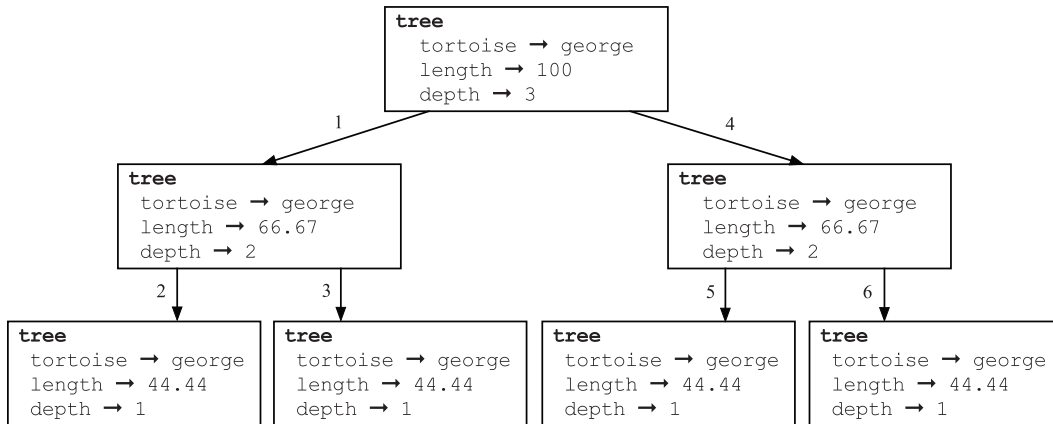
010x002.eps

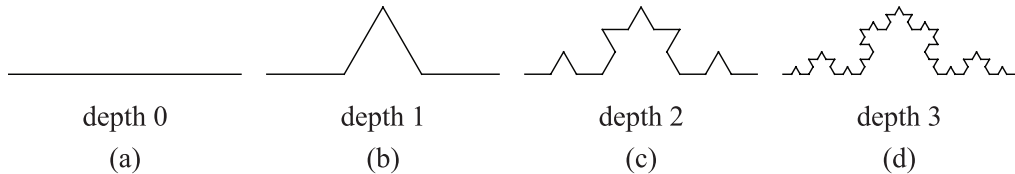Figure 10.3 An illustration of the recursive calls in tree(george, 100, 4).

depth 0

(a)

depth 1

(b)

depth 2

(c)

depth 3

(d)

Figure 10.4 The Koch curve at depths 0, 1, 2, and 3.
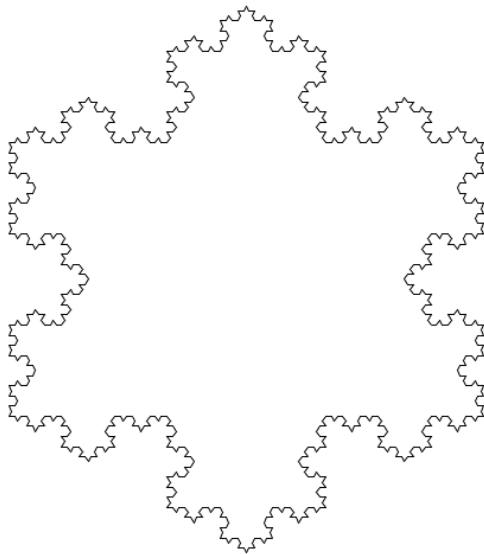
Figure 10.5 A Koch snowflake.

depth 0   depth 1   depth 2   depth 3

(a)   (b)   (c)   (d)
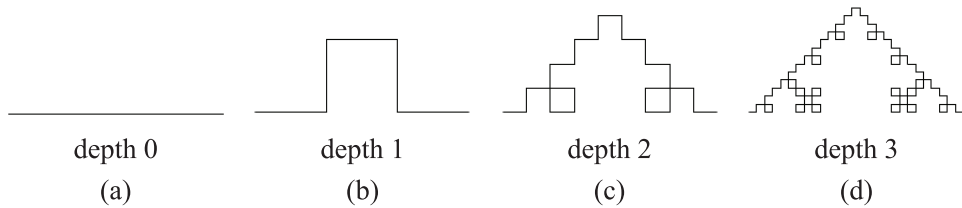
Figure 10.6 Depths 0, 1, 2, and 3 of a quadratic Koch curve.

depth 0   depth 1   depth 2   depth 3

(a)   (b)   (c)   (d)
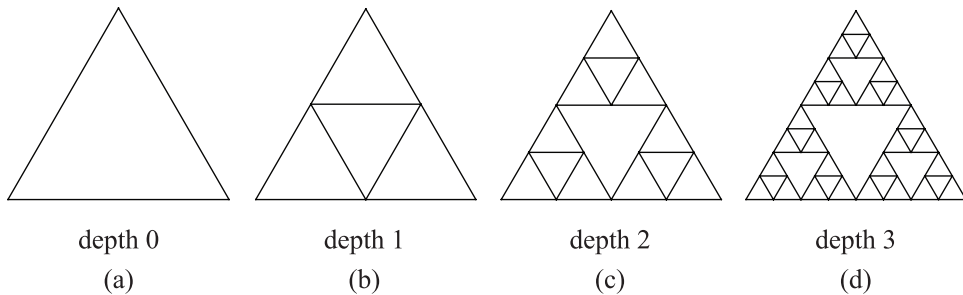
Figure 10.7 Depths 0, 1, 2, and 3 of a Sierpinski triangle.

depth 0

(a)

depth 1

(b)

depth 2

(c)

depth 3

(d)
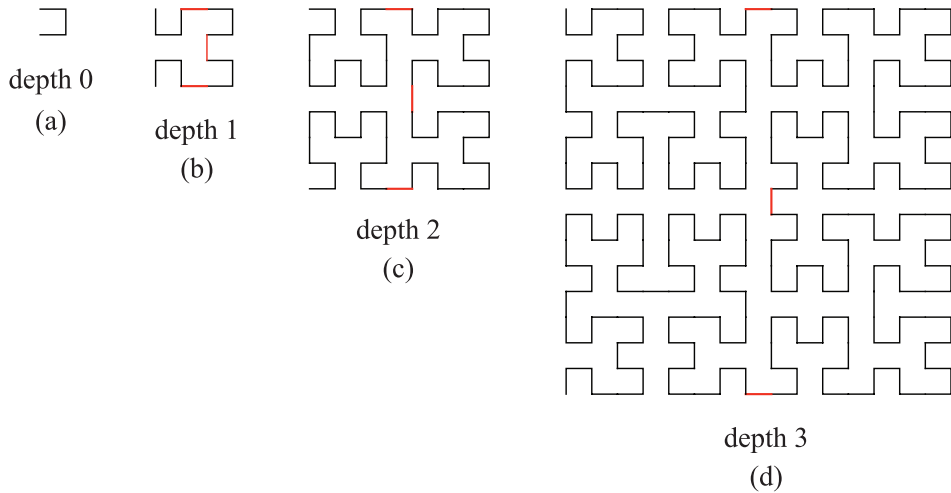
Figure 10.8 Hilbert space-filling curves with depths 0, 1, 2, and 3.

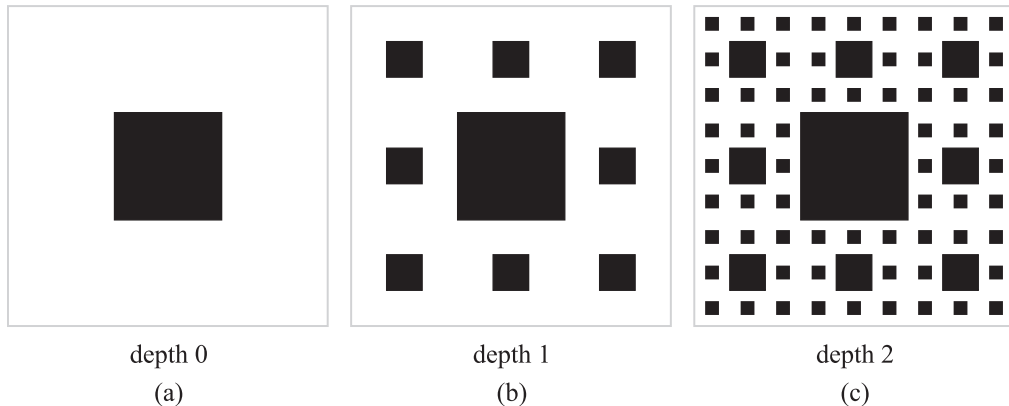| depth 0 | depth 1 | depth 2 |
| (a) | (b) | (c) |

Figure 10.9 Sierpinski carpets with depths 0, 1, and 2. (The gray bounding box shows the extent of the drawing area; it is not actually part of the fractal.)
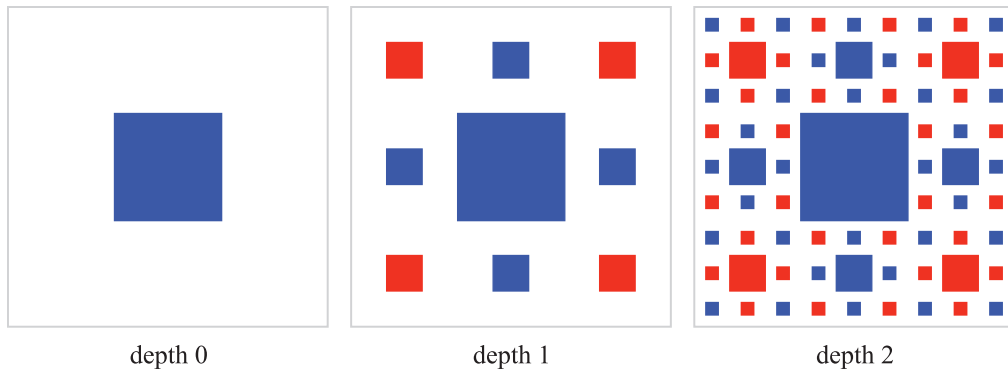
depth 0   depth 1   depth 2

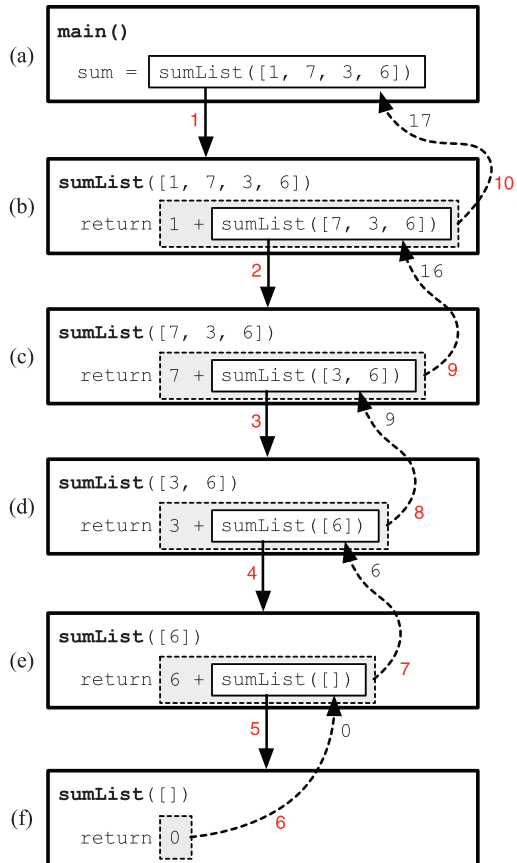Figure 10.10 Colorful Sierpinski carpets with depths 0, 1, and 2.

Figure 10.11 A representation of the function calls in the recursive sumList function. The red numbers indicate the order in which the events occur. The black numbers next to the arrows are return values.
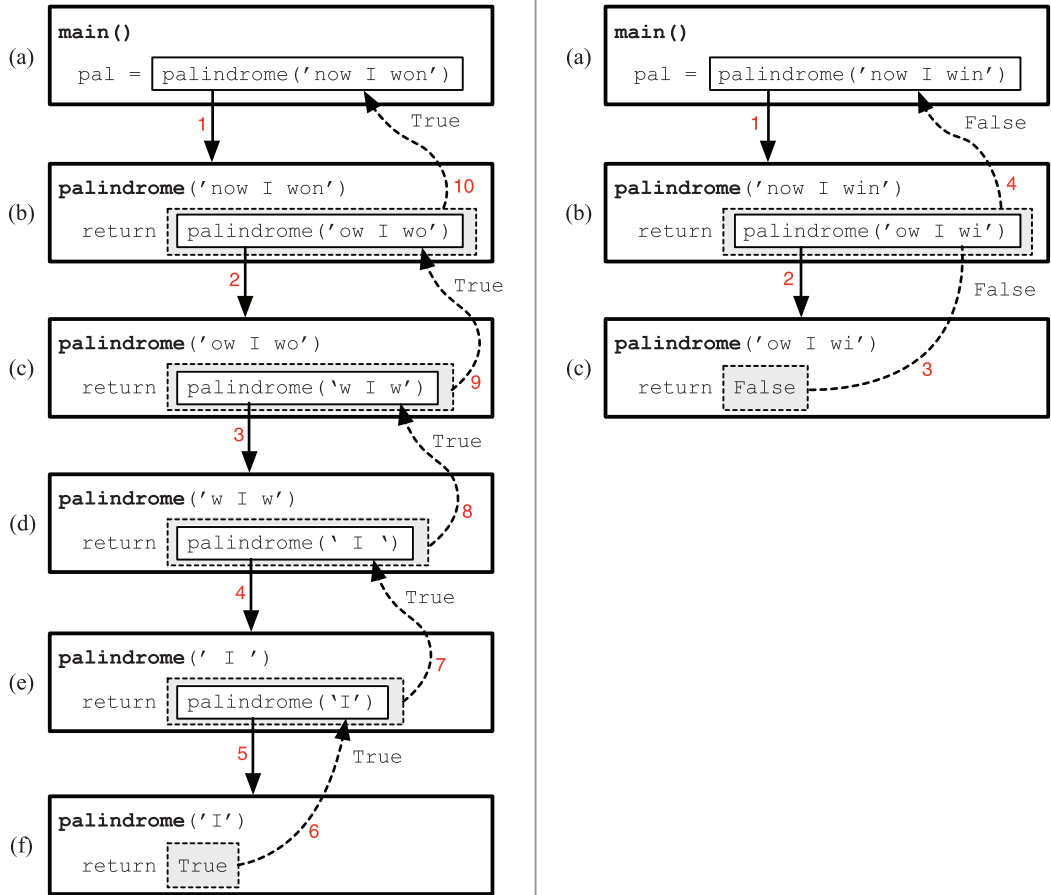
Figure 10.12 A representation of the function calls in the recursive palindrome function. The red numbers indicate the order in which the events happen. On the left is an instance in which the function reaches the base case and returns True. On the right is an instance in which the function returns False.
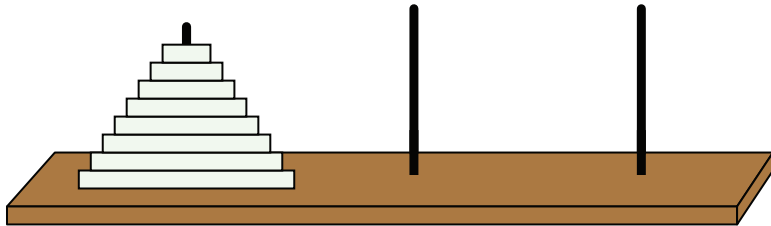
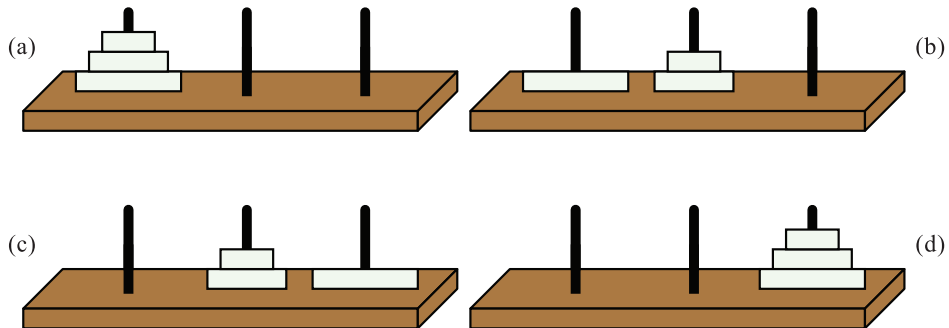Figure 10.13 Tower of Hanoi with eight disks.

Figure 10.14 Illustration of the recursive algorithm for Tower of Hanoi with three disks.

$$T(n)$$

$$T(n-1) + c \qquad c$$

$$T(n-2) + c \qquad 2c$$

$$T(n-3) + c \qquad 3c$$

$$\vdots$$

$$T(n-i) + c \qquad ic$$

$$\vdots$$

$$T(1) + c \qquad (n-1)\,c$$

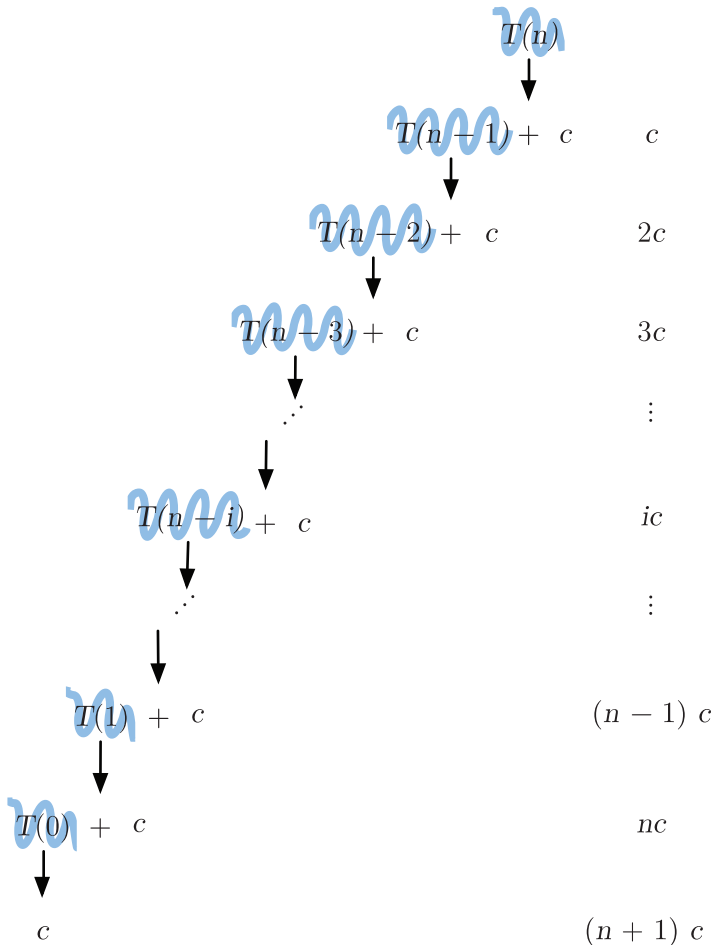$$T(0) + c \qquad nc$$

$$c \qquad (n+1)\,c$$

Figure 10.15 An illustration of how to derive a closed form for the recurrence relation $T(n) = T(n-1) + c$.
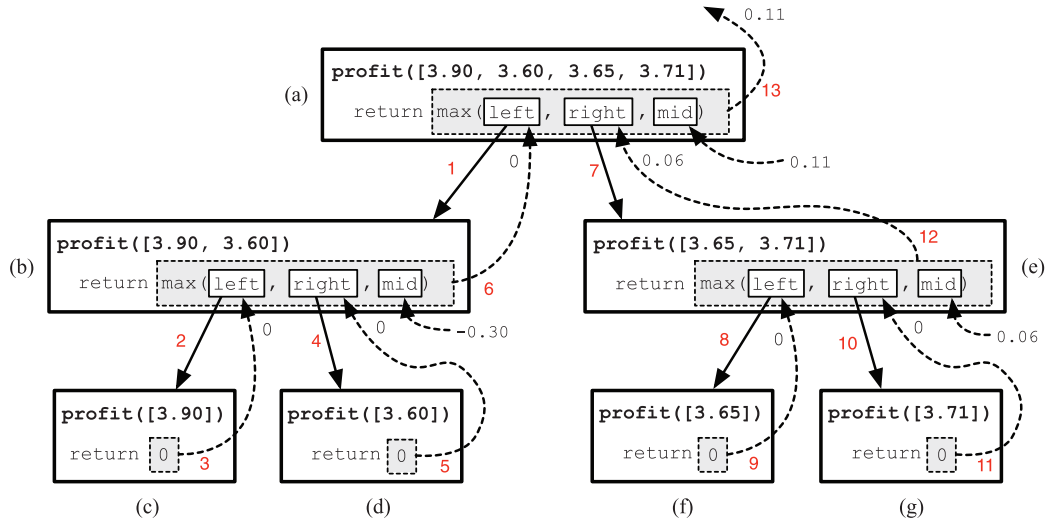
Figure 10.16 A representation of the function calls in the recursive profit function. The red numbers indicate the order in which the events happen.
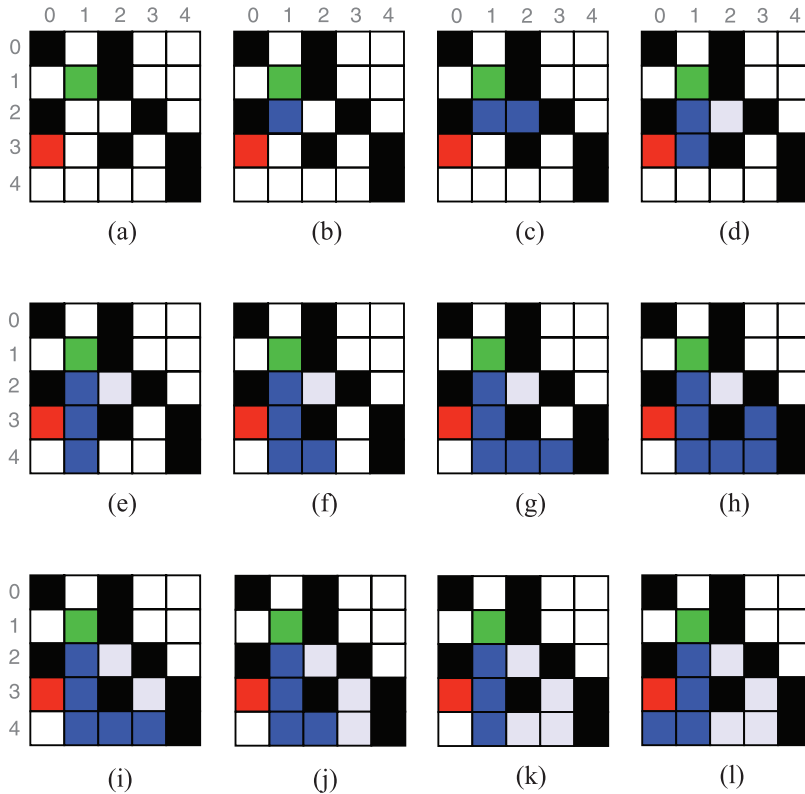
Figure 10.17 An illustration of a depth-first search on a grid.
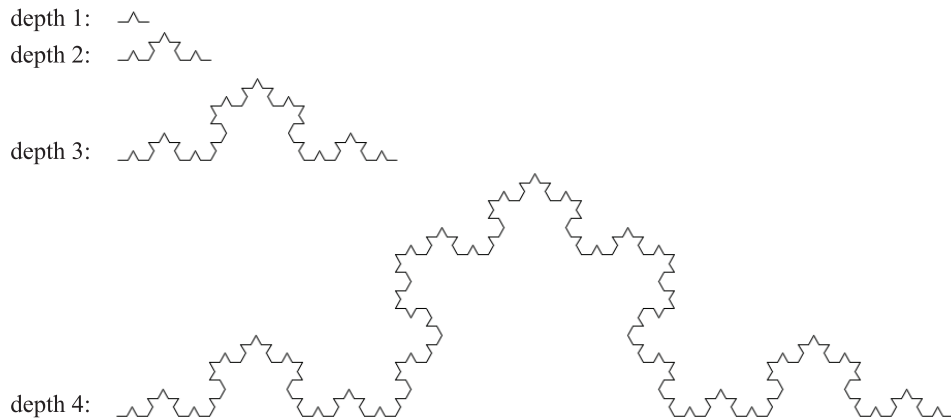
depth 1:

depth 2:

depth 3:

depth 4:

Figure 10.18 Koch curves resulting from a Lindenmayer system.
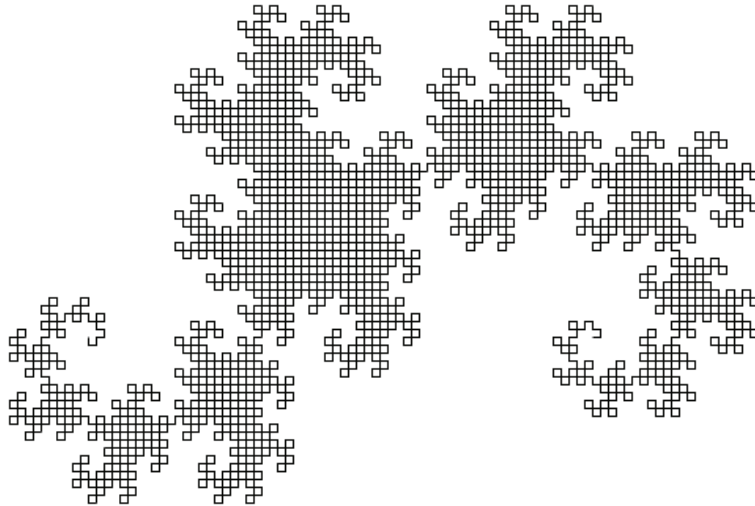
Figure 10.19 A dragon curve resulting from a Lindenmayer system.

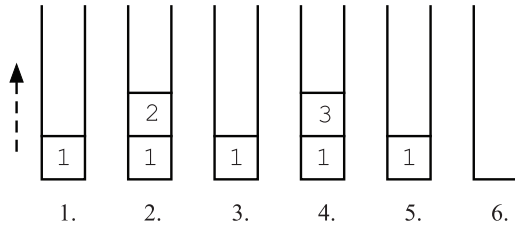Figure 10.20 The results of a sequence of stack operations.

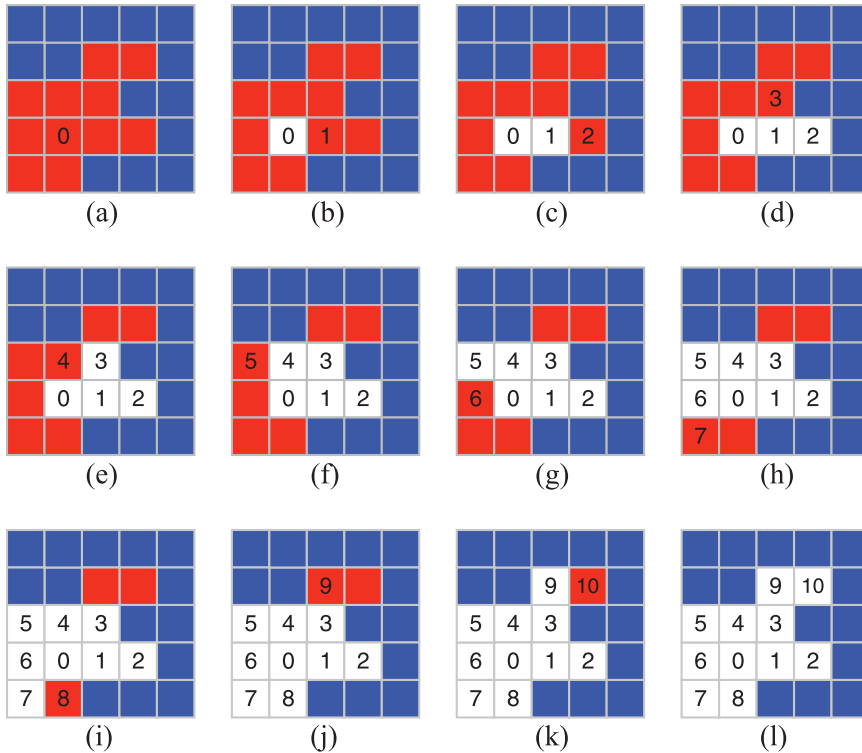Figure 10.21 Two trees from *The Algorithmic Beauty of Plants* ([43], p. 25).

010x021.eps

Figure 10.22 An example of the recursive flood fill algorithm.