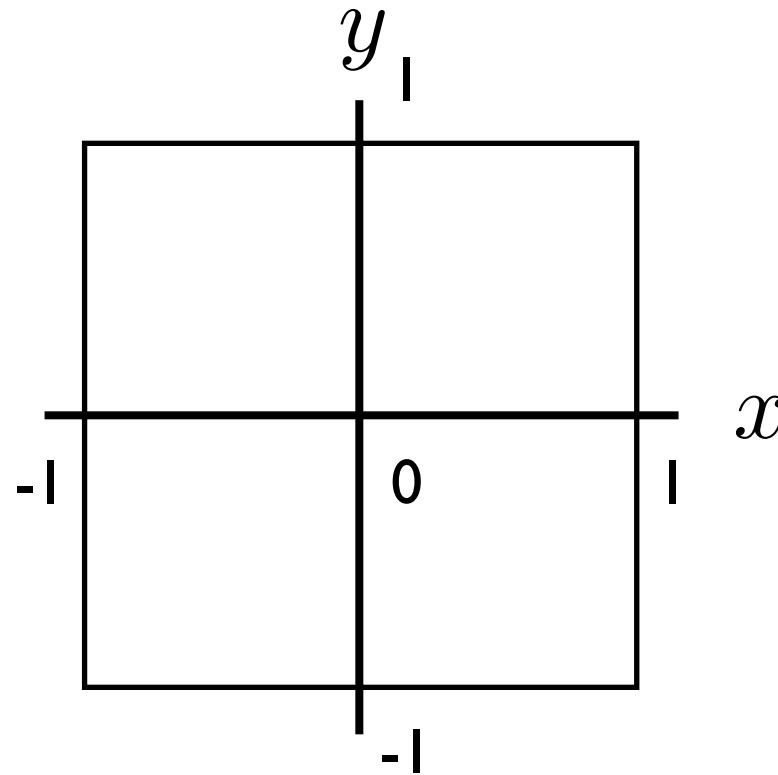# Orders of Growth and Tree Recursion

Graphics primitive operations

Graphics primitive operations

Co-ordinate system

C-Curve code

```
(define c-curve
  (lambda (x0 y0 x1 y1 level)
    (if (= level 0)
        (line x0 y0 x1 y1)
        (let ((xmid (/ (+ x0 x1) 2))
              (ymid (/ (+ y0 y1) 2))
              (dx (- x1 x0))
              (dy (- y1 y0)))
          (let ((xa (- xmid (/ dy 2)))
                (ya (+ ymid (/ dx 2))))
            (overlay (c-curve x0 y0 xa ya (- level 1))
                     (c-curve xa ya x1 y1 (- level 1)))))))))
```

C-Curve code

```
(define c-curve
  (lambda (x0 y0 x1 y1 level)
    (if (= level 0)
        (line x0 y0 x1 y1)
        (let ((xmid (/ (+ x0 x1) 2))
              (ymid (/ (+ y0 y1) 2))
              (dx (- x1 x0))
              (dy (- y1 y0)))
          (let ((xa (- xmid (/ dy 2)))
                (ya (+ ymid (/ dx 2))))
            (overlay (c-curve x0 y0 xa ya (- level 1))
                     (c-curve xa ya x1 y1 (- level 1)))))))))
```

Base case

C-Curve code

```
(define c-curve
  (lambda (x0 y0 x1 y1 level)
    (if (= level 0)
        (line x0 y0 x1 y1)
        (let ((xmid (/ (+ x0 x1) 2))
              (ymid (/ (+ y0 y1) 2))
              (dx (- x1 x0))
              (dy (- y1 y0)))
          (let ((xa (- xmid (/ dy 2)))
                (ya (+ ymid (/ dx 2))))
            (overlay (c-curve x0 y0 xa ya (- level 1))
                     (c-curve xa ya x1 y1 (- level 1)))))))))
```
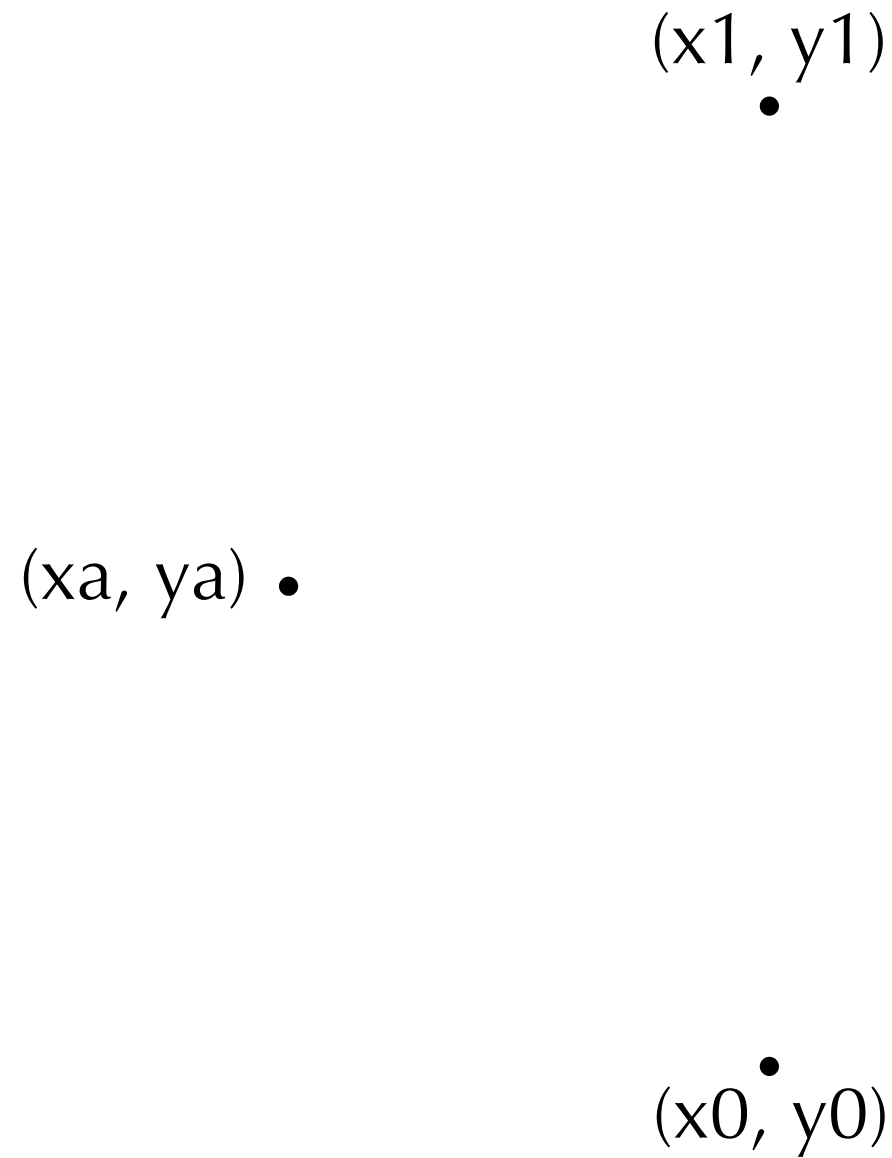
Induction case

(x1, y1)

(xa, ya) •

(x0, y0)

Figure 4.10   The three key points in a c-curve of level greater than zero.
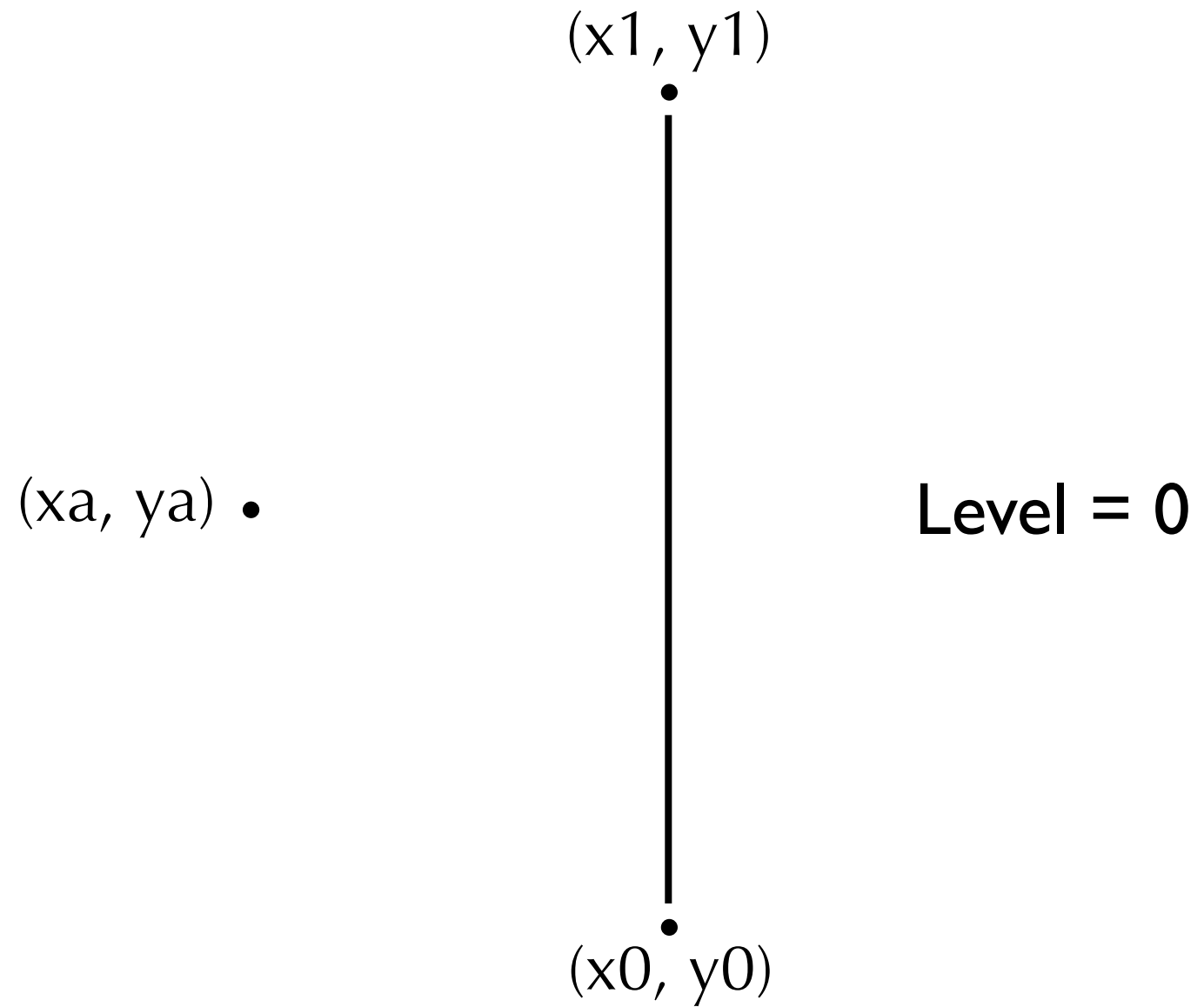
(x1, y1)

(xa, ya) •

Level = 0

(x0, y0)

Figure 4.10   The three key points in a c-curve of level greater than zero.

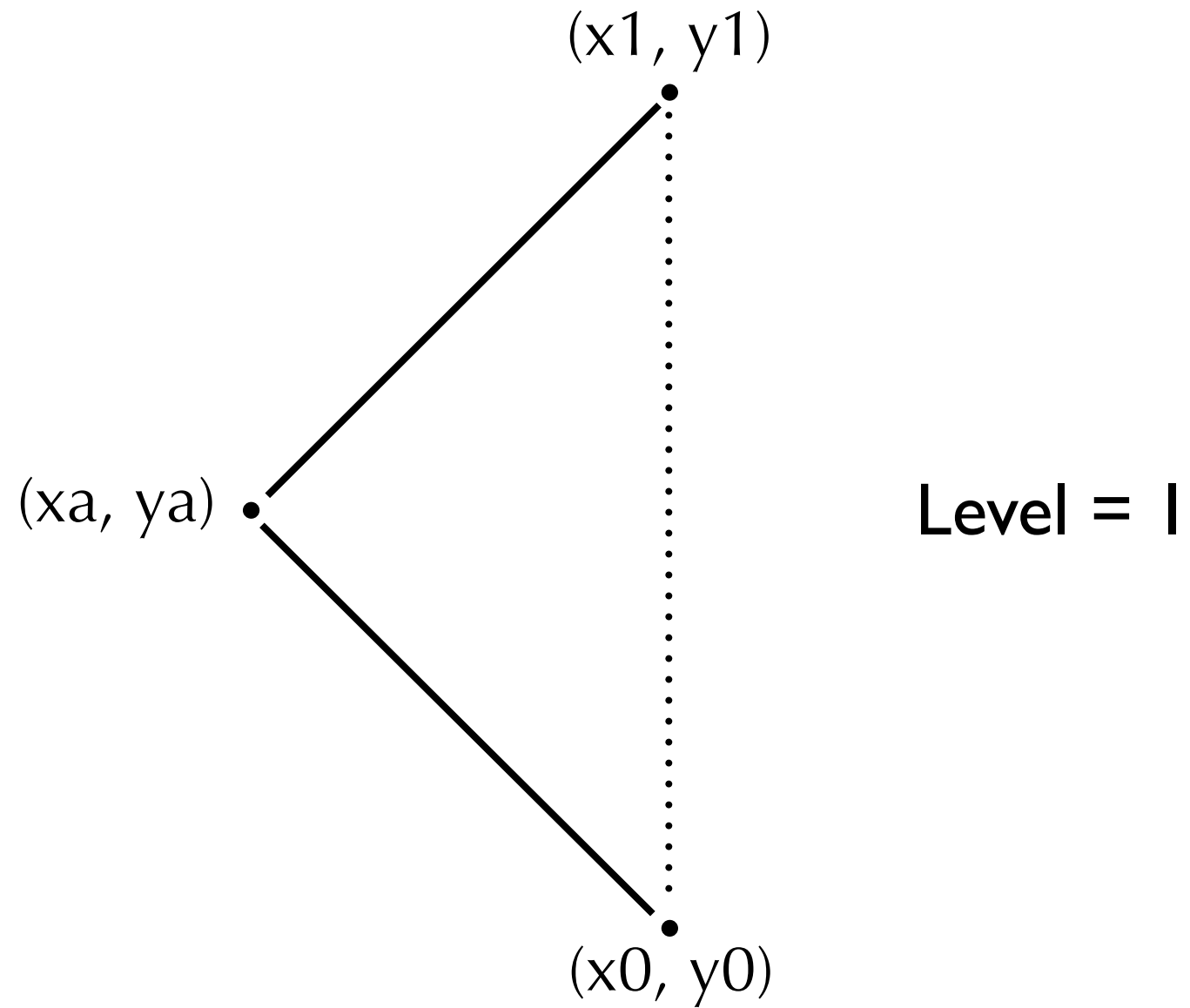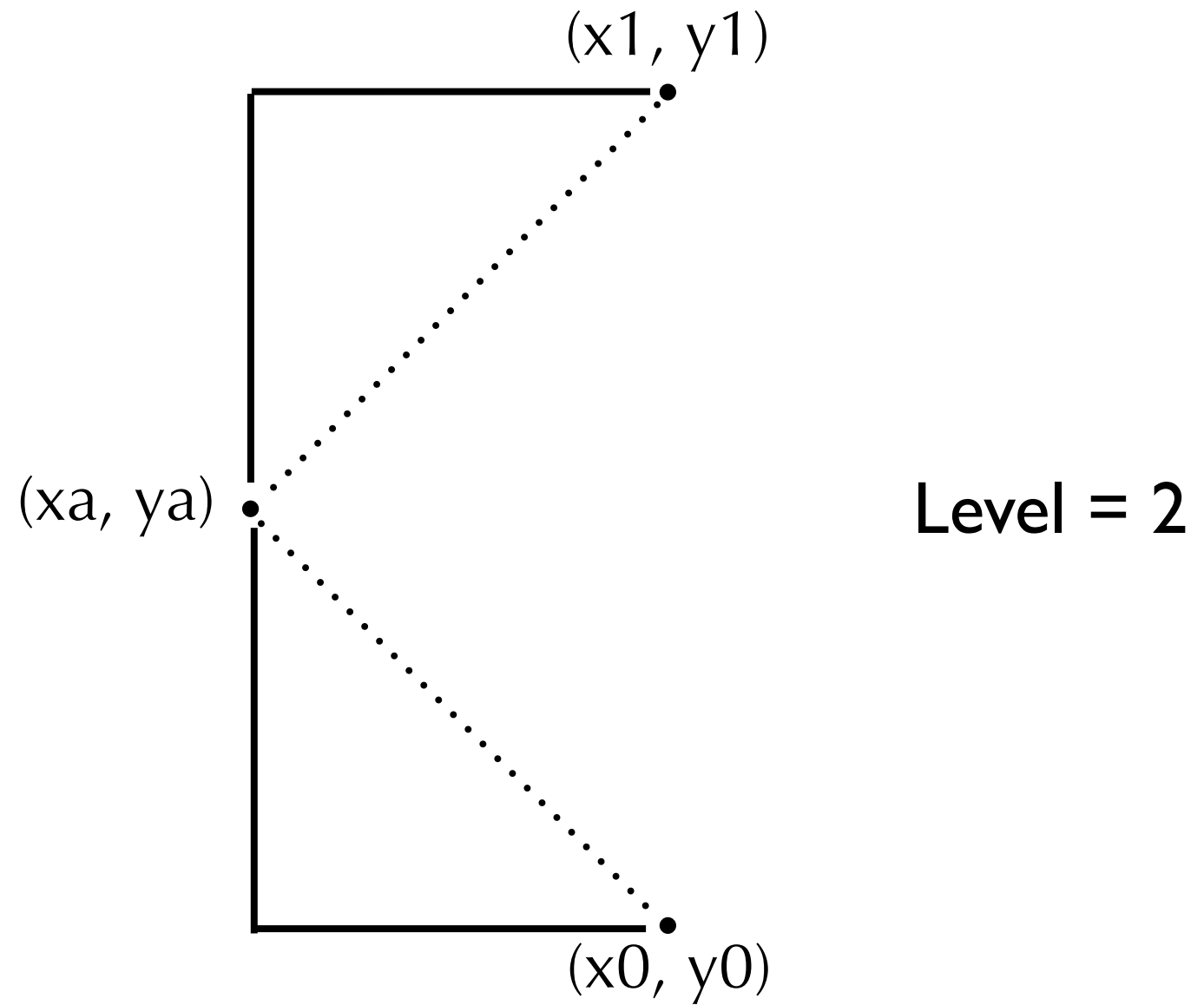Figure 4.10 The three key points in a c-curve of level greater than zero.

(x1, y1)

(xa, ya)

Level = 2

(x0, y0)

Figure 4.10   The three key points in a c-curve of level greater than zero.
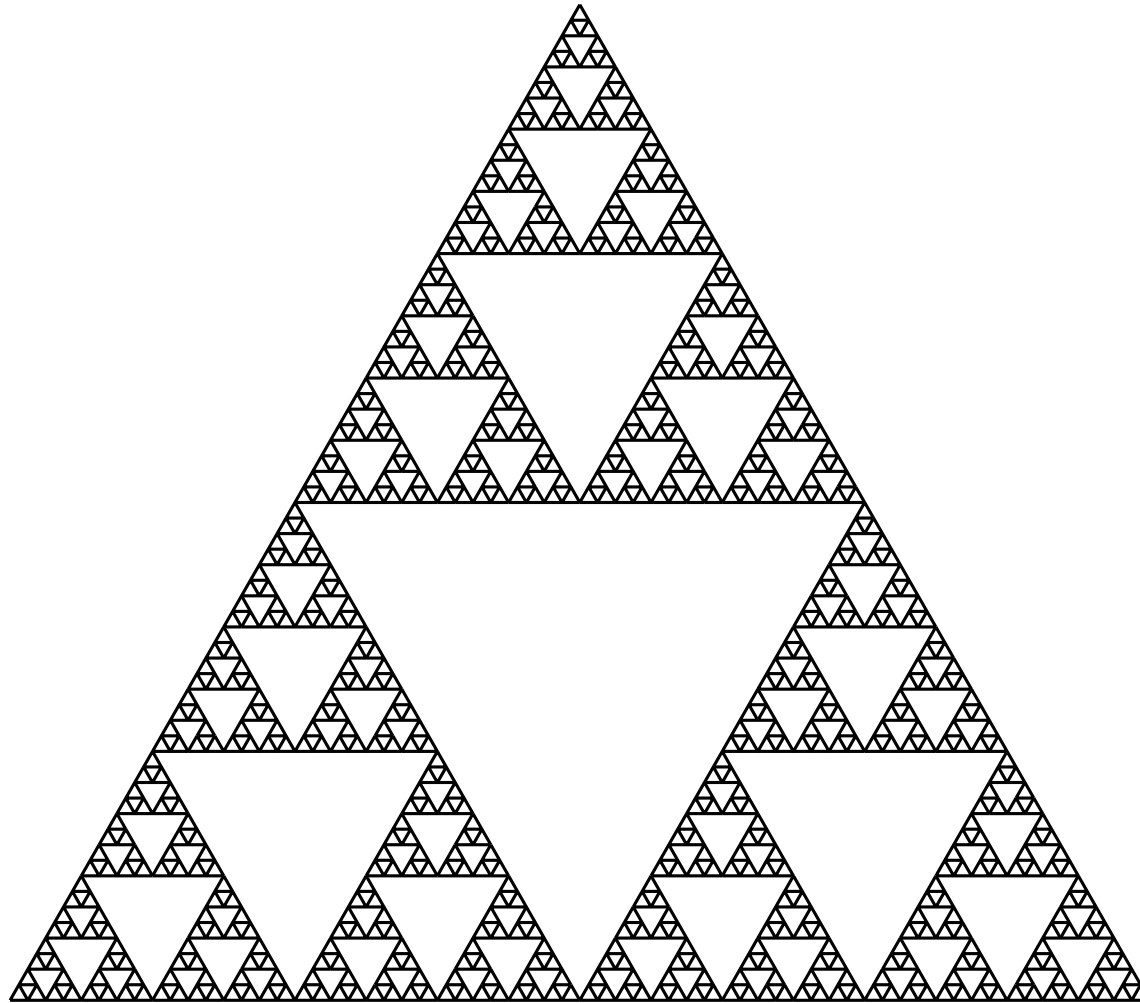
Sierpinski's gasket — Exercise for the student

Figure 4.6   An example of Sierpinski's gasket.