CHAPTER 5

Recursion as a Problem-Solving Technique

Figure 5.1

a) Five queens that cannot attack each other, but that can attack all of column 6; b) backtracking to column 5 to try another square for the queen; c) backtracking to column 4 to try another square for the queen and then considering column 5 again

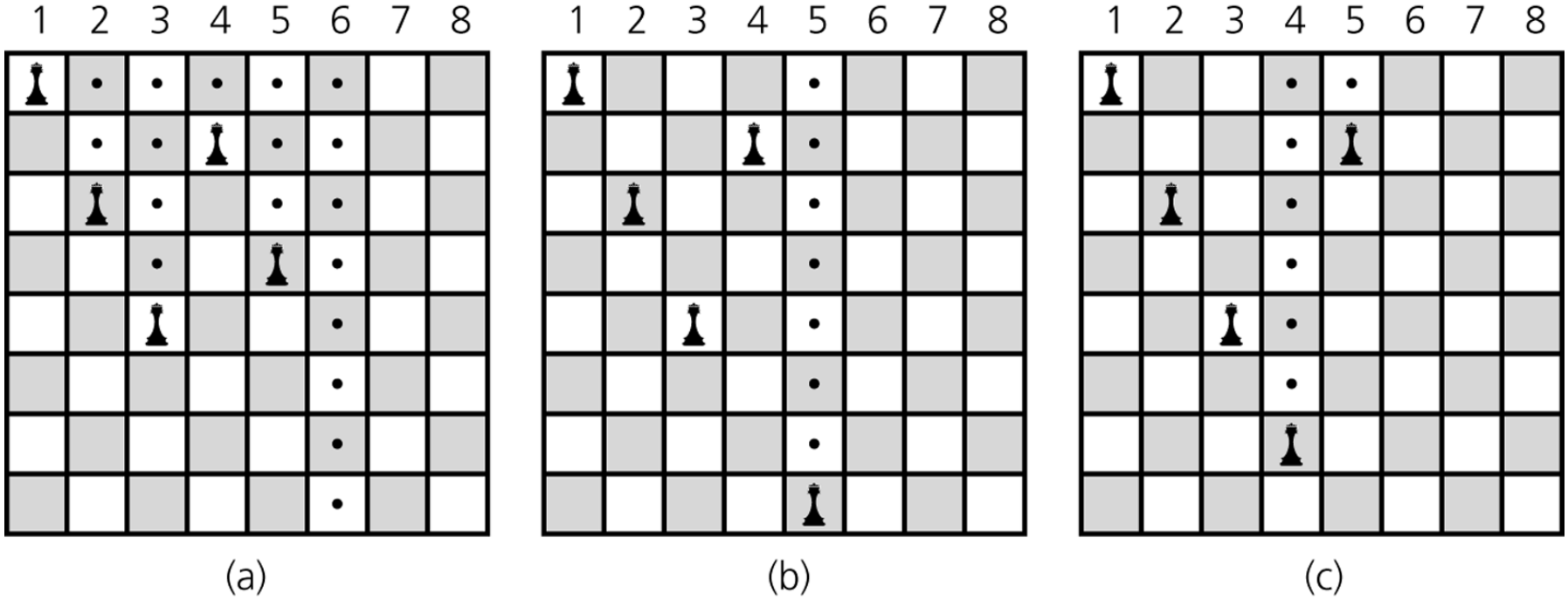


Figure 5.2

A solution to the Eight Queens problem

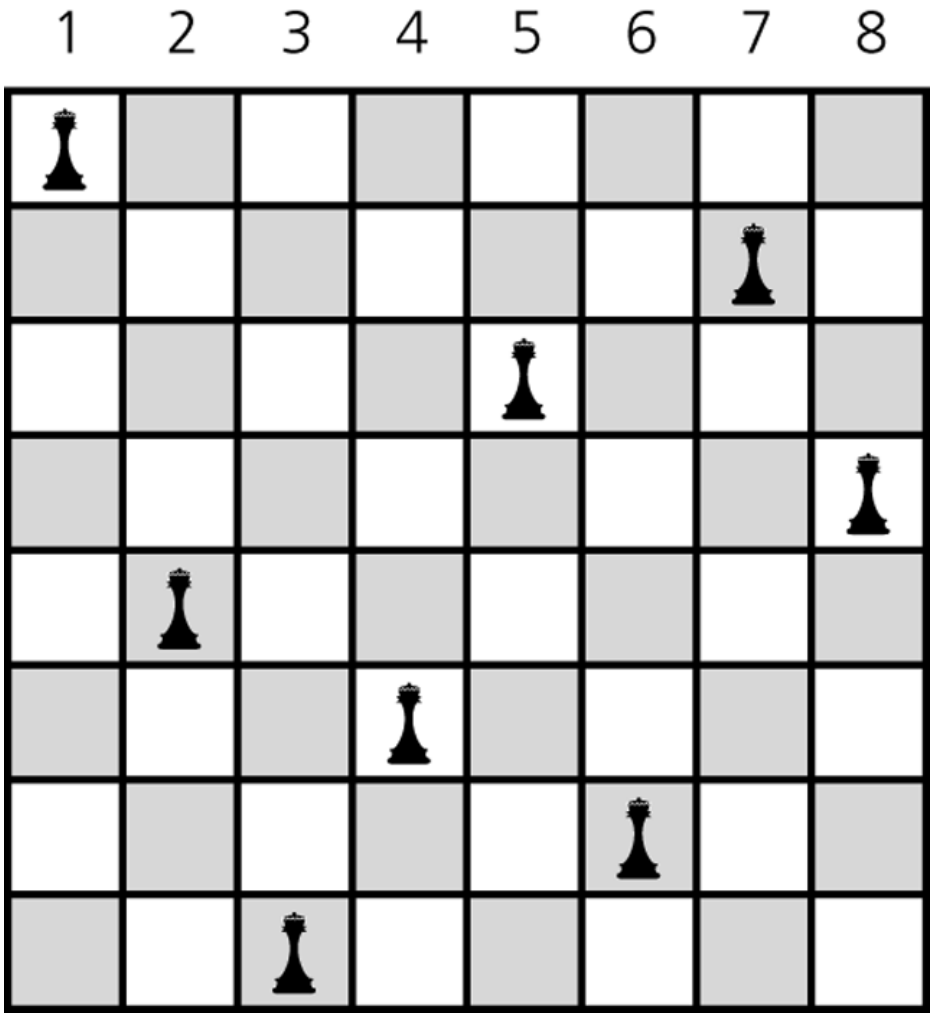


Figure 5.3

A syntax diagram for Java identifiers

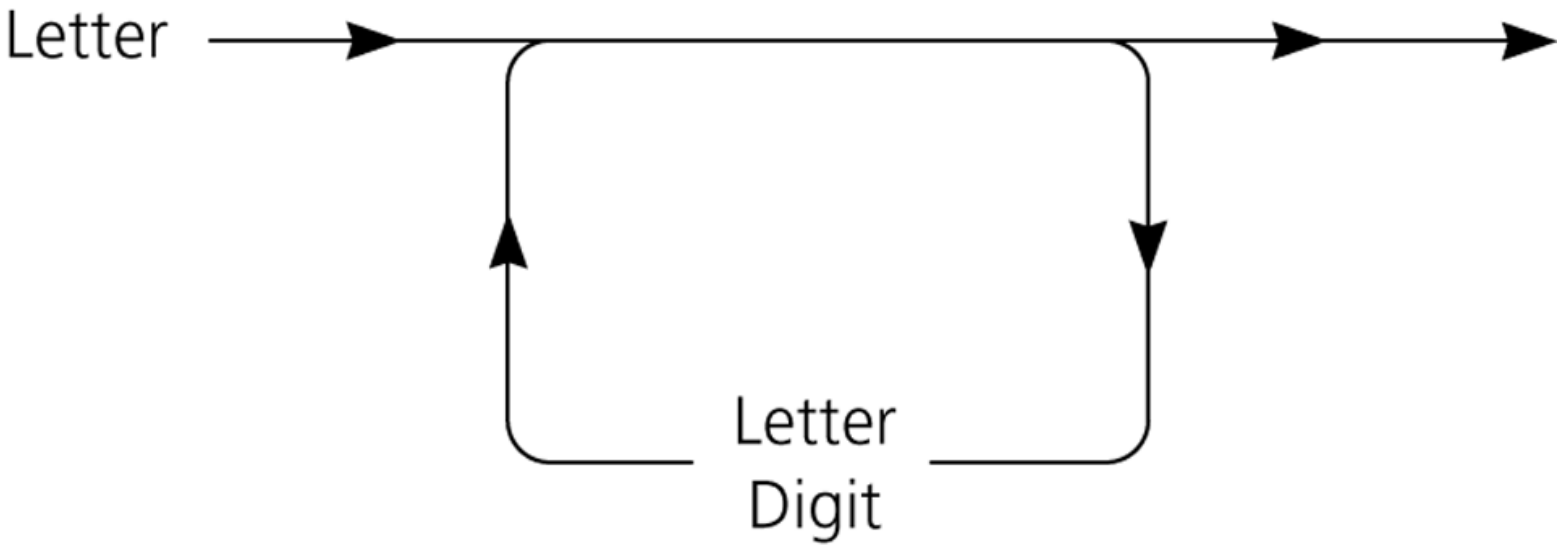
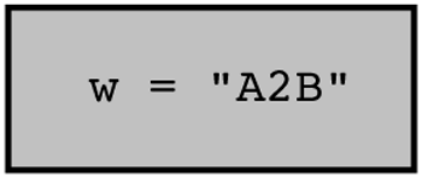


Figure 5.4a

Trace of ***isId("A2B")***

The initial call is made and the method begins execution.



At point X, a recursive call is made and the new invocation of `isId` begins execution:

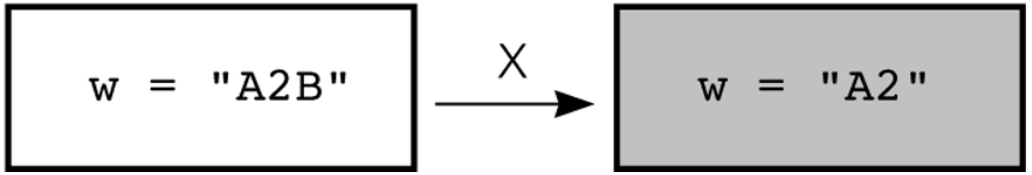


Figure 5.4b

Trace of ***isId("A2B")***

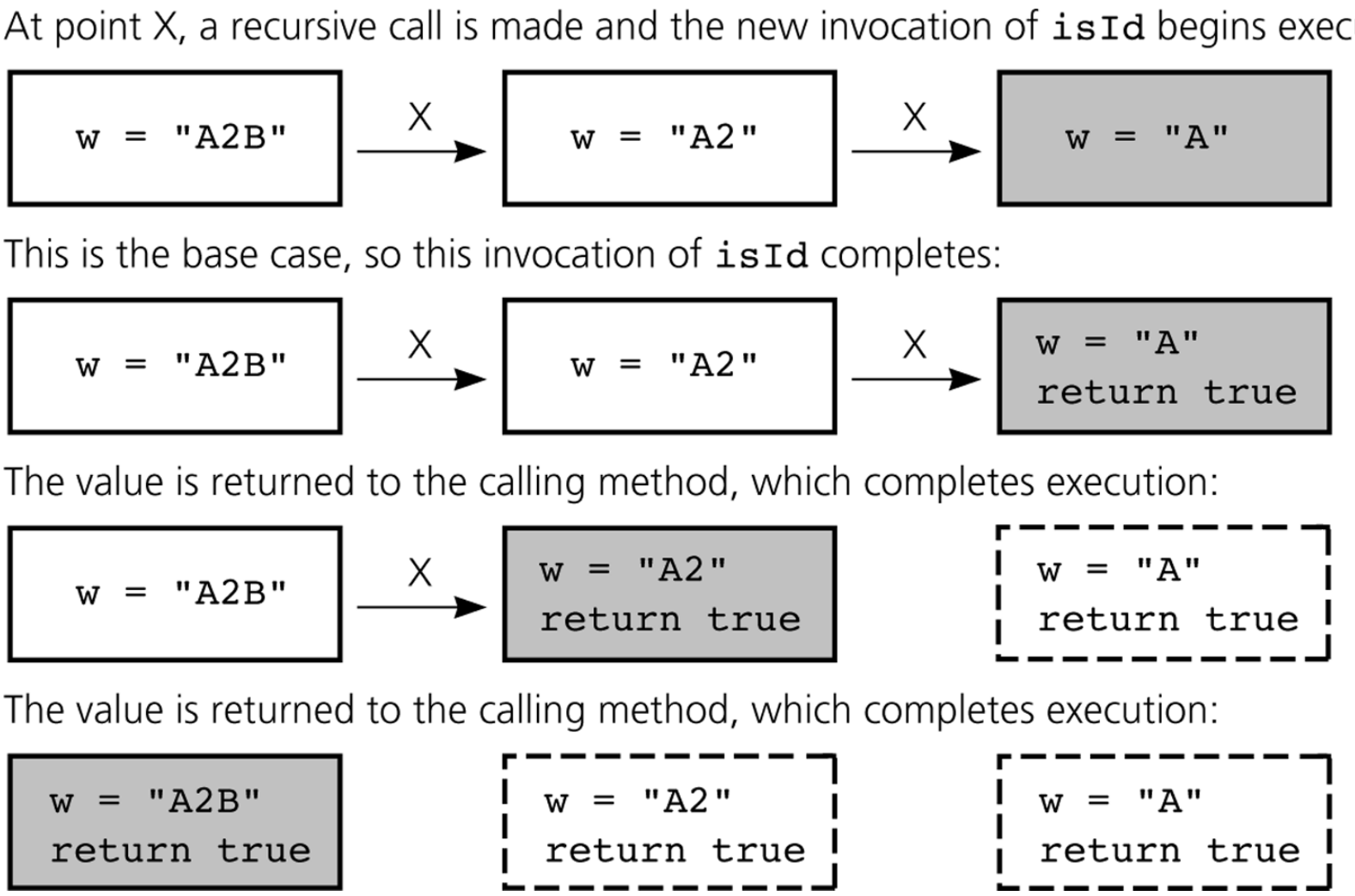
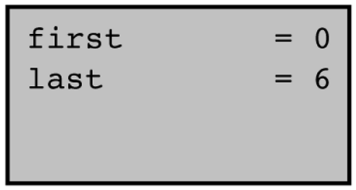


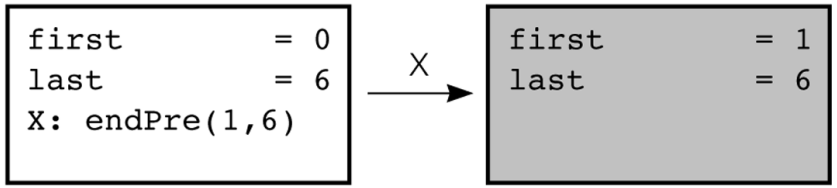
Figure 5.5a

Trace of ***endPre(first, last)***, where ***strExp*** is +/*ab-cd*

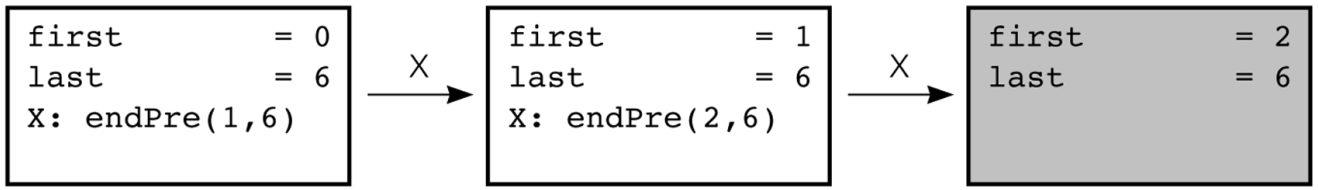
The initial call is made and `endPre` begins execution:



`first` character of `strExp` is `+`, so at point X, a recursive call is made and the new invocation of `endPre` begins execution:



Next character of `strExp` is `/`, so at point X, a recursive call is made and the new invocation of `endPre` begins execution:



Next character of `strExp` is `a`, which is a base case. The current invocation of `endPre` completes execution and returns its value:

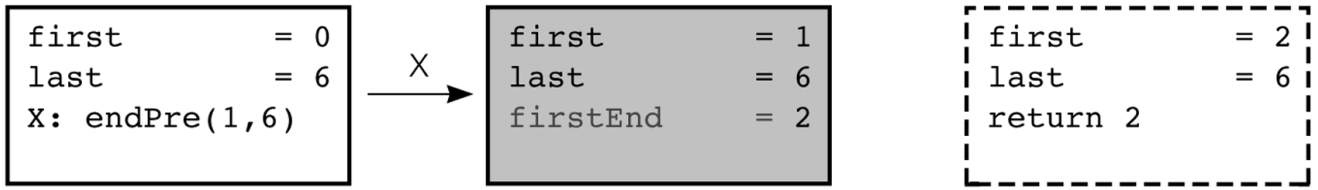
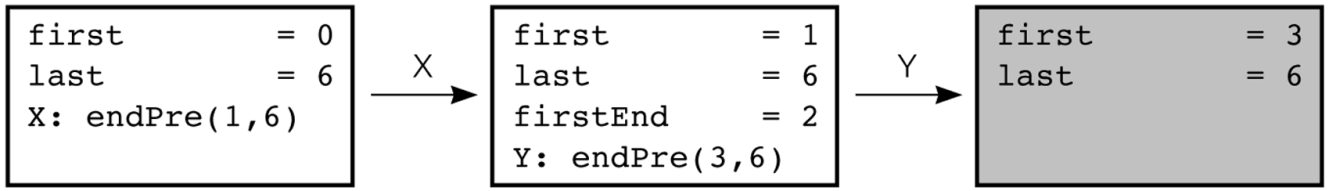


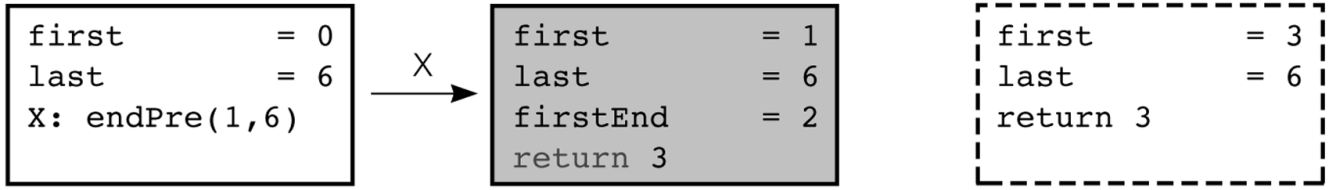
Figure 5.5b

Trace of ***endPre(first, last)***, where ***strExp*** is +/*ab-cd*

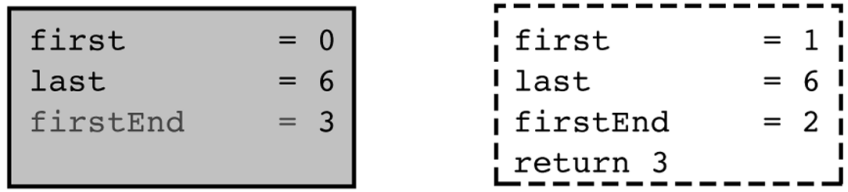
Because `firstEnd` > –1, a recursive call is made from point Y and the new invocation of `endPre` begins execution:



Next character of `strExp` is `b`, which is a base case. The current invocation of `endPre` completes execution and returns its value:



The current invocation of `endPre` completes execution and returns its value:



Because `firstEnd` > –1, a recursive call is made from point Y and the new invocation of `endPre` begins execution:

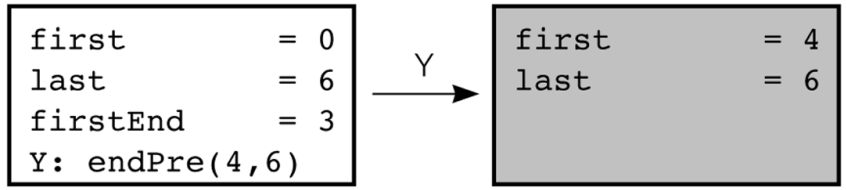
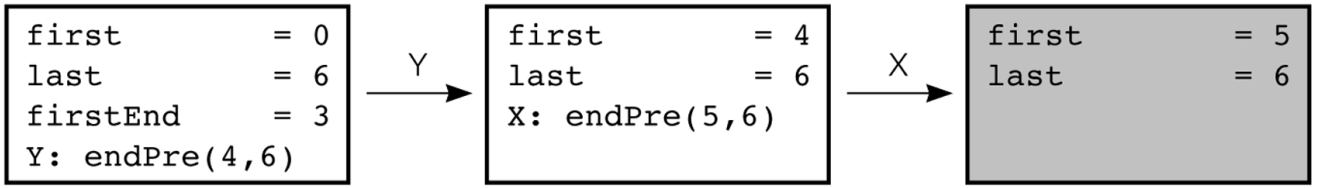


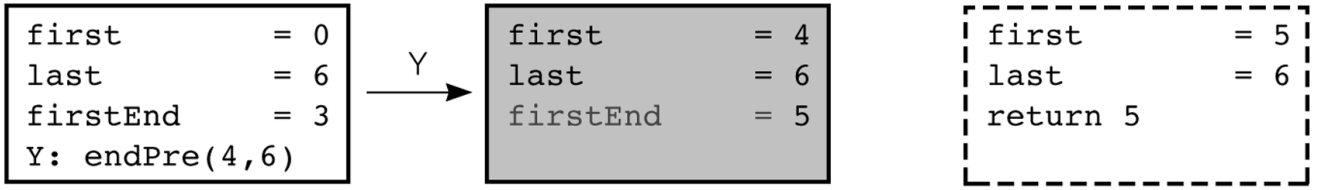
Figure 5.5c

Trace of ***endPre(first, last)***, where ***strExp*** is +/*ab-cd*

Next character of `strExp` is `-`, so at point X, a recursive call is made and the new invocation of `endPre` begins execution:



Next character of `strExp` is `c`, which is a base case. The current invocation of `endPre` completes execution and returns its value:



Because `firstEnd` > –1, a recursive call is made from point Y and the new invocation of `endPre` begins execution:

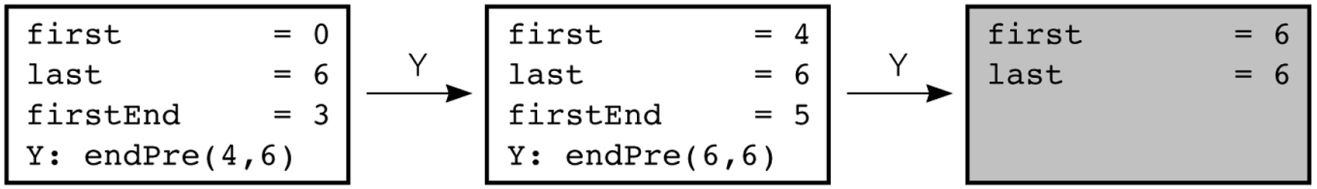
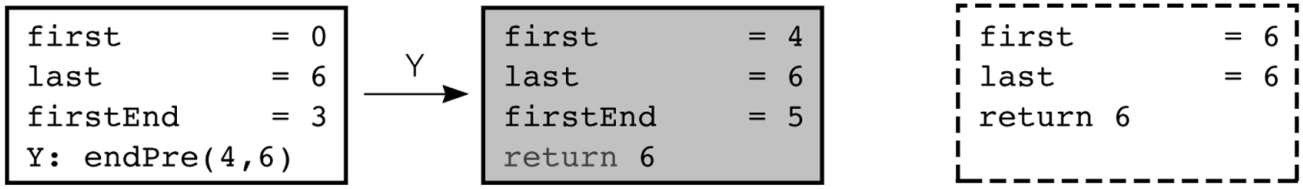


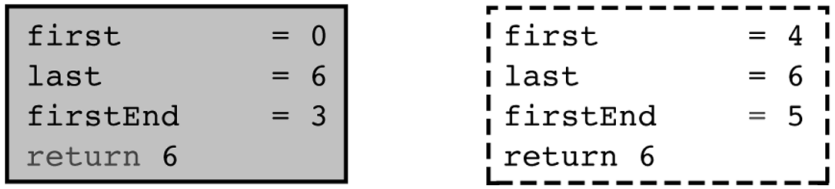
Figure 5.5d

Trace of ***endPre(first, last)***, where ***strExp*** is +/*ab-cd*

Next character of `strExp` is `d`, which is a base case. The current invocation of `endPre` completes execution and returns its value:



The current invocation of `endPre` completes execution and returns its value:



The current invocation of `endPre` completes execution and returns its value to the original call to `endPre`: