Chapter 15: Recursion

Recursive Definitions

- Recursion: solving a problem by reducing it to smaller versions of itself
  - Provides a powerful way to solve certain problems which would be complicated otherwise

Recursive Definitions (cont'd.)

- Recursive definition: defining a problem in terms of a smaller version of itself
- Base case: the case for which the solution is obtained directly
  - Every recursive definition must have one (or more) base case(s)
  - The base case stops the recursion
  - General case: must eventually reduce to a base case

Recursive Definitions (cont'd.)

- Example: factorials

$$0! = 1 \qquad (1)$$

$$n! = n \times (n-1)! \quad \text{if} \quad n > 0 \qquad (2)$$

  - Equation (1) is called the base case
  - Equation (2) is called the general case

Recursive Definitions (cont'd.)

- Recursive algorithm: finds a solution by reducing problem to smaller versions of itself
  - Must have one (or more) base cases
  - General solution must eventually reduce to a base case
- Recursive function: a function that calls itself
- Recursive algorithms are implemented using recursive functions

Recursion or Iteration?

- Iterative control structure: uses a loop to repeat a set of statements
- There are usually two ways to solve a particular problem:
  - Iteration (looping)
  - Recursion
- When choosing, must consider:
  - Nature of the problem
  - Efficiency

Recursion or Iteration? (cont'd.)

- Whenever a function is called
  - Memory space for its formal parameters and (automatic) local variables is allocated
- When the function terminates
  - That memory space is then deallocated
- Every (recursive) call has its own set of parameters and (automatic) local variables

Recursion or Iteration? (cont'd.)

- Overhead associated with executing a (recursive) function in terms of:
  - Memory space
  - Computer time
- A recursive function executes more slowly than its iterative counterpart
- Today's computers are fast
  - Overhead of a recursion function is not noticeable

Recursion or Iteration? (cont'd.)

- Sometimes iterative solution is more obvious and easier to understand
- If the definition of a problem is inherently recursive, consider a recursive solution