Recursion: Solutions to Practice Problems

Ask if you are surprised by any of these answers.

| Procedure | Termination Condition | Base Case Return Value |
| --- | --- | --- |
| factorial | n <= 1 | 1 |
| sum1toN | n < 1 | 0 |
| add | i == 0 | j |
| fib | n <= 1 | n |

| Procedure | Recursive Call(s) |
| --- | --- |
| factorial | factorial(n-1) |
| sum1toN | sum1toN(n-1) |
| add | add(i-1, j+1) |
| fib | fib(n-1) and fib(n-2) |

1. factorial(5)  
   5 \* factorial(4)  
   5 \* 4 \* factorial(3)  
   5 \* 4 \* 3 \* factorial(2)  
   5 \* 4 \* 3 \* 2 \* factorial(1)  
   5 \* 4 \* 3 \* 2 \* 1  
   120  
     
   Execution stack:  
   factorial(1) n = 1  
    return = 1  
   factorial(2) n = 2  
    return = - (not yet assigned)  
   factorial(3) 3  
    -  
   factorial(4) 4  
    -  
   factorial(5) 5  
    -
2. sum1toN(5)  
   5 + sum1toN(4)  
   5 + 4 + sum1toN(3)  
   5 + 4 + 3 + sum1toN(2)  
   5 + 4 + 3 + 2 + sum1toN(1)  
   5 + 4 + 3 + 2 + 1 + sum1toN(0)  
   5 + 4 + 3 + 2 + 1 + 0  
   15
3.   
     
     
     
   Execution stack:  
   add(0,14) i = 0  
    j = 14  
    return = 14  
   add(1,13) i = 1  
    j = 13  
    return = - (not yet assigned)  
   add(2,12) 2  
    12  
    -  
   add(3,11) 3  
    11  
    -  
   add(4,10) 4  
    10  
    -  
   add(5,9) 5  
    9  
    -
4. 
5. double investmentValue(double investment, double interestRate, int years) {  
    if (years == 0)  
    return investment;  
    else  
    return investmentValue(investment \* (1 + interestRate), interestRate, years-1);  
   }
6. double amountOwed(double loan, double interestRate, double payment, int months) {  
    if (months == 0)  
    return loan;  
    else  
    return amountOwed(loan \* (1 + interestRate/12) - payment, interestRate, payment, months-1);  
   }
7. String duplicate(String s, int i) {  
    if (i == 0)  
    return "";  
    else  
    return s + duplicate(s, i-1);  
   }
8. String doubleSuccessively(String s, int i) {  
    if (i == 0)  
    return s;  
    else  
    return doubleSuccessively(s + s, i-1);  
   }