

CS 2110: Recursion Practice Questions

Here are a few practice questions for recursion. A nice place to practice it is: <http://codingbat.com/java/Recursion-1>

1. Compute the Factorial of a number N . $Fact(N) = N \times (N - 1) \cdots 1$.
2. Compute the sum of natural numbers until N .
3. Write a function for $multiply(a, b)$, where a and b are both positive integers, but you can only use the $+$ or $-$ operators.
4. In the lecture, we discussed a method to raise a double to an integer power. In this question, write a recursive function that allows raising to a negative integer power as well.
5. Find Greatest Common Divisor (GCD) of 2 numbers using recursion.
6. Write a recursive function to reverse a string. Write a recursive function to reverse the words in a string, i.e., "cat is running" becomes "running is cat".
7. **[Medium hard]** A word is considered elfish if it contains the letters: e, l, and f in it, in any order. For example, we would say that the following words are elfish: whiteleaf, tasteful, unfriendly, and waffles, because they each contain those letters.
 - Write a predicate function called `elfish?` that, given a word, tells us if that word is elfish or not.
 - Write a more generalized predicate function called `x-ish?` that, given two words, returns true if all the letters of the first word are contained in the second.
8. **[Hard example]** Coin game: Alice and Bob are playing a game using a bunch of coins. The players pick several coins out of the bunch in turn. Each time a player is allowed to pick 1, 2 or 4 coins, and the player that gets the last coin is the winner. Assume that both players are very smart and he/she will try his/her best to work out a strategy to win the game. For example, if there are 2

coins and Alice is the first player to pick, she will definitely pick 2 coins and win. If there are 3 coins and Alice is still the first player to pick, no matter she picks 1 or 2 coins, Bob will get the last coin and win the game. Given the number of coins and the order of players (which means the first and the second players to pick the coins), you are required to write a program to calculate the winner of the game, and calculate how many different strategies there are for he/she to win the game. You should use recursion to solve the problem, and the parameters are read from the command line. You can assume that there are no more than 30 coins.

Here are some sample runs of the program:

```
./pickcoin 1 alice bob  
alice 1  
./pickcoin 2 bob alice  
bob 1  
./pickcoin 3 alice bob  
bob 2  
./pickcoin 10 alice bob  
alice 22  
./pickcoin 25 alice bob  
alice 3344  
./pickcoin 30 alice bob  
bob 18272
```