CS1102: Data Structure and Algorithms

Tutorial 5 - Recursion
Week of 1st March 2010

1.

   a. Write a recursive solution along with its Java code to reverse an integer array (not necessarily sorted). You may not use any additional arrays in your solution.

   b. Using methods from the String class, write a recursive solution along with its Java code to check if a given String is a palindrome.

   c. Write a recursive solution along with its Java code to find the smallest integer in an integer array. You are not allowed to use the code provided by your lecture notes for solving the k-th smallest element (by specifying k=1).

   d. Compare the advantages and disadvantage of the recursive solutions and iterative solutions of all these 3 questions.

2. Refer to the following method

```
public static int recur (int n) {
    if (n == 1 || n == 2) return 1;
    return (n % 2 == 0)? (recur(n -1) + recur(n -2) +
        recur(n - 3)) :(recur(n - 1) + recur(n - 2));
}
```

   a. How many times is recur (2) called as the result of calling recur(6) ?

   b. Write a better method is calculate recur (n) so that each recur (1), …, recur (n -1) should only be calculated once.

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3. We assume that our array doesn't contain duplicates. Base on the **binarySearch** method in the lecture note:

   a. Write a recursive method **ternarySearch** that will search for an integer in a sorted array by dividing the array into 3 parts.

   b. Write a recursive method **modifiedBinarySearch** that will search for an integer in a sorted array and return the location of the integer which is nearest to it. If there are 2 nearest integers, the lower location will be returned. For example, search for 4 in {1,2,3,4,9} will return 3 while search for 11 in {2, 3, 5, 7, 13, 15} will return 4.

   c. How can part b be modified such that it still returns the correct answer in case duplicates in array are allowed?

4. Given some amount of money (in cents, ¢), write a recursive solution along with its Java code to count the number of ways we can represent the money using coins. The coins are in the following denominations (¢): 1, 5, 10, 20, 50, and 100. For example:

   a. 3¢ can be represented in 1 way (3×1¢).
   b. 5¢ can be represented in 2 ways (5×1¢, or 1×5¢).
   c. 10¢ can be represented in 4 ways (10×1¢, 2×5¢, 1×5¢ $+ 5 \times 1$¢, or 1×10¢).

   Hint: Be careful not to double count.