

Lab Questions

Note: All questions need to be solved using recursion.

1. The Fibonacci sequence $a(1), a(2), a(3), \dots, a(n), \dots$ is defined by

$$a(n) = \begin{cases} 1 & \text{for } n = 1 \\ 1 & \text{for } n = 2 \\ a(n-1) + a(n-2), & \text{for all } n > 2 \end{cases}$$

This generates the sequence 1, 1, 2, 3, 5, 8, 13, 21, ...

Write a recursive function `fibonacci()` that computes the Fibonacci number corresponding to its positive integer argument, so that, for example, `fibonacci(7) == 13`.

2. Given positive two integers m and n such that $m < n$, the greatest common divisor of m and n is the same as the greatest common divisor of m and $(n - m)$. Use this fact to write a recursive definition of the function `gcd()`, which takes two positive integer arguments and returns their greatest common divisor. Test your function in a suitable `main()` program.
3. Write a recursive function `removeX()` that given a string, compute recursively a new string where all the 'x' characters have been removed. E.g.,
 - `removeX("xaxb")` returns "ab"
 - `removeX("abc")` returns "abc"
 - `removeX("xx")` returns ""

Hint: All occurrences of 'x' in string `s` can be removed by removing 'x' from first position (if exists) and recursively removing 'x' from the rest.

4. Write a recursive function `evenDigits()` that accepts an integer parameter `n` and that returns the integer formed by removing the odd digits from `n`. The following table shows several calls and their expected return values:

Call	Value returned
<code>evenDigits(8342116)</code>	8426
<code>evenDigits(4109)</code>	40
<code>evenDigits(8)</code>	8
<code>evenDigits(-34512)</code>	-42
<code>evenDigits(-163505)</code>	-60
<code>evenDigits(3052)</code>	2
<code>evenDigits(7010496)</code>	46
<code>evenDigits(35179)</code>	0
<code>evenDigits(5307)</code>	0
<code>evenDigits(7)</code>	0

If a negative number with even digits other than `0` is passed to the method, the result should also be negative, as shown above when `-34512` is passed. Leading zeros in the result should be ignored and if there are no even digits other than `0` in the number, the method should return `0`, as shown in the last three outputs.

5. Write a program to produce each of the following recursive patterns. The ratio of the sizes of the squares is 2.2:1. To draw a shaded square, draw a filled gray square, then an unfilled black square.

