Algorithms

Lab 06 (8%)

Topics: Recursion, Backtracking

Problem 01 (0.25%)
(Simplest illustration of recursion)

Write a C++ program which reads arbitrary amount of integer numbers from standard input and prints them to standard output in reversed order. Do not use loops and containers. Use recursive function readAndPrintInReversedOrder instead. Explain disadvantages of this recursive approach.

Problem 02 (0.25%)
(Factorial)

Write a C++ program which computes factorial of entered non-negative integer numbers n (Ctrl-Z – end of input). Use recursive function int64_t factorial(int n). Explain disadvantages of this recursive approach.

Problem 03 (1%)
(Greatest Common Divisor)

Write a C++ program which computes greatest common divisors of entered pairs of integer numbers (Ctrl-Z – end of input). Create functions:

- int gcd(int a, int b): checks arguments and throws std::invalid_argument exception if a == 0 and b == 0, otherwise it calls recursive function int gcdAux(int a, int b)
- int gcdAux(int a, int b): recursive function to compute greatest common divisor of numbers a and b.

Problem 04 (1%)
(Hanoi Towers)

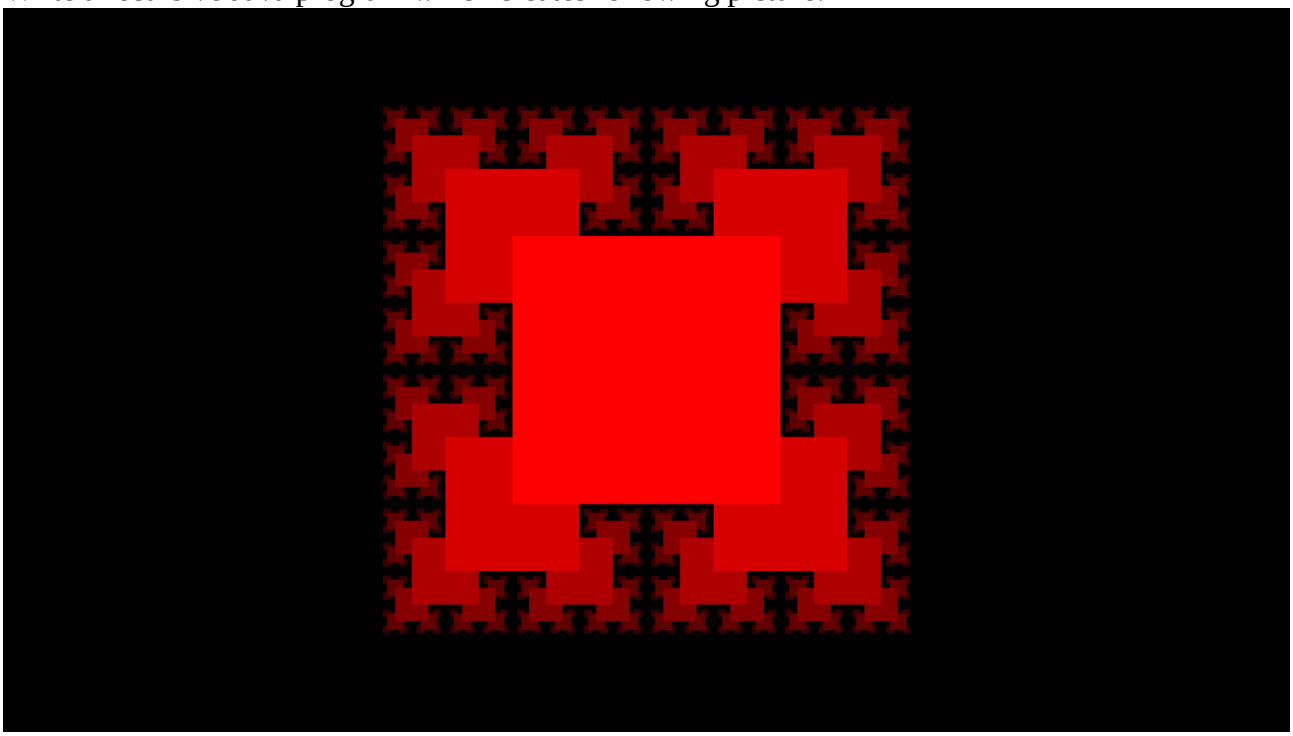
Write a C++ program which solves recursively Hanoi Towers puzzle for entered non-negative integer n. Program has to write solution as a sequence of lines <number of source tower> → <number of destination tower>.

Sample input:
3
Sample output:
1->3
1->2
3->2
1->3
2->1
2->3
1->3

Problem 05 (1%)

(Simplest Fractal)

Write a recursive Java program which creates following picture:



Problem 06 (0.5%)

(Example of bad usage of recursion)

Write a C++ program which computes nth element of Fibonacci sequence. Use direct recursive implementation of function:

$F(n) = 1$, if $n = 0$, $n = 1$;

otherwise

$F(n) = F(n - 1) + F(n + 2)$.

Explain why this function is so inefficient. Solve the same problem without recursion.

Problem 07 (2%)

(Backtracking: recursive approach)

Write a C++ program which solves famous N Queens puzzle for entered natural n – size of chessboard. Program has to print all configuration of n queens where queens do not attack each other. Use recursive function to solve this puzzle.

Problem 08 (2%)

(Backtracking: iterative implementation)

You have to solve previous problem using iterative function instead of recursive one. (Hint: use class stack from standard library)