# Homework: C Loops

This document defines the homework assignments from [the "C Programming" Course @ Software University](https://softuni.bg/trainings/1212/C-Programming-October-2015). Please submit as homework a single zip / rar / 7z archive holding the solutions (source code) of all below described problems.

## Numbers from 1 to N

Write a program that enters from the console a positive integer **n** and **prints all the numbers from 1 to n**, on a single line, separated by a space. Examples:

|  |  |
| --- | --- |
| **n** | **output** |
| 3 | 1 2 3 |
| 5 | 1 2 3 4 5 |

## Numbers Not Divisible by 3 and 7

Write a program that enters from the console a positive integer **n** and prints all the **numbers from 1 to n not divisible by 3 and 7**, on a single line, separated by a space. Examples:

|  |  |
| --- | --- |
| **n** | **output** |
| 3 | 1 2 |
| 10 | 1 2 4 5 8 10 |

## Min, Max, Sum and Average of N Numbers

Write a program that reads from the console a sequence of **n** integer numbers and returns the **minimal**, the **maximal** number, the sum and the average of all numbers (displayed with 2 digits after the decimal point). The **input** starts by the number **n** (alone in a line) followed by **n lines**, each holding an integer number. The **output** is like in the examples below. Examples:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **input** | **output** |  | **input** | **output** |
| 3  2  5  1 | min = 1.00  max = 5.00  sum = 8.00  avg = 2.67 | 2  -1  4 | min = -1.00  max = 4.00  sum = 3.00  avg = 1.50 |

## Print a Deck of 52 Cards

Write a program that generates and prints **all possible cards from a** [**standard deck of 52 cards**](http://en.wikipedia.org/wiki/Standard_52-card_deck) (without the jokers). The cards should be printed using the classical notation (like 5S (♠), AH (♥), 9C (♣) and KD (♦)). The card faces should start from 2 to A. Print each card face in its four possible suits: clubs, diamonds, hearts and spades. Use 2 nested for-loops and a switch-case statement.

|  |
| --- |
| **output** |
| 2C 2D 2H 2S  3C 3D 3H 3S  …  KC KD KH KS  AC AD AH AS |

## Calculate 1 + 1!/X + 2!/X2 + … + N!/XN

Write a program that, for a given two integer numbers **n** and **x**, calculates the sum S = 1 + 1!/x + 2!/x2 + … + n!/xn. Use only one loop. Print the result with 5 digits after the decimal point.

|  |  |  |
| --- | --- | --- |
| **n** | **x** | **S** |
| 3 | 2 | 2.75000 |
| 4 | 3 | 2.07407 |
| 5 | -4 | 0.75781 |

## Calculate N! / K!

Write a program that calculates **n! / k!** for given **n** and **k** (1 < **k** < **n** < 100). Use only one loop. Examples:

|  |  |  |
| --- | --- | --- |
| **n** | **k** | **n! / k!** |
| 5 | 2 | 60 |
| 6 | 5 | 6 |
| 8 | 3 | 6720 |

## Calculate N! / (K! \* (N-K)!)

In combinatorics, the number of ways to choose **k** different members out of a group of **n** different elements (also known as the number of [**combinations**](http://en.wikipedia.org/wiki/Combination)) is calculated by the following formula:

 \binom nk = \frac{n!}{k!(n-k)!},

For example, there are 2598960 ways to withdraw 5 cards out of a standard deck of 52 cards. Your task is to write a program that calculates **n! / (k! \* (n-k)!)** for given **n** and **k** (1 < **k** < **n** < 100). Try to use only two loops. Examples:

|  |  |  |
| --- | --- | --- |
| **n** | **k** | **n! / (k! \* (n-k)!)** |
| 3 | 2 | 3 |
| 4 | 2 | 6 |
| 10 | 6 | 210 |
| 52 | 5 | 2598960 |

## Catalan Numbers

In combinatorics, the [Catalan numbers](http://en.wikipedia.org/wiki/Catalan_number) are calculated by the following formula:

C_n = \frac{1}{n+1}{2n\choose n} = \frac{(2n)!}{(n+1)!\,n!} = \prod\limits_{k=2}^{n}\frac{n+k}{k} \qquad\mbox{ for }n\ge 0.

Write a program to calculate the **nth Catalan number** by given **n** (1 < n < 100). Examples:

|  |  |
| --- | --- |
| **n** | **Catalan(n)** |
| 0 | 1 |
| 5 | 42 |
| 10 | 16796 |
| 15 | 9694845 |

## Matrix of Numbers

Write a program that reads from the console a positive integer number n (1 ≤ n ≤ 20) and **prints a matrix** like in the examples below. Use two nested loops. Examples:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **matrix** |  | **n** | **matrix** |  | **n** | **matrix** |
| 2 | 1 2  2 3 | 3 | 1 2 3  2 3 4  3 4 5 | 4 | 1 2 3 4  2 3 4 5  3 4 5 6  4 5 6 7 |

## Odd and Even Product

You are given **n** integers (given in a single line, separated by a space). Write a program that checks whether the product of the odd elements is equal to the product of the even elements. Elements are counted from 1 to n, so the first element is odd, the second is even, etc. Examples:

|  |  |
| --- | --- |
| **numbers** | **result** |
| **2** 1 **1** 6 **3** | yes  product = 6 |
| **3** 10 **4** 6 **5** 1 | yes  product = 60 |
| **4** 3 **2** 5 **2** | no  odd\_product = 16  even\_product = 15 |

## Random Numbers in Given Range

Write a program that enters 3 integers n, min and max (min ≤ max) and prints n random numbers in the range [min...max]. Examples:

|  |  |  |  |
| --- | --- | --- | --- |
| **n** | **min** | **max** | **random numbers** |
| 5 | 0 | 1 | 1 0 0 1 1 |
| 10 | 10 | 15 | 12 14 12 15 10 12 14 13 13 11 |

Note that the above output is just an example. Due to randomness, your program most probably will produce different results.

## \* Randomize the Numbers 1…N

Write a program that enters in integer n and prints the numbers 1, 2, …, n in random order. Examples:

|  |  |
| --- | --- |
| **n** | **randomized numbers 1…n** |
| 3 | 2 1 3 |
| 10 | 3 4 8 2 6 7 9 1 10 5 |

Note that the above output is just an example. Due to randomness, your program most probably will produce different results. You might need to use [arrays](http://www.tutorialspoint.com/cprogramming/c_arrays.htm).

## Binary to Decimal Number

Using loops write a program that converts a [binary integer](http://en.wikipedia.org/wiki/Binary_numeral_system) number to its decimal form. The input is entered as string. The output should be a variable of type long. Do not use the built-in .NET functionality. Examples:

|  |  |
| --- | --- |
| **binary** | **decimal** |
| 0 | 0 |
| 11 | 3 |
| 1010101010101011 | 43691 |
| 1110000110000101100101000000 | 236476736 |

## Decimal to Binary Number

Using loops write a program that converts an integer number to its [binary representation](http://en.wikipedia.org/wiki/Binary_numeral_system). The input is entered as long. The output should be a variable of type string. Do not use the built-in .NET functionality. Examples:

|  |  |
| --- | --- |
| **decimal** | **binary** |
| 0 | 0 |
| 3 | 11 |
| 43691 | 1010101010101011 |
| 236476736 | 1110000110000101100101000000 |

## Hexadecimal to Decimal Number

Using loops write a program that converts a [hexadecimal integer](http://en.wikipedia.org/wiki/Hexadecimal) number to its decimal form. The input is entered as string. The output should be a variable of type long. Do not use the built-in .NET functionality. Examples:

|  |  |
| --- | --- |
| **hexadecimal** | **decimal** |
| FE | 254 |
| 1AE3 | 6883 |
| 4ED528CBB4 | 338583669684 |

## Decimal to Hexadecimal Number

Using loops write a program that converts an integer number to its [hexadecimal representation](http://en.wikipedia.org/wiki/Hexadecimal). The input is entered as long. The output should be a variable of type string. Do not use the built-in .NET functionality. Examples:

|  |  |
| --- | --- |
| **decimal** | **hexadecimal** |
| 254 | FE |
| 6883 | 1AE3 |
| 338583669684 | 4ED528CBB4 |

## \* Calculate GCD

Write a program that calculates the [**greatest common divisor**](http://en.wikipedia.org/wiki/Greatest_common_divisor) (**GCD**) of given two integers a and b. Use the **Euclidean algorithm** (find it in Internet). Examples:

|  |  |  |
| --- | --- | --- |
| **a** | **b** | **GCD(a, b)** |
| 3 | 2 | 1 |
| 60 | 40 | 20 |
| 5 | -15 | 5 |

## \* Trailing Zeroes in N!

Write a program that calculates with how many zeroes the factorial of a given number n has at its end. Your program should work well for very big numbers, e.g. n=100000. Examples:

|  |  |  |
| --- | --- | --- |
| **n** | **trailing zeroes of n!** | **explaination** |
| 10 | 2 | 36288**00** |
| 20 | 4 | 243290200817664**0000** |
| 100000 | 24999 | think why |

## \*\* Spiral Matrix

Write a program that reads from the console a positive integer number n (1 ≤ n ≤ 20) and **prints a matrix** holding the numbers from 1 to n\*n in the form of **square spiral** like in the examples below. Examples:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **matrix** |  | **n** | **matrix** |  | **n** | **matrix** |
| 2 | 1 2  4 3 | 3 | 1 2 3  8 9 4  7 6 5 | 4 | 1 2 3 4  12 13 14 5  11 16 15 6  10 9 8 7 |