**Homework: Loops**

**Problem 1. 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 |

**Problem 2. 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 or 7, on a single line, separated by a space.

*Examples:*

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

**Problem 3. 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.

*Example 1:*

| **input** | **output** |
| --- | --- |
| 3  2  5  1 | min = 1  max = 5  sum = 8  avg = 2.67 |

*Example 2:*

| **input** | **output** |
| --- | --- |
| 2  -1  4 | min = -1  max = 4  sum = 3  avg = 1.50 |

**Problem 4. 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 5 of spades, A of hearts, 9 of clubs; and K of diamonds).
  + 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*

2 of spades, 2 of clubs, 2 of hearts, 2 of diamonds

3 of spades, 3 of clubs, 3 of hearts, 3 of diamonds

…

K of spades, K of clubs, K of hearts, K of diamonds

A of spades, A of clubs, A of hearts, A of diamonds

*Note: You may use the suit symbols instead of text.*

**Problem 5. Calculate 1 + 1!/X + 2!/X^2 + … + N!/X^N**

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

*Examples:*

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

**Problem 6. 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 |

**Problem 7. 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) is calculated by the following formula: [formula](https://cloud.githubusercontent.com/assets/3619393/5626060/89cc780e-958e-11e4-88d2-0e1ff7229768.png)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 |

**Problem 8. Catalan Numbers**

* In combinatorics, the Catalan numbers are calculated by the following formula: [catalan-formula](https://cloud.githubusercontent.com/assets/3619393/5626137/d7ec8bc2-958f-11e4-9787-f6c386847c81.png)
* Write a program to calculate the nth Catalan number by given n (0 ≤ n ≤ 100).

*Examples:*

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

**Problem 9. 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 = 2 matrix n = 3 matrix n = 4 matrix

1 2 1 2 3 1 2 3 4

2 3 2 3 4 2 3 4 5

3 4 5 3 4 5 6

4 5 6 7

**Problem 10. 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 |  |

**Problem 11. 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: The above output is just an example. Due to randomness, your program most probably will produce different results.*

**Problem 12.\* 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: The above output is just an example. Due to randomness, your program most probably will produce different results. You might need to use arrays.*

**Problem 13. Binary to Decimal Number**

* Using loops write a program that converts a binary integer 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 |

**Problem 14. Decimal to Binary Number**

* Using loops write a program that converts an integer number to its binary representation.
* 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 |

**Problem 15. Hexadecimal to Decimal Number**

* Using loops write a program that converts a hexadecimal integer 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 |

**Problem 16. Decimal to Hexadecimal Number**

* Using loops write a program that converts an integer number to its hexadecimal representation.
* 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 |

**Problem 17.\* Calculate GCD**

* Write a program that calculates the 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 |

**Problem 18.\* 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 | 3628800 |
| 20 | 4 | 2432902008176640000 |
| 100000 | 24999 | think why |

**Problem 19.\*\* 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 = 2 matrix n = 3 matrix n = 4 matrix

1 2 1 2 3 1 2 3 4

4 3 8 9 4 12 13 14 5

7 6 5 11 16 15 6

10 9 8 7