

Homework: C Loops

This document defines the homework assignments from [the "C Programming" Course @ Software University](#). Please submit as homework a single **zip / rar / 7z** archive holding the solutions (source code) of all below described problems.

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 and 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. Examples:

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

Problem 5. Calculate $1 + 1!/x + 2!/x^2 + \dots + N!/x^N$

Write a program that, for a given two integer numbers **n** and **x**, calculates the sum $S = 1 + 1!/x + 2!/x^2 + \dots + n!/x^n$. 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

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:

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

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

Problem 8. Catalan Numbers

In combinatorics, the [Catalan numbers](#) are calculated by the following formula:

$$C_n = \frac{1}{n+1} \binom{2n}{n} = \frac{(2n)!}{(n+1)!n!} = \prod_{k=2}^n \frac{n+k}{k} \quad \text{for } n \geq 0.$$

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
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Problem 9. Matrix of Numbers

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

n	matrix
2	1 2 2 3
n	matrix
3	1 2 3 2 3 4 3 4 5
n	matrix
4	1 2 3 4 2 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** ($\text{min} \leq \text{max}$) 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.

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 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](#).

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
10101010101011	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	10101010101011
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**. 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**. 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!	explanation
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** ($1 \leq n \leq 20$) 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				
2	<table><tr><td>1</td><td>2</td></tr><tr><td>4</td><td>3</td></tr></table>	1	2	4	3
1	2				
4	3				

n	matrix									
3	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>8</td><td>9</td><td>4</td></tr><tr><td>7</td><td>6</td><td>5</td></tr></table>	1	2	3	8	9	4	7	6	5
1	2	3								
8	9	4								
7	6	5								

n	matrix																
4	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>12</td><td>13</td><td>14</td><td>5</td></tr><tr><td>11</td><td>16</td><td>15</td><td>6</td></tr><tr><td>10</td><td>9</td><td>8</td><td>7</td></tr></table>	1	2	3	4	12	13	14	5	11	16	15	6	10	9	8	7
1	2	3	4														
12	13	14	5														
11	16	15	6														
10	9	8	7														