

## ONLINE CALCULATOR FOR COMBINATIONS

Combinatorics is an area of mathematics primarily concerned with counting. Combinatorics is an integral part of our lives, even though you don't even think about it. Combinatorics is especially useful in computer science. Combinatorics methods can be used to develop estimates about how many operations a computer algorithm will require. Combinatorics is also important for the study of discrete probability. Combinatorics methods can be used to count possible outcomes in a uniform probability experiment.

The goal of the paper is to write a program that would output possible combinations of elements without repetitions from  $n$  elements by  $m$  and to visualize the answer.

Sometimes the order in which objects are chosen doesn't matter; all that matters is whether or not they were chosen. An example of this is choosing a set of problems for an exam. Although the order in which the questions are arranged may make the exam more or less intimidating, what really matters is which questions are on the exam, and which are not. Another example would be choosing shirts to pack for a trip (assuming all of your shirts are distinguishable from each other). Such kind of a choice like this is called a «combination», to indicate that it is the collection of things chosen that matters, and not the order.

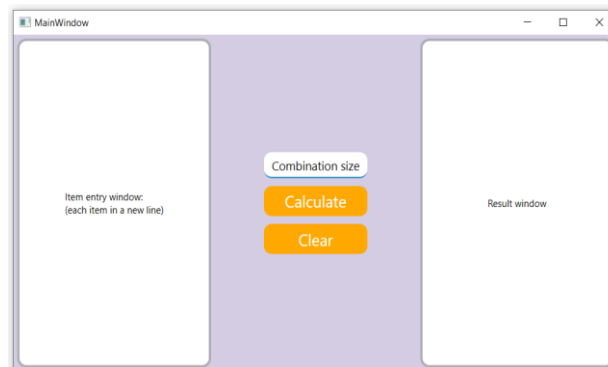
**Definition.** Let  $n$  be a positive natural number, and  $0 \leq m \leq n$ . Assume that we have  $n$  distinct objects. An  $m$ -combination of the  $n$  objects is a subset consisting of  $m$  of the objects.

So a combination involves choosing items from a finite population in which every item is uniquely identified, but the order in which the choices are made is unimportant.

Again, it should not be surprise to learn that the result is how many combinations there are, in a variety of circumstances. One significant difference from permutations is that it's not interesting to ask how many  $n$ -combinations there are of  $n$  objects; there is only one, as we must choose all of the objects.

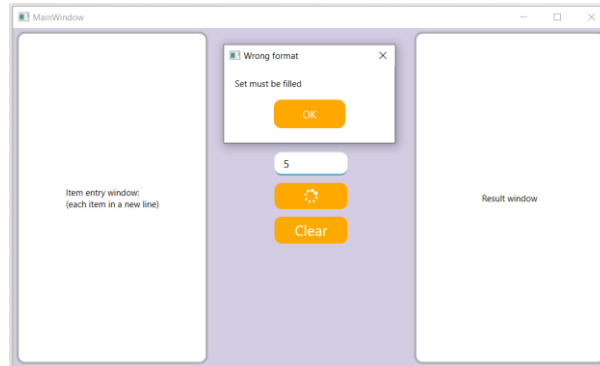
To create the project it has been used the C# programming language and the Visual Studio integrated development environment.

When we run the .exe file, we open the MainWindow dialog window, in which the user can find three workspaces: Data input area, result output area, and algorithm launch area (see picture 1).



*Picture 1 – Dialog window of the applet*

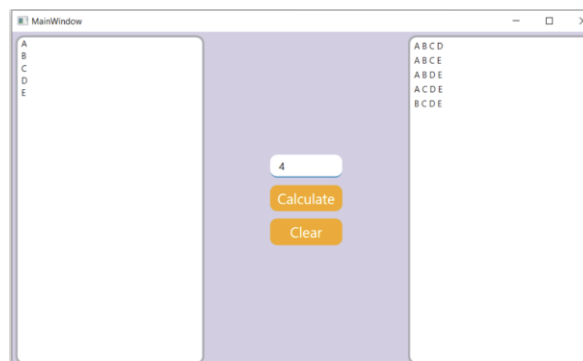
I propose to deal with the main functionality of the program, one of the tasks set was to create an application that will be as clear to the user as possible. The two areas where the user sets values, the two buttons, the so-called "PushButton" and the resulting window. The user can insert, cut, copy data, if you enter data in the wrong format, you will be notified of an error (see picture 2).



**Picture 2 – Result of the wrong format**

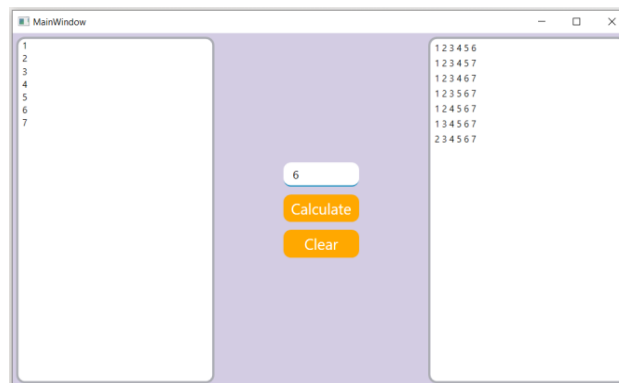
Here are some examples to help you master the basics and ease of use. Let's start with the input values, how should they be formed and what dimension should they be? it's very simple, the data can be anything from characters to whole strings.

Example 1 (simple characters) one can see on the picture 3.



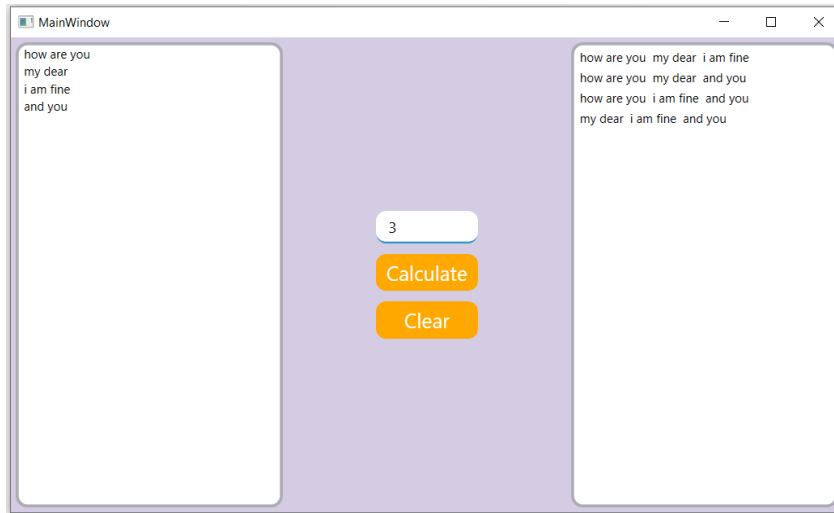
**Picture 3 – Visualization of the result in the case of the simple characters**

Example 2 (numbers) one can see on the picture 4.



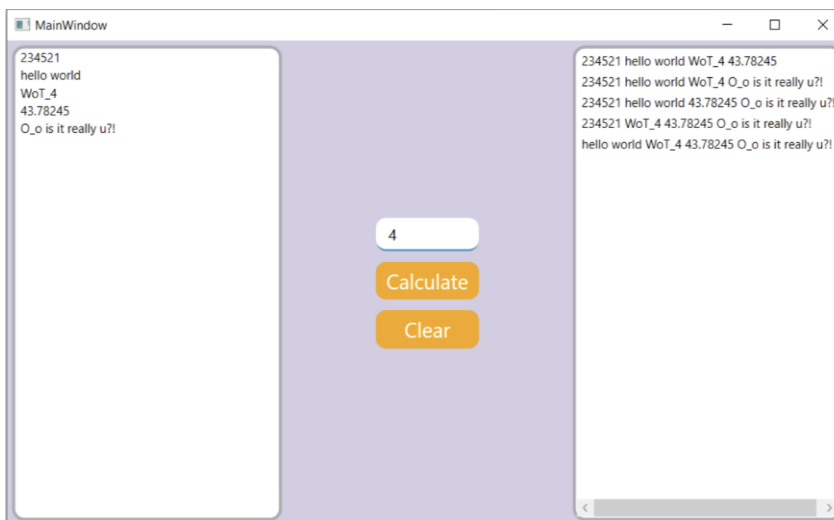
**Picture 4 – Visualization of the result in the case of the numbers**

We can see that the algorithm works flawlessly with simple data, but what if it is a whole set of characters, such as strings. On the picture 5 one can see that the algorithm with strings also works, giving us the result we need.



*Picture 5 – Visualization of the result in the case of the strings*

Well, we found out that the algorithm works with data of the same type, numbers, strings, symbols, and if you combine them all, here is an example of combinations with different data types (see picture 6).



*Picture 6 – Visualization of the result in the case of different data types*

**References:**

1. Introduction to Differential Calculus: Systematic Studies with Engineering Applications for Beginners / Rohde U.L. [et al.] . – USA : Wiley, 2012.