

НАУЧНОЕ ЗНАНИЕ СОВРЕМЕННОСТИ

ISSN 2541-7827



*Международный научный журнал*  
*Выпуск №6*  
*Казань, 2017*

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**THE NEW APPROACH OF  
ORGANIZATION OF VIRTUAL LIBRARY  
CONTENT FOR MATHEMATICS  
AND PROGRAMMERS**

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**Abstract.** In this paper, a new approach to the organization of the content of virtual libraries for mathematicians and programmers is being considered. As an example to what has been said, this paper presents computer code written in Visual C #, in which the problem of "solving triangles" is realized. At the same time, this software can be included in a virtual library stored on the server and opened from any client where it is possible to conduct active computer experiments on the downloaded code, with subsequent preservation and without changing the original on the server.

**Keywords:** virtual libraries; Visual C #; triangles.

**Introduction.** In accordance with modern requirements of the time, universities are increasingly turning their attention to the training of universal specialists with deep knowledge in related fields. In particular, the plans for training specialists in the field of mathematics and informatics are united into a single complex that forms the basis for educating professionals who have fundamental skills for solving theoretical and practical problems with the use of a powerful mathematical apparatus and computer modeling tools. Undauntedly, the implementation of this complex requires, in addition to attracting highly qualified professors in the educational process, also the availability of modern infrastructure, such as: equipped with the latest technology of classrooms, Local computer network with an Internet connection for. Access to external training resources and video conferencing, libraries with sufficient literature, and, importantly, the availability of their own virtual library with digital content.

**METHODS.** Regarding virtual libraries, their content is mainly limited to

electronic literature, video and Audio files, which is not sufficient for users whose interests and related to mathematics and its applications. The fact is that the study of mathematical models usually boils down to the construction of appropriate computer models in the form of software. Therefore, it would be very useful if, in addition the above content, the virtual libraries would be. Included read-made codes written in known programming languages. At the same time, the presence of codes for visualizing solutions to known equations of mathematical physics, differential equations, and other branches of mathematics can be very effective not only for training, but also for conducting scientific Research. In addition, the availability in the electronic library of source codes of classes, where well-know universal algorithms are implemented, will certainly be in demand for students who learn to create software on the basis of generally accepted norms. There is no doubt that a parallel study of the corresponding mathematical and computer models, with On the one hand, researchers increase the perception of the nature of real objects, and on the other hand, they develop the qualities of a systematic approach to solving problems. As an argument to what has been said, this paper presents computer code written in VisualC #, in which the problem of solving triangles is realized. At the same time, this software can be included in the virtual library stored On the server and is open from any client where it is possible to conduct active computer experiments on the downloaded code, with subsequent preservation and without changing the original on the server. The highlight of the idea is in the code itself, where not only the basic paradigms of object-oriented programming (encapsulation, polymorphism and inheritance) are fully realized, but also the classical techniques of geometry for solving problems with triangles are described in detail.

2. The object of investigation is the triangle

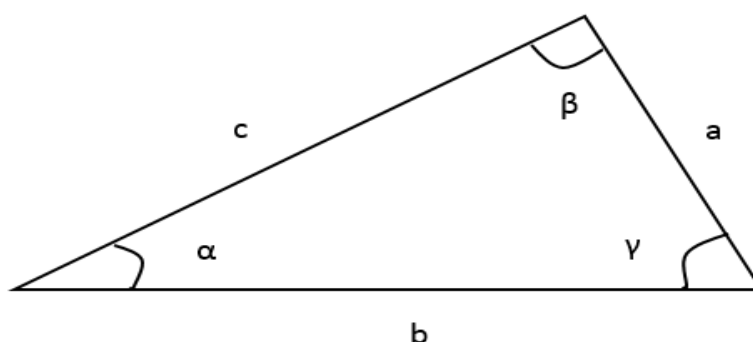


Fig. 1

- by three sides  $a$ ,  $b$ , and  $c$ . For this it is necessary and sufficient that the triangle inequalities ( $a < b + c$ ,  $b < a + c$ ,  $c < a + b$ ) be satisfied;
- two sides, for example,  $a$  and  $b$ , and also the angle  $\gamma$  between them. In this case,

it is necessary and sufficient that the inequality ( $y < 180^\circ$ );

- two angles, for example,  $a$  and  $y$ , as well as the side  $b$  adjacent to them. It is necessary and sufficient that the inequality ( $a + y < 180^\circ$ ).

Moreover, each of the above cases completely determines a set of equal triangles, and therefore is accepted not only as a sign of their equality, but also as a mathematical model for describing an arbitrary element from a given set. In practice, setting one of the triples of parameters is sufficient to calculate all other characteristics of the triangle.[1]

Computer models corresponding to the above three mathematical models of the triangle are implemented in the form of the .NetFramework4.5.2 platform classes. And combined into a single VisualC# solution. In this case, it was taken into account that the parameter  $a$  is present in all three points. Therefore, this parameter was included in the base class Basic, from which all other classes are inherited [2]:

1	<i>namespace Triangle</i>		
2	{		
3	<i>class Basis</i>		
4	{		
5	<i>protected double a;</i>		
6	<i>public double A</i>		
7	{		
8	<i>get</i>		
9	{		
10	<i>return a;</i>		
11	}		
12	<i>set</i>		
13	{		
14	<i>a = value;</i>		
15	}		
16	}		
17	}		
18	}		

In the above code, the field is protected (line 5) and working with it is organized through its property A (line 6 -16). Encapsulating the field in this way limits direct access to it from the outside, which increases the security of the code.

Then, following the principle of polymorphism, the interface Interface 1 (line 3) is determined with the Area () method (line 5), which will be specially realized in each of the heirs of the Basic class to calculate the area:



```

29     }
30
31     Set
32     {
33         gamma = value;
34     }
35 }
36
37 //----- перегружаемые конструкторы класса Class1 -----
38
39 public Class1()
40 {
41     this.A = 3; this.B = 4; this.Gamma = 90;
42 }
43
44 public Class1(double a, double b, double gamma)
45 {
46     this.A = a; this.B = b; this.Gamma = gamma;
47 }
48
49 //----- методы класса Class1 -----
50
51 public double Area()           // площадь треугольника
52 {
53     return 0.5 * this.A * this.B * Math.Sin(this.Gamma * Math.PI / 180);
54 }
55
56 public double C()             // сторона c
57 {
58     return Math.Sqrt(Math.Pow(this.A, 2) + Math.Pow(this.B, 2)
59         - 2 * this.A * this.B * Math.Cos(this.Gamma * Math.PI / 180));
60 }
61
62 public double perimeter()      // полупериметр
63 {
64     return (this.A + this.B + this.C()) * 0.5;
65 }

```



```

66
67     public double radius()           // радиус вписанной окружности
68     {
69         return this.Area() / this.perimeter();
70     }
71
72     public double Radius()           // радиус описанной окружности
73     {
74         return (this.A * this.B * this.C) / (4 * this.Area());
75     }
76
77     public double median()           // медиана треугольника
78     {
79         return Math.Sqrt(2 * Math.Pow(this.A, 2) + 2 * Math.Pow(this.B, 2) - Math.Pow(this.C,
80 2)) * 0.5;
81     }
82
83     public double bisector()         // биссектриса треугольника
84     {
85         double x = (this.C() * this.A) / (this.A + this.B);
86         double y = (this.C() * this.B) / (this.A + this.B);
87         return Math.Sqrt(this.A * this.B - x * y);
88     }
89
90     public double altitude()         // высота треугольника
91     {
92         return 2 * this.Area() / this.C();
93     }
94
95     public void parameters(Class1 obj)
96     {
97         Console.WriteLine("Площадь треугольника = " + obj.Area());
98         Console.WriteLine("полупериметр = " + obj.perimeter());
99         Console.WriteLine("радиус вписанной окружности = " + obj.radius());
100        Console.WriteLine("радиус описанной окружности = " + obj.Radius());
101        Console.WriteLine("медиана треугольника = " + obj.median());
102        Console.WriteLine("биссектриса треугольника = " + obj.bisector());
103        Console.WriteLine("высота треугольника = " + obj.altitude());
104    }
105 }
106 }

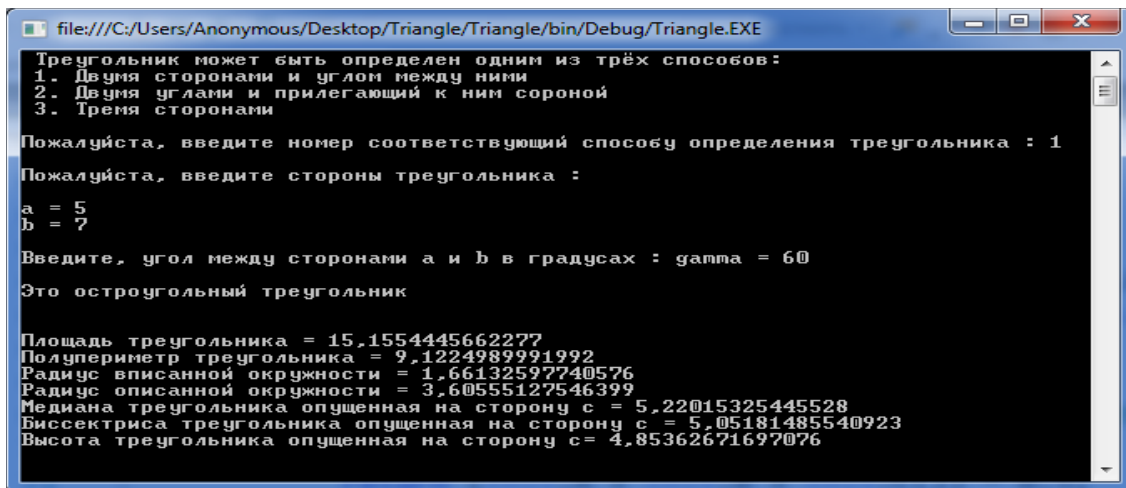
```



## НАУЧНОЕ ЗНАНИЕ СОВРЕМЕННОСТИ

*In klostergatan, with the entry point staticvoidMain(string[] args) and static method staticvoidType(doublea, doubleb, doublec) identifies the type of triangle used all of the above classes.*

*When you run the project we get the following result:*

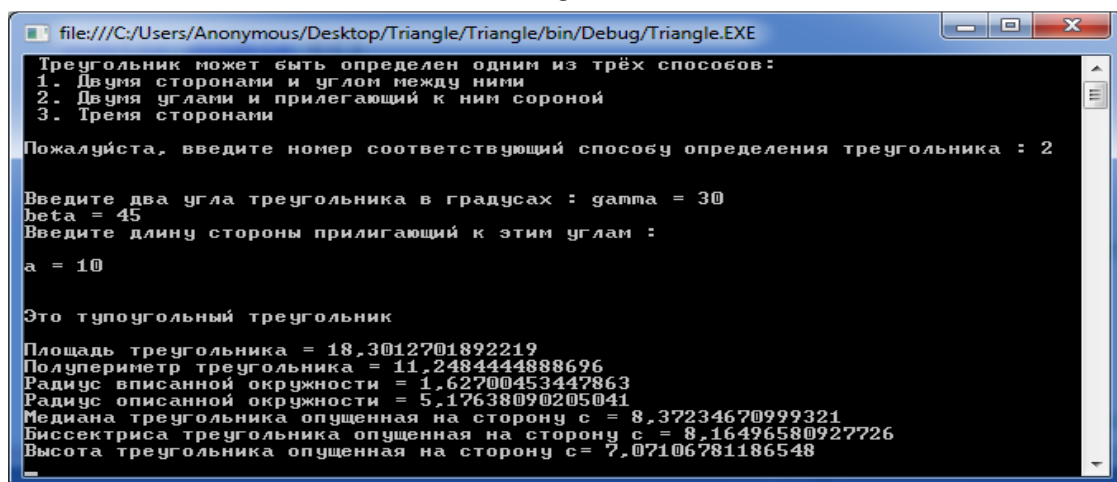


```
file:///C:/Users/Anonymous/Desktop/Triangle/Triangle/bin/Debug/Triangle.EXE
Треугольник может быть определен одним из трёх способов:
1. Двумя сторонами и углом между ними
2. Двумя углами и прилежащий к ним стороной
3. Тремя сторонами

Пожалуйста, введите номер соответствующий способу определения треугольника : 1
Пожалуйста, введите стороны треугольника :
a = 5
b = 7
Введите, угол между сторонами a и b в градусах : gamma = 60
Это остроугольный треугольник

Площадь треугольника = 15,1554445662277
Полупериметр треугольника = 9,1224989991992
Радиус вписанной окружности = 1,66132597740576
Радиус описанной окружности = 3,60555127546399
Медиана треугольника опущенная на сторону c = 5,22015325445528
Биссектриса треугольника опущенная на сторону c = 5,05181485540923
Высота треугольника опущенная на сторону c = 4,85362671697076
```

Fig. 2



```
file:///C:/Users/Anonymous/Desktop/Triangle/Triangle/bin/Debug/Triangle.EXE
Треугольник может быть определен одним из трёх способов:
1. Двумя сторонами и углом между ними
2. Двумя углами и прилежащий к ним стороной
3. Тремя сторонами

Пожалуйста, введите номер соответствующий способу определения треугольника : 2
Введите два угла треугольника в градусах : gamma = 30
beta = 45
Введите длину стороны прилежащий к этим углам :
a = 10
Это тупоугольный треугольник

Площадь треугольника = 18,3012701892219
Полупериметр треугольника = 11,2484444888696
Радиус вписанной окружности = 1,62700453447863
Радиус описанной окружности = 5,17638090205041
Медиана треугольника опущенная на сторону c = 8,37234670999321
Биссектриса треугольника опущенная на сторону c = 8,16496580927726
Высота треугольника опущенная на сторону c = 7,07106781186548
```

Fig. 3

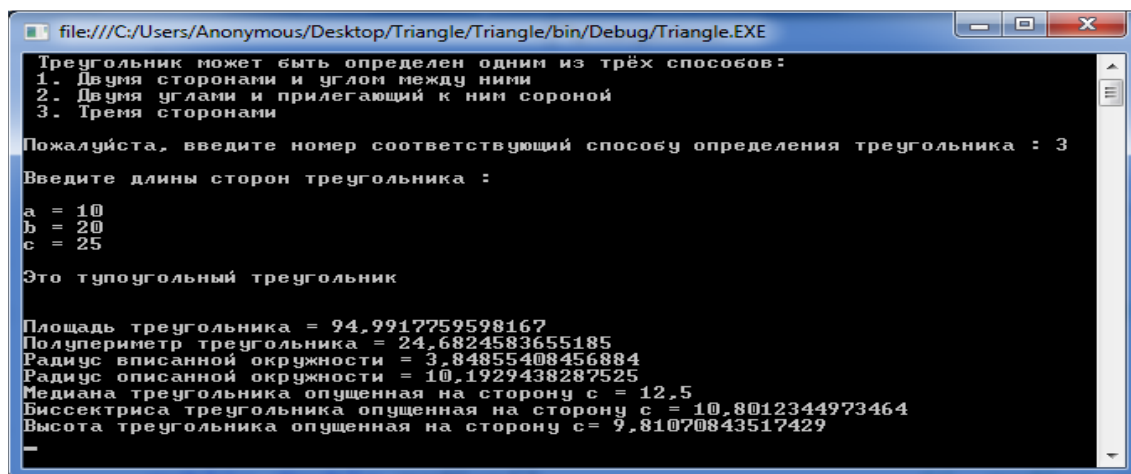


Fig. 4

## Conclusion

The main goal of this work is focused on a qualitatively new approach to organizing the content of virtual libraries by codes of computer programs, which are implemented on the basis of well-known mathematical models and algorithms. Obviously, this approach is the more effective than traditional, which provided only the storage of files over which it is impossible to conduct active computer experiments. To substantiate this assertion, the paper presents a computer simulation of the problem of “solving triangles” based on Known models from the course of geometry. At the same time, the corresponding computer model was written in Visual C # using OOP paradigms: encapsulation, polymorphism, and inheritance. As a result, the user has the opportunity to conduct an active computer experiment on the object—a triangle and in Afterwards acquires deep knowledge not only in the mathematical nature of the object, but also an important experience in the programming of triangles, which can be applied in various directions of program development, in particular in the creation of computer games.

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