FRACTAL GEOMETRY IN SCHOOLS AND UNIVERSITIES

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Annotation. The article raises the question of the actual study of fractal geometry in the framework of schooling. The objective is to show and tell the range of applications of fractal geometry. The result is the use of argumentation of the subject in terms of training for students in the school.

Аннотация. В статье поднимается актуальный вопрос изучения фрактальной геометрии в рамках школьного обучения. Целью работы является рассказать и показать спектр применения фрактальной геометрии. Результатом является аргументирование использования данного предмета в плане обучения для учащихся в школе.

Keywords: fractal geometry, recurrence formulas, tectonic fractures.

Ключевые слова: фрактальная геометрия, рекуррентные формулы, тектонические переломы.

B. Mandelbrot discovered fractals, and he explored the processes that occur during the solution of practical problems. Only in the 20th century fractal geometry revealed its full potential. Book B. Mandelbrot "Fractal Geometry of Nature" appeared on the shelves in 1983. It showed a new side of the geometry. The author wrote: "For some reason, the geometry is called cold and dry? For example, due to lack of opportunity to withdraw the shape of clouds, the sea, wood and mountains. Clouds - this is not the scope, mountains - it is not a cone, the coastline - this is not a circle, and bark is not smooth ... "The world around us shows us that nature is not so simple. And further: "These structures are challenged in a challenging goal of studying the forms that Euclid described as a formless, - the purpose of the study of the morphology of the amorphous".

Fractal geometry - a recent mathematical direction, the study of which impact on other disciplines. Fractal geometry is now being used in many areas, such as physics, medicine, psychology, economics, linguistics, and other fields.

The study of fractal geometry associated with the creation of computer technology, as fractal structures are not possible without the use of computer tools. Computer graphics in recent years has made significant progress.

There are three tectonic fractures that allow to simulate various objects and processes (see. Also [1-3]).

It should be noted that, despite the "youth" of the direction, it can be used in the process of repetition and consolidation of the students examples of work with vectors based on the coordinate method, and even this convenient platform for integration of mathematics and computer science.

Usually, the subject is taught in schools as an elective. He is not present in the training program, which is, in my opinion, not the best solution. This course attracts students in the study who like math, thereby deepening their knowledge, as well as in the subject, as well as in computer science and geometry. Moreover, it attracted the interest of students on fractal geometry increases the lure in technical colleges.

Conveniently organize training in the 10-11 class. In this step, the student must be able to specify the vector determined coordinates and, based on a recursive calculation formula to know the use of the vector for coordinate determination method.

Classes are best built by the scheme:

- story fractal geometric properties;
- determining a first or right of the first two steps in creating a fractal curve;
- develop recurrence formulas for calculating vertex coordinates of a fractal;
- programming and the creation of a fractal curve.

With a course in computer science you need to understand the method of any programming language and be able to work, for example, of Mathcad, which allows you to program and create graphics. To use a programming language with computer programs in computer science and familiarity with of Mathcad, you can limit yourself to the fact that acquainted with the content of several parts management. It is important to note that, while mastering the fractal algorithm, the students are becoming a common way to create mathematical models in nature and society.

Methods of Use

I. Construction of fractal iterations through L - systems.

The L-systems for output using turtle graphics. Construction of many fractals as follows: select an axiom and generating rule. Step algorithm for each of the segments of the broken line "crawling bug" replaces generating rule on an appropriate scale. Record the results in construction of a fractal form of a small table (Table. 1).

Table 1.

Results of constructing fractal

entrance	
The axiom (axiom):	'F'
Generating rule (newf):	'F-F ++ F - F ++ F-F'
Starting angle (α):	0
The rotation angle (θ):	π / 3

The figure below shows the fractal iteration. Axiom is a segment (obtained in the form 'F') and the axiom is a broken line (obtained vide'F-F ++ F - F ++ F-F ').
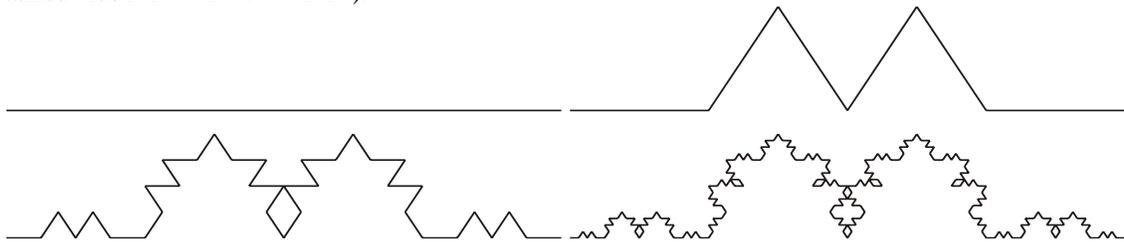

Figure 1. The iterations of a fractal

II. Construction iterations fractal in the complex plane.

In such a plane are coded using fractals iterated complex function $f(z) = z^2 + c$, $c \in C$. After several iterations becomes clear which point attractor rush z the complex plane.
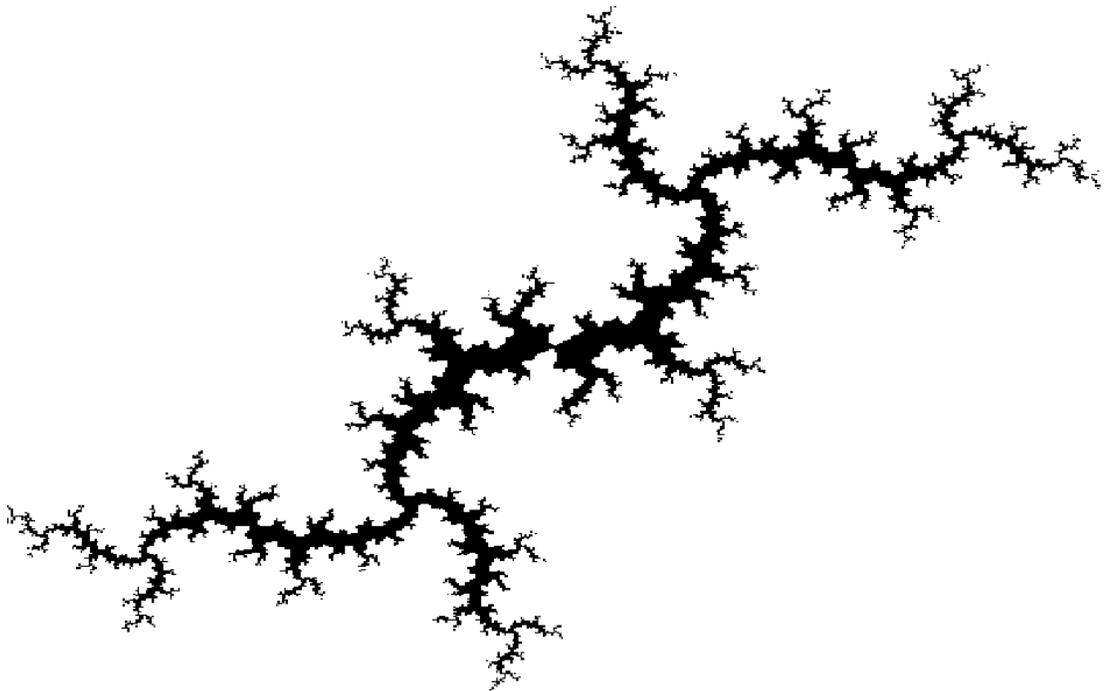

Fig. 2. Example iteration function f (z)

If its orbit is any limit, the program will mark the point of a different color. Filling Julia set will contain dots which are limited orbit. Fig. 2 as an example, shows the fractal created iteration function f (z) = z2 - 0,24251 + 0,8271i.

III. Construction of fractals using affine transformations.

When creating a fractal iterations in this example, the coefficients of the matrix are chosen multiple affine transformations. Then, the iteration process occur. Consider the use of affine transformations in the case of constructing the dust Sierpinski (Figure 3 -. 4).
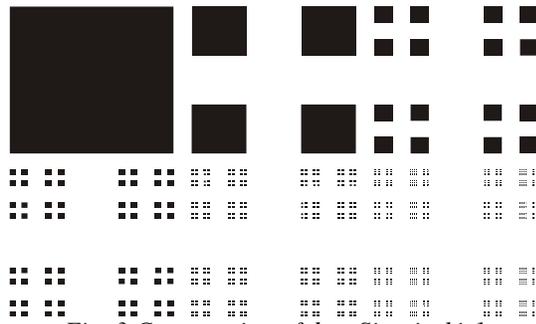
Fig. 3 Construction of dust Sierpinski-1

To construct the dust compressing Sierpinski used four affine transformation, each of which takes the original square in respective squares.

$$T_1\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \qquad T_2\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 0 \\ 2/3 \end{pmatrix}$$

$$T_3\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 2/3 \\ 2/3 \end{pmatrix}; \qquad T_4\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 2/3 \\ 0 \end{pmatrix}$$
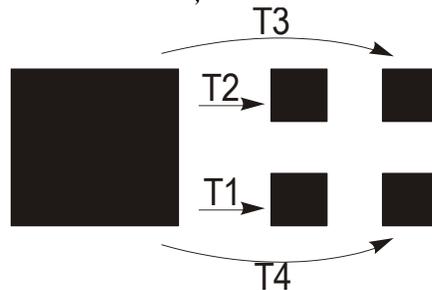

Fig. 4 Construction dust Sierpinski-2

These are not all the examples that you can build with the help of contractive affine transformations. They can also build a variety of natural objects that surround us.

We construct a "bush branch." To take an initial shape of length to square and each point is applicable set of affine changes recorded in matrix form.

The construction of this fractal is created using affine transformations A1, A2, A3, A4, A5, A6. 6 show the first iteration of the set "shrub branches."
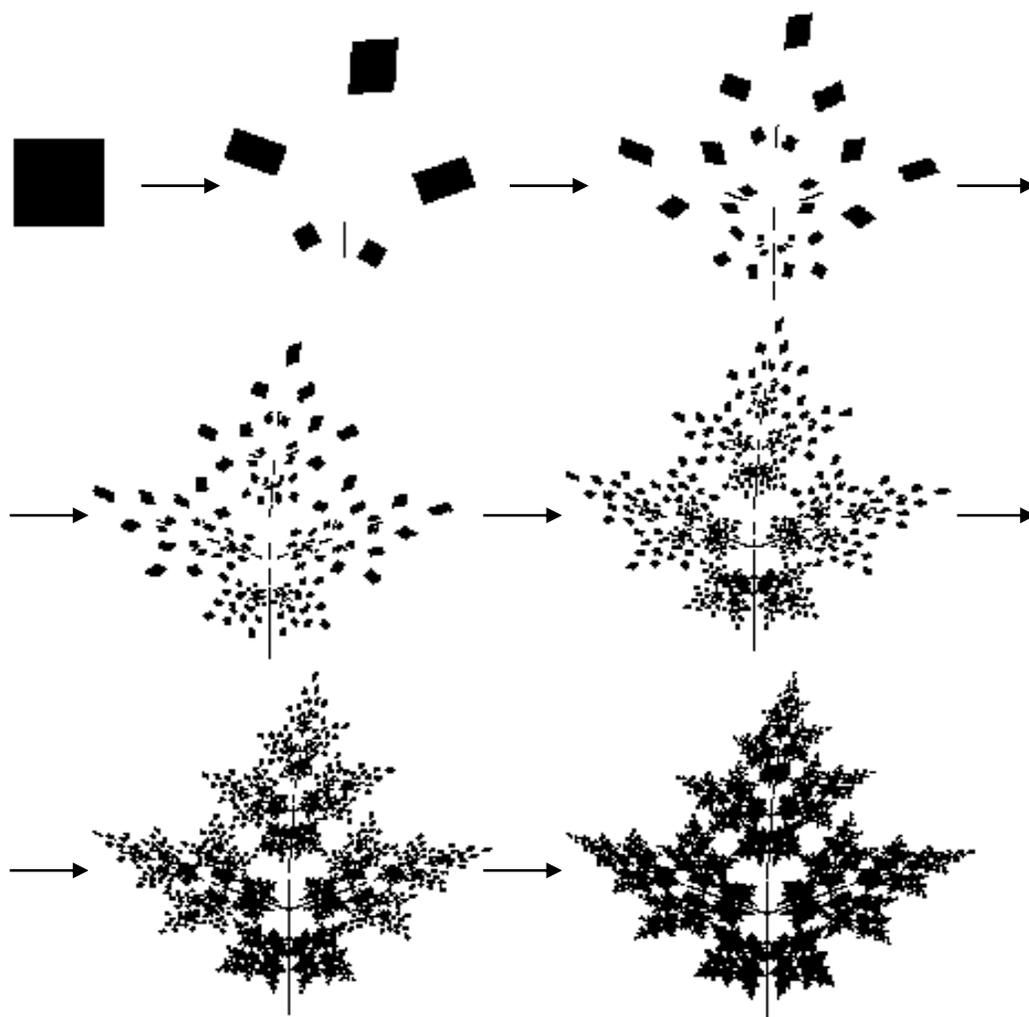
Fig. 5 branch bush

The larger the number, the sharper the image branches bush. After 6 iterations we will have a fractal pattern (Fig. 5). If you add ink to the object, you get a figure very similar to the branch of a bush.

Education data subject provides students with the inclusion of the acquired knowledge in their independent search for original solutions of the problems, and facilitates the integration of the modalities of perception of students and the development of creative qualities, adequate special kinds of creative mathematical activity.

Also note that when teaching this subject students increased level of motivation as a mathematics and computer science.

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