“Construct, Investigate, Explore”: Contest as a new Understanding of what the Distance Learning is

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Traditional mathematical and not only mathematical education uses direct teacher – student communication. Teachers use the feedback to adjust the way they present a subject for some specific audience. The interaction of students with their teacher is not so rich in Distance Learning, and usually the latter prepares tutorials for some abstract students, rather than to the real audience of the course. A lot of attention is paid to the modeling of external features of internal education, such as serving students with textbooks (of ordinary text or hypertext), video recordings or online translation of lectures. However, the problem of “materializing” the common context for all participants of Distance Learning is ignored. Lack of attention to this problem can be explained by the fact that participants hardly realize the existence of such common educational context when the process of education is successful.

Common context makes teacher and students understand each other, because they think about the concepts that they study in a similar way.

The method of the usual Distance Education system is to supply students with hypertext pages that they will use to study the subject, and a set of tests to check the acquired knowledge. Here we present another Distance Education system, its main point is that a student is made to carry out research (or investigation) by him or herself. The aim of a student is not simply to arrive at a correct solution; he or she has to run some experiments, discover dependencies and to come up with the optimal solution. The student operates not with the mathematical representation of objects, but with their intuitive visual representations. Examples of objects to operate with may be a Turing Machine, permutations of a set of n-elements, a sphere with a set of electrons on its surface. Therefore, when the teacher explains the task, he or she appeals to the student’s common world knowledge. With high probability the world knowledge specific to the problem belongs to the common context of all participants. This is a starting point to develop contexts of any degree of mathematical abstractness.

Now we are going to describe the system more specifically.

The system has the form of a contest where students compete with each other, aiming at obtaining the best solution for some optimization problem. Chosen problems do not usually have known solutions, so students really do conduct research, trying to solve the problems or thinking how to optimize the results they have already obtained.

The name of the contest is CIE, which is translated into English as Construct, Investigate, Explore.

The contest consists of three problems, and each problem is represented as a program. The program supplies a participant with a visual representation of the object being optimized, and a set of tools to control the object. For example, a problem may be *to create a Turing Machine, which makes as many steps as possible before it stops*. The alphabet and the number of machine states are bounded, so the problem is well defined. The visual representation of the Turing Machine can be a beaver that walks along the river (machine string) and puts/gets

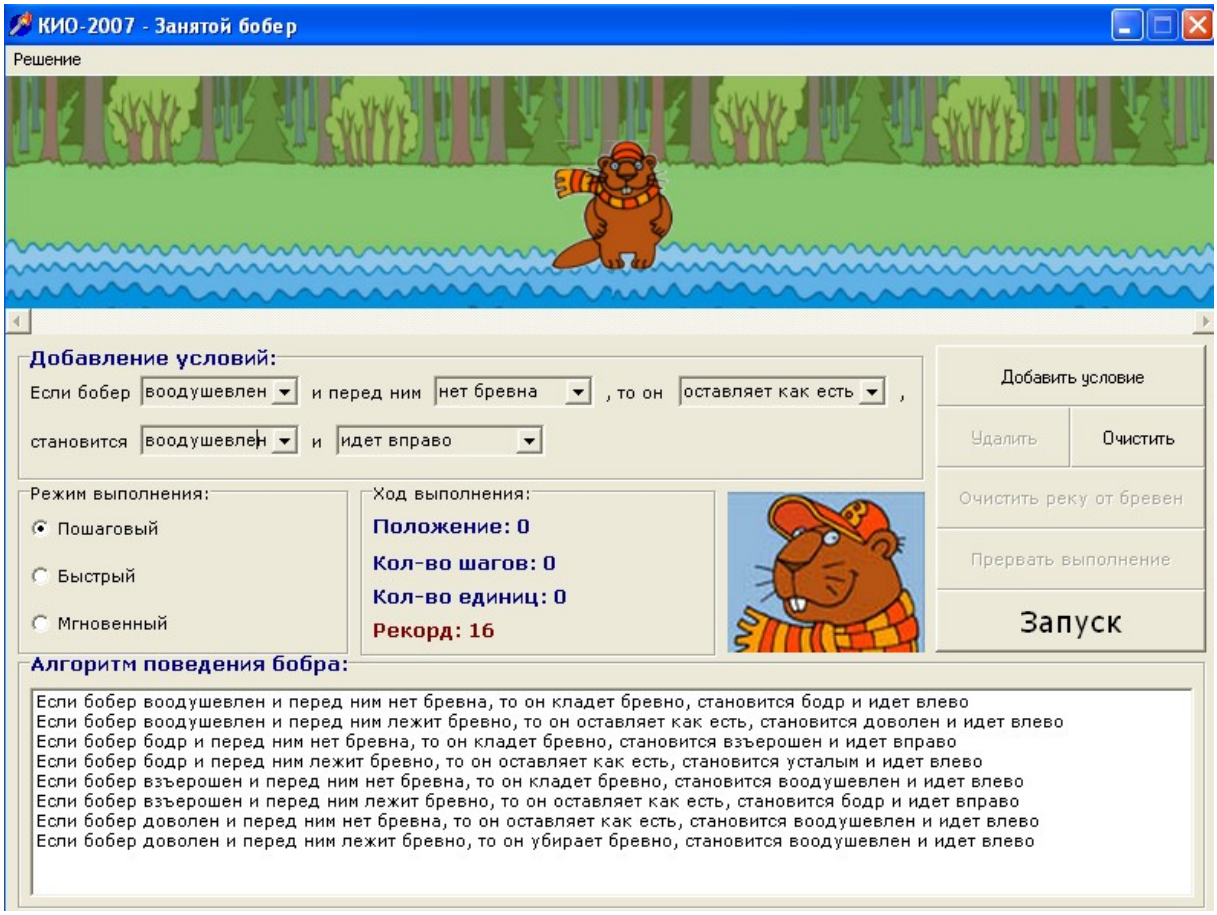
beams (symbols) into/out of it. To control the machine a participant writes a program for it using controls provided by the program (see picture).

When a participant breaks his/her own record, the information about the record and the solution invented is automatically written to a disk. Usually there are no participants that do not obtain any result. If somebody understands the statement of the problem, it is not a problem for her/him to give some solution that, by the way, may not be good enough. For example, it is not a problem to construct a Turing Machine that makes one step and stops.

At the end of the contest, all solutions of all participants are collected, several of the best solutions are selected and their authors are honored as winners with diplomas. Before the end of the contest, nobody knows what the best result is and everybody has a possibility to continue optimizing his or her own solution.

The contest has been held since 2004, and the age of its participants varies from the 6^{th} form of school to postgraduate students.

So we can sum up now with advantages of this Distance Learning system. Participants do real research, they have materialized mathematical objects in their hands and the System may be used at the same time with users of different levels of previous mathematical training.



Picture translation

Title: KIO-2007, Busy Beaver

Under the main picture ([] used for text in combo boxes):

Add conditions.

If the beaver is [inspired] and there is [no beam] in front of it, then it [leaves everything untouched], becomes [inspired] and [moves right]

Buttons to the right:

Add a condition, Clear, Start

To the left of beaver's picture:

Execution regime: step by step | fast | immediately

Execution process: position 0 | steps 0 | beams 0 | record 16

At the bottom

The beaver's algorithm

If the beaver is inspired and there is no beam in front of it, then it puts a beam, becomes bright and moves to the left

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