

# Competition in Information Technology – learning in an attractive way

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## Abstract

Computers, information technologies (IT) are involved in education process more and more. Students should learn to use IT in suitable, effective way. Organizing contests is an excellent instrument to achieve this goal. Competitions play an important role as a source of inspiration and innovation. IT contests may be the key to the potential of new knowledge and attractive way to bind up technology and education.

Interest in competitions essentially depends on problems. Really choosing and developing interesting tasks (problems) is one of the most important issues bringing students into competitions. Attraction, invention, tricks, surprise should be desirable features of each problem presented to competitors. The problems have to be selected carefully, taking into account the different aspects of each problem. IT competitions

Programming is a rapid, specific, and suitable way for students to gain experience of solving problems.

The history of the Lithuanian IT competition named "Beaver" started on October 21, 2004. Approximately 3500 students from about 150 comprehensive schools were involved in it.

## Keywords

Information technologies, computer science, problem solving, competition, learning.

## 1. Introduction

Today, we are more open and more eager to learn about information technologies, quickly adopt and utilize them in order to enrich our lives. New knowledge and competences are continuously required. However, innovation is not something that falls from the sky like a rain – it has to be planted.

Information technology, management science marketing, etc. – all of these areas of human activity offer employment and fair pay for those who are skilled in analytical thinking and problem solving.

When designing curricula for the teaching of computer science or IT, one should consider the attractiveness of teaching methods and students' motivation (Dagiene 2004; Dagiene 1997; Grigas 1993). The following aspects should be taken into account: 1) practical activities are more interesting and attractive than theoretical studies for school students; 2) elements of competition stimulate the learning process.

Competition makes the teaching of various subjects more attractive (Katz, 1992). When students start learning basic concepts of computer science they may find very soon a place where they are able to demonstrate their skills, their projects, share their interests and to compare themselves with others. This wish might be one of the reasons why a lot of students soon after they have started learning IT choose one of the areas where they are able to demonstrate their work immediately, e.g. creation of html pages, computer graphics (Papert, 1980).

For those students, one of the most powerful means which endorses their motivation is competition. There the students meet their peers from all over the country and from other countries, make friendships, wait for the next competition ready to show their abilities which have improved since the last competition.

## 2. Goals and organizing structure of the IT competition

The idea of the competition in IT for all school students in Lithuania started a few years ago. It was named by “Beaver” after the hard-working, intelligent, goal seeking, and lively beaver.

The main principles of the “Beaver” are borrowed from the international mathematical contest “Kangaroo”, which is very popular in many European countries and the world over (International..., 2005). For example, the Lithuanian tournament involves about 60 000 participants annually with more than 2/3 of schools taking part in it. The goal of the competition is to evoke interest in larger and larger numbers of students around the world. Our hope is that Lithuania will gain fame with “Beaver” someday.

Understanding and handling the basics and foundations of computer science is more important than knowing a lot of details. Of course there is the need to learn very well the basic computer managing technique, but computers have to be understood at many levels, including: as a fundamental culture and not as a collection of buttons and instructions; as a development of ideas not a finished work; as an explanation of the concepts.

The main aim of the “Beaver” is to promote interest in IT and informatics for all school students, to motivate students to learn and master IT. The competition should help to engage children to take an interest in computers and IT application from the very beginning at school.

The IT competition should encourage children to use modern technologies in their learning activities more intensively and creatively. It should bring all school students together and encourage them to brainstorm and share their experiences.

As IT becomes a commonly used tool of education, this playful contest could ensure that boys and girls will equally benefit from it. We hope that “Beaver” encourages students to learn the skills that will be needed in the labour market of the future.

Cognitive, social, cultural and cross-cultural aspects are very important while using technology – the competition will put strong emphasis on culture and language.

“Beaver” competition should help educational community to clear up school students who can use IT in most creative and profound way. Develop students’ ability to derive pleasure and satisfaction through intellectual life.

There are three mentoring schemes: the Junior (aimed primarily at pupils), Senior (for basic level) and Advanced (for secondary level). The competition is designed for all school students. The first contests were developed for three different groups according to the structure of Lithuanian school: 11–14 years (5–8 classes), 15–16 years (9–10 classes), and 17–18 years (11–12 classes).

### 2.1. The first “Beaver” contests

The history of “Beaver” began on September 25, 2004, when an experimental trial, in which 779 school students participated, was held. Its aim was to check selected technologies of the contest and to evaluate the level of complexity of the presented problems. After a month, on October 21, the first Lithuanian “Beaver” contest took place. As many as 3470 pupils from 146 schools have participated in it.

During the contest, each participant has 45 minutes to solve 18 problems of various levels of complexity: 6 problems for 3 points, 6 – for 4 points, and 6 – for 5 points. Correct answer adds as many points as indicated to the problem, incorrect one – minuses 25% of the indicated points (i.e. – 0,75, – 1, and – 1,25 point, respectively), unanswered problems – 0 points. To avoid negative results, each participant must start having the amount of points equal to the total number of the problems (e.g. 18 points in the “Beaver-2004”). By the way, the competition was subject of individual participation, like Olympiads, but the schools were rewarded for active involvement.

Each group was given two hours to perform the contest, collect the results, and send them to the organizers. Preliminary results were calculated and announced the next day. All participants of the contest, as well as local organizers, received certificates of thanks from “Beaver” Organizing Committee.

The second contests of “Beaver” proceeded on October 19–21, 2005. It was decided to choose one day for each level: October 19 for 5–9 classes, October 20 for 9–10, and October 21 for 11–12 classes. About 6000 students from 300 comprehensive schools have participated this year.

## 2.2. Technology

We have briefly described the structure of the contest, expecting that it would be helpful for the organizers in other countries.

For the contest the PDF technology was selected, taking into account that PDF is universal file format that preserves fonts, images, graphics, and layout of any source document, regardless of the application or platform used to create it. It was also clear that schools possessed different equipment and different level of IT knowledge.

The local organizer had to download from the official “Beaver” site ([www.bebas.lt](http://www.bebas.lt)) the software (Acrobat Reader CE with some extra programs for testing computers and collecting results) and PDF registration form (its aim was to collect the basic information about the participants: contacts, OS, number of students and computers involved). Filled in forms had to be uploaded to the server of the National Examination Center, which organized collection and preliminary processing of the results. One week before the contest, local organizers could download the packages of problems for each group.

On the day of contest, at fixed time known in advance, the “Beaver” site reveals the passwords for opening of the problems. The contest starts when the first problem is opened and ends when the participant pushes the “Exit” button or when time allowed for solution expires. The program forms the coded answer file. The local organizer must collect these files (via local network or manually) and to upload them to the server of the Center. When the answers are collected, the program investigates them, calculates the results, sorts them according to schools, regions, age groups, etc.

## 3. Attractive tasks – keystone of contests

Problem solving is an individual’s capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious. Interest in competitions essentially depends on problems. Attraction, invention, tricks, surprise should be desirable features of each problem presented to competitors.

The problems have to be selected carefully, taking into account the different aspects of each problem, i.e. what educational power it contains and how to interpret its’ attractiveness to students (whether it stimulates the motivation of learning).

Problems can be of different types: starting from the most common questions of IT and their applications in the day-to-day life to specific integrated problems related to history, languages, arts, and, of course, mathematics. In our IT contests some problems were related to the usage of various most common programs, others – to hardware and software, some of them were connected with the Lithuanian culture and language. More than half of tasks were devoted to introducing algorithms and understanding computer in more deep way.

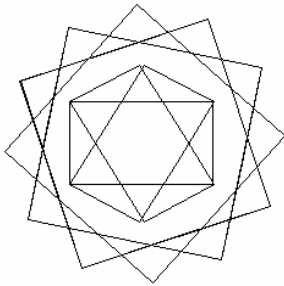
Students do not need to be familiar with a programming language. Algorithms are presented on verbal, graphical, or Logo-based (with explanation of commands) notation.

Also, it is very important to choose the problems in such a way that the participants of the competition could have as equal positions as possible, irrespective of the operating system or computer programs used by them.

One feature of the set of problems showed that they were rather well-balanced. There was not any problem that nobody would have solved, but also there was not any problem that would be solved by all participants.

### ***Example 1***

To compose the bellow showed ornamental design from two ordinary shapes, Silvija has used the rotation and copying commands of graphics editor. What were those two initial shapes? The size of all shapes of the same type is the same.



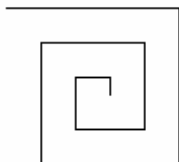
- A Square and rectangle
- B Square and rhomb
- C Triangle and square
- D Triangle and rectangle

### ***Example 2***

Using Logo, a simple programming language, Julia has drawn a rectangular spiral with the help of the following commands:

`forward 10` – the turtle moves forward drawing a line of 10 steps (dots) long;

`left 90` – the turtle turns left making an angle of 90 degrees.



Which of the following numbers express the length of the whole spiral in dots?

- A 550
- B 170
- C 300

D 250

**Example 3**

Logo Turtle may perform the following commands:

forward  $n$  – to move forward drawing a line of  $n$  steps long;

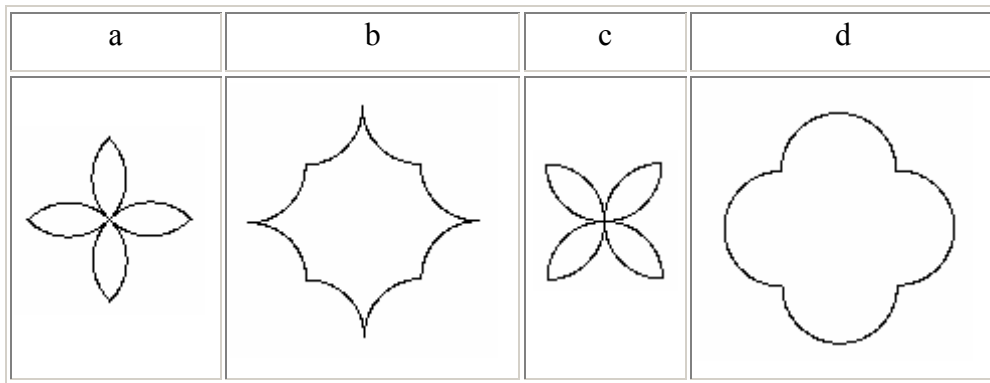
left  $\alpha$  – to turn left making an angle of  $\alpha$  degrees;

repeat  $k$  [forward 30 left 60] – to move forward drawing a line of 30 steps long and to turn left making an angle of 60 degrees; these actions are repeated  $k$  times.

The turtle looks up at the beginning.

Which of the presented shapes is drawn by using the following command

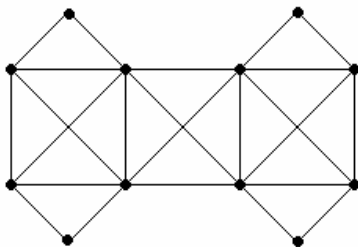
```
repeat 4 [repeat 2 [repeat 90 [forward 0.5 right 1] right 90] left 90]
```



- A a
- B b
- C c
- D d

**Example 4**

The segment which connects the vertexes of the graph is named path. If the path contains every edge exactly once it is called Eulerian path. The Eulerian path which begins and ends at the very same vertex is called Eulerian cycle. Which from the given graphs contains the Eulerian cycle?



a.



Lina
Marytė
Valdas
Vitalijus
Romualdas
Algimantas
Kęstutis

#### 4. Conclusions and discussions

IT competitions may be the key to the potential of new knowledge and attractive way to bind up technology and education. We understand that if “Beaver” remains a local contest, its perspectives will be rather poor. Lithuanian “Beaver” Organizing Committee invites everyone interested in this initiative to think about our idea, to investigate the local situation and to contact us.

We are open for all kinds of proposals and ideas of collaboration and hope to find friends and partners in all countries. Integration of IT into teaching process should be our target, and we have to try to reach it together.

We are ready to share our experience, technology, and future plans with all who are interested. We expect that it will foster your own competitions similar to the “Beaver” or will encourage you to join us. We are sure that a well-organized competition with interesting, playful, exciting problems, and attractive awards will invite children of all countries to use IT reasoning and to explore understanding of realities, possibilities, and failings of IT.

#### 5. References

- Dagiene V., Skūpiene J. (2004) Learning by competitions: Olympiads in Informatics as a tool for training high grade skills in programming. *2nd International Conference Information Technology: Research and Education*. T. Boyle, P. Oriogun, A. Pakstas (Eds.), London, 79–83.
- Dagiene, V. (1997) Learning via Electronic Mail: What and How? *Education for the 21st Century*, 2-4 December, Cape Town, 1–10.
- Grigas G. (1993) An experiment of computer programming practice by e-mail. *Interpersonal Computing and Technology*, v. 1, N. 2, 1-10.
- Katz L G and Chard S C (1992) *Engaging Children’s Minds: the Project Approach* Norwood N J, Ablex.
- Papert S. (1980) *Mindstorms: Children, Computers, and Powerful Ideas*. New York: Basic Books.
- International mathematical contest “Kengūra”:<http://www.kengura.lt> (in Lithuanian, 2005).