BULGARIAN COMPETITIONS ON INFORMATICS (computing programming)

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1. Competititon

The first competititon

Nine years ago, in 1979 the final round of the First National Competition on Programming was organized. The competititon was intended for professionals: taking part in different competition groups. Each of them used a given programming language such as: Assembler Language, FORTRAN, PL/I, COBOL etc. However, there were also participants from the high school. One of them became the prize-winner in the FORTRAN group. Now he is a distinguished young specialist in informatics. It was the beginning.

National competitions for high school students

In 1982 three competitions for high school students took place. One of them was in January during the Winter Mathematical Holidays for young mathematicians in informaticians. It was entitled 'Banner of peace'. It was organized by the Union of the Mathematicians in Bulgaria (UMB). It was required that the students should solve an algorithmic problem and check it on the computer.
The second competition, organized also by the UMB, was somewhat different: it represented a combination of mathematics and informatics, and took place in three rounds:
- a written work (solving a problem from mathematics and informatics);
- an inquiry (giving answers to some questions for a short time);
- a presence of a project (elaborated before the competition on interesting problems in mathematics and informatics).

The third one took place in July as a Republican competition on programming with the Republican reviews of the movement 'Youth Technical and Scientific Creation'. Its form and content was similar to the first one.
All these three competitions have followed a common tradition in recent years in Bulgaria, and the third one grew as the National Olympiad in informatics.

The national olympiad on informatics

This olympiad takes place in three rounds. The first one was organized independently in different cities and high schools. The competition problems of the second round, contrary to the first one, are the same for every participant. The students having obtained 75% of the maximum number of points, obtain the possibility to take part at the final round; the so called 'selection' round. It takes place annually in different cities in Bulgaria.

Year	Participants			Prize-Winners		
	3rd round			I	II	III
	boys	girls	city			
1984-'85	75	5	Sofia	3	3	7
1985-'86	86	4	Plovdiv	2	3	8
1986-'87	89	1	Stara Zagora	2	4	9
1987-'88	76	1	Vratza	1	4	9

Table 1: Participation at the National Olympiad in Informatics

The participants with the best results are reawarded by being permitted to continue their studies in the University, without an entrance examination. They represent the country in different international competititons in informatics (see Table 1).
Sinds 1987 another Olympiad has been established, organized specially for students, using the system of the Research Education Group (REG). It is very specific in this case, that the participants are students from 5th to 8th grade and the programming language used is LOGO. In 1988 students from the USSR took part at this competition.

The National tournament on Informatics

Since 1986 this competition takes place annually in the city of Plovdiv. In this competition each region of the country is represented by two age groups: from (8th to 9th) grade and from (10th to 11th) grade. It is clear that the competition problems are different for the both groups.
The top Bulgarian participants in the Open International Competition on Programming are determined as winners of this tournament.

The open international competition on programming

The first Open Competition on programming took place in May, 1987 within the International Conference 'Children in the Information Age'. Students from Bulgaria, FRG, Roumania, Hungary, USSR and Czechoslovakia took part. The best students in the junior age group were from FRG, and in the elder group - the students from Bulgaria.
In 1988 a new international competition on programming will be organized. Here the participants will be students from the technical and vocational schools from Bulgaria, GDR, Poland, USSR, Hungary and Cuba. The competition will take place in October in the city of Varna.
The Open International Competition on Programming will become an International Olympiad on Programming, which will be organized in the month of May, 1989 under the aegis of UNESCO.

2. Competition problems, programming languages and computers

These are a series of competitions at different levels and this fact determines the degree of difficulty of the corresponding competition theme. Taking into account the usage of different programming languages, the organizers have the ambition to elaborate competition problems, being independent of the computers and programming languages.
Problems, characterizing some of the competitions, are given below:

Problem 1: (Second National Olympiad on Informatics '86)
N objects: a1, a2, ..., aN (3<=N<20) are given, such that there are no two objects of equal weight. The ordered pair (i,j), where i<>j, 1<=i<=N, 1<=j<=N denotes that the object ai is lighter than the object aj. For instance, if N=6, the pairs (5,1), (5,3), (1,4), (4,6) mean, that the object a5 is lighter than a1 and a3, that a1 is lighter than a4 and that a4 is lighter dan a6.
We assume, that certain 'weight' relation within the set of all pairs of these N objects have been established by measurements.

a. Write a program which inputs the integer N and the given relations, called subsequently the subprogram, solving the problems B, C and D, and displays the corresponding results.
b. Find an ordering of the N objects such that each object precedes in this ordering of the object given (from the input relations) to be heavier than it. A possible ordering would be (5,1,2,4,3,6).
c. Determine what additional measurements (as few as possible) are necessary, allowing to order all objects with respect to their increasing weight.
d. Perform the necessary additional measurements. The results obtained must be keyed into the computer. The final result must be the complete ordering of the objects with respect to their increasing weight.

Problem 2: ('Banner of Peace', Rouse '88)
A square spiral is considered, starting from the origin of coordinates and reaching consecutively the points (1,0), (1,1), (0,1), (-1,1), (-1,0), (-1,-1), (0,-1), (1,-1), (2,-1) etc. In this way all points, having integer coordinates could belong to the spiral. Starting from the initial point (0,0), all points, having integer coordinates, are numbered consecutively by the non-negative integers 0,1,2,3,4 etc.
Design a program, which gives the solution of the following problems:

a. Determine the coordinates of the point of the considered spiral, numbered by the number n, where n is a given non-negative integer.
b. Determine the corresponding non-negative integer n of a given point, having integer coordinates (x,y).
c. Find the greatest non-negative integer, corresponding to a point of the spiral, situated inside a circle (including the points on the circle), having center coordinates (a,b) (a and b are integers) and radius r (r is a positive integer).

Problem 3: Contest problem, Journal 'Mathematics', No. 8, 1985)
Let A be and one-dimensional array with n elements (n>=2) and m - a natural number, m<n. Write a program, which:

a. Inputs the values of the variables m,n and the values of the elements of the array A and points them.
b. Rearranges the elements of the array.
   A (a_1, a_2, a_3, ..., a_{m+1}, ..., a_n),
   transforming it into the array
   A (a_{m+1}, a_{m+2}, ..., a_n, a_1, a_2, ..., a_m) and displays it.

No additional array should be used and the rearrangement of the elements of A must be as few as possible. (We say that a rearrangement has been made if

the assignment statement, in which an element of A occurs, has been executed). Find the number of rearrangement made by the program.

Problem 4: (Open Competition on Programing, 1987)
Let the bus stops in a city be denote by the integers from N = (1,2, ..., n).
Also let

$l_1 = (i_{11}, i_{12}, ..., i_{1m1}$
$M_2 = (i_{21}, i_{22}, ..., i_{2m^2})$
.....
$M_r = (i_{r1}, i_{r2}, ..., i_{rm^r}$
be all the bus routes in the city and i_{jk} in N, and for all k <> 1 it follows that:
i_{jk} <> i_{j1}.
Each M_1 is a sequence of all neighboring bus stops in one direction only. Each bus visits all stops in the route in both directions.
Design a program to the following specifications:

Input the integers n, r and the routes M_1, M_2, ..., M_r.
a. Check whether one can get from any stop to any other stop by bus and display appropriate message.
b. Input two stop numbers i and j, and display all possible ways of getting from i to stop j by bus.
c. Given the stops i and j, find the fastest possible travel route by bus from i to j. All times of travel between neighboring stops on the same line are roughly equal and 3 times less than the time to change busses.

Problem 5: (First Olympiad on Informatics for RGE-school students)

A robot car is designed to move equidecelatory, according to the following algorithm: the robot car covers a certain distance forward: turns right, making an angle of 60 degrees; moves forward, covering a distance, being 5 steps shorter than the first one; turns right again making, an angle of 60 degrees and so on. The motion stops, if the remaining distance, that must be covered, is less than one step. Define a procedure, which:
a. permits, to the 'turtle' to imitate the robot car motion, where the given initial distance has an arbitrary value;
b. displays the way, traversed by the 'turtle'.

During the first years the most used programing language was FORTRAN. In the last years (after 1985) the Bulgaria students write their programs in BASIC, PASCAL and LOGO, due to the fact that the microcomputer PRAVETZ'82 is compatible with APPLE-II is mostly widespread in the high school. However now the tendency is to the 16-bits microcomputer PRAVETZ'16, compatible with the IBM PC.

3. The out-of-class activity in informatics

In addition to the mentioned competitions the gifted Bulgarian children have the possibility to take part in groups, school and other forms of the out-of-class activity in informatics. One of them is the correspondence school in informatics. The summer schools in informatics are organized in different centres in the country. The organization of the National Summer School in Informatics for the best students from the whole country has become traditional. A lot of these students take part at the competitions of the journals 'Mathematics', 'Education in Mathematics and Informatics' and 'Computer for You'. A special program system was set up, used in the out-of-class activity in mathematics and informatics with high school students.

A problem book, containing competition problems from mathematics and informatics, is published annually.
The scientific direction of all these activities for the young Bulgarian informaticians is ensured by the Group of Informaticians from the Institute of Mathematics with Computing Centre of the Bulgarian Academy of Sciences and from the Faculty of Mathematics and Informatics of the University 'Kl. Ochridski' in Sofia. For many years Prof. P. Kenderov was the head of this group and the ideologist of the out-of-class activity in mathematics and informatics in Bulgaria. A special commission of the Ministry for Culture, Science and Education coordinates the organizing of the competitions in mathematics and informatics.