

# Informatics Olympiads in Turkey: Team Selection and Training

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**Abstract.** In this country report, we present the yearly activities related to Turkish team selection and training for national and international olympiads in informatics. First, we outline the organizational structure and describe the scientific and administrative components. We, then, describe the several stages of team selection, which start with a nation-wide written test administered in selected cities in Turkey. Each stage is followed by two week long training camps. In these camps, students are taught the IOI curriculum and they engage in programming competition practices. In this report, we give the details of curriculum organization and test preparation. We conclude with medal statistics covering the last 22 years of the Turkish IOI team.

**Keywords:** IOI Country Report, Turkey.

## 1. Introduction

Turkey has been actively participating in the International Olympiads in Informatics (IOI) since the IOI'93 in Argentina. The continued support of the government funding agency TÜBİTAK, the Scientific and Technological Research Council of Turkey<sup>1</sup>, the universities, and the IOI alumni help ensure that IOI remains a tradition among algorithms and programming enthusiasts in high schools. The first curriculum, training materials, and team selection tasks were developed by a team of faculty members lead by professors Göktürk Üçoluk, İsmail Hakkı Toroslu and Faruk Polat from the Department of Computer Engineering, Middle East Technical University (METU).<sup>2</sup> Today, the preparation, team selection, and organization for IOI participation of Turkey are conducted via a well-established work-flow (Fig. 1).

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<sup>1</sup> <http://www.tubitak.gov.tr/en>

<sup>2</sup> <http://www.ceng.metu.edu.tr>

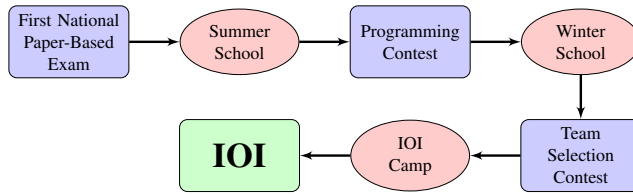


Fig. 1. Overview of the team selection and IOI organization in Turkey.

TÜBİTAK is a critical stakeholder, which provides the finances and maintains the organizational structure of the olympiads in Turkey, not only in Informatics, but also in other fields, such as Mathematics, Chemistry, Physics, and Biology. An official scientific executive committee, consisting of three academics from universities, is formed by TÜBİTAK each year. This committee is responsible for all the scientific matters from task preparation and training to team selection. The scientific committee works in collaboration with TÜBİTAK for administration of a nation-wide first-stage selection exam, for organization of training camps, and for all administrative tasks regarding participation in that year's IOI. The scientific executive committee also recruits faculty members, interested graduate students, and alumni from previous years to teach the IOI curriculum (IOIS, 2013) effectively and help students practice for the competition during the training camps.

Being organized by an official body, the participants of the National Olympiads in Turkey and the member of the Turkish IOI Team are also recognized officially by the Ministry of Education and the Higher Education Council of Turkey. Successful students are awarded additional points at the nation-wide university entrance exam and medal winners are granted acceptance to any Computer Science/Engineering Department of their choice at a state university in Turkey.

In the following sections of this national report, we give details of the entire workflow of Informatics Olympiads organization and preparation in Turkey. We also give the medal statistics covering the last 22 years of the Turkish IOI team. Finally, we conclude with a brief summary and an outlook for the future IOIs.

## 2. Team Selection and Training Camps

The national paper-based exam is held to select students that will participate in the summer school. Once the programming contest is done after the summer school, students with high scores are invited to the winter school, after which the final team selection is done. The IOI camp is held one week before the actual IOI to get the team prepared for IOI. TÜBİTAK organizes each stage (Fig. 1).

The team is selected after 3 contests and 2 training camps. After the final training camp, the students attend the final team selection contest. In this section, information will be given about contests and training camps.

## 2.1. The First Stage Exam

The first stage exam is a written exam in which nearly 1300 students from all over Turkey participate. It is paper-based, takes 2.5 hours, and consists of 50 multiple choice questions (QFSE). The exam is generally held in May.

The point distribution of the questions in the exam is as follows: 15% intelligence skills, 30% basic algorithm knowledge, 25% maths and 30% C programming language.

A sample programming question and its solution is given below:

Code	Question
<pre> 1  int ffffff(int x, int y) { 2      int z; 3      while (y!=0) { 4          z=y; 5          y=x%y; 6          x=z; 7      } 8      return x; 9  } 10 11 void main() { 12     int a=360, b=75, c=15; 13     b = a*b/fffff(a, b); 14     c = b*c/fffff(b, c); 15     printf("%d", c); 16 }</pre>	<p>What would be the output of the code?</p> <p>A) 25 B) 225 C) 1125 D) 1800 E) None</p>
	Answer
	<p>fffff function is to calculate the greatest common divisor of <math>x</math> and <math>y</math>. <math>LCM(a, b) = \frac{a \times b}{GCD(a, b)}</math>, so the 13<sup>th</sup> line indicates that <math>LCM(360, 75) = 1800</math> and the 14<sup>th</sup> line indicates that <math>LCM(1800, 15) = 1800</math>. In conclusion, the correct answer is D.</p>

After the first stage exam, the top 55 students qualify for the second stage. In general, higher participation from the more populated cities such as İstanbul, Ankara, and İzmir is observed. In Fig. 2, the location of these cities on the geographical map of Turkey is shown. In addition to high level participation, these cities are also the most successful ones. Since 1993, 88 students from Turkey have participated in IOIs. 85 of these students have been from these three cities.

## 2.2. The Summer Training Camp

Approximately, 55 top students from the first stage exam attend the scientific camp that lasts for two weeks, beginning in late August and ending in early September. The students and lecturers are accommodated at a five-star hotel in Afyon (as shown in Fig. 2).

The lecturers in this scientific camp are usually academics from the most respected universities in Turkey. Additionally, graduates who have participated in the past IOIs in recent years also help the new students in the training camps.

The curriculum of the camp is in parallel with the training curriculum adopted in other countries such as Russia (Kiryukhin, 2007) and Serbia (Ilic and Ilic, 2012) and includes all the content of the second exam, which is listed below. Note that, due to the relatively heavier schedule of the first training camp, the subject of Graph Theory is divided among

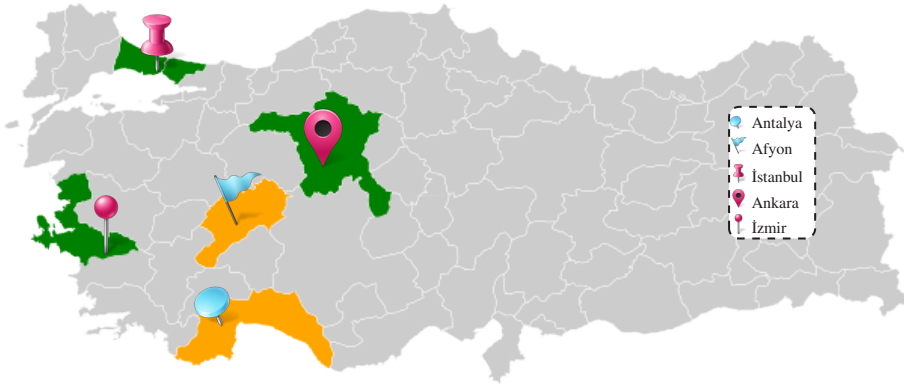


Fig. 2. Although the first stage exam is nationwide, a higher participation in this exam is observed from more populated cities such as Ankara, İstanbul, and İzmir. The summer and winter camps are held in Afyon and Antalya, respectively. These cities are colored in the map.

the two training camps and some basic graph algorithms such as “finding the connected components in graphs” are left for the second training camp (see Section 2.4).

- **Basic Data Structures:** Linked lists, stacks, queues, trees, binary trees, heaps.
- **Sorting and Searching:** Bubble sort, insertion sort, selection sort, quick sort, merge sort, heap sort, counting sort, radix sort, sequential search, binary search, basic space search, hashing.
- **Standard Template Library (STL).**
- **Dynamic Programming:** Longest common substring, knapsack problem, matrix chain product, longest increasing subsequence, Kadane’s algorithm, greedy algorithms.
- **Graphs and Basic Graph Algorithms:** Graph traversal, Dijkstra’s shortest path, Floyd-Warshall algorithm, Prim’s and Kruskal’s algorithms for minimum spanning tree, topological sort.
- **Maths and Number Theory:** Modular arithmetic, GCD-LCM, Euler-Fermat-Euclid.

Theorems, primality test, integer factorization, Chinese remainder theorem, fast exponential, matrix exponential, Fibonacci numbers.

### 2.3. The Second Stage Exam

The second stage exam is prepared according to IOI standards and taken by the 55 students who participated in the summer training camp. The exam is performed in two days of November and its questions are developed according to the contents of the summer school.

In each of the exam days, five hours are given to solve three tasks. The top 18 successful students are awarded national medals. The distribution of the medals is 3 gold, 6 silver and 9 bronze.

In addition to these medals, TÜBİTAK awards students with monetary values of approximately \$1500, \$1300 and \$1100 for each gold, silver and bronze medal respectively.

More than this one-time monetary award, each medal winner is offered monthly scholarship, enough to cover basic living costs, extending to the end of PhD study for the recipient.

Besides monetary/scholarship supports, students are entitled to additional points at the national university entrance examination.

#### 2.4. The Winter Training Camp

Approximately 18 students who have passed the second stage exam attend the winter training camp that lasts two weeks in February. This time, the students and lecturers stay at a five-star hotel in Antalya (as shown in Fig. 2).

In contrast to the summer training camp, the remaining subjects of the IOI curriculum are taught in the winter training camp. Due to the fewer number of students attending the camp, the lecturers have a chance to spend more time with the students. The curriculum of the camp covers:

- **Advanced Data Structures:** Range minimum query, segment tree, binary indexed tree, lowest common ancestor.
- **Analytic and Computational Geometry:** Vectors, line, segment, circle, polygons, convex hull, plane sweep, Voronoi diagrams.
- **String search:** Trie, suffix array, suffix tree, Aho-Corasick algorithm, Knuth-Morris-Pratt algorithm.
- **Graph Algorithms:** Bellman-Ford shortest path, longest path, connected components, articulation points, bridge edges, Eulerian path, Hamilton cycle.
- **Game Theory:** Nim game, Grundy numbers, game on graphs.

#### 2.5. The Team Selection Exam

Students who have attended the winter camp take another two day long exam, which includes the content of all of the IOI curriculum, in April. Similar to the second stage exam, five hours are given to solve three tasks in each of the exam days. The best four successful students form the final team that represents Turkey in both IOI and BOI (Balkan Olympiad in Informatics).

#### 2.6. IOI Camp

The national IOI team prepares for the IOI for two weeks just before the actual IOI. This preparation is usually held in Ankara, the capital of Turkey (see Fig. 2). Since

2011, the Computer Engineering Department of TOBB University of Economics and Technology<sup>3</sup>, located in Ankara, has hosted IOI camps as well as second stage and team selection examinations. Students take exams in each day of the camp and the solutions of the questions are discussed in detail with the students in a post-exam problem solving session.

A student who wins a medal in the IOI is given an opportunity to enter a computer engineering department of any state university, regardless of his/her achievement in the national university entrance examination. In addition, some private universities offer considerable scholarships for medal-winner students. TÜBİTAK offers one-time monetary awards to IOI medal winners: approximately \$8000 for gold, \$6000 for silver and \$4000 for bronze.

Starting in 2011, we have developed [www.ubilo.org](http://www.ubilo.org) (TOITS), written from scratch by a few Turkish IOI alumni, to serve as the national online judge during the three camps. Like Codeforces ([www.codeforces.com](http://www.codeforces.com)), it has two main interfaces: the training interface and the contest interface. With the former, the students are assigned online tasks and their submissions are graded. The latter is more like the CMS system employed in IOI exams.

The system's language, from user interfaces to task descriptions, is in Turkish since many high-schools in the country offer only Turkish curriculum.

### 3. Results and Statistics for the Last Ten Years

Table 1 shows the medal distribution of the Turkish IOI team since the first participation in 1993 in Argentina. The first gold medal was achieved by Barış Kaya in 2011 in Thailand and the second gold medal was achieved two years ago in IOI Australia by Yusuf Hakan Kalaycı. The Turkish IOI team was able to get at least one medal in all of the 22 years of attendance since 1993.

### 4. Conclusions and Outlook

Turkey has been actively participating in IOI since 1993 and a total of 55 medals have been won by the Turkish IOI teams so far. With the help of the government funding agency TÜBİTAK, the universities, and the IOI alumni, being selected as a national IOI team member attracts many high school students. Earning additional points for the national university entrance examination and even obtaining a chance to the exam-free entrance to the computer engineering department at any state university along with financial aids are the top motivations for the high school students for participating in the IOI activities in Turkey. While the medal distribution in each year varies, the gold medals were achieved within the last 4 years, showing a growing interest in IOI among Turkish students.

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<sup>3</sup> <http://www.etu.edu.tr>

Table 1  
Medal distribution of the Turkish IOI team since 1993

Year	IOI Host	Medals			
		Gold	Silver	Bronze	Total
1993	 Argentina			3	3
1994	 Sweden			2	2
1995	 Netherlands			1	1
1996	 Hungary			2	2
1997	 South Africa		1	2	3
1998	 Portugal		2	1	3
1999	 Turkey		1	1	2
2000	 China		1	1	2
2001	 Finland			3	3
2002	 South Korea		2	2	4
2003	 USA		1	1	2
2004	 Greece		1	1	2
2005	 Poland			1	1
2006	 Mexico			1	1
2007	 Croatia		1	1	2
2008	 Egypt			2	2
2009	 Bulgaria		1	3	4
2010	 Canada		1	3	4
2011	 Thailand	1	1	2	4
2012	 Italy		1		1
2013	 Australia	1	1	1	3
2014	 Taiwan		2	2	4
<b>Total</b>		<b>2</b>	<b>17</b>	<b>36</b>	<b>55</b>

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