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# The Indian Computing Olympiad

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**Abstract.** The Indian Computing Olympiad is a multi-stage national contest used to select the Indian team for the International Olympiad in Informatics. This article describes the structure of the Indian Computing Olympiad. It also highlights some of the challenges that have been faced and some steps that have been taken to overcome them.

**Key words:** Indian computing olympiad, IOI, zonal computing oplympiad.

## 1. Introduction

India started participating in the International Olympiad in Informatics (IOI) in 2002, in Korea. The Indian Computing Olympiad (ICO) was set up in 2001–2002 to select students to represent the country at IOI and has been an ongoing activity since then.

## 2. Structure

The Indian Computing Olympiad is made up of three stages. The first stage consists of the Zonal Olympiad in Informatics and the Zonal Computing Olympiad, held each year in late November. Both of these contests feed into the Indian National Olympiad in Informatics (INOI), held in January. The top students from INOI are selected for a 10–15 day residential training camp held in May–June, at the end of which the Indian team to IOI is chosen.

### 2.1. *Zonal Informatics Olympiad (ZIO)*

The Zonal Informatics Olympiad is conducted at about 40 centres across the country. The contest is open to all students in classes 8–12. The number of participants ranges from 5000 to 8000.

ZIO is a pencil and paper exam consisting of 4–5 questions. The questions are problems that require algorithmic or combinatorial insight. Instead of asking students to write out their solutions to the abstract problem, they are provided with three concrete inputs of moderate size. These inputs are expected to be too complex to work out manually without identifying and applying an efficient algorithm. Students get 5 marks for each

input correctly solved and a bonus 5 marks if they get all three parts of a question correct. A typical ZIO question is shown in Figure 1. All ZIO question papers and solutions from 2002 onwards are available online (IARCS, 2013b).

### 2.2. *Zonal Computing Olympiad (ZCO)*

The Zonal Computing Olympiad is an online programming contest. ZCO is held at a fixed time on a Saturday with two relatively simple IOI-style problems to be solved and submitted via an online judge. Like ZIO, the contest is open to all students in classes 8–12. The number of participants is quite small and ranges from 100 to 200. Students can write the exam at any location but must submit a certificate from their school and parents that

Crazyman has decided to tile the floor of his lab in Siruseri with red and green square tiles. He is a very organized person and wants the tiling to be symmetric. His lab floor requires $M$ tiles from north to south and $2N$ tiles from east to west. He has decided to use $M \cdot N$ red tiles to tile the western half of his lab and $M \cdot N$ green tiles to tile the eastern half.

The workers had tiled the lab to perfection, but when Crazyman went out to have lunch, a mischievous person came in, noticed that the cement had not yet set, and swapped some red and green tiles.

When Crazyman came back from lunch, he was heartbroken. He decided to fix the problem himself. Being crazy, however, he decided to restore the symmetry by a sequence of swaps, each involving only adjacent tiles.

For instance, suppose the tiles have been rearranged as follows, where R denotes a red tile and G a green tile. In this case, Crazyman needs 12 swaps of adjacent tiles to restore the tiles to their original arrangement.

West

```
R G R R G G G G
R G R R G G G G
R R R R G R G G
R R R R G R G G
```

East

In each of the following cases, find the minimum number of adjacent pairs of tiles that Crazyman has to swap to restore the symmetry.

(a)
```
R G R R G G R G
R G R R G G G G
G G R R G R G G
R R R R G R R G
```

(b)
```
R G R R G G G R R G
R R G R R R G G G R
G G R G G G R G G G
R R G G R R R R G R
```

(c)
```
G G R R G G R R
G G R R G G G G
G G R R G R G G
R R R R G R R R
```

Fig. 1. Sample question from ZIO

they attempted the exam without external assistance. ZCO was initiated in 2009 and all question papers are available online (IARCS, 2013b).

### 2.3. *Indian National Olympiad in Informatics (INOI)*

The Indian National Olympiad in Informatics is an offline programming contest. About 250–300 students are selected from ZIO and ZCO to take part in INOI. INOI is organized at a subset of the centres used to conduct ZIO. The reason to organize INOI offline is because many schools lack reliable Internet connectivity.

The INOI question paper consists of two IOI-style questions. Printed question papers are sent to all the centres. Each student works on a separate computer and leaves his or her solutions on the local hard disk. These solutions are collected and submitted by each centre coordinator via the Internet for automated centralized evaluation.

The level of difficulty is not very different from ZIO. The main purpose is to test for basic programming skills. All INOI question papers from 2002 onwards are available online (IARCS, 2013b).

### 2.4. *International Olympiad in Informatics Training Camp (IOITC)*

About 25 students are selected through INOI to attend the International Olympiad in Informatics Training Camp (IOITC). This is a fully residential training camp of 10–15 days held in May–June. Students attend lectures before lunch where algorithmic techniques are taught through interactive problem solving sessions involving questions from IOI and other olympiads. During the rest of the day, students work in the lab to solve problems. The lab is set up with a local server that runs an online judge. There are periodic practice tests. The last three days consist of five hour IOI-style exams with three problems on each day. The top four students from these three final exams are chosen to represent India at IOI.

## 3. Meeting the Challenges

Though 5000–8000 students participate in the first round of ICO each year, this is not a large number in the context of India's student population. The corresponding numbers for other olympiads such as mathematics or physics are typically around 15,000–20,000.

The main obstacle is that computer science (informatics) is not a core subject in secondary school. In those schools that do offer subjects related to computing, the emphasis is on courses that teach computer applications such as the usage of word processors and spreadsheets, rather than algorithmic problem solving. As a result, most students are not exposed to the subject. Also, there is a general lack of awareness about the ICO because there isn't a reliable network of school teachers to publicize this activity, unlike in core subjects like mathematics and science.

Another factor that deters participation is that most students who have an aptitude for mathematics and science are focussed on preparing for competitive entrance examinations to join various engineering courses after school. This preparation effectively takes

up all their free time and any activity that is not directly aligned to the process is discouraged. There is, unfortunately, almost no formal incentive in the Indian education system for students who excel in the various international olympiads. A handful of institutions provide direct admission or some kind of preferential treatment, but this is not enough to attract large scale participation.

The school system in India is quite decentralized, so it is almost impossible to directly intervene and implement any schemes to introduce an effective computer science curriculum in schools. The only viable approach seems to be to provide online resources outside the school system for self-learning, accompanied by competitions and other activities to attract the attention of students.

IARCS has begun compiling lecture notes, problems and other material from the annual IOI training camps into an online training archive (IARCS, 2013b). In addition, IARCS also runs an online judge where students can practice their solutions (IARCS, 2013a). This judge currently runs on a software platform developed internally, but it will soon be ported to use the Contest Management System (CMS Development Team, 2013) that was used at IOI-2012 and will be used at both IOI-2013 and IOI-2014 as well. IARCS has intermittently run a monthly online programming contest in the past. There are plans to revive this activity, in cooperation with the CodeChef team (CodeChef, 2013), which has recently started hosting regular online programming contests for Indian students.

It is worth noting that the Indian Computing Olympiad has played an important role in encouraging student interest in algorithms and programming beyond IOI. For instance, in the last 4–5 years, almost every Indian team participating in the World Finals of the ACM Inter-Collegiate Programming Contest (ICPC) has been built around students who have been through the IOI training camp.

## 4. Organizers

The ICO is coordinated by the Indian Association for Research in Computing Science (IARCS), whose members are drawn from the leading research and teaching departments in Computer Science across the country. IARCS is responsible for the entire academic content of the ICO. This includes setting questions and evaluating answers for all the exams, conducting the training camp and maintaining online resources for students to prepare for the Olympiad.

IARCS conducts ICO in coordination with the Central Board for Secondary Education (CBSE), which is the largest national school board in India. CBSE provides the infrastructure to host ZIO and INOI at multiple centres across the country.

The ICO has been fortunate to have a steady corporate sponsor, Sasken Communication Technologies (Sasken, 2013), that has underwritten the cost of hosting the training camp as well as the international travel for the team to IOI since 2003. The training camp itself has been hosted at The International School Bangalore (TISB, 2013) since 2003.

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