Olympiads in Informatics, 2026, Vol. 20, 161–169

DOI: https://doi.org/10.15388/ioi.2026.11

Open Contests in the Japanese Olympiad in Informatics

Tetsushi ITO[1], Seiji HIRATA[2], Kengo SHIMIZU[2], Hirotaka YONEDA[2]
[1]Kyoto University
[2]The University of Tokyo
e-mail: tetsushi.ito@ioi-jp.org; ret2home@gmail.com; kiyomizu@is.s.u-tokyo.ac.jp; squar37@gmail.com

Abstract. The Japanese Committee for the International Olympiad in Informatics (JCIOI) has organized open contests since 2013. These contests were originally based on tasks and contest environments prepared for the Japanese Olympiad in Informatics (JOI), but were made open to the public to contribute to the global competitive programming and informatics education communities. In this article, we describe the format, history, tasks, and technical aspects of open contests organized by JCIOI.

Keywords: open contest, online programming contests, contest management system.

1. Introduction

The Japanese Committee for the International Olympiad in Informatics (JCIOI) organizes the Japanese Olympiad in Informatics (JOI) and selects the Japanese delegation for the IOI. In addition, JCIOI has organized Open Contests since 2013.

The primary purposes of JOI are to encourage and train talented students in informatics and to select the Japanese delegation for the IOI. However, the tasks and contest environments prepared by JCIOI can also be valuable resources for people outside Japan. For this reason, JCIOI has made some of its contests open to participants worldwide. Some of these activities are also supported by sponsors and the Japanese government. We regard the Open Contests not only as part of our training and selection activities but also as a way to contribute to the global competitive programming and informatics education communities.

In this article, we describe JCIOI's activities related to Open Contests, including their format, history, tasks, and technical aspects. We hope this article serves as a useful resource for those interested in JCIOI's Open Contests.

2. Overview of the Contest Format

In this article, we use the term "Open Contest" to refer to an online programming contest in which participation is not restricted and anyone may take part freely. JCIOI has organized the following two types of Open Contests.

- (Type 1) Contests using original tasks are held under the name “JOI Open Contest”. These contests were originally designed as training opportunities for members of the Japanese delegation for the IOI. We made them open to the public so that participants from other countries could also benefit from the contests. The JOI Open Contest was held from 2013 to 2025.
- (Type 2) Contests are held at almost the same time as official JOI contests. These contests use the same tasks as the corresponding official JOI contests. They are also called “mirror contests” of JOI.

Both types of Open Contests are based on tasks and contest environments prepared primarily for JOI. By opening them to the public, JCIOI aims to make these resources available to the competitive programming and informatics education communities worldwide.

In what follows, we refer to both types of contests as “Open Contests”.

In addition to these contests, JCIOI also makes judges for past JOI tasks available on the AtCoder website: *https://atcoder.jp/contests/archive?category=200*

These are open to anyone, but they are not discussed in this article.

The contests in (Type 1) and (Type 2) differ only in the source of the tasks. Their operation as Open Contests is essentially the same. However, in (Type 2), JCIOI prioritizes the official JOI contest held at the same time. Therefore, responses to technical or other issues in the Open Contest may sometimes be delayed.

The general flow of an Open Contest is as follows. Details may vary slightly from year to year. For more information, see: *https://contests.ioi-jp.org/*

We announce the Open Contests through several channels, including the IOI-announce mailing list and Codeforces blog posts. Some contestants also share contest information on X (formerly Twitter). These announcements have been important for reaching participants outside Japan.

The basic format is the same as IOI. The contest lasts 5 hours and includes 3 tasks. The contest system is CMS. Usually, the only available programming language is C++. This is because the Japanese IOI delegation members use only C++, and one of the main purposes of Open Contests is to provide training opportunities for them.

When organizing an Open Contest, we prepare the contest tasks and the judging environment. The tasks may be original (Type 1) or drawn from another official JOI contest (Type 2). In either case, to encourage participation from around the world, the task statements are translated into English, and the contest is conducted bilingually in Japanese and English. Recent advances in machine translation have helped reduce the cost of preparing English statements, but we still carefully review them to ensure clarity and precision.

The contest website also provides an account registration page. Participants create accounts and then take part in the contest. In the past, the contest time slot was fixed. Because participants are in many different time zones, we introduced a system that lets each participant choose their own start time. Regardless of when a participant starts, the contest lasts 5

hours. However, the five-hour period must fit within the prescribed contest window. If the overall Open Contest window ends during a participant's contest, that participant's contest ends at that time, even if five hours have not yet elapsed.

Source code submitted during the contest is compiled, executed, judged, and scored in the judging environment, and feedback is returned to the participant. This is the same as in ordinary programming contests such as the IOI.

During the contest, participants may submit questions through the contest system. However, for operational reasons, it may not always be possible to answer them immediately.

After the Open Contest ends, the official input and output data are released, and the contest enters Analysis mode. During Analysis mode, participants may resubmit their solution programs.

The real-time standings are available during the contest. Participants who do not wish to be influenced by others' scores are advised not to view the standings page. After the contest ends, the standings are frozen and published.

No prizes are awarded to participants or to high-ranking contestants.

The rules for Open Contests are kept to a minimum. The 24-hour contest window introduced in 2020 has made the contest more accessible to participants in different time zones, but there is a risk that task information may be shared before some participants start, and it is difficult for the organizers to answer questions throughout the entire contest window. The operation of Open Contests necessarily relies on participants' integrity.

3. History of the JOI Open Contest

The following is a list of past JOI Open Contests. All of these used original tasks, corresponding to Type 1 in the previous section.

For the tasks, data sets, and standings, please see the following website: *https://contests.ioi-jp.org/*

JOI Open Contest, 2013

Sunday, June 23, 2013, 04:00–09:00 UTC/GMT

JOI Open Contest, 2014

Day 1, Round 1: Sunday, June 22, 2014, 04:00–09:00 UTC/GMT

Day 1, Round 2: Sunday, June 22, 2014, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

Day 2, Round 1: Sunday, June 29, 2014, 04:00–09:00 UTC/GMT

Day 2, Round 2: Sunday, June 29, 2014, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

JOI Open Contest, 2015

Round 1: Sunday, June 14, 2015, 04:00–09:00 UTC/GMT

Round 2: Sunday, June 14, 2015, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

JOI Open Contest, 2016

Round 1: Sunday, June 19, 2016, 04:00–09:00 UTC/GMT

Round 2: Sunday, June 19, 2016, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

JOI Open Contest, 2017

Round 1: Sunday, July 2, 2017, 04:00–09:00 UTC/GMT

Round 2: Sunday, July 2, 2017, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

JOI Open Contest, 2018

Round 1: Sunday, July 8, 2018, 04:15–09:15 UTC/GMT

Round 2: Sunday, July 8, 2018, 10:00–15:00 UTC/GMT

The tasks for Round 1 and Round 2 were the same.

JOI Open Contest, 2019

Round 1: Sunday, July 14, 2019, 04:00–09:00 UTC/GMT

Round 2: Sunday, July 14, 2019, 10:00–15:00 UTC/GMT

Round 3: Sunday, July 14, 2019, 15:30–20:30 UTC/GMT

The tasks for Rounds 1, 2, and 3 were the same.

JOI Open Contest, 2020

Sunday, September 6, 2020, 04:00 – Monday, September 7, 2020, 04:00 UTC/GMT

JOI Open Contest, 2021

Sunday, June 6, 2021, 04:00 – Monday, June 7, 2021, 04:00 UTC/GMT

JOI Open Contest, 2022

Sunday, July 3, 2022, 04:00 – Monday, July 4, 2022, 04:00 UTC/GMT

JOI Open Contest, 2023

Saturday, August 5, 2023, 04:00 – Sunday, August 6, 2023, 04:00 UTC/GMT

JOI Open Contest, 2024

Sunday, June 16, 2024, 04:00 – Monday, June 17, 2024, 04:00 UTC/GMT

JOI Open Contest, 2025

Sunday, June 15, 2025, 04:00 – Monday, June 16, 2025, 04:00 UTC/GMT

Since one of the main purposes of the JOI Open Contest was to provide training opportunities for contestants preparing for the IOI, it was usually held about one month before the IOI. The JOI Open Contest was held twice, in 2014 only. In all other years, it was held once.

Until 2019, the contest window was fixed at five hours. Because participants were in various time zones, we held multiple rounds, which imposed a considerable operational burden. Starting in 2020, we introduced a system that allowed participants to choose their own starting time within a 24-hour contest window. This reduced the burden of contest operations.

4. Tasks

In an Open Contest, as in IOI, three tasks have usually been given. The only exception was in 2018, when four tasks were given.

Figure 1 shows the full-score rates and task types of past JOI Open Contest tasks. Based on our experience, the full-score rate of JOI Open Contest tasks appears comparable to, or slightly lower than, what one might expect if the same tasks were used in IOI. Difficulty has varied from year to year. Around 2019–2021, many tasks were relatively easy, whereas since 2022, the task sets have tended to be more difficult, closer to the level of recent IOI tasks.

	2012	2013	2014A	2014B	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A	10.9%	*0.0%*	18.3%	*0.0%*	*???*	2.8%	28.3%	16.5%	4.6%	53.9%	50.9%	24.3%	0.6%	23.4%	26.3%
B	57.8%	1.8%	38.6%	43.1%	???	38.7%	11.7%	3.7%	56.6%	33.3%	47.4%	3.7%	0.0%	0.0%	15.1%
C	1.6%	80.7%	0.0%	44.4%	???	6.3%	1.7%	4.6%	1.3%	78.0%	7.5%	11.8%	19.8%	22.8%	1.3%
D								77.1%							

Figure 1. Full-score rates and task types of tasks used in JOI Open Contests. Unmarked tasks are Batch Tasks, underlined tasks are Communication Tasks, and italicized tasks are Output-only Tasks. Data are unavailable only for 2015.

Here are three tasks from previous JOI Open Contests.

JOI Open Contest 2018: "Xylophone"

Problem: There is a hidden permutation $(A[1], \ldots, A[N])$ of the integers from 1 to N. A contestant may ask, at most $2N$ times, for the difference between the maximum and the minimum of $A[l], \ldots, A[r]$, by specifying l and r. The goal is to determine the entire permutation A. It is guaranteed that the position of N is to the right of the position of 1.

The task can be solved by querying all pairs (l, r) with $r - l = 1$ or 2. As background, in JOI, Communication Tasks were used only at the Spring Training Camp. Because this task was easier than the Spring Training Camp level, it gave contestants across a wide range of levels an opportunity to experience a Communication Task.

JOI Open Contest 2017: "Bulldozer"

Problem: There are N points in the plane. Point i has coordinates $(X[i], Y[i])$, and its score is $W[i]$. When two parallel lines are drawn, what is the maximum possible sum of the scores of points lying between the two lines? Here $N \leq 2000$.

This task can be solved by considering $O(N^2)$ possible directions of the lines and processing them in angular order. The key observation is that when the direction changes to the next relevant direction, the order of the points in that direction changes only by swapping two adjacent points. This technique for solving such geometric problems is now called the "Bulldozer Trick" in Japan, Korea, and elsewhere.

JOI Open Contest 2023: "Cell Automaton"

Problem: There is an infinite grid. Initially, N cells $(X[1], Y[1]), \ldots, (X[N], Y[N])$ are coloured black. Every second, each cell's color changes as follows: a black cell becomes grey; a grey cell becomes white; and a white cell becomes black if at least one of its edge-adjacent neighbors is black. For each time $T[1], \ldots, T[Q]$, determine the number of black cells. Here, $N \leq 100000$ and $Q \leq 500000$.

This task is considered one of the most difficult in the history of JOI Open Contests. During the contest, the highest score was 49 points. It is very difficult to derive an efficient method for computing the intersections of squares centered at the relevant cells. Even after this observation, the implementation remains highly challenging.

5. Technical Aspects

JOI uses the CMS (Contest Management System) to provide a contest environment similar to IOI (Maggiolo & Mascellani, 2012). Rather than using the latest upstream version directly, we have continuously maintained and operated a private repository based on the 1.4 series of CMS, adding our own extensions. JOI Open Contest also uses this infrastructure.

In this section, we describe three technical aspects of our system: maintaining compatibility with older JOI task formats, Auto Scaling and monitoring on AWS (Amazon Web Services), and configuration management as Infrastructure as Code (IaC) to make infrastructure construction reproducible.

First, from an early stage, JOI used a judging system called ImoJudge, which was developed in Japan and widely used domestically (Imajo, 2011). Even now, we maintain compatibility with traditional task packages and task types originating from that system. To this end, we have extended CMS loaders for items such as Contests, Tasks, and Users, so that these older formats can be handled directly within CMS.

Second, we describe extensions to CMS that support operation on AWS. Two major operational issues are reducing server costs and making monitoring efficient. For judging workers, we use c4.2xlarge instances. Among high-performance instances, these are relatively inexpensive, provide high processing speed, and offer stable execution times because memory and cache access are less affected by other instances.

However, keeping a large number of such instances running throughout the contest period would increase costs. We therefore extended CMS to allow the number of workers to be dynamically increased or decreased while the system was running. This made it easier to manually adjust the number of workers based on load and to introduce Auto Scaling. It also enabled the safe use of inexpensive Spot Instances despite their risk of unexpected termination.

As a concrete implementation of this automation, we send the estimated wait time for the judging queue to CloudWatch and use it as an indicator for adjusting the number of instances. Unlike official JOI contests, which end relatively quickly, JOI Open Contest requires long-duration operation. Therefore, cost optimization through dynamic scaling is particularly effective.

For monitoring, we have also built a system that automatically sends notifications about the status of multiple servers and key logs to an internal communication tool. This enables a small team to efficiently monitor the entire infrastructure.

Third, we have developed IaC (Infrastructure as Code) to ensure reproducibility in infrastructure construction and configuration deployment. At JOI, we have built a mechanism that expands Jinja2 templates with configuration inputs and automatically generates Terraform configuration files that define the AWS infrastructure, as well as Ansible inventories that define the destinations for CMS and middleware configuration. This enables the management and deployment of multiple infrastructures in parallel, such as internal testing environments, domestic contest environments, and Open Contest environments, each with slightly different requirements, without duplicating or modifying the core management code.

In this way, JOI Open Contest is operated by combining CMS extensions for compatibility with existing task formats and extensions for utilizing cloud infrastructure. However, due to continuous independent extensions, the codebase has increasingly diverged from the upstream CMS. Keeping up with the latest upstream version and integrating our extensions with it remain technical challenges for the sustainable operation of the system in the future.

6. Conclusion

When JCIOI began organizing Open Contests in 2013, the online competitive programming environment was not as well developed as it is today. CMS, which is used in our Open Contests, was originally used as the contest system for IOI 2012 in Italy. At that time, practicing with IOI-level tasks was difficult, which posed a challenge for contestant training. The same situation likely existed not only in Japan but also in other countries.

When we prepared English task statements and held an Open Contest open to all, we were surprised to see more participants from outside Japan than we had expected. According to the post-contest questionnaire, several contestants who represented their countries at the IOI in the same year also participated in Open Contests. Some contestants participated in Open Contests multiple times. We believe that our Open Contests have contributed to the competitive programming and informatics education communities.

More than ten years have passed since the start of Open Contests. The competitive programming landscape has changed significantly. Many task sets, including IOI-level problems, are now available online, making it much easier than before to hold virtual training contests. On the other hand, preparing original tasks and holding the JOI Open Contest every year have required considerable effort. Taking these circumstances into account, we decided to end the JOI Open Contest (Open Contests of Type 1) using original tasks in 2025.

However, we will continue Open Contests of Type 2 (mirror contests of official JOI contests). We warmly invite everyone interested in JOI tasks and contest environments to participate in these Open Contests.

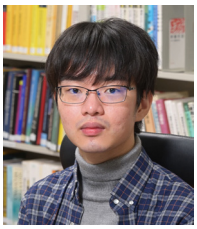
References

Imajo, K. (2011). Contest environment using wireless networks: A case study from Japan. Olympiads in Informatics, 5, 26–31. https://ioinformatics.org/journal/INFOL077.pdf

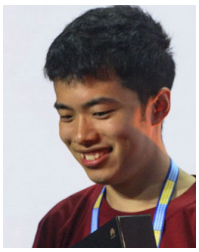
Maggiolo, S., & Mascellani, G. (2012). Introducing CMS: A contest management system. Olympiads in Informatics, 6, 86–99. https://ioinformatics.org/journal/INFOL107.pdf

Tetsushi Ito is an associate professor at Kyoto University. As a high school student, he participated in IOI 1994 and IOI 1995. He has also served several times as a leader or deputy leader of the Japanese delegation to the IOI. He served as Chairperson of the Host Scientific Committee for IOI 2018. He is currently a board member of the Japanese Committee for the International Olympiad in Informatics (JCIOI) and Chairperson of its Scientific Committee.

Seiji Hirata is an undergraduate student at the University of Tokyo. He is currently a member of the Technical Committee of JCIOI.



Kengo Shimizu is a master's student at the University of Tokyo. From 2022 to 2026, he worked on automating server and contest environment configuration as a member of the Technical Committee of JCIOI.



Hirotaka Yoneda is a master's student at the University of Tokyo. As a high school student, he participated in IOI 2018 and IOI 2020. Since then, he has competed in the International Collegiate Programming Contest (ICPC), including a second-place finish at the ICPC 2025 World Finals. He has been involved in training JOI contestants and members of the Japanese delegation to the IOI for several years.