International Olympiad in Informatics (IOI) 2022
Host Scientific Committee Report

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International Olympiad in Informatics 2022

January 3, 2023

Abstract

International Olympiad in Informatics (IOI) is an annual algorithmic programming contest and is one of the most prestigious programming contests for high school students.

IOI 2022 Host Scientific Committee is responsible for the content of the competition, including the competition rules, tasks, and results. This report discusses in detail how the competition tasks are selected, prepared, and tested. This report also discusses various scientific incidents that happened during IOI 2022, as well as learnings and recommendations for future IOI hosts.

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Abbreviations

APIO Asia-Pacific Informatics Olympiad

CMS Contest Management System

GA General Assembly

HM Honourable Mention

HSC Host Scientific Committee

HTC Host Technical Committee

ICPC International Collegiate Programming Contest

IMO International Mathematical Olympiad

IOI International Olympiad in Informatics

ISC International Scientific Committee

PIC Person In Charge

TOKI Tim Olimpiade Komputer Indonesia (Indonesian Computing Olympiad Association)

TPS Task Preparation System

VM Virtual Machine

Chapter 1

Host Scientific Committee

IOI 2022 Host Scientific Committee is composed of nine experienced members in participating and organising national and international programming contests:

- HSC Chair: **Jonathan Irvin Gunawan**, IOI 2013 Silver Medalist, IOI 2018 - 2023 ISC Member
- HSC Deputy Chair: **Prabowo Djonatan**, Indonesian National Olympiad in Informatics 2014 Silver Medalist, IOI 2020 - 2021 Invited HSC Member
- HSC Members:
  - **Abdul Malik Nurrohman**, IOI 2019 Gold Medalist
  - **Alham Fikri Aji**, IOI 2010 Silver Medalist
  - **Hocky Yudhiono**, APIO 2019 Silver Medalist
  - **Maximilianus Maria Kolbe**, Indonesian National Olympiad in Informatics 2014 Bronze Medalist
  - **Muhammad Ayaz Dzulfikar**, IOI 2015 Bronze Medalist
  - **Mushthofa**, IMO 2000 Bronze Medalist, IOI 2020 Deputy Leader
  - **Wiwit Rifa'i**, ICPC 2018 World Finalist

Chapter 2

Pre-IOI 2022 Preparation

IOI 2022 HSC was not experienced with using the Task Preparation System (TPS) framework, which is the framework commonly used to develop IOI tasks. IOI 2022 HSC and HTC are not experienced with using Contest Management System (CMS), which is the automated judging system commonly used in IOI. Therefore, we decided to organise several contests to get us familiar with the systems.

We forked TPS to our own repository in https://github.com/ioi-2022/tps. Based on our learnings from the contests, we made several changes in the fork to suit IOI 2022 needs. The HSC Chair is coordinating with Kian Mirjalali, the current maintainer of TPS, to merge some of the changes back to the main TPS repository. Since both repositories have diverged, this effort is not trivial and still in progress.

2.1 TOKI CMS Contest

TOKI CMS Contest is a 2-hour mini contest on 10 January 2021. The contest was available to the public and announced in a Codeforces blog. The tasks were prepared using TPS and the contest was hosted using CMS. The tasks cover various possible task types, including batch, output-only, two-steps, and online query.

2.1.1 Learnings

While organizing this contest, we discovered several learnings.

Score precision

If a contestant achieved a raw score (the number returned by the checker multiplied by the subtask score) more precise than 2 decimal points on more than one subtask, the contestant's score on the contest page (CMS ContestWebServer) differs from the contestant's score in the public scoreboard (CMS RankingWebServer). This is because one service rounds (to 2 decimal points) the score for each subtask and then sums them, while the other service sums the score for each subtask and then rounds them (to 2 decimal points). For example, if a contestant's raw scores on two subtasks are 0.123 and 1.234, one service displays the score $0.12 + 1.23 = 1.35$, while the other one displays 1.36, since $0.123 + 1.234 = 1.357$, which gets rounded to 1.36.

In the contest, the output-only task has 8 files (subtasks), each has a partial score between 0 and 12.5. The checker needs to ensure that it produces a number which is an integer multiple of 0.0008 so that any number produced by the checker multiplied by 12.5 is an integer multiple of 0.01.

Non UTF-8 characters printed by checkers

We learnt that non-UTF-8 characters printed (either to standard output or error) by checkers cause CMS to be unable to judge the solution with a `UnicodeDecodeError`. Also, the default checker provided by the `testlib.h` used for previous IOIs prints contestants' output in case it mismatches the correct output.

On batch tasks, if a contestant tries to print any character (including non-UTF-8 characters), the checker will return "Protocol Violation" and terminate earlier before it tries to print the offending character. However, it is not the case with output-only tasks. The checker prints any characters in the file submitted by the contestants, which might contain a non-UTF-8 character.

We fixed this issue by modifying `testlib.h` such that checkers can avoid printing error messages. The change is available at
https://github.com/ioi-2022/tps/commit/f390dae49200eada9d0ca600ed21f64b199ba4d4.

Duplicated hard-coded numbers in gen/data

We realised that `gen/data` contains a lot of duplicated hard-coded numbers, such as the maximum number constraint. To deduplicate the numbers and make it easier to maintain if the maximum number constraint changes, we wrote a Python generator `gen/data.py`, which

is a generator for `gen/data`. We needed to modify the TPS and `Makefile`s used to compile the generator files so that running `tps gen` would first run the Python generator before generating the test cases.

TPS invoke runtime for the first test case

We observed that when running `tps invoke`, the runtime for the first test case might be prolonged by TPS. In some cases, this might cause the solution to be incorrectly marked as "Time Limit Exceeded" even though the solution should terminate instantly for the test case. Unfortunately, we did not manage to figure out the proper fix for this issue. Whenever TPS incorrectly marked solutions as "Time Limit Exceeded" because of this issue, we just tried invoking the solution again.

2.1.2 TPS Changes

We made the following changes to our TPS repository:

- We added the summary of each subtask when invoking a solution using `tps invoke`. For each subtask, various information is shown: the score, maximum runtime, verdict, and whether the verdict matches the expected verdict specified in `solutions.json`. This change is merged back to the main TPS repository and available at https://github.com/ioi-2022/tps/commit/e5c866a146202b894d6d0a53cd4f3c209996975f.

- We set `HAS_LANG_JAVA=false` in `scripts/internal/problem_data.sh` so TPS will not look for Java grader files. This change is available at https://github.com/ioi-2022/tps/commit/40879b1dced0498cd9e8be82531b211459aaa905.

- We added the support to write a generator for `gen/data` as mentioned in the previous section. To achieve this, we modified `Makefile` and moved `Makefile` and `testlib.h` to TPS, and then each task can reference these files using symbolic links to the TPS repository. This change is available at https://github.com/ioi-2022/tps/commit/62c8100e7d3188f3fb1d5f17047d3fdd291590a9 and https://github.com/ioi-2022/tps/commit/ee68fcb2bb23932583b94537138559d86c0fe1e3.

2.2 APIO 2021

Asia-Pacific Informatics Olympiad (APIO) is an IOI-like competition for delegations within the Asian and Western Pacific regions. Indonesia was chosen as the host of APIO 2021. This gives us more opportunities to familiarise ourselves with TPS.

2.2.1 Learnings

While organizing this contest, we discovered several learnings.

Task statement images

Using the IOI Translation System, images must be referenced by the task statement in the same directory. Therefore, to make it easier between local development and deployment in IOI Translation System, images must be located in the same directory as the `index.md` task statement. For example, they must not be inside a separate `images/` directory. Also, IOI Translation System will collate images for all tasks together. Therefore, image filenames should be prefixed by the task code to avoid filename conflicts among different tasks.

I/O for communication tasks

We realised that solutions which crash early, even before the method to be implemented is called, may cause some FIFOs to be stuck and CMS cannot gracefully judge the solution. To fix this issue, each process (other than the manager) should communicate with the manager using standard I/O instead of FIFOs.

2.2.2 TPS Changes

We made the following changes to our TPS repository:

- Modify `testlib.h` to follow APIO 2021 and IOI 2022 competition rules, such as the verdict messages. This change is available at https://github.com/ioi-2022/tps/commit/ab5a8dd712efe0327441f36ab0be574487c833db.
- Change C++ compiler flags to use C++17. This change is available at https://github.com/ioi-2022/tps/commit/fc320409d25556e033b2f4af4fb6d20cc375eb1b.

- Add `invoke-all` command to invoke all solutions and compare the verdict of each subtask to the expected verdict specified in `solutions.json`. This change is available at https://github.com/ioi-2022/tps/commit/619866d1878a4c69bb48644b1d5ffffb5ef6fbc5 and https://github.com/ioi-2022/tps/commit/f6b70af2f0db89080bdf40540a4ebf6d89757728.
- Modify processes to communicate with the manager using standard I/O instead of FIFOs as mentioned in the previous section. This change is available at https://github.com/ioi-2022/tps/commit/72b9f2c05145b34e1542ce3db051b929057639dc. TPS loader in IOI 2022 CMS is also changed to use this configuration. The CMS change is available at https://github.com/ioi-2022/cms/commit/eb3cad462ffdc8f40eb72378cc2b58020268fdd6.

2.3 TOKI VM Contest

TOKI VM Contest is a mini contest on 13 December 2021. The main purpose of the contest is for HTC to familiarise themselves with the IOI VM and their connectivity. Since the contestants of this contest are required to use IOI VM, this contest is only restricted to approximately 40 Indonesian national training camp contestants. Nevertheless, this contest gives us more opportunities to be more familiar with TPS and CMS as well.

There are not a lot of major learnings or TPS changes. The only TPS change worth mentioning in this report is the support to have a sample subtask for output-only tasks. The change is available at
https://github.com/ioi-2022/tps/commit/d94db2401f48a4185c2aa7c0723f4e9c803c8267.

Chapter 3

Task Selection

3.1 Call for Tasks

The IOI 2022 Call for Tasks was announced on the IOI 2022 website on 12 July 2021. The call for tasks is also advertised in Facebook posts, Codeforces blog, and ioi-announce mailing list. The tasks are to be submitted to IOI Dropbox, which is maintained by Martin Mareš. Mareš provided us access to the IOI Dropbox server so that we can periodically check the submissions.

The original deadline for the Call for Tasks is 12 December 2021. The call for tasks needed a minimum of 9 tasks for 6 IOI 2022 main tasks and 3 IOI 2022 backup tasks. We expected much more than 9 tasks so that we have several choices for choosing IOI 2022 tasks.

By 18 October 2021, we only received 4 tasks. We sent a reminder in the Codeforces blog and the mailing list. We also asked several people, including ISC members, to promote the call for tasks. By 11 December 2021, we received 14 tasks. We decided to extend the call for tasks for 5 weeks (until 16 January 2022). By 16 January 2022, we received 36 tasks and decided not to accept any more tasks.

Figure 3.1 illustrates the timeline distribution of the submitted tasks across the duration of the call for tasks. The complete timestamps for each submission are available in Appendix A.

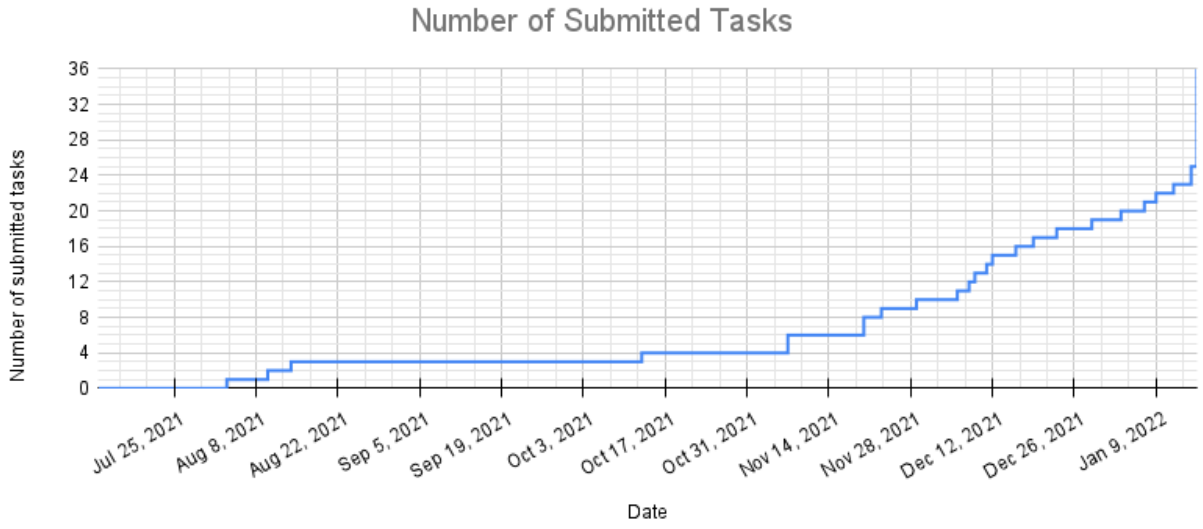

Figure 3.1: Number of submitted tasks across the duration of the call for tasks.

3.2 Task Selection

3.2.1 Task Longlist

We needed to present a subset of the submitted tasks to ISC during the March pre-IOI meeting on 8 March 2022. By 23 December 2021, there were 18 task submissions. We defined these tasks to be the "first batch" and sent these tasks to ISC and all HSC members via secure Matrix communication[1]. At the same time, we assigned each of the 18 tasks to two HSC members. Each assigned member is responsible to do the following:

- Understand the proposed task and its solution.
- If the proposed task is vague, consider several exact formulations of the task to make it well-defined.
- Rate the task using a single 1 - 10 score considering the difficulty of the task, the novelty of the task, the scope of the task, whether the task covers some topics excluded by the IOI syllabus, and whether the task can be divided into many subtasks. The member is also expected to provide a short one-line comment justifying their score.

Between 23 December 2021 and 16 January 2022, each new task submission is distributed

[1]Self-hosted Matrix protocol was set up by HTC for IOI 2022.

to all HSC members in real-time and two HSC members are assigned to do the above responsibilities. The assignment of the tasks is heuristically chosen based on familiarity. In particular, if the author of a task is a member of HSC, the member is prioritised to be assigned to the task.

By early February, all tasks have already been scored by at least two HSC members. Some HSC members also voluntarily scored some tasks even though they are not assigned, thus some tasks are scored by three HSC members. On 6 February 2022, the HSC Chair and Deputy Chair discussed all the tasks and partitioned all 36 tasks into three longlists, considering all the scores and the comments:

1. Longlist 1 contains 15 tasks which we deemed interesting and suitable for IOI tasks.

2. Longlist 2 contains 15 other tasks which we deemed less interesting, but still usable for IOI tasks.

3. Longlist 3 contains 6 tasks which we deemed unusable for IOI tasks.

We intentionally have a lower preference towards output-only tasks due to the hybrid setting of IOI 2022. We cannot guarantee that all contestants have the same machine performance specification. A contestant who has a better machine might gain an advantage to produce a better output in a shorter amount of time. We also cannot guarantee that all contestants will be able to submit large output files since different contestants have different internet connection quality and latency to our grading servers.

For each of the tasks in longlist 3, we provided a reason why we deemed them to be unusable.

- For one of the tasks, the task is publicly available in Sphere Online Judge (SPOJ).

- For one of the tasks, the task is a classic task.

- For one of the tasks, the solution requires modular division, which is explicitly excluded in IOI 2022 Syllabus.

- For one of the tasks, the solution requires Gaussian Elimination, which is explicitly excluded in IOI 2022 Syllabus.

- For two of the tasks, the proposed solution by the task author is incorrect and HSC did not manage to find a correct solution.

The following day, HSC distributed all tasks in the three longlists to ISC and proposed that we only present tasks in the first longlist unless some ISC members would like to discuss any tasks in the other longlists.

3.2.2 Task Presentation

During the March pre-IOI meeting, for each task in longlist 1, either one of the two HSC members initially assigned to score the task is assigned to present the task to ISC. The presentation includes the task idea, task solution, possible subtasks, possible extensions (if any), and why we feel the task is interesting and suitable for IOI.

3.2.3 Task Selection

After all tasks have been presented, ISC worked together with HSC to come up with a set of shortlisted tasks for IOI 2022, containing three first competition day tasks, three second competition day tasks, and three backup tasks. The set of tasks for each day should have tasks of varying difficulties, topics coverage, and task types.

The chosen tasks are the following:

- Competition Day 1
    1. **Catfish Farm**[2] (task code: `fish`): Batch dynamic programming task
    2. **Prisoner Challenge**[3] (task code: `prison`): Batch constructive task
    3. **Radio Towers**[4] (task code: `towers`): Online query data structure task
- Competition Day 2
    1. **Digital Circuit**[5] (task code: `circuit`): Online query combinatorics task
    2. **Rarest Insects**[6] (task code: `insects`): Interactive task
    3. **Thousands Islands**[7] (task code: `islands`): Batch graph observation task

[2] authored by **Lim Rui Yuan** (Singapore), NUS High School
[3] authored by **Masataka Yoneda & Hirotaka Yoneda** (Japan), The University of Tokyo
[4] authored by **Kevin Luiz Ponte Pucci** (Portugal), Oporto University
[5] authored by **Prabowo Djonatan** (Indonesia), Garena Singapore
[6] authored by **Hazem Issa** (Egypt), Egyptian Olympiad in Informatics (EOI)
[7] authored by **Félix Moreno Peñarrubia** (Spain),
Universitat Polit‘ecnica de Catalunya - BarcelonaTech

- Backup
    1. [Redacted]
    2. [Redacted]
    3. [Redacted]

Note that the task titles described above are the task titles that are eventually distributed to the contestants. The original task title in the call for task submission might differ.

All of the shortlisted tasks are to be prepared by HSC before IOI 2022. The preparation includes (but is not limited to) writing task statements, task solutions, and test data. The three backup tasks are prepared in case some of the tasks for the first or second competition day become unusable (e.g., due to rejections by the GA). The title of the backup tasks is redacted for task confidentiality since they can be used for future contests.

3.3 Task Submission Feedback

On 20 March 2022, the HSC chair sent feedback to the author of each submitted task using the email address indicated in the submission.

For two of the tasks not on the shortlist, the task is interesting and suitable for IOI but does not fit to form a set of IOI tasks for IOI 2022. Nevertheless, we encouraged the author of these tasks to consider submitting their tasks again for future IOIs. For other tasks not on the shortlist, we provided a one-sentence reason to the author why we did not include it in the shortlist. For tasks in the shortlist, we congratulated the task author and let them know that they will be invited to IOI 2022, pending more detailed information.

Chapter 4

Task Preparation

4.1 Person In Charge (PIC)

Each task is assigned one HSC member to be the Person In Charge (PIC) responsible for the preparation of the task, which includes (but is not limited to) preparing most of the task components, ensuring the quality of the task, and being aware of any changes related to the task.

There are nine HSC members and nine shortlisted tasks, thus each HSC member is assigned to be a PIC for one shortlisted task. This ensures each PIC has enough bandwidth to ensure the quality of their assigned task. The PIC of a task is heuristically chosen based on familiarity. In particular, if the author of a task is a member of HSC, the member is prioritised to be the PIC of the task.

4.2 Subtasks

The PIC of each task is responsible to come up with various subtasks and its solution for the task. These subtasks are presented to ISC during the April pre-IOI meeting for gathering feedback.

4.3 Task Framework and Task Repository

The task components are prepared using the TPS framework. For easier collaboration, a Git repository was created in a self-hosted Gitlab set up by HTC to host all of the task

components. Whenever an HSC member would like to add or modify a task component to the repository, the HSC member must create a Gitlab Merge Request. The components must be reviewed and approved by other HSC members before the task component is considered to be completed.

We decided to use monorepo strategy for IOI 2022, which means the components for all IOI 2022 tasks are in a single repository combined, instead of having a separate repository for each task, which have been practised by past IOI hosts. The main reasons behind our decision are:

- To have a single TPS code in the tasks repository, which is linked to the IOI 2022 TPS repository added as a submodule. In each task, the TPS code is linked to the single TPS code in the tasks repository using a symbolic link.
- To have a single configuration for CI/CD pipeline.
- When we want to make a change that applies to multiple tasks (for example, a change in the task framework, or a style in the task statement which affects multiple tasks), we can create a single commit to do so, so the state for all tasks is consistent at all times.

To help in keeping track of the changes and issues for each task, we created a label for each task. Each Gitlab issue and merge requests are then to be labelled properly by the author.

After IOI 2022 ends, for future reference, the task repository is archived in `https://github.com/ioi-2022/tasks`, with commits history and backup tasks removed.

4.4 Task Components

HSC prepares the following components for each task:

1. **Task statement**: A document explaining the task for the contestants. This component was written by the HSC Chair and Deputy Chair.
2. **Public grader and skeleton (sample code)**: C++ files that the contestants can use to write and test their solutions. This component wasis written by the HSC Chair and Deputy Chair.
3. **Private grader**: C++ source code that is going to be compiled together with the contestants' solution in the grading server.

4. **Model solution**: A correct solution used to generate the test data output. This component should be written by the task PIC.

5. **Test data generator**: Scripts and C++ source code to generate the test data input. This component should be written by the task PIC.

6. **Test data validator**: C++ source code to validate that the test data follows the constraints specified in the task statement. This component should not be written by the task PIC.

7. **Solution checker**: C++ source code to check whether the output produced by the contestants' solution is correct. This component should be written by the task PIC.

8. **Additional full solutions**: Correct solutions used to verify the test data output.

9. **Solutions for each subtask**: Correct solutions for each subtask. This component should be written by the task PIC.

10. **Additional solutions with its corresponding expected verdict**

4.4.1 Task statement and Public grader and skeleton (sample code)

Since task statements and C++ public graders and skeletons are distributed to the contestants during the contest, these components need to have the same style across all tasks. Therefore, these components are written only by the HSC Chair and Deputy Chair for consistency and are reviewed by the PIC of the task.[1] These components are the first to be written, as these components determine the sample cases, subtasks, and implementation details.

4.4.2 Test data validator

The input validator should not be written by the task PIC so that the test data generator and the test data validator are written by different authors.

[1] If the PIC of the task is the HSC Chair or Deputy Chair, another member of the HSC is assigned for review.

4.4.3 Additional full solutions

The purpose of additional full solutions is to ensure that the test data output produced by the model solution is correct. Therefore, there has to be at least one additional full solution written independently from the model solution. This means that the author of the additional full solution is different from the author of the model solution and the authors were discouraged to collaborate.

4.4.4 Solutions for each subtask

For each subtask, a solution specifically intended to solve that subtask is written. This serves two purposes:

1. An additional verification that the test data in the subtask satisfies the subtask constraints and can be solved by the solution.

2. A verification that other subtasks which should not be solved by the solution have test data which are not solved by the solution.

4.4.5 Additional solutions with its corresponding expected verdict

Additional solutions can be contributed by any HSC members to further verify that the solution should solve the same set of subtasks as expected. This can be automatically verified by IOI 2022 TPS.

4.5 Subtask Points

By early July 2022, the majority of task components have already been written. The last piece of the puzzle is to assign points for each subtask. After all of the task components have been written, we have more sense of the difficulty of each subtask, including the implementation difficulty. This gives us better judgement for assigning the points.

On 3 July 2022, all HSC members discussed the points for each subtask for all tasks in an online meeting.

Chapter 5

Task Quality Assurance and Testing

5.1 Proofreading and Beta Testing Sessions

HSC planned to conduct two sessions of proofreading and beta testing. The main purpose of the beta testing sessions includes:

1. Ensuring that people who have not known the task before can correctly understand the task from the task statement.

2. Ensuring that the test data is correct.

3. Ensuring that the test data coverage is robust and suboptimal solutions should solve the intended set of subtasks.

4. Getting a more accurate sense of the difficulty level of the tasks.

Since the proofreaders were not expected to solve the tasks, the main purpose of the proofreading sessions is only the first purpose listed above.

The beta testers were given access to the CMS staging environment to submit their solutions to the tasks. The proofreaders were only given the task statements. The proofreaders and beta testers were expected to provide feedback to HSC if they have any via secure Matrix communication. The feedback from the first proofreading and beta testing session was adapted for the second session.

5.2 Timeline and Members

The proofreaders and beta testers are experienced programming contest participants who are not HSC or ISC members but are trusted by HSC. The proofreaders and beta testers, as well as the timeline for each session, are the following:

1. First Session: 7 July 2022 to 21 July 2022
    - Beta testers
        - **Fausta Anugrah Dianprama**: IOI 2019 Silver Medalist
        - **Andreas Martin**: ICPC 2019 World Finalist
    - Proofreader
        - **Ranald Yun Shao Lam**: IOI 2014 Gold Medalist, IOI 2022 ITC Member
2. Second Session: 22 July 2022 to 5 August 2022
    - Beta testers
        - **Wen Yuen Pang**: IOI 2017 Silver Medalist
        - **Ahmad Zaky**: ACM-ICPC 2013 World Finalist
    - Proofreader
        - **Ashar Fuadi**: IOI 2010 Silver Medalist, IOI 2022 ITC Member
        - **Lin Si Jie**: Singapore NOI 2016 Bronze Medalist, IOI 2022 Invited HTC Member

5.3 Task Statement Changes by ISC Members

Once the proofreading and beta testing sessions have started, we would like to avoid changing the tasks[1] since doing so will defeat the purpose of the sessions.

Before the first session started, two ISC members (including the ISC Chair) helped with proofreading the task statements and proposed several changes as merge requests in the Gitlab repository. On 2 July 2022, to accelerate the discussion of the changes, the HSC Chair and Deputy Chair discussed the changes with the two ISC members in an online

[1]Except when such changes are obviously necessary or caused by the feedback of the proofreaders or beta testers.

meeting. The online meeting, compared to the asynchronous discussion via secure Matrix communication, helped with accelerating the discussion especially due to the huge time zone difference between ISC and HSC members. We felt the acceleration was necessary since we were planning to start the proofreading and beta testing sessions soon.

5.4 Task Components Quality Assurance

HSC is also helped by Kian Mirjalali (IOI 2019 HSC Member) for checking our task components. Kian is experienced in writing rigorous and secure graders and solution checkers in past IOIs. We provided access to our task repository to Kian.

5.5 Result

We felt that the proofreading and beta testing sessions were useful. We received several good task statement suggestions which we applied. Some beta testers also managed to solve some subtasks using a solution which is not supposed to solve those subtasks. We modified the specification of the test data and/or the time limit to address the issue.

Before the sessions, the task `circuit` did not have $N = 1$ subtask (the first subtask), which means solving any subtask for the task requires understanding Dynamic Programming. Some proofreaders and beta testers suggested adding $N = 1$ subtask for task `circuit` to make the task more approachable by less experienced contestants. We decided to approve the suggestion.

Kian also suggested some changes regarding inconsistencies across tasks, grader behaviour in corner cases, better code style, and others. We applied some of the suggestions.

5.6 Checklist

Due to various revisions after the proofreading and beta testing sessions, HSC prepared a checklist to once again verify the correctness of the task materials. HSC members would run the checklist just several hours before the contest to ensure that all late revisions do not break the task. There are three checklists. The individual items inside these checklists are available in B.

5.6.1 Dev Task Checklist

This checklist contains two parts. The first part checks the task statement and needed to be run before the task statement was printed to be distributed to the team leaders for the translation night, approximately 5 hours before the translation night. The second part checks the rest of the task materials. This could be done before or during the translation night since these materials would not be distributed to team leaders, and thus can be modified during the translation night.

5.6.2 CMS Task Checklist

This checklist needed to be run after the translations of the task statements are uploaded to CMS, approximately 3 hours before the start of the contest. This checks all components of the task in CMS, including task statements and attachments.

5.6.3 CMS Contest Checklist

This checklist needed to be run approximately 3 hours before the start of the contest. This checks the configuration of the contest.

Chapter 6

Competition Rules

HSC, working together with ISC during both March and April pre-IOI meetings, proposed to change some sections in the competition rules. Some of the changes were due to some of them being impractical in hybrid IOI. The changes were published in the IOI website by the end of April 2022, as well as presented in the first GA meeting. The changes were approved by the GA.

The changes are the following:

1. The previous competition rules instructed contestants to submit their items by submitting them to the technical staff. To make it easier for HTC, in IOI 2022, contestants were instructed to submit their items by leaving them in a provided designated container instead.

2. In IOI 2022, contestants asked for assistance by raising coloured cards instead of a designated system. This change was made since it was not trivial to develop such a system for hybrid IOI. Also, using coloured cards make it easier for volunteers to determine which requests have been completely fulfilled.

3. The previous competition rules guaranteed that grading workstations will be provisioned on similar hardware as the contestant's workstations. Since the IOI 2022 grading workstations are in the cloud, we cannot guarantee anything about the grading workstations.

4. IOI 2022 used the "Protocol Violation" verdict when contestants called grader functions with invalid parameters or called them too many times (usually for interactive tasks).

5. IOI 2022 removed the "Accepted" vs "Output is correct" verdict distinction for tasks with partial scores. All tasks now have consistent possible verdicts.

6. Due to the hybrid setup of IOI 2022, contestants could not print any materials during the contest.

7. Since contestants needed to submit their solutions via the internet, the file size limit of each submission is reduced to reduce the network traffic. HSC guaranteed that this limit is still much more than needed.

8. It is made explicit that contestants who would like to request extra time need to make such requests as soon as possible. If they still have not received any response by the end of the contest, they should continue working on the contest.

Chapter 7

Practice Session

The main purpose of the practice session is for the contestants to familiarise themselves with the actual contest environment.

7.1 Task Selection

To keep our task preparation focused on the shortlisted IOI 2022 tasks, we decided to re-use some of the tasks from pre-IOI 2022 preparation contests, which have been prepared using the same framework. HSC Chair and Deputy Chair decided to choose the following four tasks, which cover all possible IOI 2022 task types:

1. **Magic Cards** (task code: `cards`): Two-steps constructive task from TOKI CMS Contest

2. **Hoax Spreading** (task code: `hoax`): Online query data structure task from APIO 2021 Practice Session

3. **Team Contest** (task code: `team`): Batch greedy task from TOKI VM Contest

4. **Connected Towns** (task code: `towns`): Interactive greedy task from TOKI VM Contest

It was intentional that we did not choose any output-only task since there is no output-only task in IOI 2022 due to conscious preference.

7.2 Early Practice Contest

The early practice contest starts 3 weeks before IOI 2022. It was available from 17 July 2022 07:00 (UTC+7) to 3 August 2022 07:00 (UTC+7). Registered IOI 2022 contestants could participate in the early practice contest using the provided contestant machine environment image. Therefore, they can try both the contestant machine environment and CMS.

Having several grading servers always available during the whole duration of the early practice session is expensive and deemed impracticable. Therefore, HTC and HSC decided to use more affordable grading servers with slightly worse performance to save costs. We posted the following announcement in CMS to let the contestant know about the compromise:

> The purpose of this practice session is for you to familiarise with the Contest Management System interface and the Contestant's machine environment.
>
> Please note that this early practice contest does not use the same grading machine as the actual contest in August, due to operational costs. However, the practice session during the week of IOI 2022 on August 8 will use the same grading machine as the actual contest, thus you will be able to test the performance of the grading machines.

158 contestants submitted at least one solution to the early practice contest.

7.3 Mock Translation Session

Before the actual practice session during the IOI week, a mock translation session was conducted. The purpose of this session is for the team leaders to familiarise themselves with the translation system, the procedure to file objections, and the procedure to print and seal the envelopes containing task statements for their contestants.

The session only lasted for 2 hours. To save time, only the task `team` was available for translation. Team leaders were also instructed to translate only the task story (containing only two paragraphs) and skip the rest of the task statement, such as the implementation details, examples, and subtasks. The source file (Markdown) of the ISC Version of the task also has a Markdown comment marking which paragraphs are to be translated as a reminder.

7.3.1 Translation session procedure

Each team could choose whether they want to translate the tasks. If they wanted to translate the tasks, they had to click the "Submit" button to finalise their translation. While

translating, teams could print their draft translation. The volunteers would come with the draft translation marked with "DRAFT" markings on the top of the pages to avoid confusion between draft translations from final translations.

For teams which had an onsite contestant, the team could request two other languages translated by other teams. After the "Submit" button was pressed, once the English task statements had been finalised by ISC, and all of the requested translations (if any) had been finalised, a volunteer would approach the team leaders with envelopes, the English task statements, task statements in their language (if they are translating), and task statements in requested languages (if any). The team leaders were then responsible to insert the copies into the envelopes accordingly, based on which contestants require which translations.

For online contestants, the team could print the task statements on their own. The team could also request other translations by contacting the respective team leaders outside the translation system.

7.3.2 Issues from the session

During the session, there were several issues, some of which were caused by the committee. The issues were used for our learning for the translation sessions for the actual competition days:

1. The hard copy of the first version of the task to be translated was not distributed to the team leaders. This was due to miscommunication in the committee that no one is assigned to be responsible to do so.

2. Due to a technical issue in the translation system, the PDF of the translation could not be rendered. HTC managed to solve the issue before the session ended.

3. Due to a technical issue in the translation system, teams requesting the translation by the IOI Delegation did not get the translation.

4. Some non-translating teams did not receive English task statements due to ineffective committee procedures.

The details of some of the technical issues are available in IOI 2022 HTC Report.

We also learned that during the session, a team submitted a request for another team's translation, but the requested team did not translate during the session. This caused a deadlock, which means the requester would never get any printed task statement. For the

translation sessions for the actual competition days, we reminded all teams that this is a possible scenario and team leaders should request other translations carefully.

At the end of the second hour of the session, the session needed to be ended due to time constraints. Some teams had still not received and sealed their envelopes yet, including a team mentioned in the previous paragraph. We reassured the teams that we will wait for these teams until they have sealed their envelopes for the competition days.

7.4 Practice Session

The practice session started only 2 hours after the end of the mock translation session. During the 2 hours, the translated task statements had to be uploaded to CMS and the envelopes containing the task statements needed to be brought to the contest hall.

On each of the contestants' desks, we provided a clarification request form. Contestants could use this form to ask for clarifications in their own language, especially if they would like to use their native languages which might be hard to type in CMS.

7.4.1 Start of the session

HSC and the envelopes arrived in the contest hall approximately 1 hour before the start of the practice session. After the translations were uploaded to CMS by HTC, HSC then ran the "CMS Task Checklist" of the practice session tasks.

Due to miscommunication among committee members, the envelopes were not distributed to contestants' desks until approximately 10 minutes before the practice session. HSC and HTC then hurried to distribute task statements, which only finished less than one minute before the practice session.

7.4.2 Issues during the session

After the sessions started, several contestants could not access their CMS account from the workstation on their desks, even though the accounts should be automatically logged in based on the seat location. These contestants also did not get their envelopes. The cause is due to the last-minute changes of the contestants' seat location. The contestants' guide (liaison officer) was not aware of the change, thus still directing the contestants to the outdated location.

Several contestants also reported that the room temperature was too cold. During the GA meeting following the session, we surveyed the team leaders to get rough numbers of contestants who felt too cold, because it is possible that some of them reported to their team leaders but not to the committees directly. Based on the responses, it was immediately obvious that the high number means there was no space to move them to warmer locations, thus the only solution was to modify the temperature of the room.

Several contestants also reported they were not comfortable with the noise level, be it from the neighbouring contestants' keyboard or the chandelier. We worked with IOI 2022 organizing committee to provide earplugs for the competition days to contestants who need them.

Several contestants were confused since only one out of four tasks were translated. Some contestants also requested whether they can use a translator. We rejected the request for a translator and reassured the contestants that all of the tasks for the competition days will be translated.

We planned to distribute task attachments to the contestants' VM. This is not a trivial task, since distributing large files to online contestants might take some time, and HTC needs to ensure that the materials are only accessible once the contest starts. Due to several things that needed to be done before the session started, we were not able to distribute task attachments to the contestants' VM[1]. We did not receive any feedback regarding this. We checked the competition rules and it is not explicitly mentioned that task attachments would be available in contestants' VM. We coordinated with HTC and decided to remove this from our requirement, so we can focus on other important things before the contest. We then modified our checklists to not check the task attachments in contestants' VM.

Several contestants also asked for technical assistance (e.g., changing keyboard layouts, using the provided script, text editors, etc.). HSC and HTC tried to be as helpful as possible during the practice session.

7.5 Items Submission

For each of the items that the contestants would like to use during the competition days, the contestants were required to leave them on their desks at the end of the practice session. The items include keyboards, mice, language dictionaries, books, mascots, food, and drinks. HSC spent approximately 3.5 hours at the end of the practice session day to ensure that

[1]They can still download them from CMS.

each of the submitted items are allowed by the contest rules.

7.5.1 Keyboards and mice

For keyboards and mice, we ensured that they abide by the competition rules, that is, they must neither be wireless nor have calculation and/or programmable functions.

We did our best effort to determine whether a keyboard/mouse has programmable functions. If an item has suspiciously much more buttons than usual, we tried to search for the model of the item on the internet. If we found enough evidence that such an item has programmable functions (especially macro recordings), we rejected the items. In the end, we rejected 9 programmable keyboards.

We also found 4 keyboards and 1 mouse with detachable wire. For each of these items, either it is clear from inspecting the hardware that it supports wireless mode (e.g., it has a button to enable wireless mode), or we found that it supports wireless mode upon searching the model of the item on the internet. In the end, we rejected all 5 items with wireless capability.

To address the complaints from the contestants regarding the noise level from the neighbouring contestants' keyboards, HSC checked the noise level for each keyboard under normal use. If a contestant uses their keyboard aggressively, we will alert the contestant during the contest instead. This problem is not exclusive to keyboards—contestants may produce excessive noise using any equipment, including pens. In the end, we decided not to reject any keyboards because of their noise level.

7.5.2 Other items

Some contestants also submitted physical language dictionaries. For each of them, we briefly verified that all of the pages did not have additional handwritten notes.

Some contestants also submitted notebooks. For each of them, we briefly verified that all of the pages were blank. We rejected 1 notebook which had handwritten notes on some of the pages.

A contestant submitted a physical calculator. HSC considered this as an electronic device prohibited by the competition rules, so we rejected it.

7.5.3 Rejected items

In total, 16 items (9 programmable keyboards, 4 wireless keyboards, 1 wireless mouse, 1 calculator, 1 non-empty notebook) from 15 different contestants were rejected by HSC, shown in figure 7.1. In some cases when it was unclear whether the item is violating the competition rules, the item was discussed by multiple HSC members to avoid biases.

Figure 7.1: Rejected items labelled with the contestant code of the owner.

By 1 pm the following day, HSC notified the team leaders of the 15 affected contestants. They are asked to notify their student to collect their items from HSC and offered to submit a replacement item that abides by the competition rules.

A contestant whose keyboard supports macro recording appealed to HSC that they strongly preferred to use the keyboard. To accommodate, we did our best effort to reset the macro recording and disable the macro buttons using duct tape. The item was then allowed to be used during the competition days.

Chapter 8

Contest

In previous onsite IOIs, the first competition day happened one day after the practice session. This year, we decided to conduct the first competition day two days after the practice session. This gives an extra day for online contestants to make modifications to their contest setup if necessary. Between the practice session day and the first competition day, all contestants, team leaders, and guests had the opening ceremony. HSC and HTC members worked together and took advantage of this extra day to fix various issues that happened during the practice session, and we believe that this extra day is valuable. This extra day also gave us more time to inspect contestants' submitted items, and for the contestants to submit replacements for rejected items.

8.1 Competition Day 1

8.1.1 Before the contest

The tasks were distributed for objections and translation at approximately 8:15 pm. We received no major objections for the first competition day tasks and the tasks were approved by the GA. We received several minor objections and made revisions to tasks `prison` and `towers`. The revisions are minor. The issues during the mock translation session were fixed and there was no issue during the translation session for the first competition day. At approximately 11 pm, the English task statements were finalised, and by approximately 2:45 am the following day, all teams finished their translation.

Approximately 3 hours before the contest started, HSC ran the "CMS Task Checklist" and realised that the sample case for task `fish` in the task attachment did not match the

sample case in the task statement. However, the sample case used for judging is correct. This mistake was fixed immediately. The task was re-imported to CMS and we reran the checklist. We have separate files in `gen/manual/sample-1.in` (for the sample case used for judging) and in `public/samples/sample-1.in` (for the sample case in the task attachment). We believe that deduplicating these files should avoid this issue.

8.1.2 During the contest

Approximately 13 minutes after the contest started, a contestant complained that their keyboard layout worked during the practice session but did not work during the contest. HSC then realised that the issue was due to a switch in the keyboard that toggles between Mac vs Windows keyboard layout. We believe that we accidentally toggled the switch when we inspected the keyboard after the practice session.

Approximately 100 minutes after the contest started, we received a clarification in CMS for the task `prison`, asking whether contestants need to have $x = 2$ for their solutions to be marked as correct for the sample cases in CMS. While we specified the limit for the value of x in the main subtasks, we did not specify such limit for the sample subtask. We responded to the clarification by explicitly clarifying the requirement to solve the sample subtask.

8.1.3 Appeals

We received an appeal where a contestant claimed that they tried to submit 15 seconds before the end of the contest, but the submission is not shown in the system and points are not given. ISC rejected this appeal because the contestant should have submitted the submission using the backup submission mechanism.

We also received another appeal where a contestant claimed that CMS did not respond when they tried to submit within seconds before the end of the contest. ISC also rejected this appeal for the same reason.

We received a report where a contestant used the backup submission mechanism two minutes before the end of the contest. ISC decided to accept this submission. This submission gets 0 points, thus did not change the result of the contest.

8.2 Competition Day 2

8.2.1 Before the contest

The tasks were distributed for objections and translation at approximately 7:30 pm. We received no major objections for the second competition day tasks and the tasks were approved by the GA. We received several minor objections and made revisions to all three tasks. The revisions are minor. At approximately 10:30 pm, the English task statements were finalised, and by approximately 2:30 am the following day, all teams have finished their translation.

8.2.2 During the contest

Approximately 10 minutes after the contest started, we received a report that the Korean task statements were not uploaded to CMS HTC immediately fixed this issue.

We received approximately 4 clarifications in CMS and 12 onsite assistance requests regarding difficulties with compiling the skeleton for task `islands`[1] using built-in editor functions. We suggested these contestants to compile their code using the provided script. HTC and HSC members also helped some contestants to configure their editor to compile using the C++17 flag. After the contest, we realised that we should have been more consistent in the amount of help we give to the contestants.

We received a clarification request from a contestant in their language using the clarification request form. Since none of the HSC or ISC members speaks the language, we took a photo of the form and asked the team leader (via IOI 2022 Matrix) of the contestant to translate their clarification. We then responded to the request by writing our answer (in English) in the form and returning the form to the contestant.

A team participating online claimed that their contestants were not able to reach their contest venue as it was deemed unsafe due to ongoing clashes and protests in the area. ISC granted an exception for the contestants to compete from home and to be proctored by their parents and cameras. One of the contestants from the team was not able to connect to CMS until approximately 80 minutes into the contest. The team leader confirmed that they were not given the task statements. ISC decided to grant a 1 hour time extension for this contestant. In the end, this contestant did not use the additional time and left the contest early.

[1] For this task, the contestants are required to implement a method that returns a `std::variant`, which is a feature introduced in C++17. Therefore, compiling the code requires the C++17 flag.

8.2.3 Appeals

We received an appeal where a contestant claimed that their workstation failed and required a restart, which took approximately 6 minutes. The contestant appealed to accept a submission that was sent 15 minutes after the end of the contest. ISC decided to reject the appeal following ISC's extra time policy.

Chapter 9

Result

9.1 Competition Tasks

The task statements (including the translations), test data, and supplementary materials for the practice session, first competition day, and second competition day are available in https://ioi2022.id/tasks/. Task editorial/discussion for the first competition day and second competition day tasks is also available in https://ioi2022.id/tasks/.

9.2 Competition Result

To calculate medal boundaries, we needed to calculate the official number of contestants. A contestant is counted as long as they were present on the contest site during at least one of the competition days. For onsite contestants, it was easy to check whether they were in the Yogyakarta contest hall. For online contestants who did not make any submissions, we checked with their proctors whether they were attending their contest site.

Out of 353 registered contestants[1], 5 of them did not attend the first competition day. 1 of the 5 attended the second competition day. Therefore, IOI 2022 has 349 official contestants.

Following IOI 2022 Regulation, the medal boundaries are the following:

- Gold cutoff is 415.99 points. 30 contestants, ranked 1 to 30, achieved this.
- Silver cutoff is 257.8 points. 58 contestants[2], ranked 31 to 88, achieved this.

[1] 4 contestants from the second Indonesian team is not counted.
[2] 1 contestant from the second Indonesian team is not counted.

- Bronze cutoff is 147.0 points. 88 contestants[3], ranked 89 to 175, achieved this.
- Honourable Mention. 36 contestants achieved this.
  - First day cutoff is 78.0 points
  - Second day cutoff is 65.0 points

  In other words, any contestant who did not win any medal that achieved at least 78.0 points on the first day or at least 65.0 points on the second day won an Honourable Mention.

The full result is available in Appendix D.

[3] 3 contestants from the second Indonesian team are not counted.

Chapter 10

Feedback and Survey

At the end of IOI 2022, the HSC chair distributed a feedback and survey form to all team leaders and suggested the team leaders to distribute the form to their contestants. The form covers various topics, including competition tasks, environment, and organisation. 119 people responded to the form. This report focuses only on interesting findings or learning around topics related to HSC work.

10.1 Tasks

Respondents were asked to score each task based on subtask quality, task statement clarity, and overall task quality metrics. Each score is between 1 to 5, where a larger number means a better score. The tasks receive generally positive feedback.

On subtasks quality, task `prison` gets the largest average score of 4.03 while task `circuit` gets the smallest average score of 3.63. For task `circuit`, one respondent mentioned that the subtasks are misleading. Another respondent mentioned that the task is suited to binary scoring because there is basically one main idea. Another respondent mentioned that the first five subtasks should get more points and there is a gap between the first five subtasks and the next subtask.

On task statement clarity, task `insects` and `islands` get the largest average score of 4.67 while task `circuit` gets the smallest average score of 4.31. Finally, on overall task quality, task `insects` gets the largest average score of 4.57 while task `circuit` gets the smallest average score of 4.06.

The full distribution of the feedback scores is available in appendix C.

10.2 Compiling and running code

Respondents were asked about their preferred way of compiling and running code. 111 respondents responded to this question as follows:

- 46 (41.4%) of them indicated using the provided scripts.
- 40 (36%) of them indicated using the editor build features.
- 23 (20.7%) of them indicated typing the compilation command manually.
- 2 (1.8%) of them indicated binding a hotkey in the editor that runs their custom command.

This result concludes that a large number of contestants prefer to use the editor build features. For most of the supported editors, the default installation does not enable C++17 compilation flags. Therefore, these editors will not be able to compile C++ code with C++17 features.

Chapter 11

Conclusion

We believe IOI 2022 was organised without any major scientific glitches. However, there were still minor inconveniences that could be avoided for future IOIs. In this chapter, we will present our key insights, takeaways, learnings, as well as recommendation to future IOI HSCs when hosting an IOI.

We believe that TPS is a great framework for preparing IOI tasks. It has a lot of features for preparing tasks which require contestants to implement their solution in a specified method, rather than reading from I/O. It also has various tests to ensure that the task components are prepared correctly. We also believe that the contests we organised before IOI 2022 helped us to be more familiar with and improve the framework.

We believe that having constant communication with ISC members since the pre-IOI meeting, including sharing the task repository and updates, helps a lot. Early task statement reviews and regular collaboration with ISC members help to avoid task statement changes during the IOI week. We also believe that having a secure chat platform, instead of encrypted emails, tremendously makes communication easier.

We believe that the beta testing and proofreading sessions are useful. People who have not seen the tasks before can give us a new perspective on the tasks.

We believe that checklists help to detect mistakes before it was too late. We also believe that automation and deduplication help to avoid mistakes in the first place.

We learnt that having features introduced in C++17 in sample grader and skeleton complicates several contestants who use the editor build features without modifying the editor configuration. We recommend future IOI hosts to ensure that the sample grader and skeleton are compilable on the default installation of all provided text editors.

We overlooked that the requirement to solve the sample subtask for task `prison` is not

explicitly specified in the task statement. We recommend future IOI hosts to ensure that the requirement to solve each subtask[1] is explicitly specified in the task statement.

We learnt that only translating one task in the practice session confuses the contestants. We recommend future IOI hosts to avoid this potential confusion by explicitly informing the contestant before the practice session starts.

[1]Especially on sample subtask on tasks with constructive nature.

Appendix A

Call for Tasks Submission Timestamp

2021/08/03 10:11:25	2021/08/10 12:55:35	2021/08/14 16:10:51	2021/10/13 10:32:11
2021/11/07 7:25:36	2021/11/07 7:28:27	2021/11/20 8:34:18	2021/11/20 8:36:05
2021/11/23 11:13:57	2021/11/29 4:01:57	2021/12/06 21:35:03	2021/12/08 1:56:53
2021/12/09 6:32:46	2021/12/11 23:39:57	2021/12/12 16:43:01	2021/12/16 9:21:24
2021/12/19 18:52:24	2021/12/23 3:09:21	2021/12/29 14:43:48	2022/01/03 17:59:39
2022/01/07 9:33:46	2022/01/09 0:36:54	2022/01/12 0:35:40	2022/01/15 11:24:18
2022/01/15 17:17:47	2022/01/16 0:52:17	2022/01/16 2:23:44	2022/01/16 3:42:58
2022/01/16 6:18:28	2022/01/16 17:23:59	2022/01/16 17:27:56	2022/01/16 18:12:32
2022/01/16 18:13:18	2022/01/16 18:14:01	2022/01/16 22:10:07	2022/01/16 23:09:27

Table A.1: Timestamp for each call for tasks submission in CET.

Appendix B

HSC Checklists

B.1 Dev Task Checklist

This checklist should be done before the task statement is printed for translation.

- Task statement
  - Put the task statement in Grammarly and check that there are no obvious spelling/-grammatical errors.
  - Check that all data types used in the method signatures defined in the task statement are defined in the "notice" document of the contest.
  - Check that subtask points written in the task statement match our discussion.
  - For practice session tasks, check with the points in subtasks.json.
  - Check that sample test cases written in the task statement match the public files.
  - Check that the method signatures written in the task statement match the public files.
  - Check that all variables introduced in the task statement have Constraints.
  - Check that the public grader behaviour written in the task statement, including I/O format, matches the public files.

This checklist should be done before or during the translation night.

- Test cases
  - Run tps gen and tps invoke-all and check that all verdicts are intended

  - Submit all solutions in solutions.json to staging CMS and check that all verdicts are intended.

- Validator
  - Check the test case validator.

- Checker
  - Check the test case checker.

- Task attachment
  - Check that the header code includes all necessary headers and does not include unnecessary headers and namespaces.
  - Check that the public grader includes all necessary headers and does not include unnecessary headers and namespaces. Do not rely on headers being included transitively.
  - Check that the skeleton code includes all necessary headers and does not include unnecessary headers and namespaces. Do not rely on headers being included transitively.
  - Check that all public code has 2 spaces for indentation and each line has at most 80 characters.

B.2 CMS Task Checklist

This checklist should be done around 1-2 hours before the start of the contest. All the following are to be done in the production contest using Contestant's VM.

- Task statements
  - Check that all languages are uploaded.
  - Check that the English language is set as default.
  - Download and check the English language is uploaded for the correct task.
  - Download and check two other languages are uploaded for the correct task.
- Attachment
  - Check that the public sample test cases match the task statement.
  - Check that the method signatures match the task statement.
  - Check that the public grader behaviour, including I/O format, matches the task statement.
  - Check that the header code includes all necessary headers and does not include unnecessary headers and namespaces.
  - Check that the public grader includes all necessary headers and does not include unnecessary headers and namespaces. Do not rely on headers being included transitively.
  - Check that the skeleton code includes all necessary headers and does not include unnecessary headers and namespaces. Do not rely on headers being included transitively.
  - Check that all public code has 2 spaces for indentation and each line has at most 80 characters.
  - Check that the compilation script matches the template and the grader and the problem name variable is set to the correct name.
  - Check that the run script matches the template and the problem name variable is set to the correct name.
  - Run the compilation script to compile the skeleton code and check that there is no warning (except unused variables in the method parameters).

  - Run the run script to run the skeleton code using all public sample test cases and ensure it does not crash.

- Subtasks
  - Implement a solution that solves the sample test cases, submit, and check whether the solution solves the sample subtask.
  - Check that subtask points in the CMS match task statement.

- ~~Attachment in VM~~
  - ~~Check that task attachment has been dropped to contes Desktop and matches CMS attachment (Use md5sum).~~

B.3 CMS Contest Checklist

- Contest information
  - Allowed programming languages: C++17 / g++
  - Submissions download allowed: yes
  - Allow questions: yes
  - Allow user tests: no
  - Score decimal places: 2
  - Allow unofficial submission before analysis mode: yes
- Logging in
  - Block hidden participations: no
  - Allow password authentication: no
  - Allow registration: no
  - IP based login restriction: yes
  - IP based autologin: yes
- Tokens parameters
  - Token mode: Disabled
- Times
  - Start time (in UTC): [DEPENDS]
  - End time (in UTC): [DEPENDS]
  - Timezone: Asia/Jakarta
- Limits
  - Minimum submission interval grace period: 900
- Analysis mode
  - Enabled: yes
  - Analysis mode start time (in UTC): [DEPENDS]
  - Analysis mode end time (in UTC): [DEPENDS]

Appendix C

Task Feedback

Subtasks quality							
Task	Average score	Number of respondents					
		1	2	3	4	5	Total
`fish`	3.90	3	8	22	26	37	96
`prison`	4.03	2	7	15	38	38	100
`towers`	3.83	3	10	18	30	31	92
`circuit`	3.63	4	13	23	36	24	100
`insects`	3.91	1	13	16	30	36	96
`islands`	3.74	5	14	16	28	34	97

Task statement clarity							
Task	Average score	Number of respondents					
		1	2	3	4	5	Total
fish	4.60	0	2	7	21	73	103
prison	4.46	0	4	10	24	65	103
towers	4.44	1	6	8	20	68	103
circuit	4.31	2	7	9	24	61	103
insects	4.67	0	1	6	19	77	103
islands	4.67	1	1	6	15	80	103

Overall task quality							
Task	Average score	Number of respondents					
		1	2	3	4	5	Total
fish	4.11	4	1	19	35	44	103
prison	4.46	0	3	8	31	61	103
towers	4.29	2	3	12	28	52	97
circuit	4.06	3	4	18	37	41	103
insects	4.57	0	2	7	24	70	103
islands	4.19	3	3	13	34	47	100

Appendix D

Full Result

#	Code	Team	Award	Name	Total	1-1	1-2	1-3	2-1	2-2	2-3
1	CHN1	CHN	Gold	Shaoxuan Tang	**600**	100	100	100	100	100	100
1	CHN2	CHN	Gold	Jiangqi Dai	**600**	100	100	100	100	100	100
3	CHN3	CHN	Gold	Hangrui Zhou	**555**	100	100	100	100	100	55
3	CHN4	CHN	Gold	Junkai Zhang	**555**	100	100	100	100	100	55
5	USA4	USA	Gold	Hankai Zhang	**534.56**	100	80	100	100	99.56	55
6	CAN2	CAN	Gold	Zixiang Zhou	**532**	100	100	77	100	100	55
7	UKR1	UKR	Gold	Roman Yanushevskyi	**523.29**	100	72	60	100	91.29	100
8	USA2	USA	Gold	Timothy Feng	**520**	100	80	40	100	100	100
9	IOI8	IOI	Gold	Aleksandr Babin	**511.89**	100	80	77	100	99.89	55
10	IRN4	IRN	Gold	Koosha Moosavi	**505.04**	100	80	77	100	93.04	55
11	IOI6	IOI	Gold	Vsevolod Nagibin	**492.9**	100	80	58	100	99.9	55
12	IRN2	IRN	Gold	Alireza Kaviani	**490**	100	65	100	100	70	55
13	HRV2	HRV	Gold	Dorijan Lendvaj	**486.95**	100	100	58	100	99.95	29
14	UKR2	UKR	Gold	Oleh Naver	**485.89**	100	90	41	100	99.89	55
15	SGP1	SGP	Gold	Ashley Aragorn Khoo	**483.89**	100	90	60	34	99.89	100
16	JPN1	JPN	Gold	Daiki Kodama	**479.68**	100	90	41	100	93.68	55
17	JPN2	JPN	Gold	Yuto Watanabe	**479**	100	80	44	100	100	55
18	ROU1	ROU	Gold	Alexandru Luchianov	**476.29**	100	65	60	100	96.29	55
19	TWN1	TWN	Gold	Elliot En-Yi Liu	**470.48**	100	48.5	77	100	89.98	55
20	HRV1	HRV	Gold	Patrick Pavić	**470**	100	65	100	100	50	55
21	USA3	USA	Gold	Benjamin Chen	**461.89**	100	80	27	100	99.89	55
22	KOR3	KOR	Gold	Taehwan Jang	**459.05**	100	53	58	100	93.05	55
23	JPN3	JPN	Gold	Yui Tamura	**457.89**	3	100	100	100	99.89	55
24	JPN4	JPN	Gold	Yuki Tanaka	**454.49**	100	50	58	100	91.49	55
25	IOI7	IOI	Gold	Danil Klisch	**432.21**	100	80	41	100	56.21	55

26	KOR4	KOR	Gold	Younguk Jo	**431.28**	67	51.5	58	100	99.78	55
27	ISR4	ISR	Gold	Daniel Weber	**425.75**	70	53	58	100	89.75	55
28	SVN1	SVN	Gold	Benjamin Bajd	**425.14**	100	72	41	100	57.14	55
29	TWN2	TWN	Gold	Hsin-Wei Hou	**417.06**	100	65	58	100	39.06	55
30	VNM3	VNM	Gold	Bach Tran Xuan	**415.99**	100	48.5	41	100	71.49	55
31	SVK1	SVK	Silver	Eliška Macáková	**398.39**	100	65	4	100	95.39	34
32	POL3	POL	Silver	Kacper Paciorek	**398.1**	100	65	0	100	100	33.1
33	AUS4	AUS	Silver	Jerry Zirui Li	**396.88**	46	65	41	100	89.88	55
34	CAN1	CAN	Silver	Allen Pei	**394.89**	100	65	41	34	99.89	55
35	POL1	POL	Silver	Jan Strzeszyński	**394**	70	56	23	100	90	55
36	USA1	USA	Silver	Rain Jiang	**392.1**	100	65	60	100	10	57.1
37	MKD2	MKD	Silver	Blagojche Pavleski	**386.64**	100	39.5	15	100	77.14	55
38	KOR1	KOR	Silver	Ditbul Ban	**380**	53	80	58	34	100	55
39	ROU2	ROU	Silver	Luca Perju Verzotti	**368.04**	67	65	0	100	99.89	36.15
40	MAC1	MAC	Silver	Cheng U Ian	**360.95**	67	90	15	34	99.95	55
41	IND4	IND	Silver	Kshitij Sodani	**354.93**	100	80	27	34	58.93	55
42	KOR2	KOR	Silver	Sanghoon Park	**354.1**	70	72	27	34	96.1	55
43	CUB1	CUB	Silver	Manuel Darío Oliver Ballesteros	**347.39**	100	65	41	0	99.89	41.5
44	IOI1	IOI	Silver	Daniil Zabauski	**345.24**	64	65	37	34	90.24	55
45	IRN3	IRN	Silver	Alireza Samimi	**343.5**	100	51.5	27	100	10	55
46	POL2	POL	Silver	Michał Stawarz	**341.58**	3	36.5	60	100	90.33	51.75
47	BGR4	BGR	Silver	Atanas Dimitrov	**341.55**	47	48.5	44	100	47.05	55
48	HKG2	HKG	Silver	Man Tsung Yeung	**338.73**	100	90	27	18	69.73	34
49	TWN3	TWN	Silver	Che Liu	**337.14**	100	50	41	34	57.14	55
50	DEU2	DEU	Silver	Lucas Schwebler	**335.93**	61	56	15	46	57.93	100

51	CAN3	CAN	Silver	Ryan Bai	**321**	67	80	60	34	25	55
52	SRB1	SRB	Silver	Jovan Bengin	**316.77**	100	65	41	22	57.77	31
53	ROU3	ROU	Silver	Alexandru-Raul Todoran	**310.5**	55	38	0	100	62.5	55
54	SGP2	SGP	Silver	Tan Si Jie	**309.57**	100	50	41	22	41.57	55
55	NLD4	NLD	Silver	Andy van Horssen	**309.13**	47	72	11	100	53.13	26
56	BGD1	BGD	Silver	Farhan Ahmad	**308.96**	53	47	29	34	90.96	55
57	BRA2	BRA	Silver	Leonardo Valente Nascimento	**307**	100	41	41	100	25	0
58	ISR2	ISR	Silver	Eitan Elbaum	**306.45**	32	50	41	34	94.45	55
59	UKR4	UKR	Silver	Vladyslav Denysiuk	**306**	100	65	27	34	25	55
60	TUR4	TUR	Silver	Alperen Tupurtu	**305.81**	100	56	15	18	61.81	55
61	GBR2	GBR	Silver	Erekle Roinishvili	**305.04**	46	100	4	18	82.04	55
62	IDN1	IDN	Silver	Albert Yulius Ramahalim	**303**	67	56	41	34	50	55
63	AUS3	AUS	Silver	Arthur Wenqi Sun	**302.07**	78	80	4	13	87.67	39.4
64	ISR1	ISR	Silver	Alon Tanay	**298.31**	32	90	27	34	60.31	55
65	AUS2	AUS	Silver	Joshua Chen	**298**	46	72	41	22	62	55
66	IND1	IND	Silver	Paras Kasmalkar	**296.8**	70	48.5	41	22	60.3	55
67	SRB2	SRB	Silver	Mateja Vukelić	**293.04**	100	60	15	9	57.29	51.75
68	VNM4	VNM	Silver	Khoi Duong Minh	**293**	70	47	11	100	10	55
69	FRA1	FRA	Silver	François Vogel	**291.03**	67	44	41	34	50.03	55
70	SGP3	SGP	Silver	Daniel Toh Jing En	**290.95**	32	80	18	34	71.95	55
71	AUS1	AUS	Silver	Evan Lin	**288.25**	53	65	27	22	66.25	55
72	IOI5	IOI	Silver	Fedor Romashov	**287.57**	55	48.5	41	34	70.97	38.1
73	ITA1	ITA	Silver	Filippo Casarin	**285.61**	32	72	41	34	51.61	55
74	TUR3	TUR	Silver	Yunus Taha Bingül	**285.5**	3	65	41	100	47.5	29
75	VNM2	VNM	Silver	Nghia Le Huu	**280.83**	9	30	4	100	89.33	48.5

76	BGR2	BGR	Silver	Deyan Hadzhi-Manich	**280.51**	70	41	44	22	93.51	10
77	VNM1	VNM	Silver	Bao Truong Van Quoc	**279.9**	100	65	60	18	25	11.9
	IDN8	IDN	Silver*	Vannes Wijaya	**279.35**	46	65	41	100	10	17.35
78	KAZ2	KAZ	Silver	Zhambyl Maksotov	**278**	70	65	41	22	25	55
79	TWN4	TWN	Silver	Jhao-Syun Lai	**277.35**	18	38	41	61	64.35	55
80	LTU1	LTU	Silver	Aldas Lenkšas	**276.77**	18	38	41	34	90.77	55
81	IDN4	IDN	Silver	Joseph Oliver Lim	**273.37**	53	65	41	22	61.37	31
82	BRA4	BRA	Silver	Rafael Nascimento Soares	**270.61**	53	65	27	34	57.61	34
83	FRA3	FRA	Silver	Charles Dai	**268**	18	56	14	100	25	55
84	BRA1	BRA	Silver	Carolina Moura Valle Costa	**265.27**	67	65	27	18	57.27	31
85	GEO2	GEO	Silver	Ketevan Tsimakuridze	**263.05**	100	10	41	18	54.65	39.4
86	HUN1	HUN	Silver	István Ádám Molnár	**263**	46	90	37	25	10	55
87	KAZ4	KAZ	Silver	Mukhammadarif Sakhmoldin	**257.94**	70	30	23	22	57.94	55
88	NLD1	NLD	Silver	Daan de Groot	**257.8**	9	65	11	18	99.8	55
89	MYS4	MYS	Bronze	Isaac Kai Sheng Hew	**257.06**	0	90	0	100	60.31	6.75
90	HRV4	HRV	Bronze	Matej Vojvodić	**256.39**	32	42.5	18	9	99.89	55
91	CAN4	CAN	Bronze	Edward Xiao	**256.14**	47	60	27	34	57.14	31
92	ISR3	ISR	Bronze	Elazar Koren	**255.5**	70	45.5	41	34	10	55
93	TUR2	TUR	Bronze	Fatih Solak	**254**	46	65	44	34	10	55
94	MAC4	MAC	Bronze	Chon Hou Ye	**251.5**	70	48.5	29	89	10	5
	IDN7	IDN	Bronze*	Andrew Andrew	**250.91**	46	48.5	41	34	50.41	31
95	MYS1	MYS	Bronze	Hua Zhi Vee	**250.2**	3	65	58	25	44.2	55
96	TUR1	TUR	Bronze	Yusuf Onur Usumez	**247.81**	47	48.5	0	61	60.31	31
97	IDN3	IDN	Bronze	Maximilliano Utomo Quok	**247.5**	32	65	4	89	47.5	10
98	GEO4	GEO	Bronze	David Memarnishvili	**242.08**	100	65	0	0	65.18	11.9

99	BGR1	BGR	Bronze	Martin Kopchev	**241.41**	67	5	29	18	83.01	39.4
100	KAZ3	KAZ	Bronze	Taimas Korganbayev	**239**	70	47	23	34	10	55
101	GBR4	GBR	Bronze	Hanks Chong	**237**	53	56	41	22	10	55
	IDN5	IDN	Bronze*	Albert Ariel Putra	**236**	32	80	41	18	10	55
102	BGR3	BGR	Bronze	Andon Todorov	**235.25**	32	80	41	34	10	38.25
103	IOI3	IOI	Bronze	Dzmitry Antashkevich	**235**	3	65	41	61	10	55
104	LVA1	LVA	Bronze	Ansis Gustavs Andersons	**232.35**	26	65	14	100	10	17.35
105	KGZ1	KGZ	Bronze	Aidar Munduzbaev	**232.3**	53	47	60	18	47.55	6.75
106	ARM1	ARM	Bronze	Arayi Khalatyan	**232.19**	6	90	4	34	91.44	6.75
107	ROU4	ROU	Bronze	Andrei-Robert Ion	**231.92**	18	80	15	2	91.17	25.75
108	CZE2	CZE	Bronze	Benjamin Swart	**231.61**	18	65	27	0	90.61	31
109	THA2	THA	Bronze	Krit Suwanpaiboon	**230.77**	18	80	27	22	52.77	31
110	MAR1	MAR	Bronze	Ayman Riad Solh	**230.5**	53	36.5	27	34	25	55
111	MKD3	MKD	Bronze	Marko Tanevski	**229.25**	9	48.5	15	100	50	6.75
112	HUN2	HUN	Bronze	Pál Czanik	**228.71**	18	56	27	22	50.71	55
113	IND3	IND	Bronze	Ritul Kumar Singh	**225.53**	32	51.5	27	34	50.03	31
114	MYS2	MYS	Bronze	Shao Qian Chew	**224.14**	78	0	23	61	57.14	5
	IDN6	IDN	Bronze*	Matthew Allan	**222.75**	100	0	0	34	57.75	31
115	IOI4	IOI	Bronze	Bogdan Tolstik	**220.53**	64	48.5	41	22	38.28	6.75
116	CYP1	CYP	Bronze	Theofanis Orfanou	**219.42**	32	65	15	34	63.42	10
117	HKG1	HKG	Bronze	Chun Wong	**217**	12	65	41	34	10	55
118	IDN2	IDN	Bronze	Juan Carlo Vieri	**214.25**	67	48.5	41	22	10	25.75
119	PHL1	PHL	Bronze	Raphael Dylan Dalida	**214.19**	18	80	4	18	84.19	10
120	ITA3	ITA	Bronze	Valerio Stancanelli	**213.9**	12	48.5	27	18	91.05	17.35
121	BGD3	BGD	Bronze	Md Nafis Ul Haque Shifat	**212.41**	61	5	23	34	58.41	31

122	BGD4	BGD	Bronze	Debojoti Das Soumya	**211.51**	46	0	41	22	47.51	55
123	IOI2	IOI	Bronze	Tsimafei Baliukonis	**211.35**	40	48.5	23	18	59.35	22.5
124	BRA3	BRA	Bronze	Pedro Shinzato Chen	**210.03**	38	65	0	2	50.03	55
125	ITA2	ITA	Bronze	Davide Bartoli	**209.78**	53	41	27	25	53.78	10
126	BEL2	BEL	Bronze	Zhiyi Luo	**205**	67	56	4	13	10	55
127	SGP4	SGP	Bronze	Joel Au Heng Hoi	**204.5**	46	48.5	41	34	25	10
128	POL4	POL	Bronze	Jeremiasz Preiss	**199.75**	9	80	15	34	10	51.75
129	HKG3	HKG	Bronze	Wai Lok Lai	**194.35**	3	0	23	100	58.35	10
130	PHL2	PHL	Bronze	Frederick Ivan Tan	**194.04**	61	0	0	18	99.89	15.15
131	ZAF1	ZAF	Bronze	Minkyum Kim	**192.17**	9	65	0	0	99.77	18.4
132	ARM4	ARM	Bronze	Hamlet Petrosyan	**191.5**	18	42.5	41	25	10	55
133	MAC2	MAC	Bronze	Tong Sam Zheng	**190.14**	53	41	4	13	61.79	17.35
134	KGZ3	KGZ	Bronze	Tengiz Bekkoyonov	**189**	18	30	27	34	25	55
135	MDA3	MDA	Bronze	Victor Purice	**186.97**	18	48.5	29	18	42.47	31
136	GEO1	GEO	Bronze	Luka Mosiashvili	**185.6**	61	36.5	27	22	25	14.1
137	UKR3	UKR	Bronze	Daryna Karpenko	**185.1**	26	65	27	2	53.2	11.9
138	ITA4	ITA	Bronze	Francesco Lugli	**184.45**	50	42.5	15	9	57.95	10
139	DNK1	DNK	Bronze	Thor Vejen Eriksen	**182.75**	46	5	37	18	25	51.75
140	MKD4	MKD	Bronze	Teo Kitanovski	**181.39**	18	65	4	18	71.39	5
141	DEU4	DEU	Bronze	Leandro Conte	**181.15**	46	60	27	2	10	36.15
142	PSE1	PSE	Bronze	Nicola Abusaad	**180**	18	56	41	0	10	55
143	TJK1	TJK	Bronze	Shakhrom Aminov	**179**	26	72	44	2	25	10
144	MNE1	MNE	Bronze	Egor Georgievskii	**178**	17	65	27	25	10	34
145	TKM1	TKM	Bronze	Gurbanberdi Gulladyyev	**176**	70	0	41	34	0	31
146	MYS3	MYS	Bronze	Hau Ye Heng	**175.33**	47	30	23	22	44.23	9.1

147	MEX2	MEX	Bronze	Alier Sanchez y Sanchez	**175.13**	18	90	4	0	53.13	10
148	CHE1	CHE	Bronze	Elias Bauer	**175**	3	38	29	25	25	55
149	ISL1	ISL	Bronze	Benedikt Vilji Magnússon	**174.27**	40	65	0	0	59.27	10
150	NZL2	NZL	Bronze	Nicholas Grace	**173.75**	32	65	18	23	10	25.75
150	AUT4	AUT	Bronze	Martin Bierbaumer	**173.75**	46	65	4	2	50	6.75
152	CHE2	CHE	Bronze	Josia John	**173.25**	3	65	27	0	47.5	30.75
153	SWE1	SWE	Bronze	Olle Lapidus	**172.29**	9	51.5	0	0	99.89	11.9
154	MNG3	MNG	Bronze	Jangar Enkhbaatar	**171**	32	30	27	2	25	55
155	KGZ2	KGZ	Bronze	Daniyar Beishekeev	**169**	18	80	4	2	10	55
155	AUT2	AUT	Bronze	Matthias Pleschinger	**169**	3	72	4	25	10	55
157	BIH1	BIH	Bronze	Haris Imamovic	**168.41**	3	65	0	22	61.06	17.35
158	MEX4	MEX	Bronze	Cynthia Naely López Estrada	**166.92**	32	56	4	9	47.52	18.4
159	SRB4	SRB	Bronze	Filip Bojković	**165.75**	100	30	0	0	10	25.75
160	EGY3	EGY	Bronze	Abdelmaged Ibrahim	**164.12**	3	42.5	27	22	59.62	10
161	MNG2	MNG	Bronze	Bat-Erdene Batsukh	**163.67**	18	30	4	2	57.92	51.75
162	EGY2	EGY	Bronze	Mohamed Bakry	**163.35**	18	5	56	18	25	41.35
163	SYR4	SYR	Bronze	Amin Charba	**163.06**	18	38	15	0	61.06	31
164	AZE1	AZE	Bronze	Said Nasibov	**163**	64	65	0	0	0	34
165	KAZ1	KAZ	Bronze	Van Li	**160.9**	53	48.5	41	0	0	18.4
166	PER2	PER	Bronze	Rolly Mamani	**157**	46	5	4	22	25	55
167	MEX1	MEX	Bronze	Alejandro Ozymandias Cepeda Beltran	**155.32**	18	38	23	7	62.57	6.75
168	LVA3	LVA	Bronze	Matīss Kristiņš	**155**	53	56	4	22	10	10
169	SAU2	SAU	Bronze	Abdulaziz Alshibli	**153**	18	65	27	2	10	31
170	DEU3	DEU	Bronze	Johann Gaulke	**152**	18	41	18	34	10	31
171	ESP3	ESP	Bronze	Sergio Domínguez Alonso	**150.44**	18	38	15	9	58.54	11.9

172	SYR2	SYR	Bronze	Hazem Dalati	**150**	53	30	4	22	10	31
173	CZE3	CZE	Bronze	Daniel Skýpala	**148**	12	65	27	0	10	34
174	FIN1	FIN	Bronze	Leo Varis	**147.3**	9	45.5	4	2	45.45	41.35
175	IND2	IND	Bronze	Harshin Posina	**147**	18	56	18	0	0	55
175	FIN2	FIN	Bronze	Henrik Aalto	**147**	18	56	4	34	25	10
177	CYP3	CYP	HM	Demetris Chrysostomou	**146**	18	50	4	9	10	55
178	SVK2	SVK	HM	Jakub Konc	**145.4**	12	51.5	4	16	50	11.9
179	GBR1	GBR	HM	Ojas Gulati	**143**	3	80	0	0	10	50
180	DEU1	DEU	HM	Niklas Leinert	**142**	3	30	56	18	25	10
180	KGZ4	KGZ	HM	Talant Diykanbaev	**142**	18	5	4	100	10	5
182	HUN3	HUN	HM	Márton Tamás Németh	**141.15**	17	65	4	0	0	55.15
183	EGY4	EGY	HM	Salman Elgamal	**141**	0	60	0	16	10	55
184	THA3	THA	HM	Pitakpong Kapincharanont	**140.65**	12	56	0	2	60.65	10
185	DNK2	DNK	HM	Lorenzo Ferrari	**138**	46	5	4	18	10	55
186	CUB2	CUB	HM	Alberto Leyva Guerra	**137.03**	18	38	0	0	50.03	31
187	SVN2	SVN		Matija Likar	**136**	12	38	27	18	10	31
188	BIH2	BIH	HM	Benjamin Mujkić	**135**	53	0	41	0	10	31
188	NOR4	NOR	HM	Jakob Rødal Skaar	**135**	32	38	0	0	10	55
190	HRV3	HRV	HM	Ivan Janjić	**134.24**	3	36.5	11	0	49.74	34
191	MDA2	MDA	HM	Victor Vorona	**134**	9	65	23	2	25	10
191	FRA2	FRA		Alice Tosel	**134**	3	30	37	25	10	29
193	ESP1	ESP	HM	Darío Martínez Ramírez	**133**	12	65	15	0	10	31
194	EST1	EST	HM	Marko Tsengov	**129.75**	23	72	0	18	10	6.75
195	BEL4	BEL	HM	Pieterjan Vandecasteele	**129.65**	18	5	29	13	54.65	10
196	LTU2	LTU		Augustinas Jučas	**129.5**	18	48.5	0	22	10	31

197	PHL3	PHL	HM	Cassidy Kyler Tan	**129**	18	65	4	22	10	10
198	HUN4	HUN	HM	Lőrinc Máté	**128.48**	18	0	0	0	55.48	55
199	CYP2	CYP	HM	Christos Falas	**128**	9	65	4	9	10	31
200	PRT1	PRT	HM	Tiago Marques	**126.5**	18	48.5	18	22	10	10
201	HKG4	HKG	HM	Chi Ho Wang	**124.5**	12	42.5	41	9	10	10
202	DNK4	DNK	HM	Elias Rasmussen Lolck	**124.25**	18	60	0	2	25	19.25
203	EST4	EST	HM	Peeter Aleksander Randla	**124**	3	80	4	22	10	5
204	UZB3	UZB	HM	Dilyorbek Valijonov	**123**	18	56	4	25	10	10
205	NOR2	NOR	HM	David S. Eikeland	**122.35**	9	80	4	2	10	17.35
206	NZL3	NZL		Zalan Varga	**120.57**	18	41	4	0	47.57	10
207	BEL1	BEL		Petar Vitorac	**120**	3	56	18	2	10	31
207	TUN2	TUN		Amine Oueslati	**120**	32	38	0	9	10	31
209	SWE3	SWE	HM	Victor Vatn	**117.75**	14	0	27	0	25	51.75
210	DNK3	DNK	HM	Malte Rosenkilde	**116.15**	53	38	0	0	10	15.15
211	ARG2	ARG	HM	Lucas Hernán Tarche	**115.75**	9	65	4	2	10	25.75
212	LVA2	LVA		Valters Kalniņš	**113.9**	18	48.5	11	18	10	8.4
213	GRC3	GRC		Markos Radaios	**113.5**	9	41	4	2	47.5	10
214	MAR2	MAR		Nabil Boudra	**113**	46	10	15	22	10	10
215	MNG4	MNG		Enerelt Delgerdalai	**112**	12	0	41	18	10	31
216	BIH4	BIH		Faruk Ibrahimović	**111.5**	12	45.5	0	13	10	31
217	BEL3	BEL		Vladislav Morozov	**111**	3	65	0	2	10	31
218	SVK4	SVK	HM	Jakub Drobný	**110.7**	18	0	15	2	58.35	17.35
219	CHE3	CHE		Linus Lüchinger	**110**	3	47	4	0	25	31
220	TUN3	TUN	HM	Amir El Arbi	**109.75**	12	41	27	13	10	6.75
221	BGD2	BGD	HM	Jarif Rahman	**109.72**	12	0	0	2	61.72	34

222	IRN1	IRN		Ariya Hemmati	**109**	32	0	23	34	10	10
222	NZL4	NZL		Qiushi Chen	**109**	18	30	4	2	0	55
224	SAU3	SAU		Almothana Alzahrani	**108.6**	3	38	4	0	53.6	10
225	THA4	THA		Mok Wattanasopon	**108.35**	12	60	0	9	10	17.35
226	TUN1	TUN		Hedi Chehaidar	**108**	32	30	4	22	10	10
226	SVK3	SVK	HM	Ján Gottweis	**108**	9	5	27	2	10	55
228	SLV1	SLV		César Esaú Flores Martínez	**106**	12	53	0	0	10	31
229	TJK2	TJK		Dilshod Imomov	**104**	18	30	15	0	10	31
230	SYR1	SYR		Antwan Dabbous	**103.35**	18	5	27	2	10	41.35
231	CZE4	CZE		Robert Jaworski	**103**	0	65	0	18	10	10
232	FIN4	FIN		Väinö Mäkelä	**101.4**	9	30	4	9	10	39.4
233	EST3	EST		Olivia Tennisberg	**99**	3	53	0	2	10	31
234	ESP2	ESP		Manuel Torres Cid	**98.63**	18	5	15	0	50.63	10
235	MNG1	MNG		Belgutei Byambadorj	**97**	53	0	15	9	10	10
236	PRT4	PRT		Tiago Sousa	**95**	18	30	4	2	10	31
237	SWE2	SWE		Alexander Wahlsten	**94.55**	40	0	0	7	47.55	0
238	ESP4	ESP		Hugo Domínguez Santana	**93.4**	18	30	4	13	10	18.4
239	AZE2	AZE		Fuad Garayev	**92**	18	30	15	9	10	10
240	VEN2	VEN		Diego Fernando Ortiz Tepedino	**91**	53	5	4	9	10	10
241	PHL4	PHL		Filbert Ephraim Wu	**90.35**	32	10	4	2	25	17.35
242	CHE4	CHE		Lukas Münzel	**90**	17	30	0	2	10	31
243	ARG1	ARG		Ulises López Pacholczak	**89.26**	3	30	0	2	47.51	6.75
244	GEO3	GEO		George Chkhaidze	**86.75**	9	5	41	0	25	6.75
245	CZE1	CZE		Lukáš Tomoszek	**86**	18	36.5	15	13	0	3.5
246	NOR1	NOR		Jonas Elvedal Hole	**85.5**	9	54.5	0	2	10	10

247	FRA4	FRA		Yann Viegas	**85**	18	30	15	2	10	10
248	PER1	PER		Angie Alcantara	**81**	44	0	15	2	10	10
249	THA1	THA		Kamanun Maneesri	**80.75**	53	5	4	2	10	6.75
250	EST2	EST	HM	Kregor Ööbik	**76.75**	3	5	0	18	25	25.75
251	ARM3	ARM		Samvel Abelyan	**76.5**	18	36.5	0	2	10	10
252	GBR3	GBR		Toby Collins	**74.4**	12	30	4	0	10	18.4
253	IRL4	IRL		Isaac Lee	**72**	9	41	0	2	10	10
253	IRL1	IRL		Ayushi Mahajan	**72**	9	41	0	2	10	10
253	SLV2	SLV		José Manuel Cabrera Guardado	**72**	9	0	27	0	10	26
256	SYR3	SYR		Bernard Ibrahimcha	**70.4**	12	30	4	6	0	18.4
257	SAU1	SAU		Adeeb AlShehry	**69.06**	9	5	4	2	39.06	10
258	PRT3	PRT	HM	Jorge Costa	**68.38**	0	0	0	9	52.63	6.75
259	ISL3	ISL		Kirill Zolotuskiy	**67.25**	0	48.5	0	2	10	6.75
260	UZB4	UZB		Dilshodbek Khujaev	**66.4**	9	5	11	13	10	18.4
261	TUN4	TUN		Mohamed Ali Saidane	**65.75**	3	5	4	18	10	25.75
262	MEX3	MEX		Juan Pablo Amezcua González	**65.5**	3	36.5	4	2	10	10
263	PSE3	PSE		Mohammed Atalah	**65**	9	30	4	2	10	10
263	ARM2	ARM		Gagik Gevorgyan	**65**	12	0	15	18	10	10
263	LTU4	LTU	HM	Nedas Bolevičius	**65**	0	0	0	0	10	55
266	GRC4	GRC		Sokratis Iliadis	**62.75**	18	5	4	0	10	25.75
267	LTU3	LTU		Joris Pevcevičius	**62.5**	9	36.5	0	2	10	5
268	DOM1	DOM		Jair Rafael Santana Benzan	**59.75**	26	5	15	2	10	1.75
269	SVN3	SVN		Jakob Žorž	**59.61**	18	0	0	0	39.86	1.75
270	UZB1	UZB		Svyatoslav Kim	**58**	3	0	11	0	10	34
271	ZAF3	ZAF		Benjamin Kleyn	**57.35**	12	5	0	13	10	17.35

272	TJK4	TJK	Voris Rahimov	**57**	12	0	23	2	10	10
273	NZL1	NZL	Phoebe Zhang	**56**	32	5	4	0	10	5
273	AZE4	AZE	Fidan Huseynova	**56**	18	5	4	9	10	10
275	MDA1	MDA	Veaceslav Guzun	**55.75**	32	0	0	7	10	6.75
276	MAC3	MAC	Hok Fong Wong	**54.35**	9	5	4	9	10	17.35
277	LVA4	LVA	Krišjānis Petručeņa	**54**	18	10	4	2	10	10
278	PER3	PER	Angelo Torres	**52.35**	9	10	4	2	10	17.35
279	CUB3	CUB	John Mauris López Ramos	**52.25**	9	36.5	0	0	0	6.75
280	CHL1	CHL	Diego Arias	**52**	18	5	4	0	25	0
281	EGY1	EGY	Ahmad Moursi	**51.5**	9	5	0	0	10	27.5
282	PSE2	PSE	Sohaib Sawalha	**51**	32	5	4	0	10	0
283	TJK3	TJK	Musharraf Shukrulloev	**50.4**	18	0	4	0	10	18.4
284	NLD3	NLD	Olaf Herman	**50**	0	38	0	2	0	10
285	BOL1	BOL	Daner Zein Tonconi Mendoza	**49**	18	5	4	2	10	10
285	SRB3	SRB	Toni Škrijelj	**49**	3	5	15	0	0	26
287	PSE4	PSE	Roba Katout	**47**	18	5	4	0	10	10
287	SLV3	SLV	Fernando Andreé González Meléndez	**47**	9	5	4	9	10	10
287	NLD2	NLD	Jona Bedaux	**47**	3	0	0	0	10	34
290	LKA3	LKA	Chirath Nirodha	**46**	18	0	11	2	10	5
291	CHL2	CHL	Marcelo Lemus	**45.75**	3	5	0	2	10	25.75
292	LKA2	LKA	Minindu Jayasekara	**45.35**	9	5	4	0	10	17.35
292	CYP4	CYP	Panagiotis Chatzikostas	**45.35**	12	0	4	2	10	17.35
294	SWE4	SWE	Erik Hedin	**45**	12	5	23	0	0	5
295	MDA4	MDA	Marian Soltan	**44.4**	9	5	0	2	10	18.4
296	ZAF2	ZAF	Emmanuel Rassou	**44**	18	0	4	2	10	10

297	IRL2	IRL	Benjamin Faltin	**43.4**	9	10	4	2	0	18.4
298	UZB2	UZB	Khusanboy Mansuraliev	**40**	9	5	4	2	10	10
298	NGA3	NGA	Moyinoluwa David Orimoloye	**40**	9	5	4	2	10	10
300	MKD1	MKD	Sofija Velkovska	**39**	3	5	11	0	10	10
301	AUT3	AUT	Thomas Riedle	**37.35**	3	5	0	2	10	17.35
302	FIN3	FIN	Elias Simojoki	**37**	3	5	0	9	10	10
303	SAU4	SAU	Abdulmohsen Mohammedsaleh	**36**	3	0	11	2	10	10
303	SVN4	SVN	Bor Brudar	**36**	9	5	0	2	10	10
303	BOL3	BOL	Alejandro Fabio Castro Álvarez	**36**	9	5	0	2	10	10
303	BOL2	BOL	Gilberto Rodrigo Pierre Gosset Gonzales	**36**	9	5	0	2	10	10
307	MAR4	MAR	Akram El Omrani	**35.5**	9	0	11	2	10	3.5
308	IRL3	IRL	Ruadhán Mac Giolla Phádraig	**35**	9	0	4	2	10	10
308	VEN3	VEN	Juan Diego Marcano Cuellar	**35**	9	0	4	2	10	10
310	NGA4	NGA	Daniel Emeka-Ilozor	**33.5**	18	0	0	2	10	3.5
311	BIH3	BIH	Emira Ibrahimovic	**33.35**	3	0	11	2	0	17.35
312	NGA2	NGA	Joseph Achimugu	**31.75**	9	0	4	2	10	6.75
312	MAR3	MAR	Soufien El Mazlouzi	**31.75**	9	0	4	2	10	6.75
314	AUT1	AUT	Thomas Wachter	**30.75**	9	5	0	0	10	6.75
315	COL2	COL	Kiara Jimena González Almanzar	**30**	3	5	0	2	10	10
316	LUX4	LUX	Thanh-Viêt Jean Nguyen	**29**	9	0	0	0	10	10
316	LUX1	LUX	Daniel Murphy	**29**	3	0	4	2	10	10
316	LKA1	LKA	Shithila Mahabaduge	**29**	3	0	4	2	10	10
319	JOR2	JOR	Muhammad Saad	**27.75**	9	0	0	2	10	6.75
320	PER4	PER	Bryan Mauricio	**27**	3	0	4	0	10	10
321	NOR3	NOR	Adrian Dobbe Flemmen	**26.75**	18	0	0	2	0	6.75

322	LUX3	LUX	Pierre Roth	**26**	9	5	0	2	10	0
323	VEN1	VEN	Rubdary Valentina Rojas Linarez	**25.75**	3	0	4	2	10	6.75
324	TKM2	TKM	Orazmuhammet Begenjov	**25**	9	0	4	2	10	0
324	JOR3	JOR	Malik Sadaqa	**25**	3	0	0	2	10	10
326	CHL4	CHL	Alex Blanchard	**24.75**	3	5	0	0	10	6.75
327	ISL2	ISL	Einar Andri Víisson	**23**	3	0	0	0	10	10
328	AZE3	AZE	Omar Afandi	**22**	3	5	4	0	0	10
328	CUB4	CUB	Ernesto David Serize Portela	**22**	0	0	0	2	10	10
328	PRT2	PRT	Tomás Faria	**22**	0	0	0	2	10	10
331	JOR4	JOR	Raed Naseer	**21.75**	3	0	0	2	10	6.75
331	COL1	COL	Miguel Angel Sáenz Válcarcel	**21.75**	3	0	0	2	10	6.75
333	ARG3	ARG	Juan Ignacio Cantarella	**21**	9	0	0	2	10	0
334	LKA4	LKA	Apiram Rajamohan	**19.75**	3	0	0	0	10	6.75
335	GRC1	GRC	Panagiotis Liampas	**19**	0	0	0	9	10	0
336	CHL3	CHL	Diego Emilio Rebollo García	**18**	3	5	0	0	0	10
336	ARG4	ARG	Jeremías Figueiredo Paschmann	**18**	3	0	0	0	10	5
338	GRC2	GRC	Andreas Rasvanis	**15.75**	3	0	4	2	0	6.75
338	SLV4	SLV	Cristofer Adonis Vásquez Estrada	**15.75**	3	0	4	2	0	6.75
340	ZAF4	ZAF	Kenna Nemera	**15**	3	0	0	2	0	10
341	TKM4	TKM	Rejepmyrat Shemsetdinov	**13**	3	0	0	0	10	0
342	BOL4	BOL	Shamir Leonardo Terán Mustafá	**12.75**	9	0	0	2	0	1.75
343	LUX2	LUX	Adam Hustava	**8**	3	5	0	0	0	0
344	COL4	COL	Mauricio Bacca Peña	**6.75**	0	0	0	0	0	6.75
345	COL3	COL	Daniel Francisco Hello Puccini	**5**	3	0	0	2	0	0
346	ECU3	ECU	Michael Crescencio Poveda Quimiz	**0**	0	0	0	0	0	0

346	ECU2	ECU	Jahir Manuel Cajas Toapanta	**0**	0	0	0	0	0	0
346	ECU4	ECU	Steven Daniel Mera Cacao	**0**	0	0	0	0	0	0
346	NGA1	NGA	Ayomipe Treasure Moyinlorun	**0**	0	0	0	0	0	0