Olympiads in Informatics, 2023, Vol. 17, 173–188

DOI: 10.15388/ioi.2023.13

Team Competition in Informatics and Mathematics "Cēsis"

Mārtiņš OPMANIS[1], Diāna SILIŅA[2], Sandra SILIŅA[1],
Pēteris PAKALNS
[1]*Institute of Mathematics and Computer Science, University of Latvia,*
[2]*Cēsis State Gymnasium*
e-mail: martins.opmanis@lumii.lv, diana.silina@inbox.lv, sandra.silina@lumii.lv, peterispakalns@gmail.com

Abstract. Team competition in informatics and mathematics for high-school students "Cēsis" still is a rare competition where usage of Internet resources is allowed. Internet availability puts additional requirements for competition tasks. We give a brief overview of used task types together with task examples. Fast and accurate evaluation and grading of solutions to non-standard tasks in a limited time interval is challenging, and automated evaluation tools used at the competition are described.

Keywords: team competition, automated evaluation, Internet resources, task types.

1. Introduction

In the third volume of "Olympiads in Informatics," there was a paper about the team competition in informatics and mathematics (TCIM) "Ugāle" (Opmanis, 2009). TCIM "Ugāle" was an annual event organized until its 20th edition in 2015. Since 2016 competitions almost in the same format have been organized by Cēsis State Gymnasium. In the following, by the abbreviation TCIM, the TCIM "Cēsis" will be assumed. Relocation of onsite competition from one town to another, even if problem setters remain the same, is not a trivial task, and some requirements and observations from the experience together with the general competition format are described in the second section, "From Ugāle to Cēsis." The general structure of the competition is described in the third section, while tasks and solutions of various task types are described in the fourth section. While the main features of the competition were kept traditional, there are essential differences, including the evaluation and grading of solutions described in the fifth section. The last section briefly mentions features of the new evaluation and grading system, "UIM."

2. From Ugāle to Cēsis

At the end of 2014, in discussions with Ugāle Secondary School teacher Aivars Žogla, the main organizer of TCIM "Ugāle," it became clear that it would be better to finish organizing competitions in Ugāle since TCIM here was organized for 20 years, and in some sense reached its limits. At least for local organizers, onsite finals became a routine task for a few passionate people who established this event long ago. Not the slightest reason for this decision was almost a predefined impossibility for host teams to successfully compete with the strongest teams from the gymnasiums from the capital of Latvia, Riga, and other cities.

It should be noted that almost any event has its beginning and end. Even with the same title, the content may be completely different. The biggest challenge in our case in 2015 was providing competition in the usual way, already knowing that this would be the last one in the current form and Ugāle. Since there were people ready to continue contributing to organizing similar events even if the competition would be relocated, the process to find another host – an organization and, most importantly, passionate people willing to do this, started. It was clear that the new host should also be outside Riga. After rejecting some mostly theoretical candidates, there came a proposal from Cēsis State Gymnasium and namely teachers Diāna Siliņa and Agrita Bartušēvica to host the competition in Cēsis, one of the eldest towns (established in 1206) in Latvia. While towns are located in different regions (Ugāle in Kurzeme, Cēsis in Vidzeme), its distance from Riga (95 km), traditionally having most finalists, makes it a perfect place for the event.

3. The General Format of TCIM

TCIM is an annual high-school team competition provided in two rounds – supervised online semifinals in January and onsite finals in May. Each team consists of three participants and may use one computer with access to the Internet. Due to the COVID pandemic in 2020, only the semifinals were organized, and the 2021 competition was canceled altogether. Up to now, seven semifinals and six finals have been organized.

In the semifinals, there is one week when the local supervisor should find a 5-hour window for a local contest. All solutions are sent for evaluation to TCIM organizers via e-mail. After evaluation, finalists are announced. The ten best teams from the semifinals are invited to the final round. The host can invite some additional teams – usually to widen geographical representation or to present finals to schools not previously participated. There is a strict rule that at the final round, no more than two teams can represent the same school or out-of-school organization, like a computer club.

The number of teams and the best result for a particular round are shown in Table 1.

In total, 651 teams from 47 schools were in the semifinals, and 73 teams from 20 schools participated in Cēsis at the finals.

Table 1
Number of teams and schools represented at TCIM "Cēsis" and the best result

Year	Semifinals: teams/schools	The best result (max 1000 points)	Finals: teams/schools	The best result (max 1000 points)
2016	75/18	833	11/8	652.18
2017	100/27	860	10/9	715
2018	126/31	979	13/10	666
2019	118/25	814	13/10	607.44
2020	109/24	809	–	–
2022	40/15	988	11/7	863
2023	83/22	927	15/11	554.32

The schedule of finals is traditional – in the morning, all teams arrive in Cēsis, have a draw for a room where they work (each team in a separate room), and after the short opening ceremony, start working on tasks. For solving, 5.5 hours are given with a small break for lunch. After that jury proceeds with the evaluation of solutions, and at the closing ceremony, teams are awarded. All teams get diplomas – the first three place winners for medals, the following three get honorable mentions, and all others for participation. First-place winner also receives a trophy and is obliged to cut the winner's cake in pieces to treat all participants and organizers.

It should be noted that, despite a high level of competition content, the atmosphere at the finals is friendly and informal. For example, traditionally printed task descriptions are not simply given to teams; they should solve a small task to deserve them. For example, in the final round of 2023, this task was to name any Latvian city having at least three letters shared with the name "CĒSIS."

Traditionally, the strongest teams were from Riga State Gymnasium N1, which won 6 out of 7 finals, and only in 2019, the host team from Cēsis State Gymnasium won the competition.

Besides the contest part, serious organizational work is "behind the scenes." Since TCIM is provided without financial support from the state, the successful provision of competition depends on the support of local enthusiasts from Cēsis State Gymnasium (with the direct support of directors Gunta Bērziņa and Ina Gaiķe), Cēsis municipality and sponsors. At the finals, there are "must have" things like a separate working room, one computer with Internet access for each team, and writing utensils and scratch paper. Traditionally, during finals, there is an excursion for teachers of participating teams and some activities for participants while submitted answers are evaluated. All participants of TCIM finals receive small memorabilia gifts at the end of the competition.

4. Tasks and Solutions

A lot about task types in TCIMs was written in previous papers (Opmanis, 2009; Opmanis, 2015).

There still are no widely known competitions in mathematics and informatics where unlimited usage of Internet resources is allowed. It should be emphasized that "Internet resources" assumes only access to materials and not the usage of the Internet as a communication environment to get help from outside. Allowance of Internet usage defines strict rules for task selection – tasks taken "as is" from public sources should be, in general, avoided (if it is not intended to search for this particular information). Published tasks can be given with some modifications or as subtasks. However, figures should not be copied but made from scratch to exclude direct matches with published sources. Even if the author of the task assumes that his task is original, it should be carefully checked that a solution can't be obtained by a simple search.

Since task descriptions are prepared in Latvian, it simplifies the risk of finding a similar task compared to task descriptions in English. However, participant's knowledge of English, the rapid evolution of translation and search systems, and artificial intelligence systems like ChatGPT make the preparation of task sets more and more challenging.

We will characterize some general aspects of tasks and expected answers:

Answers should be short in form – one or a few numbers, a short text string, some configuration of elements (like domino or pentamino pieces) or filled table (like SUDOKU). All possible correct answers should be found if it is not stated that it is enough to find any one of them. Traditionally it is not said whether there is one or several answers.

The number of tasks. In each round, ten tasks, each worth 100 points, are given.

Subtasks and grading schema. In the task set, tasks with "all or nothing" grading are rare – almost all tasks have 2–5 subtasks with partial scores. Different amounts of points are given for solved subtasks in various tasks, and this results in an excellent distribution of total points without (in finals) or rare (in semifinals) ties and, as a consequence, no problems with the determination of the winner or deciding the best teams.

Description of tasks. TCIM has much more freedom in task themes and task description formats than classic olympiads and contests like Bebras, where there is no space to describe unknown concepts or complicated rules. In Bebras, there is also time pressure since contestants should be able to comprehend and solve each task in 2–3 minutes.

TCIM has no formal limits on a description length or how standard language should be used. The main principle is that task descriptions should be clear and unambiguous. However, in the history of TCIM, there has been a case when due to text modification, the initial content of the task was slightly changed, leading to more than one correct answer. While the length of task descriptions is not limited, the usual length of a printed task set is 3 to 5 pages.

We feel free to use not-so-formal language. For example, in the task "Equivalent" (see below), after the observation that several jury members missed one particular clue, the last sentence was added.

While sometimes it is hard to label some tasks properly, the usual **task types** used are the following:

4.1. *Data Processing/Data Mining Tasks*

These tasks are traditional and were presented at all TCIM rounds. In these tasks file with some data or a link to the online data source is given, and teams are asked to explore these data and get answers to several questions. The intended tool is a spreadsheet, while it can be some database managing system or programming language. For example, at the finals of 2023, historical daily weather data for four years in five Latvian cities were obtained from the site "Visual Crossing Weather" (Visual Crossing), and one of the questions offered was: "In how many days there are no two cities with the same description of weather?"

It should be noted that since 2018 no team has gotten a full score in data processing tasks at TCIM finals.

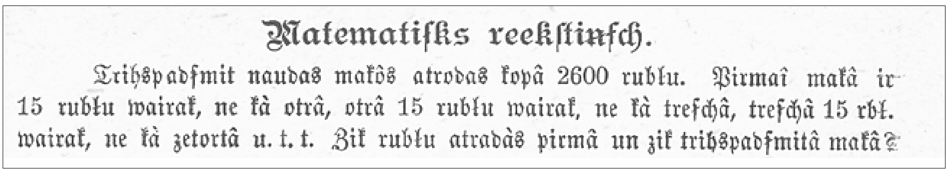
4.2. *Word Problems*

Good tasks can be found in old journals and books. Since the Latvian National Digital Library (Periodika) contains scanned old periodicals, it is easy to find word problems even from the 19th century. One of such tasks from the "Rota" journal (issue 7, 1886) in its original form (including Gothic writing and rules to denote diacritical signs characteristic for this period) was given in the semifinal of 2017 (see Fig. 1), and 67% of teams solved this task.

A similar approach was used in the semifinals of 2023, where an even older task from the same journal (issue 1, 1884) in its original form was given. However, the success rate was lower this time – only 16,7% of teams solved this task. Of course, in these cases, the historical representation of the task is also essential.

4.3. *Geometry*

During the task preparation, several possible side effects should be considered. As a rule, there should be no answers that are easy to guess in geometrical tasks – like an angle of 30°, 45°, or 60°. From the experience of the last Latvian Math Olympiad (LMO), there may be an erroneous assumption that the answer should always be an integer. For example, if it is given that area of a rectangle is 20, then possible options for the shortest



Matematiſks reekſtiņſch.

Trihspadſmit naudas makôs atrodas kopâ 2600 rubļu. Pirmaî makâ ir 15 rubļu wairak, ne kà otrâ, otrâ 15 rubļu wairak, ne kà treſchâ, treſchâ 15 rbl. wairak, ne kà zetortâ u. t. t. Zik rubļu atradàs pirmâ un zik trihspadſmitâ makâ?

Fig. 1. The task from the journal "Rota."

side can be only 1, 2, and 4. Therefore at TCIM, in geometrical tasks, almost all answers are real numbers, not integers, and an accuracy of 10^{-6} is required to get a full score. However, even this cannot help if the participant is familiar with software like GeoGebra in which you, in particular tasks, can get the proper answer just by the correct drawing.

Example of a task in geometry (semifinals of 2023):

In the convex quadrilateral ABCD, ∠ABD = ∠ACD = 90°. Lengths of three edges are known: AB = 487 cm, BC = 283 cm, and AD = 2022 cm. Find the length of the edge CD in centimeters!

4.4. *Combinatorics*

Allowing the usage of Internet resources makes it more and more challenging to create tasks in combinatorics. For example, suppose it is asked to find several different combinations for particular parameter values. In that case, a standard way of solving may be to find "by hand" the answers for some small parameter values and use them to search for an appropriate integer sequence in the famous Online Encyclopaedia of Integer Sequences (OEIS®). If there are enough correct first members and the contestant can understand the mathematical language of how the particular sequence is described, the problem can likely be solved (at least partially). The task for problem setters now includes mandatory checking of OEIS® sources and (if possible) asking for solutions for values above those given in OEIS® or linked resources. It should be noted that finding an appropriate sequence, in general, is welcome, especially if a problem is formulated in a not straightforward form where the skill to understand that this is the correct sequence is deciding.

The task authors can be even more proud if the task has no corresponding sequence in OEIS® at the time when this task is given in a competition. One such task, "Guards of a castle," was presented at the finals of 2023:

Four walls of the castle are defended by guards who may be positioned only in eight places – in towers at the corners or in the middle of each wall. Guards in the towers defend two appendant walls while guards in the middle of the wall guard only this wall. Guards should be distributed so that the same number of guards defends all four walls. If one distribution can be obtained from another by reflection and/or rotation, they are counted as one. For example, if there are six guards, there are five different distributions shown in Fig. 2.

What is the number of different distributions for a) 9, b) 30, c) 91, d) 2023 guards?

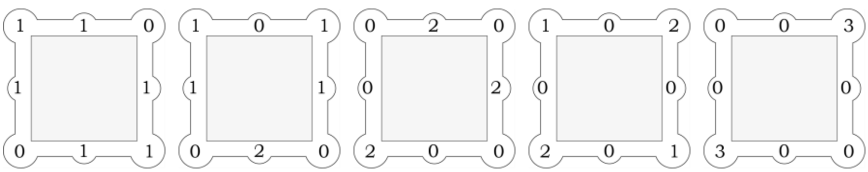


Fig. 2. Different distributions of six guards.

This task is interesting because you should write an effective computer program to solve subtasks b) to d) and be ready to wait for the computations to get the answer in subtask d). At the competition, only one team solved three first subtasks, but no one succeeded with the last one.

The task was inspired by tasks "The Courageous Garrison" and "Daylight lamps" (Kordemsky, 1972) where (in terms of our task) for the changing number of guards, it was asked to find a valid configuration for a particular constant number of guards defending each wall.

4.5. *Number Theory*

Immediate computer usage is not always the best option – from the viewpoint of time invested a "pure" mathematical approach can be more successful. At the finals of 2023, the task "Two last digits" was given:

Aivars investigates two increasing sequences of integers. In the sequence $\{p_i\} = \{2, 3, 5, 7, \ldots\}$, he consecutively writes all prime numbers, and in the sequence $\{q_i\} = \{499999999, 589999999, 598999999, 599899999, 599989999, 599998999, \ldots\}$ – all integers with the sum of digits 76. After some time, Aivars notices a pair of consecutive numbers ($p_k = q_m$, $p_{k+1} = q_{m+1}$) shared between the sequences, and the difference between these numbers is 72.

What are the last two digits of p_k?

One obvious solution is to write a computer program that simulates the two sequences in the description until the matching pair is found. However, finding the first matching pair will take quite a lot of computational time (on the only available computer!). Therefore, the best way is to get the only possible option by excluding all others and giving this as the answer.

Most probably, such a task will not be given at the pure mathematical competition because there it would not be enough to find the only possible candidate for the last two digits by excluding unacceptable options – you need to show also that such a number exists. To avoid the necessity to find the number itself, the task was reformulated from strict mathematical language to a story about some imaginary mathematician Aivars who found such a pair of numbers giving an indirect clue that there is a solution (maybe more than one).

4.6. *Dominoes*

Tasks about dominoes are traditionally used at almost all TCIM rounds. Sets of dominoes with various numbers of pieces appear in tasks alone or in combination with other classic games or puzzles (like SUDOKU at the finals of 2022 and chess at the finals of 2023).

Despite previous remarks about the need to avoid already published tasks, puzzle #492, "The domino column" from the book (Dudeney, 1976), was successfully used in the semifinals of 2020. While Dudeney's book gives just one solution, it is easy to find general rules to obtain more solutions.

7	6	5	8	3	9	2		4
3		8	6	1	4	5	9	7
9	1	4	5	7	2		6	8
1	7	6	9	5	3		8	2
4	9	3	7	2	8	1	5	6
8		2	1	4		9		3
5	4	7	3		1	6	2	9
2	8		4	6	5	7	3	
6	3	1		9	7	8	4	5

...

7	6	5	8	3	9	2	**1**	4
3	**2**	8	6	1	4	5	9	7
9	1	4	5	7	2	**3**	6	8
1	7	6	9	5	3	**4**	8	2
4	9	3	7	2	8	1	5	6
8	**5**	2	1	4	**6**	9	**7**	3
5	4	7	3	**8**	1	6	2	9
2	8	**9**	4	6	5	7	3	**1**
6	3	1	**2**	9	7	8	4	5

Fig. 3. Example of a valid LUDOKU puzzle and its solution.

4.7. *SUDOKU*

SUDOKU is a well-known logical puzzle, and nine tasks with its variations have been used at TCIM. One of its variations was the task "LUDOKU" (finals of 2016):

Little Ludis invented a new logical puzzle based on SUDOKU and named it LUDOKU. LUDOKU is a traditional SUDOKU puzzle with the additional constraint that ***the only solution*** *can be obtained by filling empty cells consecutively with numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, 4, … in the rows from top-down and each row from left to right. One valid LUDOKU puzzle and its solution are shown in Fig. 3.*

Create a LUDOKU puzzle with as many empty cells as possible! Be aware that the puzzle may have other solutions besides those obtained by LUDOKU rules!

4.8. *Other Logical Puzzles*

Variations of well-known puzzles besides SUDOKU are also given at TCIM rounds regularly.

For example, the previously mentioned task "Equivalent" (semifinals of 2023):

Fill squares in Fig. 4 with numbers from 1 to 6 so that:

- *In each row, all numbers are distinct.*
- *In each column, all numbers are distinct.*
- *If a line segment connects "diagonal neighbors" of two rows, then numbers in these squares are the same. It is known that* ***all*** *equivalent diagonal neighbors are marked.*

Five squares are already filled.

In the task description, there is one essential requirement that is missed by many readers (who are then surprised that they can't solve the task).

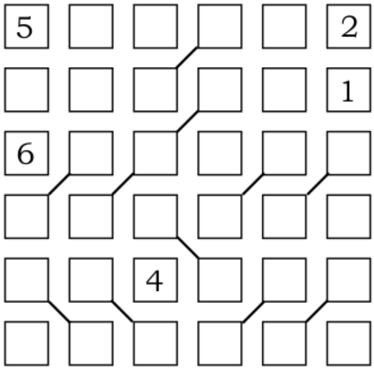


Fig. 4. Task "Equivalent".

Fig. 5. Photo from the task "The Sorting Hat".

4.9. *Non-traditional Tasks*

It should be noted that contestants enjoy non-traditional tasks very much.

At least twice, "think out of the box" tasks were given in the finals: to measure the precise volume of a trash bin (finals of 2018) and to estimate the length of yarn in a crocheted object (finals of 2019, see Fig. 5).

4.10. *Search for Information*

Especially popular (in the sense that all teams tried to solve them and got at least some partial scores) have been tasks connected to Internet searches. A current example of such a task is "Traffic accident" (finals of 2023), where a fragment from a photo (see Fig. 6)

Fig. 6. Photo from the task “Traffic accident”.

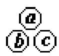
from a traffic accident was given, and it was asked when and where (country, precise coordinates) this accident took place.

It was assumed that contestants would find the proper place using “Google Maps” and a description of an accident in the local newspaper where the original photo was published. Even if contestants succeed and find the correct issue of the newspaper, they can easily lose points by missing the word “yesterday” in the accident description.

4.11. *Tasks with the Unknown Best Answer*

Strictly speaking, in all “classic” Math Olympiads and similar competitions, participants are solving tasks already solved previously by someone. At TCIM, tasks with the unknown best answer are not rare. For grading such tasks, formulae gave maximum points if the answer is best known at the moment of grading and proportionally fewer points if the answer does not reach this value.

One such task, “Felicitous pyramid,” was given at the finals of 2023:

A pyramid of integer numbers is built in the following way: At the beginning, N (where N > 1) circles in a row are drawn, and in each of them, some distinct integer is written. Then above the first row, there the next row of circles is drawn having one circle less and so that each circle is located in-between and above two circles of the previous row: 

In the circle at the top (a) is written the absolute value of the difference between the two integers in circles located immediately below it (|b - c|). So rows are added and filled one by one until there is just one circle in the current row – the top of the pyramid is reached.

Let’s say that a pyramid is felicitous if all numbers in it are distinct.

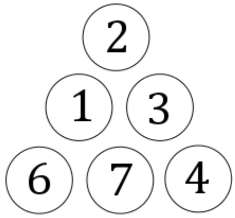


Fig. 7. Example of the felicitous pyramid for N = 3.

An example of a felicitous pyramid for N = 3 is shown in Fig. 7, and its largest integer is 7.

Your task is to create a felicitous pyramid with the largest integer as small as possible for a) N = 6, b) N = 10, c) N = 15.

If you know or find out during competition that such pyramids are called "anti-Pascal triangles" or "subtractive triangles," then you can find (OEIS®, Cazor (2022)) the best answers for the first two subtasks. Unfortunately (for the participants), the answer for the last subtask still can't be found there, and you should find some in any other way.

4.12. *Just Try!*

There are a lot of tasks where the best option is to take paper and pencil and start thinking about possible solutions.

One such task is: "Equivalent parts" (finals of 2023):

Each of the given five figures (see Fig. 8) containing 36 unit squares should be cut by lines into as few equivalent parts as possible (the same number of squares and identical or symmetrical form) so that these parts can be put together to form a 6×6 square. In the square, parts obtained may be rotated and/or flipped.

Each subtask should be solved separately.

Grading: 20 points for the subtask if the number of parts is the least known and 4 points if it is the next possible (under the given conditions, only possible numbers of parts in increasing order are 2-3-4-6-9-12-18-36). Solutions where there will be different parts will receive 0 points.

It can be added that no team got a full score on this task at the competition – the best result was 60 points.

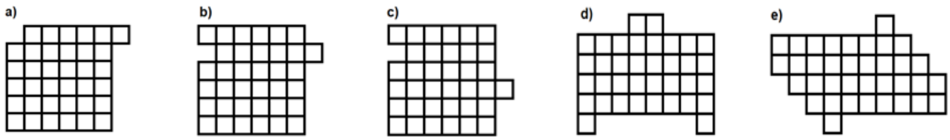


Fig. 8. Task "Equivalent parts" – given figures.

5. Evaluation and Grading

Evaluation of solutions at TCIM is challenging in two different ways: at the semifinals, there are many solutions, while at finals, solutions should be evaluated and graded in a short time interval (less than two hours). Without proper tools, it may lead to a heavy routine job at the semifinals or working in stressful conditions at finals. In both situations, there is a risk of making mistakes which can be crucial, especially in the final round. From the viewpoint of time invested, it was advantageous to implement an automatic evaluation and grading system for all competition rounds.

Diāna Siliņa suggested the usage of MS Excel as an evaluation and grading tool. She had previously successfully used the same approach for evaluating tests and homework in the gymnasium.

MS Excel and VBA spreadsheet applications were used for checking and evaluating answers at all TCIM rounds from the first of 2016 till the semifinals of 2023.

Automatic evaluation can have different implementations. If it is expected that everyone will be allowed to check their work individually, then it would be natural that the task, answer, test, and result are in one file. However, including confidential information in the file offered to the participants in graded tests and competitions is not wise.

Theoretically, part of the information can be hidden and the file protected with a password – but the risk remains that the password can be guessed. It is safer to put only the information the participants can see in the file intended for them (*answer file*). However, you still need a file that contains all the "magic" – the correct answers, the prepared table with empty cells for filling by the participants' answers, formulas, condition formatting, and the START button (starts the execution of the VBA code. VBA is always used to record the results of the tasks in the summary table) – we will call this file the *evaluation file*.

The overall evaluation and grading process contains the following steps:

1) Open the evaluation file.
2) Open all submitted answer files and click the START button in the evaluation file. After each submission is evaluated, a corresponding notification allows you to follow the progress. Creating backup copies of submissions and the result table would be advisable for security purposes.

The "evaluation difficulty" of the task has almost nothing in common with its "scientific difficulty."

By classifying the tasks of previous years and collecting data in a table (see Table 2), a subjective assessment of the difficulty of implementing evaluation and grading has been given, which includes the time and knowledge necessary for the implementation of the evaluation.

Some comments about the difficulty levels in the table:

1. The fastest and easiest way to implement an automated evaluation is for tasks where the answer is unequivocal, entered in one cell of the spreadsheet, and only wholly correct answers are accepted by assigning 100 points.

Table 2
Estimation of the automated evaluation difficulty

Difficulty (1 – easy)	Task types	Spreadsheet functions (highest levels include lowers)	VBA	Time	Grading
1	Cryptarithms, geometry	SUM, AVERAGE, MIN, MAX, IF, ROUND	-	+	Correct/incorrect – 100/0
2	Equations, cryptarithms, data analysis, searching for information	OR, AND, COUNTIF, SUMPRODUCT	-	++	Contains subtasks
3	Geometry, data analysis	ABS, LOOKUP, GCD	-	+	The accuracy of the answer is rated.
4	Non-standard tasks		+	++	Answers may be in arbitrary order.
5		Supporting sheets	++	+++	

2. Little more time-consuming is the implementation of evaluation if the answer is unambiguous, but the task has partial scores, and/or the total number of points depends on the number of correctly solved sub-tasks.
3. The answer's accuracy is also considered during the evaluation.
4. Answers may sometimes be allowed to be entered in arbitrary order (it's easier not to allow this), so you need to sort them before comparing them with the set of correct answers. Participants may also find just some of the answers, so it may be necessary to review the textual information given by participants.
5. As it is usually more common in MS Excel to work with built-in functions than using VBA, in some cases, it is more convenient to copy answers from participant files to additional tables, which are located in the worksheet created for a specific task, and perform calculations/checks afterward with standard MS Excel tools. Then the results obtained from this worksheet can be copied into the results table using VBA.

Of course, not all tasks are suitable for a fully automated evaluation and grading. For example, in domino tasks, it is too hard to implement checking that the complete set of domino pieces is correctly used. At the same time, in such tasks, checking can be done at least partially (like checking that sums of points in domino halves fulfill some requirement).

Likewise, there is checking of the uniqueness of the solution in the SUDOKU tasks in VBA – such checkers can be found on the Internet, and their integration into the evaluation environment would be technically complicated.

Also, answers with various figures whose borders may change are not automatically evaluated.

The answer file should be carefully prepared, namely:

- Warn in the file that there will be automated evaluation, so the required input format should be strictly followed.
- Control/restrict data entry as much as possible.
- Strictly define the conditions for entering the answers, for example, forcing to enter the answers in alphabetical or ascending order.

- It is recommended to use the options offered by the spreadsheet application – drop-down lists, control of data to be entered (Data Validation), while at the same time providing an option to input large numbers or numbers with high accuracy as text.
- To reduce the possibility of entering information in an incorrect place, protect the worksheets (without a password, if an unexpected situation occurs that participants must be allowed to correct).
- Even a hidden type and password-protected workbook offered to participants should not contain correct answers or other confidential information.

Summary of the experience obtained from the preparation of the *evaluation file*:

- In all self-checking tasks, VBA is used to read information from answer files, process and compile it.
- If the answer to the task is short enough to be easily reviewed in the width of one screen, the information should be copied from the answer files to the evaluation file with the help of VBA – this helps to control the correctness of the evaluation, as well as quickly review all answers.
- If you can't check submitted answers automatically, a summary is helpful to review and evaluate all teams' responses manually.
- Use MS Excel's standard options where possible.
- If the number of points assigned depends on the number of correct answers, it is advantageous to use the LOOKUP function.
- Use conditional formatting for visual checking of evaluation correctness.

6. Further Development of the Evaluation System

The existing approach was successfully used till the semifinals of 2023 when Pēteris Pakalns suggested using a new web-based evaluation system, "UIM," made by himself, at the finals of 2023.

This system was used without any problems, and imposing was its strength in tasks where an Excel-based system could not have been used, like in the already mentioned task, "Equivalent parts," in which participants were able to define their configuration of a part on-screen and move, flip, and rotate to be sure that their solution works.

A screenshot from the "UIM" system submission page for the previously mentioned task "Equivalent parts" is given in Fig. 9.

The UIM system is currently undergoing active development, and the platform is accessible online (UIM). Within the platform, all tasks of the TCIM 2023 finals are available for public solving in the Latvian language. To view tasks in other languages, please utilize the translation options provided by your web browser.

The UIM platform was developed to evaluate solutions more promptly and identify potential problems during the contest. After the contest, it also gives participants a summary of testing results without a score and allows for timely appeals before the award ceremony and results announcement.

In the UIM system, all submissions are evaluated immediately after submission using a program written in the Rust programming language. The program is fed with the

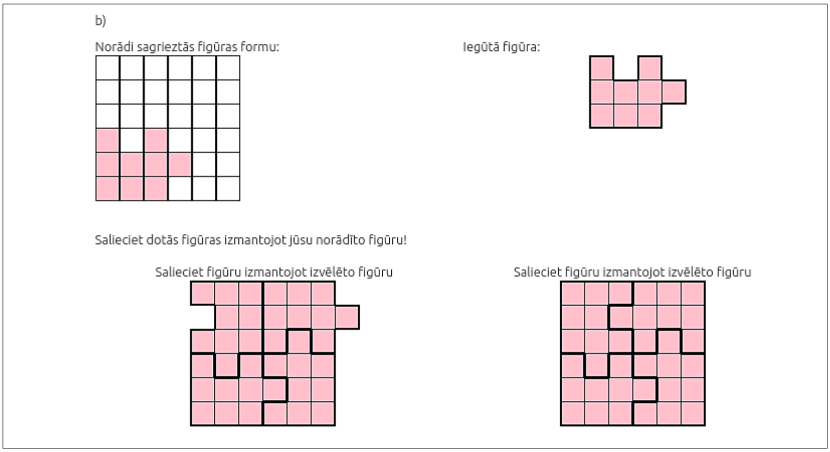


Fig. 9. Task "Equivalent parts" – definition of a part and assembled initial figure and a square.

definition of the answer form, the jury solution, and the participant solution. These programs validate the jury solution and participant solution based on the same criteria. If all criteria are passed, the participant's score is calculated by comparing the processed jury and the participant's answers. In addition, the UIM system provides a Rust library for writing submission evaluation programs, which makes the implementation process very ergonomic.

Due to the limited usage of the UIM system thus far, we have decided to postpone its detailed description until it reaches a more mature state after several (hopefully!) successful future TCIMs.

Acknowledgments

The authors would like to thank "Tom Sawyer Software Latvia" for their support of the finals of TCIM 2023 and Ahto Truu for his valuable comments.

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M. Opmanis is a researcher at the Institute of Mathematics and Computer Science of the University of Latvia. He is head of the jury of Latvian OI and TCIM, and a lot of times, was a leader of the Latvian team at IOI and Baltic OI. He is the author of tasks for various contests in informatics and mathematics.

D. Siliņa is an informatics and programming teacher (since 1995) at Cēsis State Gymnasium and one of the key organizers of TCIM. She was the leader of the Latvian team at Baltic OI in 2012 and 2020 and the main organizer of Latvian OI in 2011 hosted by Cēsis State Gymnasium.

S. Siliņa is a leading programming technician at the Institute of Mathematics and Computer Science of the University of Latvia. She graduated from Cēsis State Gymnasium and is the winner of TCIM 2019. Sandra works on the TCIM and Latvian OI jury, and she was the deputy leader of the Latvian team at European Girls OI in 2022.

P. Pakalns graduated from Cēsis State Gymnasium and won TCIM "Ugāle" in 2014. Now he works on the TCIM and Latvian OI jury and was the leader of the Latvian team at Baltic OI. He is the developer of an automated system for evaluating student programming assignments, used at the Faculty of Computer Science at the University of Latvia, evaluating over 20,000 student submissions. He is the author of the new automated competition platform UIM.