GENERAL SECONDARY EDUCATION

ЗАГАЛЬНА СЕРЕДНЯ ОСВІТА

UDC 372.8:004
DOI 10.35433/pedagogy.3(110).2022.67-84

HOLDING SCHOOL OLYMPIADS ON COMPUTER SCIENCE IN PANDEMIC CONDITIONS

S. D. Vapnichnyi*, S. S. Zhukovskyi**

The COVID-19 pandemic has changed attitudes to the educational process around the world, including Ukraine. Considering the importance of the Students Olympiad in computer science (CS) for the formation of future IT professionals in Ukraine, it was necessary to quickly develop appropriate approaches and safe formats for all stages of this Olympiad. Based on a survey of organizers, a review of Olympiads in CS in countries such as Azerbaijan, Bulgaria, Armenia, Georgia, Latvia, Lithuania, Moldova, Poland, Croatia, and the Czech Republic was observed, and the format of the World Olympiad in Singapore was analyzed. Based on the analysis conducted and taking into account the importance of strict observance of all competition rules, including integrity and the importance of social contacts of all participants in the Olympic movement, it was decided that only the online format is insufficient and there was developed a safe format for the third and fourth stages of the competition, that includes a combination of in-person, online and mixed formats. Detailed requirements for each of these formats are formulated. Due to a significant increase in the load on the e-olymp server online verification system, the relevant software has been updated. The article provides detailed information on the holding of all four stages of the All-Ukrainian Students Olympiad in CS in a pandemic condition during 2019/2020 and 2020/2021 academic year using established formats and an improved verification system and describes a typical algorithm of the participant’s actions. Therefore, new competition rules are detailed and innovative, taking into account unexpected circumstances in the whole world. They were tested and they proved their effectiveness, so they were also used for the finals of the Ukrainian Junior Olympiad in Informatics and the Ukrainian Girls’ Olympiad in Informatics. Since there is uncertainty about the pandemic in Ukraine, the article proposes to apply the proposed rules to hold all future stages of the Olympiad in Informatics during a pandemic at the official level.

Key words: olympiad in Informatics; online competitions; programming; pandemic; COVID-19.

* Senior Lecturer
(Uzhhorod National University)
serrhii.vapnichny@uzhnu.edu.ua
ORCID: 0000-0001-8131-0884

** Candidate of Pedagogical Sciences (PhD in Pedagogy), Associate Professor
(Zhytomyr Ivan Franko State University)
zss@zu.edu.ua
ORCID: 0000-0001-5826-0751
ПРОВЕДЕННЯ ШКІЛЬНИХ ОЛІМПІАД З ІНФОРМАТИКИ В УМОВАХ ПАНДЕМІЇ

С. Д. Вапнічний, С. С. Жуковський

У зв'язку з пандемією COVID-19 змінилися підходи до освітнього процесу в усьому світі, зокрема і в Україні. З огляду на важливість учнівських олімпіад з інформатики для формування майбутніх IT-спеціалістів в Україні, необхідно було оперативно напрацювати відповідні підходи щодо безпечних форматів проведення всіх етапів цієї олімпіади. На основі опитувань організаторів зроблено огляд проведення олімпіад з інформатики в таких країнах, як Азербайджан, Болгарія, Бірмія, Грузія, Латвія, Литва, Молдова, Польща, Хорватія та Чехія, проаналізовано формат проведення Всеукраїнської олімпіади в Сингапурі. Заходи з цього аналізу та зважаючи на важливість суворого дотримання всіх правил змагання, зокрема й доброчесності, та важливість соціальних контактів усіх учасників олімпіадного руху, прийнято рішення про недостатність тільки онлайн-формату, але було напрацьовано безпечний формат проведення третього та четвертого етапів змагання, що включало комбінацію очного, онлайн та смішаного форматів. Сформульовано детальні вимоги до кожного з цих форматів. У зв'язку зі сукупним збільшенням навантаження на систему онлайн-перевірки серверу e-olymp, було доопрацьовано відповідне програмне забезпечення. У статті наведено детальну інформацію про проведення всіх чотирьох етапів Всеукраїнської учнівської олімпіади з інформатики у вумені пандемії протягом 2019/2020 та 2020/2021 н.р. з використанням напрацьованих форматів та використанням відповідних систем перевірки, а також описано типовий алгоритм дій учасника. Таким чином вирішено заходи та нові правила проведення є детально розробленими та інноваційними, враховуючи неперевершені обставини. Ці заходи і правила пройшли випробування і підтвердили свою ефективність, тому вони були застосовані для проведення фіналу Всеукраїнської юніорської олімпіади з інформатики та Всеукраїнської дівочої олімпіади з інформатики. Оскільки є невизначеність щодо тривалості пандемії в Україні, у статті пропонується застосувати запропоновані та апробовані формати проведення олімпіади з інформатики під час пандемії на офіційному рівні.

Ключові слова: олімпіада з інформатики; онлайн-змагання; програмування; пандемія; COVID-19.

Introduction of the issue. The COVID-19 pandemic has led to significant changes in almost all areas of human activity. It did not miss education as well. Educational institutions started massive mastering of various distance learning technologies. It is clear that the changes affected the Olympiads movement, in particular the Olympiads in Informatics. In the 2019-2020 academic year, before the pandemic, the stages 1-3 of the Olympiads were held in-person, as it happened in recent years, but the fourth stage was canceled by the Ministry of Education and Science of Ukraine (MES). There appeared a problem of the holding next stages of the Olympiad, since the majority of students were intensively preparing for the fourth stage, expressed a desire to participate in this stage, of course, in a safe format. Since until now all stages of the Olympiads were held in-person, it was necessary to develop such a format for holding the competition that would be safe...
for all participants, but ensure the necessary control over the course of the competition, namely the absence of plagiarism, recourse to third-party resources or gadgets, help from others, etc.

**Current state of the issue.** The COVID-19 pandemic has led to transition in learning to the predominant use of distance technologies, such as online conferencing, learning management systems, and other tools [1]. The problem of organizing computer science Olympiads in the conditions of the pandemic turned out to be new for all countries. The reaction was different. So, in Ukraine, the fourth stage of the Olympics was canceled, the same happened, for example, in Romania. There, at the call of the National Council of Students, Olympic students supported their colleagues in an Internet seminar as a kind of Olympic solidarity (https://www.facebook.com/consiliulelevilor) [2]. In 2020, Moldova also did not host the final stage of the Olympiad in Informatics and did not present a team for the International Olympiad in Informatics (IOI), and in 2021 the Olympiad was postponed for an indefinite period, and it is not known whether it will be held.

However, a number of countries in 2020 managed to hold in-person final rounds before the implementation of quarantine restrictions, some countries conducted final rounds and selections in remote form, and teachers of students, who participated in the Olympiad, were the observers. In some countries the first stages took place remotely without any control. The issue of integrity was left to the participants themselves. In this regard, the quota for the final stage has been increased. However, all interviewed who confirmed their participation in the International Olympiad affirm that the selections at the IOI were held in-person.

### Table 1

<table>
<thead>
<tr>
<th>Country</th>
<th>2020</th>
<th>2021</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan</td>
<td>The National Olympiad was held under the auspices of the Ministry of Quarantine</td>
<td>The first stage took place remotely, the second stage in-person in compliance with quarantine</td>
<td><a href="https://codeforces.com/profile/medv">https://codeforces.com/profile/medv</a></td>
</tr>
</tbody>
</table>

Аналіз останніх досліджень і публікацій. Пандемія COVID-19 призвела до переходу навчання на переважне використання дистанційних технологій, таких як онлайн-конференції, системи управління навчанням та інші інструменти [1]. Проблема організації олімпіад з інформатики в умовах пандемії виявилась новою для всіх країн. Реакція була різною. Так, в Україні четвертий етап олімпіад було скасовано, це ж відбулося, наприклад, і в Румунії. Там на заклик Національної ради студентів олімпійські студенти підтримували своїх колег в Інтернет-семінарі в якості своєрідної олімпіадної солідарності (https://www.facebook.com/consiliulelevilor) [2]. У Молдові 2020 року також не проводився фінальний етап олімпіади з інформатики, і не було представлено команду на Всесвітню учнівську олімпіаду з інформатики (IOI), а в 2021 році олімпіаду перенесено на невизначений період, і не відомо, чи буде вона проводитись.

Проте ряд країн у 2020 році зуміли провести очні фінальні тури до введення карантинних обмежень, деякі країни проводили фінальні тури та відбори дистанційно, і спостерігачами були вчителі учнів, які брали участь в олімпіаді. У деяких країнах перші етапи проходили дистанційно без будь-якого контролю. Питання дотримання доброчесності було покладено на самих учасників. У зв’язку з цим збільшено квоту на фінальний етап. Проте всі опитані, хто підтверджив участь у Міжнародній олімпіаді, стверджують, що відбори на IOI проводили очно.
<table>
<thead>
<tr>
<th>Country</th>
<th>Event Description</th>
<th>Outcome/Additional Information</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>The National Olympiad and selections were held in each school of the participants. The observer was their teacher. The number of participants in selections has been reduced.</td>
<td>As in 2020.</td>
<td><a href="https://codeforces.com/profile/Martin53">https://codeforces.com/profile/Martin53</a></td>
</tr>
<tr>
<td>Armenia</td>
<td>The National Olympiad took place before the quarantine restrictions.</td>
<td>The first stage took place online. The regional stage and the final were held as usual.</td>
<td><a href="https://codeforces.com/profile/EmilConst">https://codeforces.com/profile/EmilConst</a></td>
</tr>
<tr>
<td>Georgia</td>
<td>The first stages were held online. The final, as usual. Qualifying stages for IOI as well.</td>
<td>As in 2020.</td>
<td><a href="https://codeforces.com/profile/achi_basadzishvili">https://codeforces.com/profile/achi_basadzishvili</a></td>
</tr>
<tr>
<td>Latvia</td>
<td>Everything were held before quarantine.</td>
<td>The National Olympiad has been cancelled, the selection process for the IOI is still unknown.</td>
<td><a href="https://codeforces.com/profile/realcomplex">https://codeforces.com/profile/realcomplex</a></td>
</tr>
<tr>
<td>Lithuania</td>
<td>The National Olympiad was held online from home under cameras. The team was also selected on the base of results of the Baltic Informatics Olympiad (BOI).</td>
<td>National Olympiad in schools or online.</td>
<td><a href="https://codeforces.com/profile/">https://codeforces.com/profile/</a>.__.</td>
</tr>
<tr>
<td>Moldova</td>
<td>They had time to hold only the mathematics competition, so there was only a national team at the IMO, the team was not sent to the IOI.</td>
<td>Rescheduled. It is not known whether anything will happen.</td>
<td><a href="https://codeforces.com/profile/I_Love_Tina">https://codeforces.com/profile/I_Love_Tina</a></td>
</tr>
<tr>
<td>Poland</td>
<td>The third (final) stage has been canceled. All participants who passed it are declared winners. The teams for the Central European (CEOI) and Baltic (BOI) Olympiads were conducted online without supervision, so the integrity of this stage is questionable. Due to this, the number of participants of the third stage has been.</td>
<td>The second stage was conducted online without supervision, so the integrity of this stage is questionable. Due to this, the number of participants of the third stage has been.</td>
<td><a href="https://codeforces.com/profile/Goorkiewicz">https://codeforces.com/profile/Goorkiewicz</a></td>
</tr>
</tbody>
</table>
formed based on the results of the second stage. The best 25 participants of the second stage are invited to the meeting at the IOI. (Usually, the first four participants based on the results of the final stage are invited to the IOI).

increased. The third stage is planned to be in-person. Participants in the third stage no longer receive any benefits (as they did before), but the winners do.

Croatia

The National Olympiad was held in-person. The Croatian Open Olympiad in Informatics (COCI) was held online, with participants writing from home. The selections passed without any changes.


Czech

Republic

The final stage was conducted online with proctoring. There were no selections, the national team was determined by the result of the final stage.

The regional and final stages were held online. Selections were in-person.

https://codeforces.com/profile/osladky

Regarding the 2020 IOI in Singapore, the organizing committee decided to hold the competition online. Rules for its implementation were developed, one can get acquainted with them here [3]. These developments were used in our research, although, in our opinion, only a completely online format is not enough, because in an online competition it is much more difficult to control the process of conducting and complying with all the requirements, in addition, social connections between students are very important, of course, in a safe format. There is an understanding of this in many countries, as evidenced by the data from Table 1.

**Aim of research** is to develop formats for the safe conduct of all stages of the Student Olympiad in Informatics in the conditions of the COVID-19 pandemic, to finalize the e-olymp server for the

Щодо IOI 2020 р. в Сингапурі, організатори вирішили провести змагання онлайн. Були розроблені правила їх проведення, з ними можна ознайомитись тут [3]. Ці напрацювання були використані в нашому дослідженні, хоча, на нашу думку, тільки повністю онлайн-формату недостатньо, оскільки в онлайн-змаганні значно важче контролювати процес проведення та дотримання всіх вимог, крім того, дуже важливими є соціальні зв'язки між учнями, зрозуміло, у безпечному форматі. Розуміння цього є в багатьох країнах, про що свідчать дані з Табл. 1.

**Метою дослідження** є розробка форматів безпечного проведення всіх етапів учнівської олімпіади з інформатики в умовах пандемії COVID-19, доопрацювання серверу е-олимп для успішного проведення цієї олімпіади в
successful conduct of this Olympiad on a nationwide scale, and to implement these developments to the various types of Olympiad competitions in informatics in Ukraine.

Research methods. Due to the cancellation by the Ministry of Education and Science of the fourth stage of the All-Ukrainian Students Olympiad in Informatics and the importance of such competitions for the formation of future high-class IT specialists of Ukraine, the jury of this stage headed by Oleksandr Mitsa, with the active participation of Anton Tsypko and other jury members, trainers, an expert consultant, decided not to leave students without their favorite and long-awaited competitions and to hold the fourth stage on public grounds.

There were held a series of online consultations for working out the format of the fourth stage, and in early May 2020 an online training tour was held to prepare for the fourth stage. It was decided to use the following technology for conducting the training tour: all participants must work with computer cameras turned on and screen recording. The tour took place in the Zoom program, the participants were assigned to rooms, and in each room there was an observer from the jury. The progress of the competition was recorded in each room. In addition to the actual problem solutions, the students had to send a screen recording file to the jury.

The training tour aroused great interest among students, more than a hundred participants took part in it. The successful experience of its holding showed the reality of organizing online competitions on the scale of the whole of Ukraine. The organizers also shared with the participants the experience and methodology of solving Olympiad problems in informatics [4].

Results and discussion. For, as already mentioned above, it is impractical to hold the competition only online, in further consultations the following format of the fourth stage was developed: all those willing from among those selected according to the results of the 3rd stage (the desire was confirmed by the corresponding application) were distributed

маштабах всієї країни та впровадження цих напрацювань до різних видів олімпіадних змагань з інформатики в Україні.

Методика дослідження. У зв'язку зі скасуванням Міністерством освіти і науки четвертого етапу Всеукраїнської учнівської олімпіади з інформатики та важливістю таких змагань для формування майбутніх висококласних IT-спеціалістів України, журі цього етапу на чолі з Олександром Міцою, за активної участі Антона Ципка та інших членів журі, тренерів, експерта-консультанта, вирішило не залишати учнів без улюблених і довгоочікуваних змагань і провести четвертій етап на громадських засадах.

Була проведена низка онлайн-консультацій для напрацювання формату четвертого етапу, та на початку травня 2020 р. проведено тренувальний онлайн-тур для підготовки до четвертого етапу. Вирішено застосувати таку технологію проведення тренувального туру: усі учні, які підтвердили свою участь, працювали з відкритими камерами комп'ютерів та з веденням запису екрану. Турист тренувався на програмі Zoom, учні були розподілені за кімнатами, кожна з кімнат мала спостерігачів із журналістами. Оператори записували хід змагання в кожній кімнаті. Крім того, була проведена частина змагання, що здійснювалася онлайн.

Тренувальний тур викликав велику зацікавленість серед учнів, у ньому взяли участь більше 100 учнів.

Виклад основного матеріалу.

Проведення четвертого етапу Всеукраїнської учнівської олімпіади з інформатики у 2020 р.

Оскільки, як уже було зазначено вище, проводити змагання тільки онлайн нецісно, у подальших консультаціях був вироблений наступний формат четвертого етапу: усі охочі з числа тих, хто був відбранний за результатами 3-го етапу (бажання підтверджувалось відповідною заявою), були розподілені по декількох
in several cities of Ukraine, where they participated in the stage under the supervision of the jury representatives, who also voluntarily agreed to it. Totally 131 students took part in this stage.

The best 20 students were invited to the training and selection sessions held at the Kremenchuk A. S. Makarenko Pedagogical College. Based on the results of these sessions, a student national team of Ukraine was formed, consisting of Oleg Naver and Sofia Melnyk (both from the Poltava regional scientific boarding lyceum of II-III degrees at Kremenchuk A. S. Makarenko Pedagogical College), Andriy Kovrygin (Lyceum No. 208 m. Kyiv) and Vladyslav Zavodnyk (Ukrainian Physics and Mathematics Lyceum).

The World Student Olympiad in Informatics, which was supposed to be held in Singapore, took place online. Pupils of each participating country wrote in one designated place on the territory of their state. The national team of Ukraine wrote on the basis of the Poltava Regional Scientific Boarding Lyceum of the II-III degrees at the Kremenchug Pedagogical College named after A. S. Makarenko All members of our national team won silver medals. The results of the International Olympiad in Informatics can be found here [5].

Holding stages 1-2 of the All-Ukrainian Student Olympiad in Informatics in 2020/2021.

In the 2020/2021 academic year, the Ministry of Education and Culture issued Order No. 1175 dated September 24, 2020, on the holding of student subject Olympiads and indicated the relevant terms [6]. In some regions, the first stage of these Olympiads was held. But due to the second wave of the coronavirus pandemic, by the order of the Ministry of Education and Culture No. 1/9-694 dated 12.15.2020, the holding of student subject Olympiads was canceled [7].

The public organization "Federation of Olympiad Programming of Ukraine" took the initiative that it is always possible to develop and ensure a safe format for holding Olympiads, and took upon itself all the concerns related to the holding of the All-Ukrainian Students Olympiad in Informatics. The basis of this public
organization was the members of the jury and participants of the Olympiads in informatics of the past years. In order to avoid legal conflicts, the event itself was renamed the "All-Ukrainian Programming Olympiad". The need for the emergence of such a public organization was also determined by appearance of competitions for schoolchildren in Ukraine, which do not comply with the "Regulations on All-Ukrainian Olympiads and Tournaments". In particular, these are the European Junior and Girls’ Programming Olympiads, which are already very popular in Europe.

The created public organization coordinates the above-mentioned Olympiads and will coordinate other competitions that will appear and will be related to Olympiad informatics.

It was decided to hold the All-Ukrainian Programming Olympiad in 4 stages. Due to the situation, the first two rounds were held exclusively online.

By reason of the large number of participants in the first and second stages, there arose the issue of resource for holding the Olympiad. The Internet portal https://www.e-olymp.com [8] was taken as a basis. There was developed a competition system for the Olympiad, with the ability to submit solutions, feedback from the jury, online compilers, automatic check system. In this system participants could write code, test it in online mode on tests from the condition of the problem and on their own tests. During the first stage, the load on the server was not very high, during that time 3241 participants registered and 73223 solutions were checked, but for a long time.

The first stage lasted from December 17 to January 22. More than 2,000 participants received 500 or more points, which allowed them to enter the second stage. The distribution of participants by region is shown in Fig. 1.
The second stage consisted of two rounds, each lasting 5 hours and was held entirely online. In order to get to the next stage, it was necessary to score at least 500 points in any round. The first round was held on January 24.

Fig. 1. Number of participants in the first stage of the Olympiad by region

Fig. 2. The number of solution submits during the first round of stage 2
2,261 persons participated in the second round, and 39,391 solutions were checked in 5 hours of the first round of stage 2. For the stable operation of the Olympiad system there was used the possibility of connecting additional test systems when the load increased and turning them off automatically when the load on the system decreased. Thus, during the first round of stage 2, more than 20 test systems were simultaneously working at peak loads (Fig. 2).

Totally 470 participants received at least 500 points and went to the third stage. Works are checked for plagiarism, identity of code and code fragments [9]. More than 500 cases of violations of the rules were found, due to which the works of 225 participants were canceled (Fig. 3).

The second round took place on January 6 and also lasted five hours. However, only a few cases of plagiarism were detected in the 2nd round.

In total, based on the results of the 2nd stage, 576 participants were selected for the third stage, 530 of whom took part in

Другий тур відбувся 6 січня, також тривав п'ять годин. Проте в 2 турі було виявлено лише декілька випадків плагіату.

Загалом за результатами 2-го етапу було відібрано 576 учасників третього етапу, 530 з яких взяли в ньому участь. 3-й етап відбувся 27-28 лютого 2021 р. на більше
Development of the format for the stage 3 of the All-Ukrainian Student Olympiad in Informatics in pandemic conditions.

Since, as was mentioned above, the third stage should include not only an online format, the jury, the organizing committee, and an expert consultant of the Olympiad developed such a document regarding the format of the III stage of the All-Ukrainian Programming Olympiad in 2021. Let us consider its content.

I. General
- Stage III of the Olympiad can be held in one of three options: in-person format, online format or mixed format.
- In each region the format of the event is determined by the regional coordinator.
- The regional coordinator is responsible for compliance with the rules in that region.
- Before the start of the Olympiad participants need to confirm the data they entered in the registration form. To do this, they need to send the following data to the e-mail of the regional coordinator:
  1. Scan or photo of ID card (or birth certificate for participants who have not yet received an ID card). The document number can be hidden, for example, sketched.
  2. Scan or photo of a school certificate.
- Only after the regional coordinator confirms the data reliability, the participant will be able to participate in the III stage.

II. In-person format
All participants take part in the Olympiad in-person in the appropriate places determined by the regional coordinator.

Exceptionally, the regional coordinator can allow a participant to participate in the Olympiad online, if the participant objectively cannot appear in person. In this case, the rules of the online format will applied.

The participant must come to the Olympiad with an original identity document.

It. The 3rd stage took place on February 27-28, 2021, at more than 30 venues in Ukraine, 25 coordinators from different regions of Ukraine participated in the stage.

Development of the format for the stage 3 of the All-Ukrainian Student Olympiad in Informatics in pandemic conditions.

Since, as was mentioned above, the third stage should include not only an online format, the jury, the organizing committee, and an expert consultant of the Olympiad developed such a document regarding the format of the III stage of the All-Ukrainian Programming Olympiad in 2021. Let us consider its content.

I. General
- Stage III of the Olympiad can be held in one of three options: in-person format, online format or mixed format.
- In each region the format of the event is determined by the regional coordinator.
- The regional coordinator is responsible for compliance with the rules in that region.
- Before the start of the Olympiad participants need to confirm the data they entered in the registration form. To do this, they need to send the following data to the e-mail of the regional coordinator:
  1. Scan or photo of ID card (or birth certificate for participants who have not yet received an ID card). The document number can be hidden, for example, sketched.
  2. Scan or photo of a school certificate.
- Only after the regional coordinator confirms the data reliability, the participant will be able to participate in the III stage.

II. In-person format
All participants take part in the Olympiad in-person in the appropriate places determined by the regional coordinator.

Exceptionally, the regional coordinator can allow a participant to participate in the Olympiad online, if the participant objectively cannot appear in person. In this case, the rules of the online format will applied.

The participant must come to the Olympiad with an original identity document.
document (ID card, foreign passport, etc.).

During the competition, participants may not use electronic devices and any printed literature, except for a computer provided by the organizers.

During the competition, participants are prohibited from communicating with other people who are not the organizers of the Olympiad.

III. Online format
- All participants participate remotely.
- The participant must record the process of tasks completion, for example, through the OBS Studio program. The record must include:
  - Image from a webcam recording the participant’s work from the front or side. The webcam must capture the participant’s face. The minimum frequency is 5 frames per second.
  - Sound. The recording must contain sound.
  - Screen image. The quality of the video must be such that the participant code can be readable. The minimum frequency is 5 frames per second.
- The participant must record a test video for a few minutes no later than three days before the start of the Olympiad, and then send it to the coordinator. If the coordinator has any comments, he will inform about it.
- At the end of each tour, the participant must upload the recording to the YouTube service, so that the video can then be viewed via the link. The link to the video must be emailed to the regional coordinator on the same day. In the letter, indicate the surname, first name, patronymic, as well as a link to the video.
- The participant can use any operating system that meets all the requirements of the organizers.
- The participant can use any environment installed on the computer to write the code.

The participant is prohibited from:
1) be absent from the workplace (i.e. without camera surveillance) for a total of more than 15 minutes during the entire tour;
2) communicate with strangers in any way;
3) use more than one monitor;
4) use headphones;
5) use communication programs (Skype, Telegram and others);
6) use a web browser to visit any sites except the test system page.
7) use online compilers and interpreters;
8) use any code that was written before the start of the tour;
9) use any literature (including printed or electronic);
10) if the participant wants to have access to the instructions for using the environment or programming language, he must send it to the organizers in *.pdf format at least one week before the start. During the tour, the organizers will provide access to these instructions to anyone who wishes.
11) have electronic devices, except for those necessary for participation in the competition, at the workplace: phones, tablets, smart watches and others.

IV. Mixed format
- All participants who want to work online participate in the Olympiad according to the online format.
- Teachers, parents, employees of educational institutions or other interested persons can submit an application to the regional coordinator for permission to organize a venue for participation in the Olympiad, where participants will be able to take part in the Olympiad in-person.
- To participate in a special venue, a participant must obtain permission of the regional coordinator.
- There are in-person format rules in the venue.
- The regional coordinator can determine the requirements for a specific venue, for example:
  1. Each participant must keep a screen recording.
  2. There must be a video recording of the process of writing the Olympiad.

Holding competitions using the developed format.
The third stage took place on February 27-28, 2021, at more than 30 venues in Ukraine, 530 students and 25 coordinators from different regions of Ukraine participated in the stage.
The fourth stage was held on March 20-
21, 2021 in two rounds. It was held in the same format as the third stage. 134 students participated in the stage. The results of the fourth stage are shown in Table 1.

During the third and fourth stages, the load on the verification system was small, but the system was improved to support different types of tasks, block testing.

The holding of all stages of the All-Ukrainian Programming Olympiad itself gave another impetus to the improvement of the e-olymp system. The e-olymp Internet portal is a unique development that was created in accordance with the Concept of the "State Program for Work with Gifted Youth for 2006-2010" and the State Program "Information and Communication Technologies in Education and Science" for 2006-2010 (agreement No. IT/548-2009, registration number 0109U005929) and is being completed and improved today with the challenge of modern needs and requirements of the International Olympiad in Informatics. The e-olymp database contains more than 10,000 tasks of different levels of School and Student Olympiads, each of which contains a set of tests for checking. The automatic check system has tested and evaluated more than 10 million solutions during its lifetime. More than 20,000 competitions of various levels (from educational and training to All-Ukrainian level Olympiads) were held. It has the ability to create groups for study and training.

Regardless of the format of the Olympiad held in one or another region, the participants worked according to the usual algorithm developed for the Olympiads in informatics in previous years. The e-olymp server has an online system for checking participants’ works, created by the developers of this system. This system was additionally adjusted for each tour, based on the peculiarities of testing a specific task. Each participant received a link to the current tour. Using this link through the web interface, he received the tour tasks, on his local computer in the IDE of his choice (the list of supported compilers was indicated in the participant’s memo) he developed solution programs and sent 530 учнів та 25 координаторів з різних областей України.

Четвертій етап був проведений 20-21 березня 2021 р. у два тури. Проводився він у тому ж форматі, що і третій етап. В етапі брали участь 134 учні. Результати четвертого етапу наведено в Таблиці 1.

Під час проведення третього та четвертого етапів навантаження на систему перевірки було невелике, але систему було вдосконалено для підтримки різних типів задач, блокового тестування.


Незалежно від формату проведення олімпіади в тому чи іншому регіоні, учасники працювали за звичним алгоритмом, випрацьованим для олімпіад з інформатики за попередні роки. На сервері e-олімп встановлена система онлайн перевірки робіт учасників, створена розробниками цієї системи. Ця система додатково налаштовувалася для кожного туру, виходячи з особливостей тестування конкретної задачі. Кожен учасник отримував посилання на поточний туру. За цим посиланням через веб-інтерфейс він отримував умови задач туру, на локальному комп’ютері у обраній ним IDE (спісок підтримуваних компіляторів
them through the same system, immediately seeing the testing results. Besides, through this system, he could ask questions to the methodological committee of the jury, which included the authors of the tasks and the head of the jury. The format of the questions was described in the participant memo.

Table 2

Results of the fourth stage of the All-Ukrainian Programming Olympiad in 2021

<table>
<thead>
<tr>
<th>Region</th>
<th>Total number</th>
<th>Diplomas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Avtonomna Respublika Krym</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Vinnytska oblast</td>
<td>185</td>
<td>143</td>
</tr>
<tr>
<td>Volynska oblast</td>
<td>145</td>
<td>94</td>
</tr>
<tr>
<td>Dnipropetrovska oblast</td>
<td>266</td>
<td>135</td>
</tr>
<tr>
<td>Donetskia</td>
<td>58</td>
<td>33</td>
</tr>
<tr>
<td>Zhytomyrska oblast</td>
<td>124</td>
<td>84</td>
</tr>
<tr>
<td>Zakarpatska oblast</td>
<td>122</td>
<td>97</td>
</tr>
<tr>
<td>Zaporizka oblast</td>
<td>76</td>
<td>67</td>
</tr>
<tr>
<td>Ivano-Frankivska oblast</td>
<td>131</td>
<td>83</td>
</tr>
<tr>
<td>Kyivska oblast</td>
<td>121</td>
<td>65</td>
</tr>
<tr>
<td>Kirovohradska oblast</td>
<td>75</td>
<td>43</td>
</tr>
<tr>
<td>Luhanska oblast</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Lvivska oblast</td>
<td>132</td>
<td>83</td>
</tr>
<tr>
<td>Kyiv city</td>
<td>392</td>
<td>320</td>
</tr>
<tr>
<td>Sevastopol city</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mykolaivska oblast</td>
<td>79</td>
<td>37</td>
</tr>
<tr>
<td>Odeska oblast</td>
<td>104</td>
<td>85</td>
</tr>
<tr>
<td>Poltavska oblast</td>
<td>113</td>
<td>98</td>
</tr>
<tr>
<td>Rivnenska oblast</td>
<td>73</td>
<td>57</td>
</tr>
<tr>
<td>Sumsha oblast</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>Ternopilska</td>
<td>70</td>
<td>52</td>
</tr>
<tr>
<td>Ukrainian Physics and Mathematics Lyceum</td>
<td>59</td>
<td>56</td>
</tr>
<tr>
<td>Kharkivska oblast</td>
<td>414</td>
<td>320</td>
</tr>
<tr>
<td>Khersonska oblast</td>
<td>41</td>
<td>58</td>
</tr>
<tr>
<td>Khmelnyskha oblast</td>
<td>145</td>
<td>110</td>
</tr>
<tr>
<td>Cherkaskha oblast</td>
<td>58</td>
<td>34</td>
</tr>
<tr>
<td>Chernivetska oblast</td>
<td>81</td>
<td>55</td>
</tr>
<tr>
<td>Chernihivska oblast</td>
<td>107</td>
<td>76</td>
</tr>
<tr>
<td>Summarily</td>
<td>3241</td>
<td>2330</td>
</tr>
</tbody>
</table>
According to the results of the fourth round, there was selected a team of 20 students to participate in the selection and training session to form a team that will participate in the World Olympiad in Informatics.

The finals of the All-Ukrainian Junior Olympiad in Informatics and the All-Ukrainian Girls’ Olympiad in Informatics were held as well. This happened on March 28, 2021. The results of the Junior Olympiad are available at [10], and the results of the girls’ Olympiad are available at [11]. The best 12 participants of each of these Olympiads are invited to the selection and training sessions of the European Junior Olympiad in Informatics and the European Girls’ Olympiad in Informatics.

The process of the competitions, news, various statistical data, the tasks and their and analysis concerning the Olympic competitions in Informatics can be found on the website of the All-Ukrainian Olympiads in Informatics, which is maintained by representatives of the public organization "Federation of Olympic Programming" [12].

Conclusions and research perspectives. The IT industry of Ukraine has become, in fact, state-building. It needs more and more high-quality specialists. The number of IT workers from other countries who come to work in Ukraine is extremely small. Accordingly, such workers should be trained in Ukraine. The Olympic movement in informatics greatly contributes to this, since most participants, and even more so the winners of Olympiads in informatics, associate their future professional activities with the IT field. As in sports or any other field of activity, success in Olympic programming requires a lot of work, constantly developing the relevant skills. Such human qualities as discipline, endurance and resilience, that also need to be formed, have a significant impact on the result. Perhaps, one of the most effective ways of forming and training such skills is constant participation in various types of Olympic competitions. It is also important that competitions in person must be among such competitions, because in-person

За результатами четвертого туру відібрано команду з 20 учнів, які візьмуть участь у відбірково-тренувальних зборах для формування команди, що візьме участь у Всесвітній олімпіаді з інформатики.


Хід проведення змагань, новини, різноманітні статистичні дані, умови та розбір задач щодо олімпіадних змагань з інформатики можна дізнатися з сайту Всеукраїнських олімпіад з інформатики, наповненням якого займаються представники громадської організації "Федерація олімпіадного програмування" [12].

Висновки з даного дослідження і перспектив подальших розвідок. ІТ-галузь України стала, по суті, державотворчою. Вона потребує все більше і більше фахівців високої якості. Кількість працівників з інших країн, які прибувають працювати в Україну, є надзвичайно малою. Відповідно, таких працівників потрібно готувати самим. Олімпіадний рух з інформатики дуже сприяє цьому, оскільки переважна більшість учасників, а тим більше переможців олімпіад з інформатики, пов'язують свою майбутню професійну діяльність з ІТ-сферою. Як і в спорти або в будь-якій інший сфері діяльності, щоб досягти успіху в олімпіадному програмуванні, потрібно дуже багато працювати, постійно розвиваючи відповідні навички. Значний вплив на результат мають також такі людські якості, як дисциплінованість, витримка і стійкість, які теж потрібно формувати. Мабуть, одним з найефективніших способів формування та тренування таких навичок є постійна участь у різного виду олімпіадних.
competitions have a special atmosphere, promote direct communication and exchange of experience, form social ties between competition participants, that over time will contribute to successful cooperation during further work in the IT field. This thesis is confirmed by many years of experience of the authors of the article.

However, the COVID-19 pandemic disrupted the procedure of holding such competitions established in previous years. Immediately, many Olympic competitions were simply canceled or transferred exclusively to the online format. For it became clear that the pandemic is a long-term one, there was a need to develop such a format for Olympiad competitions, especially the Olympiad in informatics, that would be safe for all participants, combining online and in-person formats.

One of the proposed approaches to solving the problem is the approach proposed in this paper and tested in practice, which combines online and in-person formats.

For successful holding the online competitions across the country there were updated the software of the e-olymp server. A typical algorithm of actions of a participant of online competitions is presented.

Two All-Ukrainian Student Olympiads in Informatics, held in the pandemic of COVID-19, made it possible to maintain students’ interest in programming and solving complex problems. The proposed formats were effective, and all stages were held at a high level.

We believe that due to the uncertainty of the pandemic duration, it is advisable to apply the work done on the All-Ukrainian Student Programming Olympiad to hold all future stages of the Informatics Olympiad during the pandemic at the official level.

REFERENCES (TRANSLATED & TRANSLITERATED)


Received: August 08, 2022
Accepted: September 02, 2022