Coach Report on International Olympiad in Informatics (IOI) 2017 at Tehran, Iran from 27 July - 4 August 2017

Introduction

The IOI is one of the five international science Olympiads. The primary goal of IOI is to stimulate interest in informatics (computer science) and information technology. This year, the 29th IOI will be organised and held at Tehran, Iran.

The average IOI lasts approximately 1 week, inclusive of opening and closing ceremony, 2 contest days, 2 excursion days and 2 days dedicated for arrival and departure of teams.

On each of the 2 contest days, contestants will typically be presented with 3 tasks with 5 hours to program working solutions to solve these tasks. The competition tasks are of algorithmic nature, requiring contestants to demonstrate not only basic IT skills such as programming and testing, but also in-depth knowledge of designing algorithms, data structures and information theory.

Singapore has been participating in IOI since 1992 and will be the host for IOI in year 2020. For every year, the top 4 students within Singapore would be selected. This year, the selection is based on scores of both National Olympiad in Informatics (NOI) and Asia-Pacific Informatics Olympiad (APIO) with equal weightage.

Preparation

June-July Training Sessions

Before the IOI, a total of 19 training sessions were conducted in the ACM-ICPC Lab at School of Computing (SoC), National University of Singapore (NUS). These training sessions involved a 1.5h to 2h lecture on specific topics such as Dynamic Programming, Data Structures, Graph Theory and other relevant topics such as Information Theory and Contest Strategies.

In addition, there was also a 5h topical contest accompanying these lectures in order to reinforce what had been taught earlier that day.

On top of these physical training sessions, the team were also tasked to ‘compete’ or practice on several online contests such as Internet Problem Solving Contest (IPSC), Japan Olympiad in Informatics, Open Contest (JOI Open) as well as various other online judges (CodeForces, AtCoder).
ASEAN Sparring Contests

With the agreement and arrangement between key training personnels of several ASEAN countries, Indonesia, Malaysia and Philippines, a total of 4 sparring contests were conducted for the IOI contestants of these 4 countries in the days leading to the actual IOI.

Each sparring contest is aimed at replicating a single contest day of the actual IOI, (albeit with a slightly lower difficulty) with 3 tasks to be solved in 5 hours. Each country was tasked to set one contest each.

The aim of these sparring contests are to allow contestants to adapt with competing against contestants they are unfamiliar with (from other countries). In addition, it allowed the trainers of these countries to make a fair gauge on the rough standings of their team against the regions' competitors.

The sparring contests proved to be a success this year and I hope that this arrangement can be expanded to more countries in the region for upcoming IOIs, by future coaches of Singapore IOI Team.
Day 0

Flight and Arrival

In contrast to flight arrangement of previous years, our flight for IOI 2017 arrived one day earlier than the scheduled Arrival Date of 28 July. We took TG403 from Singapore to Bangkok, and then TG527 from Bangkok to Tehran, arriving at approximately 10pm Iran time (IRT) on 27 July instead.

The organisers are very hospitable and helped us in many ways at the airport. For instance, they managed to expedite our landing visa using particulars we had previously submitted. Our local guide, Pegar was also at the airport to welcome us.
Day 1

Arrival

Since we had arrived on the night before, the team decided to make use of the spare time to visit an Iranian bazaar together with our guide. The bazaar is mainly local-oriented and consisted of majority second-hand goods/antiques. At there, we tried a local yoghurt drink which also contained raisins and cucumber.

There was supposed to be a visit to Bird Garden in the afternoon. However, after a tiring visit to the bazaar in the morning, the contestants and I decided to opt out of the trip.
Day 2

Practice Contest

A practice contest was conducted to allow participants to get a feel of the physical environment of which the actual contests will be held. This year, the contest was divided into 2 conference rooms, one on level 1, one on level 2. All 4 contestants in Singapore were allocated to the conference room on level 2.

Overall, the practice contest went smoothly. The contestants were able to replicate their solutions for the practice tasks and successfully submitted to the grading server.

In addition, test submissions were also performed on the grading server to familiarise with the responses that the grading server will return. Throughout the testing, it was discovered that if your program uses more memory than required (Memory Limit Exceeded), encounters a Segmentation Fault, or you have a failed assert in your code, the grading server will return “Run-time Error” with not much indication of to the reason for the run time error.

From the practice contest, the contestants raised minor concerns. Of which, they asked if it was possible to remove the keyboards provided if they had already brought their own keyboard.
Several images of the contestants during the practice contest is as above.

Opening Ceremony
After the practice contest was the opening ceremony at Milad Convention Centre. Overall, it was rather well organised except for the glaring mix-ups the organisers had with several countries’ flag when introducing the teams. Luckily for us, there were no such issues.
Day 3

Contest Day 1

Day 1 began with 3 tasks. This day also saw an re-emergence of a ‘Output-only’ task where by contestants were given access to all the input files for the problem and they have to submit their best output files by the end of the 5 hour competition.

For Day 1, the task was called ‘Nowrus’ which is NP-hard in nature. According to the ISC, contestants were expected to obtain higher scores by employing general NP-hard optimisation techniques like local search, hill climbing and generating patterns for special input cases that are not NP-hard.

At the 2.5h hour mark (half of the contest), our contestants were with the following score breakdown:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Contestant</th>
<th>Nowrus</th>
<th>Wiring</th>
<th>Toy Train</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Wen Yuen</td>
<td>88.16</td>
<td>30</td>
<td></td>
<td>118.16</td>
</tr>
<tr>
<td>30</td>
<td>Guang Xuan</td>
<td>88.03</td>
<td></td>
<td></td>
<td>88.03</td>
</tr>
<tr>
<td>44</td>
<td>Xing Chen</td>
<td>44.16</td>
<td>13</td>
<td></td>
<td>57.16</td>
</tr>
<tr>
<td>46</td>
<td>Lim Li</td>
<td>46.45</td>
<td>7</td>
<td></td>
<td>53.45</td>
</tr>
</tbody>
</table>

This would place Singapore with 1G 3S based on the ranking at the half contest mark.

At the 5 hour mark, our contestants had the following score:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Contestant</th>
<th>Nowrus</th>
<th>Wiring</th>
<th>Toy Train</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Guang Xuan</td>
<td>89.55</td>
<td>20</td>
<td>38</td>
<td>147.55</td>
</tr>
<tr>
<td>54</td>
<td>Wen Yuen</td>
<td>88.16</td>
<td>30</td>
<td>5</td>
<td>123.16</td>
</tr>
<tr>
<td>95</td>
<td>Lim Li</td>
<td>60.08</td>
<td>20</td>
<td>16</td>
<td>96.08</td>
</tr>
<tr>
<td>139</td>
<td>Xing Chen</td>
<td>44.16</td>
<td>13</td>
<td>5</td>
<td>62.16</td>
</tr>
</tbody>
</table>

During the appeal stage of the contest, it was found out that Guang Xuan’s submission for Task 3 (Toy Train) was judged as “Time Limit Exceeded” on the grading server but ran in 1.6s on his
contestant machine. Since the time limit was 2s, and 1.6s is well within the time limit on the contestant machine, we felt that there is a discrepancy in grading as we were told that the grading servers uses identical physical machines as the contestant machine.

After consultation with Dr. Steven Halim (Singapore Team Leader, 2017), we decided to lodge an official appeal with the ISC and ITC. We argued that with such a situation, a contestant will never be able to replicate the “Time Limit Exceeded” verdict on his computer with any crafted testcases. Hence, we appeal that the contestant should have been awarded an “Accepted” verdict instead.

GA Meeting 4

During the GA, the appeal we have submitted was addressed by the ISC and ITC. During that evening, they indicated that the issue seems to be machines running at different speeds due to minor differences in components not even disclosed by competitors. This might trigger a regrade of all submissions and the committee promised that in that event, scores will be the maximum of both cases.

After the GA, the HTC provided an update on the investigation in private. It seems that the machines itself were running at identical speeds if they are performing the same task. However, it is noted that when the monitor (screen) is plugged in, it seems that the machines ran faster. The investigation will continue and the scores for Day 1 will be pending.
Day 4

Dolphin Park

We went to Dolphin Park and Tehran Milad Tower for excursion today. At the Dolphin Park, there was a dolphin and seal performance for about 1.5 hours. The Iranian (kindergarten) kids that were also in the same performance session were very enthusiastic! They screamed and cheered for the dolphins and made the atmosphere of the entire show more lively.
Tehran Milad Tower

The Tehran Milad Tower is claimed to be the 6th tallest telecommunication tower in the world. We were provided tickets to enter the observation galleries at the top of the tower. From there, we could see a large portion of Tehran and their urban planning layout.

GA Meeting 5

Updates were provided with regards to the appeal for Day 1. ITC indicated that the root cause of the issue is a feature in Linux kernel called “Transparent hugepage support”. In essence, this feature allows the linux kernel decides whether to allocate 2MB or 4KB pages depending on various criteria. One uses more memory, the other makes the program slower. A rejudging of the task will be done with this feature disabled. Contestants will keep the highest score.

At about 1am on the night of the translation, ITC and ISC informed us that the appeal for Guang Xuan has been rejected after careful investigation. However, they offered a possibility for us to communicate the result of the appeal to Guang Xuan, before the start of Day 2’s contest.
Day 5

Contest Day 2

Before Day 2, we decided to take up ISC’s offer to communicate the result of the appeal to Guang Xuan. We eventually decided to let Richard Peng (member of ISC) to inform Guang Xuan about the result of the appeal.

Day 2 began with 3 tasks as well. This day had 2 interactive ‘black-box’ style problem where contestants have to obtain information based on using a set number of queries to the grader. The last remaining problem is a standard batch problem. It was noted that the task ‘Books’ is a backup task that was swapped in before the ISC revealed the tasks.

At the 2.5h hour mark (half of the contest), our contestants were with the following score breakdown:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Contestant</th>
<th>Day 1</th>
<th>Prize</th>
<th>Sirmurgh</th>
<th>Books</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Wen Yuen</td>
<td>123.16</td>
<td>92.44</td>
<td>0</td>
<td>50</td>
<td>265.60</td>
</tr>
<tr>
<td>36</td>
<td>Guang Xuan</td>
<td>147.55</td>
<td>95.29</td>
<td>0</td>
<td></td>
<td>242.84</td>
</tr>
<tr>
<td>134</td>
<td>Lim Li</td>
<td>96.08</td>
<td>20</td>
<td></td>
<td></td>
<td>116.08</td>
</tr>
<tr>
<td>165</td>
<td>Xing Chen</td>
<td>62.16</td>
<td>20</td>
<td></td>
<td></td>
<td>82.16</td>
</tr>
</tbody>
</table>

This would place Singapore with 2S 1B based on the ranking at the half contest mark.

At the end of the contest, our contestants had the following score.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Contestant</th>
<th>Day 1</th>
<th>Prize</th>
<th>Sirmurgh</th>
<th>Books</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Guang Xuan</td>
<td>147.55</td>
<td>95.31</td>
<td>30</td>
<td>50</td>
<td>322.86</td>
</tr>
<tr>
<td>36</td>
<td>Wen Yuen</td>
<td>123.16</td>
<td>94.01</td>
<td>51</td>
<td>50</td>
<td>318.17</td>
</tr>
<tr>
<td>66</td>
<td>Lim Li</td>
<td>96.08</td>
<td>93.28</td>
<td>30</td>
<td>50</td>
<td>269.36</td>
</tr>
<tr>
<td>133</td>
<td>Xing Chen</td>
<td>62.16</td>
<td>20</td>
<td>30</td>
<td>50</td>
<td>162.16</td>
</tr>
</tbody>
</table>

This would place Singapore with a medal tally of 3 silver and 1 bronze tentatively.
It was later learnt from the contestants that the contest time was extended by a total of 30 minutes due to issues with the grading server. It was later revealed by ITC that the database serving the grading servers had ran out of disk space. (This issue was similar to what we experienced in Singapore NOI 2017) However, they manage to remedy the situation in about 20 minutes.

**Botanical Gardens**

After the contest, we were ushered for a visit to Botanical Gardens. As it is far away from the hustle and bustle of the city, it turned out to be a rather relaxing walk with amazing scenery.
Day 6

Excursion

For today, we went to Golestan Palace and the Grand Bazaar as part of our excursion activities, both located in Tehran and in close proximity.

The palace was an eye-opener as it exhibited the rich cultural heritage of Iran, dating back to several hundred years ago, when monarchs still ruled Iran. Places we have visited inside the palace included mirror rooms and exhibitions of art and porcelain works. However, we were not allowed to do any photography inside the palace.
The Grand Bazaar was conveniently located right outside the Golestan Palace. We tried various local food such as sour candy and Iranian Nougats (contained pistachios) and bought some back for our friends and family members.
Day 7

GA Meeting
The final GA meeting for IOI 2017 kicked off in the morning of Day 7. The official number of contestants were confirmed to be 304, resulting in 26 gold, 52 silvers and 78 bronze medals being awarded. Singapore were to receive 3 silvers and 1 bronze.

On which, there was also a discussion and voting for future members of the IC, ISC and ITC. Of which, Jonathan Irvin Gunawan, a friend whom I have participated in IOI 2013 with and a NUS Alumni, were selected to be part of the ISC for a 3-year term. The 3 year term includes IOI 2020 and I would be looking forward to work with him for IOI 2020 in Singapore.

Another important thing to note during this GA meeting is that the decision to stop support for Pascal in IOI was made by a majority vote. The GA eventually voted to let IOI 2018 be the last year that allows Pascal and IOI 2019 onwards will not have Pascal. This proved to be a very sentimental moment for many leaders and members of the community as Pascal was a very popular language in the early days of IOI. Many current leaders and committee members have previously competed in IOI using Pascal, before the introduction of C++.

Closing Ceremony
The closing ceremony was held at the Tehran International Convention Centre. The convention centre was magnificent and beautifully built.

The final results are as follows:
Zhang Guangxuan - Silver
Pang Wen Yuen - Silver
Lim Li - Silver
Huang Xing Chen - Bronze
Team Singapore photo for IOI 2017

From left to right: Ranald Lam (Coach), Steven Halim (Team Leader), Lim Li (Contestant, Silver), Huang Xing Chen (Contestant, Bronze), Pang Wen Yuen (Contestant, Silver), Zhang Guangxuan (Contestant, Silver), Eileen Moh (Deputy Leader), Tan Sun Teck (IC Member)
At the end of the closing ceremony, the IOI flag was passed to the Japanese delegation, which would be hosting IOI 2018 in Tsukuba city, Ibaraki prefecture, Japan between 1 - 8 September 2018. A short preview video by the Japanese host was also screened to invite all delegations to the next iteration of the competition.
Day 8

Before departure

As our flight was scheduled to be at 10pm, we explored a nearby shopping mall together with our guide Pegar. The shopping mall is a huge contrast compared to the bazaars we have explored in the previous days, and it bears huge resemblance to the shopping malls in Singapore. The team visited the supermarket and bought snacks to be brought back to Singapore.
Day 9

Transit

The first segment of our flight from Tehran to Bangkok was delayed by close to 2 hours, resulting in us missing the second segment of the flight, from Bangkok to Singapore. We got rearranged to the next available flight about 3 hours later than the original and were each provided meal vouchers as compensation.

The whole team finally reached Singapore at about 3.30pm on 5th August, marking the end of the IOI 2017 journey.
Reflection

Initially, I thought that by attending IOI as a coach, instead of a contestant, it would be less tiring as there is less pressure to compete with other contestants. However, after attending IOI 2017, it made me realise that the leader’s schedule is much more packed as compared to the contestants. While the contestants are in quarantine, the leaders were debating and refining the problem statements for the following day. While the contestants have finished the contest, the leaders still are not relieved of their duties; they have to handle appeals and make decisions regarding future IOIs during the GA meetings.

In addition, this trip also serves to let me understand the inner workings of hosting an IOI. As Singapore is hosting IOI 2020, it is important to observe and learn from past hosts. The hosts of IOI 2017 did a excellent job in creating many tools such as a revamped Translation System, Task Preparation System and a management system for contestant machines which we hope to be able to use during IOI 2020 as well.

As a consequence of being a future host, me and Gan Wei Liang (SG IOI Coach, 2016) were nominated to the International Technical Committee (ITC) and International Scientific Committee (ISC) respectively for the duration of 2018 - 2021 to represent Singapore in these committees. I am honoured to be able to contribute to the hosting of IOI 2020 by being a member of the ITC and would like to thank Dr. Steven Halim and A/Prof Tan Sun Teck for the opportunity. I hope to learn as much by being in the committee and in return execute the technical aspects of IOI 2020 smoothly.

Lastly, being an alumni of the Singapore IOI team myself, I greatly appreciate how much it has transformed me by allowing me to meet like-minded people from all over the world. In addition, I would like to thank the Ministry of Education (MOE) and School of Computing (SoC) for their unwavering support over the years. I hope that more of my juniors and future students will be inspired to compete for Singapore at the IOI and that IOI 2020 will kickstart more efforts in secondary schools and junior colleges to focus on informatics as a whole. In my personal opinion, I feel that the level of pre-tertiary informatics education was inadequate when I was in school and were vastly limited to a few selected schools, in a few selected niche areas. However, many changes were implemented since then and I hope that informatics education in Singapore would continue to grow and be regarded as one of the important subjects in addition to traditional school subjects.