About Us

Our team consists of 3 sophomores in NUS. The only girl in our team, Lim Li, is majoring in Computer Science and Math (Double Degree Programme). Meanwhile, Yehezkiel (Yehez) and Steven both study Computer Science. The team was assembled around March 2019 when all three of us needed to prepare a team for the CS3233 midterm contest, a competitive programming module in NUS. In ICPC 2018, we participated in different teams. Lim Li was a member of 3NationsIOI; meanwhile, Steven and Yehez were part of RefreshPHD. However, all the other members of 3NationsIOI and RefreshPHD decided to retire this year. Hence, considering our similar background in programming competitions (i.e., all three of us joined IOI during high school where Steven and Yehez were part of the Indonesia team, and Lim Li was part of the Singapore team), we decided to form one team for ICPC 2019.

Why 7 Halim? Creating a team name in ICPC is one of the most challenging parts of registering for the competition. 7 Halim is just a random idea suggested by one of us. The initial idea came from the film Naruto, where the leading character team is Team 7, and the team composition is also two boys and one girl. Besides, Team 7 has a teacher called Kakashi, quite similar to us, who had a teacher called Dr. Steven Halim when taking CS3233 in NUS. Therefore, we came up with 7 Halim as it sounds similar to our teacher’s name while still having an association with team 7. Apart from it, we also found that Dr. Steven Halim really likes number 7. Thus, our team name could be linked to many interpretations. Mostly, people would know that our team name refers to Dr. Steven Halim, but only a few would know that it initially comes from Naruto.

Background

7 Halim is one of the 46 participants of ICPC Asia-Manila Regional 2019, hosted at Ateneo de Manila University, Quezon City, The Philippines from 14th - 15th December 2019. In the ICPC Contest, generally, there are ten or more algorithmic problems to be solved by each team within 5 hours. Winners are ranked by the number of problems that they solved. In case of a tie, the team with less penalty time, which is calculated based on the time taken to solve the problem + the number of wrong attempts, will have a higher rank.

As one of the NUS ICPC Team, 7 Halim was given the flexibility to choose their ICPC site. Eventually, we decided to go to Bangkok and Manila site. Compared with other sites, Manila is the last ICPC Regional in the Asia Pacific and Southeast Peninsula area. Furthermore, Manila is conducted after NUS Semester ends, which let us focus more on the competition. Finally, none of us has ever visited Manila before. Thus, competing in the Manila site allows us to explore new places.

Practice Session

We had to work on past Philippine NOI problems for the practice session. We have 1h30m and 11 problems to be solved. Since the beginning, we realized that it was almost impossible to solve all of
the problems given the limited amount of time. As Dr. Steven Halim asked NUS teams to do speed contests during the practice session, we decided just to try our best to solve as many problems as possible. We also decided to test another strategy in the case on the contest day we need to split our focus into three problems at the same time.

It turned out that in the practice session itself, we got so many bugs. At the start of the contest, we realized that we forgot to include our template code to the cheatsheet. Luckily, we still got a decent rank at the end of the practice, with an equal number of solves with the 2nd rank. Our significant time penalty made us ranked 5th. However, because we were too focused on getting a good rank in the practice contest, we also did not manage to test a lot of things such as memory, time limit, stack limit, etc. We only tested the printing system because we had a limited amount of time and assumed that the rest should be quite similar to other ICPC competitions. It would be better not to repeat this in the other practice sessions because ranking in practice contest does not give any benefit for the competition (other than looking a bit strong in front of other participants).

**The Contest**

The contest day finally came. After practicing for several months, we just wished that we would be able to do our best in our last competition in 2019. We arrived a bit too early at the university because we lived quite close to it and was afraid to come late. Nonetheless, waiting for about two hours helped us to calm down our minds and prepare our best for the contest. According to the announcement on the opening ceremony, there were 13 problems to be solved in 5 hours.

The contest started at 10 am local time. As usual, Lim Li began to read the problems from the first problem (A), Yehez from the last problem (M), and Steven prepared the coding environment and template. However, as predicted, it turned out that there was a "free" AC (Accepted; the term that is generally used to refer to correct submissions) problem in the problem set. In the 2m, Lim Li told Steven directly to solve problem A which just needs to read one line input and do simple if-else based on the last character. As Steven had not finished the template at that time and playing with string in C++ could be troublesome, he decided just to code using Python. However, that's where the problem came because, after coding, we just realized that we did not test Python on the practice day and also did not know whether the judge used Python 3 or Python 2. After checking again the specifications and PC^2 system, which was used to submit the solution, we noticed that they allowed submission for Python 3. We also spent quite some time because we did not want to take the risk to submit before testing, so we made sure to test at least all the sample test cases. Finally, we got our first AC in 5m (quite slow compared to some teams who AC-ed it in 2m).

Afterward, Steven continued to finish the template and then switched with Yehez because he said that he had already got the solution for problem M. While Yehez was coding for M, Lim Li told Steven that she noticed another easy problem which basically just need to do simple checking for connected component and briefly explained the task and solution. The second solution submitted, Steven quickly switched again with Yehez and started to code for problem D. In the midst of implementation, bad news came, we got the wrong answer for M. Yehez was quite confused as the problem seemed easy, so he said to just print the solution and let Steven finish the implementation for D as soon as possible. However, it turned out that there were some problems when submitting a
print job, which made us split the screen. After several mins, we submitted our solution for D, but another one wrong answer feedback appeared. Steven quickly noticed that he used a wrong variable name in checking for one special case and decided to submit again, but well, we still got another wrong answer. We were quite pressured as its almost 40m, and all we got were 1 AC and 3 WAs.

The scoreboard at 31 mins after the contest started. We were still left behind in 7th place with one AC and 1 WA. Meanwhile, the other NUS team, 3Sophonomore, led the scoreboard by 3 ACs.

It was indeed not a good start as we noticed some teams (including 3Sophonomore) had got 3 ACs and probably was preparing for their next problem. We then decided to calm down a bit and make sure to test carefully before submitting it again because our time penalty was already quite significant. Afterward, Yehez noticed the bug in the solution for M and tried to fix it. In the meantime, after reading the problem description once more, Steven also realized that the sketch solution for one of the exceptional cases that Lim Li told was wrong because there should be some extra steps to find the correct answer. Yehez submitted the solution for M, and finally, we got our 2nd AC in 44m. Afterward, Steven also fixed the solution for D, and we got our 3rd AC in 53m. At that time, our total number of ACs was the same with team BBQube from National Taiwan University, who was leading the scoreboard at that time but with higher penalty time.
We were ranked 3rd at 53m with 3 ACs and six attempts.

Before fixing the solution for D, Lim Li had also explained the solution for the problem I to Steven, so he just continued to code the solution for problem I after successfully coded D, which only required case division. However, it resulted in a runtime error, one of the assertions for the case division failed. Steven then switched position with Yehez, who had discussed the solutions for problem L and H with Lim Li. Because we were sure that there was no memory problem, Lim Li and Steven rechecked all the assumptions made for problem I. After several minutes, they noticed that there was another special case that they had not noticed. Steven then asked Yehez to switch again because it did not require a lot of changes. Before submitting, we made sure to do another series of testing to minimize our time penalty. And yeah, we finally got AC for the problem I in 75 min. At that time, Yehez had also finished the solution for L but just wanted to read the solution once more and do more testing since, no other team had solved that problem at that time, and we were also not sure whether there was any tricky case. After a few mins, we finally got AC for problem L at 86m and became the first team to solve problem L.

At that time, our team led the scoreboard with 5 ACs. We noticed that we actually got some chance to finish in good rank as long as we maintain our pace. We tried to keep the good momentum. As there was no AC-ed problem that our team had not solved, Lim Li and Steven decided just to continue reading all problems and try to identify other problems that we might be able to solve while Yehez was coding for problem H using some observations that Lim Li got on how to construct the answer. After reading all of the problems, Steven marked problem J and K as difficult problems, which were not worth to spend time thinking about the solutions or even implementing it, considering we still had a lot of other problems. Lim Li also felt similar things toward problem F and G. It looked like problem G needs some geometry observations, so we just avoided it. Lim Li got some observations for problem F but could not construct the answer as it required more in-depth thinking to work with the 2D grid. Hence, we decided to just focus on problems B, C, and E, which looked much more solvable.
After a while, Lim Li pointed out the idea to solve problem C using maxflow N times in a graph containing N*K edges, where N ≤ 4200 and K ≤ 32. She was not sure whether it would be able to pass as sometimes estimating the time limit for maxflow is a bit difficult. After noticing that the time limit was 6s, Steven felt confident that it would be okay. Steven then discussed with Lim Li on how to model the network and ensure that it would output the correct answer as at that time, no team had solved the problem. It took around 10 mins, and finally, both of them were sure that we at least would not get WA for problem C.

Around 120m after the contest started, we just noticed that 3Sophonomore had solved problem E at 99m and at that time led the scoreboard with 6 ACs. Steven had read that problem at the beginning of the contest and given the DP tag for the problem even though he had not got the solution. Lim Li and Steven then started to discuss various possible approaches to solving that problem. Suddenly, at 141m, Yehez successfully got another first AC on problem H with a single try. We were thrilled at that time to regain the 1st position with 6 ACs and a bit smaller time penalty compared to 3Sophonomore.

We regained the 1st position after solving problem H at 141m.

Steven then swapped position with Yehez to implement the solution for problem C. Yehez and Lim Li continued to discuss potential solutions for problem E. However, another bad thing happened. Steven somehow could not find an implementation for the Dinic algorithm in the cheatsheet that we printed, so he had to implement it by himself. It caused some trouble for our team because coding dinic without our cheatsheet might introduce some bugs if we are careless in implementing them. Fortunately, there were only a few bugs, and it could quickly pass the sample test cases. However, after submitting the solution, a TLE (Time Limit Exceeded) verdict appeared, something that we were terrified of. Steven tried to do more optimizations, but it still resulted in TLE. Finally, Steven switched position with Yehez, who had discussed the solution for problem E with Lim Li.
Until 211m, we did not manage to get more AC and temporarily seated at the 3rd position.

We were quite sure at that time that many teams would end up with \( \geq 7 \) ACs. Hence, we decided to think everything more carefully, especially because we already had two failed attempts for problem C. Honestly, we were quite unsure as our solution for problem E was DP with time complexity \( N^4 \) (\( N \leq 120 \)) and the time limit was only 2s. However, because we had no other option, Yehez just straightly coded for it. Fortunately, we got our next AC at 238m with a single try! It was a good day for Yehez; he solved four problems with only five attempts, which helped us to get a quite low time penalty.

We were placed at 2nd position when the scoreboard was about to be frozen.
Since the top three teams were tied with seven problems, we had a feeling that the 8th problem would be the decider for this contest. Hence, we initially focused on problem C, which we had almost solved. We added more optimizations and tried to submit once more, which turned out to be another TLE. Steven finally decided to generate random big test cases to evaluate how slow was our solution. However, what we did not expect was that it went into an infinite loop, which meant that there was a bug in our code. We felt delighted at that time because it gave us a signal that our idea might not be wrong. Steven then noticed that he forgot to write a return statement at a particular part of the code, which could return 0 for relatively small test cases but would return a random number for big test cases due to OS implementation for managing stack memory. After fixing it, we submitted the solution for C again, and it resulted in an AC verdict at 264m. We were very happy because we predicted that we would at least be able to secure the top 3. Our time penalty was quite low even after solving problem C with four tries. Other unsolved problems were also quite difficult, which caused us to believe almost impossible for other teams to get 9 ACs suddenly. We still tried to solve other problems, but it seemed like there were not enough time to think and implement. We finished the contest with 8 ACs.

Closing Ceremony

During the closing ceremony, prizes were awarded to the top teams, first solves, as well as the best coaches.

The prize for the first to solve is 3 Google duffel bags. Out of the 13 problems, 9 of them had solvers, and out of those 9, 6 of them belonged to NUS. Hence, NUS won a grand total of 18 brightly colored Google duffel bags. Before the closing ceremony, we asked around other coaches on how their teams did, and so far only find our team and team "Registers" from VNU Vietnam that solved 8 problems. We are still unsure about team BBQube’s performances since they will definitely beat our penalty time if they also manage to solve another one problem within the last hour. Fortunately, during the top 3 announcement, we were awarded as the champion. Each of us won an Acer laptop for coming first, and our coach, Mr. Akshay, won a laptop for being the best coach.

Here are some photos that we took that night:
Our Trophy

Coach Certificate

7 Halim Certificate
After the closing ceremony, we skipped the dinner organized by the ICPC in favor of going to Manam, a local restaurant, to have a celebratory dinner. We had our dinner with 3Sophonomore (Lung Sin, Robin, and Sergio), Mr. Akshay, and Robin’s family. We ordered a lot of local cuisines and ate until we were stuffed. In the end, the receipt for the meal was so long that Mr. Akshay had to take a panorama to fully capture the receipt.
We ordered about 3N servings of food where N is the number of people eating.

**Excursion**

We have decided to extend our stay in Manila for one more day so that we could have fun and explore Manila city. Therefore, the next day, Mr. Akshay left earlier to the airport whereas we moved to another hotel which was located nearer to the airport. Since 7 Halim and 3 Sophonomore have different planning on that day, we have decided to go on our own and meet again at the airport the next day. From the hotel that we stayed in, it is only a walking distance to reach the Mall of Asia (MoA), which is one of the biggest malls in Asia.
When we arrived inside the mall, we walked around for a while before moving to find our lunch. As it is a huge mall, we had a hard time deciding what to eat. Eventually, we follow the recommendation from the Internet, and we arrived at Gerry’s Grill.

We finished our lunch at around 4 pm. Because the sun is not too bright at that time, we believed that it was the best time to visit SM by the bay, a bay located just behind the mall. In addition to enjoying the view, SM by the bay has a great amusement park. They have plenty of amusement rides for both kids and adults. Out of all the rides that they have, we found that riding a cruise is one of the most exciting things to do. Therefore, we got on the cruise, took a lot of photos from it, and enjoyed the ride for about 30 minutes.

After getting off the cruise, we continued exploring the bay until sunset. Afterward, we went back to the shopping mall and spent the rest of the time to find some souvenirs. Before going back, we ended our day by eating dinner at Juan’s Bistro.
We felt so tired after exploring the gigantic mall that we decided to take a cab to get home. While waiting for the taxi at the main entrance, we observed that we only explore around half of the mall even after spending the whole day there. One can go to the left or the right after entering the building through the main entrance, and apparently, we only visited the left part of the mall.

The next morning, we did not plan to go anywhere, as it might be cumbersome to bring around our luggage. Therefore, we checked out of our hotel and went to the airport immediately. At the airport, we reunited with 3Sophonomore and went back home together.

**Reflection and Acknowledgement**

Overall, we were very satisfied with our performance as we did much better than our previous site in Bangkok. Honestly, we had never expected to be able to win the Manila site as a champion. Moreover, we were quite lucky as there were not many math questions, which is one of our weakest topics, and we win only by a small margin, beating the 2nd place by penalty time.

We would like to express our gratitude to our sponsors: Indeed, Seagroup, SenseTime, Jump Trading, HRT, and DRW for making such a wonderful experience possible. We would also like to thank NUS School of Computing, especially our coach Mr. Akshay, who supported us, gave us valuable advice, as well as organizing the trip, our ICPC and competitive programming trainer Dr. Steven Halim, who trained us and gave us many pointers on the kind of problems to expect for this contest, and Prof Tan Sun Teck, for organizing spectacular training events such as the Discover Singapore ICPC Workshop. None of these would have been achievable without their support. We
would also like to thank Dr. Steven Halim for letting us use his last name in our team name, bringing us good luck.

In the end, Merry Christmas and Happy New Year from all of us!