

Team Report: 3body3

Members:

Bay Wei Heng, BSc in Mathematics / BComp in Computer Science, Year 4

Bernard Teo Zhi Yi, BComp in Computer Science / BSc in Applied Mathematics, Year 3

Sidhant Bansal, BComp in Computer Science, Year 3

Our team participated in ICPC Kuala Lumpur 2019, hosted by Kulliyah of Information and Communication Technology, International Islamic University Malaysia, Kuala Lumpur, from 8th to 10th November 2019, We competed against 33 other teams from the ASEAN region, including teams from University of Indonesia and National Tsing Hua University.

The contest had 10 algorithmic problems, to be solved within 5 hours. The primary goal was to solve as many problems as possible, with the secondary goal of minimising the time penalty, which is calculated based upon submission times and accuracy of solutions.

Malaysia only hosts ICPC regional contests occasionally, and the last ICPC regional contest that Malaysia had hosted was five years ago. Unfortunately NUS has never been able to bag a position in top 3. As such, we expected there to be quite some uncertainty of the type of problems that we would encounter in the contest. Furthermore, there were a number of other regional contests that were held at a date very near to the Kuala Lumpur contest. For instance: ICPC Seoul 2019 was on the same weekend, due to which no Korean team was seen competing at Kuala Lumpur. This turned out to be good for us, since many teams shy away from such uncertainties, and some teams couldn't compete in two contests happening simultaneously, leading to fewer number of teams at the Kuala Lumpur site.

For the actual contest, we decided to stick to our old strategy that worked well last year as well, of attempting to solve questions that were tough, but that we had comparative advantage in (e.g. math). This would counter "follow-the-leader" strategies that other teams might decide to adopt. We let the other teams discover the trivial questions for us, immediately switching to those once there was a few ACs. Although towards the end of the contest, we were indeed the one getting First Solve's on the relatively harder questions.

Sidhant started reading the first 3 problems (A,B,C), Wei Heng the next 3 problems (D,E,F), and Bernard was reading the next 3 problems (G,H,I), during the first 10 minutes of the contest.

Most of the problems seemed to be doable but none of them were cakewalk. Fortunately, due to our team's previous practices, we agreed beforehand to pass questions around. A common strategy that we followed this time around as well, was that all the math questions are given to Wei Heng first, since he is the best in math and the other questions are split between Bernard and Sidhant. We proceeded to solve 4 questions in the first hour (D, E, J, G). There was one minor bug, that Sidhant had in E which caused 1 WA apart from that this was pretty much smooth-sailing.

At this point we were done with 4 out of the 10 questions of the set and had a lead of 2 problems over the 2nd team on the rank list. Now all the remaining problems were relatively more time consuming. After some

discussion Sidhant and Wei Heng figured out that H was a string hashing question and I was a data structural question, a variant of which we had seen before in ICPC Jakarta 2017. So Sidhant started coding these 2 problems and we were able to get them AC by around 2:30 mark of the contest. Meanwhile Bernard and Wei-Heng were finalising and framing the correct logic for C and F. As it turns out C was a min-cost max flow problem and F required some brute-force + mathematical insights.

C and F, both had tedious implementations. C required copy-pasting 70-80 lines of book code and F also had some edge cases. Our rank during this period slid from 1st to 5th position. During this period, we also observed that a lot of teams had done B, and our current sketch for the problem was a rather complex data structure. Seeing the fact that a lot of teams had already done B, Wei Heng quickly realised another approach to solve this problem which was relatively much simpler to code. So from 147 minute to roughly 200 minute mark, all three of us were coding B (Sidhant), C (Bernard) and F (Wei Heng), 3 different problems in turns and in a mere span of 11 minutes, i.e from 200th to 211th minute, all 3 of us got AC on our respective problems, shooting our rank up from 5th back to 1st.

At this point only problem A was left (later we realised that we had won the contest at this point only, since the 2nd best team ended up solving 8 problems, whereas we were on 9 already), and Bernard already had some ideas about it. Bernard discussed those ideas with Wei Heng and they both implemented the problem together (i.e one of them writing the code and the other one looking at the screen for bugs and vice-versa) for the next 45 minutes. The code was rather complex and we hoped that it AC's in one attempt since debugging that code would be hard. Fortunately, it did AC in our first submission at 265th minute. With this we were elated since we had solved the entire problem set and were now only worried if UKUNICHIA, a team from the University of Aizu, Japan could catch up with us and get all the problems correct but with a lower penalties than us.

Since the rank list had already been frozen at the 240th minute, so we were now only speculating and trying to calculate other team's best case scenarios. The way the rank list works after freeze is that we can only see if a team submits a problem but cannot see what verdict they got. At around 4:50th minute, we became certain that even in the best case scenarios of other teams during the freeze hour i.e they get AC on all problems they submitted, by calculating the penalty we were certain to stay ahead.

Also we received 4 first to solve awards for A, C, D and J. This was the first time we had completed an entire problem set in an actual contest and we were elated because of that. Of course, we could not have achieved this without our sponsors: Indeed, Sea Group, SenseTime, Jump Trading, Hudson River Trading, and DRW.

We would also like to thank our coach Dr. Suhendry and Dr. Sufatrio, who supported us and gave us valuable advice, as well as for organising the trip and helping to handle unexpected mishaps; and 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.










Day 0 - Before Practice Contest. Left to Right - Pokemon Goh, spaghettiM, 3body3

Day 3 - Post Contest Dinner

RANK	TEAM	SCORE	A	B	C	D	E	F	G	H	I	J
1	3body3 National University of Singapore	4 161				23 1 try	28 2 tries		50 1 try			40 1 try
7	spaghetteaM National University of Singapore	2 53					17 1 try		36 1 try			
14	Pokemon Goh National University of Singapore	1 10					10 1 try					
1	3body3 National University of Singapore	4 161				23 1 try	28 2 tries		50 1 try			40 1 try
2	hex(10101100) Universitas Indonesia	2 31					12 1 try		19 1 try	1 try		
3	Quantasaurus Tiguerria Universitas Indonesia	2 40					11 1 try		29 1 try			
4	HaH Bina Nusantara University	2 46				1 try	10 1 try		36 1 try			
5	UKUNICHIA University of Aizu	2 49					21 1 try		28 1 try			
6	BenIsVeryBen Nanyang Technological University	2 50					20 1 try		30 1 try			
7	spaghetteaM National University of Singapore	2 53					17 1 try		36 1 try			
8	NTU_stdio National Taiwan University	2 55					14 1 try		41 1 try			
9	Mainboard University of Engineering and Technology - VNU	2 58					15 1 try		43 1 try			
10	NTU KDB Nanyang Technological University	2 64				37 1 try	27 1 try					

Day 2: At 00:52 minutes after the start of the contest, where we are leading by +2 problems

RANK	TEAM	SCORE	A	B	C	D	E	F	G	H	I	J
1	 3body3 National University of Singapore	10 1411	265 1 try	211 3 tries	200 1 try	23 1 try	28 2 tries	207 5 tries	50 1 try	100 1 try	147 1 try	40 1 try
2	 UKUNICHIA University of Aizu	8 854	275 1 try	143 1 try		58 1 try	21 1 try	5 tries	28 1 try	123 2 tries	81 1 try	105 1 try
3	 Quantasaurus Tiguerra Universitas Indonesia	8 1239	1 try	181 1 try		141 2 tries	11 1 try	284 2 tries	29 1 try	270 2 tries	144 1 try	99 2 tries
4	 NTU_stdio National Taiwan University	8 1270	292 3 tries	261 2 tries		73 1 try	14 1 try		41 1 try	116 3 tries	245 2 tries	108 1 try
5	 NP-TRAN Hanoi University of Science and Technology	7 760	3 tries	78 2 tries		37 2 tries	45 1 try		60 1 try	142 3 tries	123 2 tries	175 1 try
6	 Pokemon Goh National University of Singapore	7 810		163 1 try		59 3 tries	10 1 try	7 tries	68 1 try	121 3 tries	198 1 try	91 2 tries
7	 28 National Taing Hua University	7 830		115 1 try	4 tries	176 2 tries	16 3 tries	264 2 tries	21 1 try	51 2 tries		87 1 try
8	 BenlsVeryBen Nanyang Technological University	6 506	2 tries	112 1 try		61 1 try	20 1 try		30 1 try	1 try	170 2 tries	93 1 try
9	 hex(10101100) Universitas Indonesia	6 582		219 1 try		74 2 tries	12 1 try		19 1 try	53 2 tries		145 2 tries
10	 KFC Ateneo de Manila University	6 635		71 1 try		36 2 tries	18 1 try	185 7 tries	79 1 try	10 tries		106 1 try
11	 TJU_wannacry Tianjin University	6 912		152 3 tries		98 2 tries	18 1 try	6 tries	70 2 tries	292 2 tries		182 1 try
12	 spaghetteaM National University of Singapore	5 526		4 tries		170 1 try	17 1 try	122 6 tries	36 1 try	14 tries		81 1 try
13	 Bump Bung Bina Nusantara University	5 788		276 1 try		121 3 tries	28 1 try		160 1 try			163 1 try
14	 Monokurobo2 STMIK Mikroskil	5 831				179 3 tries	22 1 try		54 2 tries	102 3 tries		294 5 tries
15	 NTU KDB Nanyang Technological University	4 395		15 tries		37 1 try	27 1 try		114 1 try			197 2 tries
16	 Mainboard University of Engineering and Technology - VNU	4 404		3 tries		86 2 tries	15 1 try		43 1 try	2 tries		200 3 tries
17	 Test (XMUM)	4 440		210			36		101			73

Day 2 - Final scoreboard post contest