Festival of Maths – IMO Argentina

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2nd July – 16th July 2012

Introduction – Introducción

An individual competition where scores are summed and compared between countries

The International Mathematical Olympiad was held this year in Argentina over the early weeks of the school summer holidays. This is an annual event that is designed to bring bright students from all over the world together, with a hundred countries sending teams this year. The olympiad itself is comprised of two days of exams and contains six problems, which require some ingenuity to solve. This report is designed to give the reader a feel for the IMO experience from the point of view of a student.

Well, other than being a brilliant holiday, there was also the minor issue of a maths competition, so here are our results:

Name	Q1	Q2	Q3	Q4	Q5	Q6	Total	Medal
James Aaronson	7	0	4	7	2	0	20	Bronze
Sam Cappleman-Lynes	7	0	0	7	0	0	14	Bronze
Andrew Carlotti	7	7	5	6	0	4	29	Gold
Daniel Hu	7	0	0	7	2	0	16	Bronze
Josh Lam	7	1	0	7	7	0	22	Silver
Matei Mandache	1	4	0	7	0	2	14	Bronze
Min	1	0	0	6	0	0	7	
Max	7	7	5	7	7	4	37	Gold
Total	36	12	9	41	11	6	115	22$^{\text{nd}}$

The other main characters of mention were James Cranch and Jack Shotton our leader and deputy leader respectively, Geoff Smith on his IMO Advisory Board business, and Beverley Detoeuf was the observer with contestants and made sure all our needs were met.

The UK team had quite an average year, but we are pleased to have all achieved medals, and coming joint top of Western Europe is an excellent title to hold. We beat the team we were aiming to beat (the Lisa-less Germany) by 9 places which is a strong result given their dominance in recent years. Unlike the last few years, our non-competing contestant Min wouldn't even have got an honourable mention (getting one problem as a full seven marks), but our similarly non-competing contestant Max would have been placed a nice high joint 8th in the world.

This was a well organised IMO in a nice hotel with loads of activities, the 24,000 piece jigsaw being just one highlight, but the best part perhaps was getting to mingle with people from all over the world.

Arrival – Llegada – Monday 2nd July

A long flight from summer to winter, but still familiarly European

Our team once again for this year was comprised only of students with surnames in the first half of the alphabet, following the same alphabetical prejudice in the IMO 2011 team and the Balkan 2012 team. This strange phenomenon seems to pervade UK training camps with their bias towards surnames early in the alphabet. After all, we even have our own Triple-A Ronson on the team. IMO official seems to disagree, ranking in reverse alphabetical order, placing James at an unfittingly lowly 21$^{\text{st}}$ in the UK Hall of Fame.

We meet at Heathrow terminal 5 on Sunday afternoon and receive our UKMT shirt, tie, blazer and red hoodie. Most of us UNKs have not ventured far away enough from Europe to have reached the southern hemisphere, and only Jack, Bev, and Andrew can claim otherwise. No-one has been to Argentina before, and it seems exciting to be going so far from home. We suspect that the shortened number of daylight hours and the switch in season (from summer to winter) will be more disorientating than any jet lag.

Our BA flight is a long one, and at 14 hours, is many times longer than the longest flight Matei has been on before. After watching a film or two, sleeping, and stuffing swollen feet back into our shoes, we are picked up by a school bus. It drives us to St. George's College in Quilmes, a school where we will be training for the next week. The school is a bilingual one with courses taught in Spanish and English, and is a very international one – James later finds the crest of St. Paul's School and tells us that his school visited St. George's on a rugby tour. The school is a private school with some money, and is top quality in Argentina, having large grounds and facilities, including multiple fields, squash courts, tennis courts, swimming pools, a shooting range and a chapel. The grounds are surrounded by high walls with barbed wire, and we are very isolated from the rest of the area. Inside, we are treated to a familiar experience of blocks of brick buildings, paved ground, regular shapes of grass patches, and teaching with whiteboards.

We split into 4 (James, Josh, Matei, me) and 2 (Sam and Andrew) for our rooms. The room of 4 seems smaller than the room of 2, and has less than enough room for opening all our suitcases at once. We make it our home for a few days anyway by immediately throwing everything we might need for the week on the ground, and then go on a tour of the school by Stephen, the head of maths whose classroom we are taking for the week. Stephen helps us out on whatever we need throughout our stay.

The Australians arrive in the evening and seem friendly enough that we might have a good time. Last year four of them had two-letter surnames ending in 'u', but this year they haven't done as well and only have two (Fu and Xu). Still, they soon accept me as a long-lost Aussie. We get to meet their mascot the koala Sampson and his appendix who also seems friendly enough at first, but then again, looks can be deceiving.

Preparation – preparación – Tuesday 3rd July – Saturday 7th July

To make the IMO paper feel like a normal day's work, we do an similar exam every day beforehand

Tuesday 3rd July

We spend the next few mornings doing practice exams. The practice exams are to be like standard $\frac{1}{2}$ IMOs, being 3 questions long and lasting 4.5 hours. The questions are meant to be graded in difficulty, but unlike the IMO which is usually quite reliable on increasing difficulty (an exception

being last year's question 2, the famous windmill from Geoff), we are warned that these papers are not necessarily that way. Each question is marked out of 7 as usual. Our first practice exam is quite successful, with our Min's score of 14 equalling the Aussies' Max's score of 14. The Aussies can probably be excused on their half-day jet lag, but we are more than pleased to keep reminding them of the result.

In the afternoon after the noon of the first exam, Jack shares an interesting youtube video: viscous syrup falling on a moving belt. A stream of syrup is released from above onto a conveyor belt whose speed slows down gradually. The syrup begins by going in a straight line that wiggles more and more, until the pattern spontaneously changes into a long figure of eight. The pattern gets a bit chaotic and then settles into a regular pattern of coils again.

We begin to get used to our schedule and the free time it offers by playing some card games like "We Didn't Playtest This At All", "We Didn't Playtest This Either" (games with no thinking involved) and Mao (Playtest's polar opposite) with the Australians, while our deputies mark our scripts. We discuss solutions and then have tea at 5pm, and dinner at 8pm (early by Argentinian standards!). We notice that Argentinians seem to love sweet food, a highlight being the dulce de leche, a sort of caramel that goes in just about anything the Argentinians decide to put it in. In the evening before he leaves for the IMO, James Cranch gives us a rousing speech that is meant to represent the secret of his success as leader. He reminds us that we are not expected to do any of the problems on the IMO paper: we are only expected to attempt them.

Wednesday 4th July

We beat the Australians again on the practice exams today. During the day, news seeps through that the Higgs boson has been discovered at CERN with 99%+ certainty. We speculate a bit as to the meaning of the level of precision (6 s.f.) to which the certainty was given.

James reveals that the source of his outbursts of choking laughter at throwing things on the ground is due to some youtube video with 34 million views. Having shown us the video, we also begin to find hilarity everywhere we go. While playing frisbee as much as we can now before it gets dark, we throw frisbees on the ground.

Thursday 5th July

We beat the Australians again on the practice exams today. At lunchtime on the 3rd day, Sam gets mobbed by girls wanting to see him solve his Rubik's cube, having somehow heard that he can blind solve, and they follow him all the way to the classroom. We play the Australians in an all-important match of ultimate frisbee, the winning team getting a 50 point bonus on the Ashes. Despite being mathematicians, some of the Australians can actually throw and catch, and once they get used to the rules, the game becomes very intense and dramatic. We get a lead of 4–0, only to lose it to the upstarts 5–7. Playing to 10, we dig deep, and manage to clinch a close win 10–9. It looks unlikely the Aussies can beat us at the Ashes now!

Friday 6th July

On the Thursday, we sit the BAMO: the Buenos Aires Mathematical Olympiad. This was fun as we set a paper for the Australians, and they set a paper for us. Subsequently, we had to undergo the strange position of co-ordinating the papers, and fighting for Aussie marks. Question 2 on the BAMO we were set was G6 (the code from the IMO shortlist problems last year, G meaning geometry), and it involved the mysterious point P (misnamed in the question and called point K!). Surprisingly, Sam, our geometry meister who knows all about point P, doesn't manage it, though

he is an angle chase away, and leaves with 2 marks. But after all, it doesn't matter since perhaps, as Triple-A Ronson says, "geography isn't maths".

Since the exams the Australians set for us was different to the one we set them, there is little meaning in comparing our results. But, we still beat them.

After lunch, Sampson performed some of his vicious drop-bear attacks. Some of us spend too long looking into his adorable eyes and forget our caution. Perhaps he was trying to protect his appendix. Sampson's bad behaviour gets worse as he tries to claim the Ashes for his own:

The Australians show us some good limericks which involve reciting true mathematical equations:

"The integral of t squared dt,

From one to the cube root of three,

Multiply the cosine,

Of three pi over nine,

Gives the log of the cube root of e!"

and

"A dozen, a gross, and a score,

Plus three times the square root of four,

Divided by seven,

Plus five times eleven,

Gives nine squared and not a bit more!"

We attempt to verify whether they are true, but we decide that as mathematicians, we are not good enough at arithmetic.

Some of us (mainly Aussies) keep trying to play football in one of the school's sports hall,

and set off alarms twice before being kicked out by someone speaking Spanish. The Australian's superior proficiency in football shows as they then beat us 5–3 on the field.

Saturday 7th July

The Pre-IMO camp in Quilmes culminates in the Mathematical Ashes. The team that wins this can get eternal glory .... . Well, at least, they can get the ashes of the British scripts of the first Ashes in 2008. After sitting the exam, we discuss which questions we have solved and speculate on the surely very close outcome of competition. This time, there is no hesitation in reminding the Australians that they are not going to see the Ashes for yet another year if we win – the Aussies have only won it once in 2008 (it was tied last year). After much tense waiting for co-ordination, Jack reveals to us that we managed to thrash the Aussies 72–52. Furthermore, we each weakly beat our arch nemeses – the Aussie with the same number as our UNK number. We finally beat the Aussies in a geometry question in an important exam, problem 2 being G3, all credit due to Josh Lam, the only person who solved it. Surprisingly, Tim Large (AUS 1) is unable to make headway with problem 2, despite being very good at geometry! He should probably stop pretending to be Kaimyn. This is a good result, but we become a bit thoughtful, when we realise that the last time we beat the Aussies outright in the Ashes (2010), they beat us by ten places in the IMO.

During one of our trivia discussions, we note for at least the last two years, if the number of UNKs in the IMO team who are available to compete the following year is N, then the number of them who are actually in the IMO team the next year is $N-1$. Looking for patterns, we also note that both contestants who have been unfortunate enough to miss out have also been report writers. Given that Andrew (available next year) has also written a report, I wonder what this phenomenon will mean for next year's team.

In the evening, we pack all our bags and stuff into them some gifts that we will be distributing to the other teams: pens, playing decks, and BMO1 booklets.

Sea of Silver – MAR DEL PLATA – Sunday 8th July

Our hotel is grand and large enough for some adventuring but we voluntarily keep ourselves in the recreation room which satisfies us for the duration of the IMO

We met at 0730 as usual outside the breakfast hall only to find it locked and empty. Being the Sunday before the winter holidays, no-one is at school, and we stand around wondering what to do with our stomachs. We see some hope in a truck arriving at the school, but it turns out to be bin men. I go for a run, and at 8am, a man arrives and lets us in, cooking some well needed eggs on toast for us. We say goodbye to Stephen, are driven to the main Buenos Aires bus station, and wait for our 5 hour bus journey to Mar del Plata (it's 250 miles away). Most of the adverts in the bus station are the same, saying "The exploitation and trafficking of boys, girls and adolescents is a crime" (translation from Spanish). At least Argentina can't be as dangerous as Colombia, where the IMO will be next year.

On the way, many of us doze off with the comfy footrests, watch the film, and Matei manages to finish his 51-case case bash for problem 3 on the Ashes. He was unable to finish more than zero cases in the exam after having to correct some of his definitions. Happily every case works, and he is at peace at last! Wondering about poverty in and around Buenos Aires, I notice that there are dozens of flimsy corrugated iron dwellings in silent occupation of the wasteland surrounding the motorway out of Buenos Aires, some of the shanty towns being very large.

We check in at the IMO hotel: NH Gran Hotel Provincial at 1600. It is a huge hotel (wikiable), and a very important one too. The list of signatures and photos from visitors include the heads of state of at least 9 countries, and there are multiple eating areas and large conference rooms, one of which we will be sitting the IMO in. We are greeted by our guide Javier Corti. He is a computer science student who did some maths training, but didn't get onto the Argentinian IMO team. On the other hand, he has competed at the IOI[1] 3 times, and this probably means he can have some interesting conversation with Andrew Carlotti, who is in the UK IOI team this year.

We check out our rooms, and find our way to the recreation room, having come down the double helix stairs. Due to the structure of the stairs, the two stairways lead to different places, and one of them doesn't even have access to the 1st floor! The rec room turns out to be a place where we will be spending most of our time (even more than sleeping in our rooms!). It is a large games hall than includes an amazing assortment of puzzles that even Sam would surely take a while to solve. There are racing cars, video games, table tennis, a mechanical bull, karaoke, a band room, a large pile of board games, computers and much more. We receive some standard freebies in a backpack here once Javier gives up trying to distract us from the puzzles table and gets them for us himself. We all read the large poster on all the amazing facts about 2012 that encourages us to put our own amazing facts about 2012 on there. Some of the poster is serious, some not so much – "2012^2 is a

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[1] The IOI is the International Olympiad in Informatics, one of the many International Science Olympiads that aim to challenge bright students around the world, of which the IMO is the oldest

perfect square!" and "All events at this IMO take place within a 2012 km radius of this poster!" At the bottom is a memory challenge for memorising as many of the digits of 2012! as you can (it has 5776 digits, 501 of which are zeros at the end). Tonight and over the next day I memorise about 250 digits before getting distracted by some unimportant competition called the IMO. We attempt to find some very late lunch, and are welcomed into a pizza restaurant. All the restaurants around the hotel seem to be Italian.

Before dinner, Andrew quickly gets attracted to the 24,000 piece jigsaw, and we all wander off to our own little corners. Half of us go to our rooms at 11pm, and half of us don't, the missing half interestingly being our top three contestants.

Parade – Desfile – Monday 9th July

Local residents take photos and watch alongside the Parade as we take up all their space

We meet at breakfast at 8am in time for sunrise, and the breakfast conversation involves much IMO trivia, primarily from Sam. We learn the Peruvian team's average age is less than 15 (they still beat us), and of course Raul, who came 6th last year, is competing for the last time before going to university at the age of 15. James gets us wondering about the name of the person with the 2nd highest score (after Lisa) in IMO 2011 by telling us his surname is a mathematical operator. This Singaporean goes on to get the only full score this year. Between breakfast and the carnival, the Australians manage to attach koalas to many teams, and the diffusion of koalas happens without too many people noticing. The march to the opening ceremony takes a long time, and our noisy parade fills the streets of Mar del Plata. The unrelenting drumming that fills the air leads us on. I strike up some good conversation with some of the Argentinian team on the way.

The opening ceremony starts by trying to deafen us with some of the Argentine national anthem, and is followed by some speeches with questionable translations. They express some nice sentiments about bringing maths to the rest of society, though saying this IMO will bring with it a freer future seems a bit over the top.

On returning back, we take a detour via the seaside. Our guide comments on a seaside house in the style of an old English mansion, and about what he knows about Great Britain from reading lots of Sherlock Holmes. He wonders where Dartmoor is relative to London. I hold the UNK placard and wave it around, using it as a fan to cool down the team. Matei decides to take it before realising he's not sure we should be advertising our Britishness on Argentinian soil now that we've split from the main parade. This is good logic and the placard stops waving.

Andrew quickly gets back to work on the 24,000 piece jigsaw puzzle, and Matei helps though he becomes skeptical that it will be finished. The recreation room is also a room for the tournaments that will be taking place over the IMO stay, and these include chess, go, jenga, set (Triple Bongui), Ta-Te-Ti-To, scalextric, table tennis, table football, and beach football (just a few dozen metres away). There is a long sheet of rules for the tournament, including one that says any team of N members must have at least $\max(2, \frac{N}{2})$ different first languages, clearly attempting to promote inter-continental mixing. We note that the UK team is quite ethnically diverse with 3 first languages among 6 people. Matei speaks Romanian, Josh speaks Cantonese, and some of us can speak English. This clearly meets the conditions technically if we wish to enter as a team, but this is also clearly discouraged.

The rec room turns out to have more than first meets the eye. On the windows are all the IMO questions back to 1959, and people have written up solutions using marker pen on the windows. There is also an interesting pair of slopes from one point to another – one is a cycloid, and the other a straight line. Dropping two metal balls simultaneously demonstrates that the cycloid path is quicker.

Day 1 – Día Primero – Tuesday 10th July

A disappointing paper leaves us disorientated

We get our daily morning edition of IMO news, in which Gunning (AUS 3) features prominently with a photo of him impersonating a zombie on stage at the opening ceremony. We Brits feature too, with James having been interviewed about how the journey to the IMO was – he was glad that we'd had a week to get used to the Argentinian timezone.

We sit the exam for the next 4.5 hours. POR 4 on my right shakes everybody's hand around him and wishes them good luck. At 09:00:00, POL 4 wonders whether to start. Finally a bell rings, and everyone opens the envelope to read the papers in their chosen languages (anything from English and Spanish to Montenegrin and Azerbaijani). Problem 1 is a simple geometry, Problem 2 a silly inequality, and Problem 3 a hard combinatorics. After the exam, only Andrew is satisfied with the paper, claiming solutions to 1,2,3(1) and an idea for 3(2), having done most of every question. No-one else claims much more than the first problem, and Matei is disappointed to have no full solutions. Sam and I attempt to support the claim that problem 1 is the easiest geometry on an IMO for a while, being merely an angle chase (+cyclic quads to spot), that even Triple-A Ronson, our local anti-geography protestor ("geography isn't maths") solved using angle chasing. Jack, who sat the paper simultaneously in a room for deputies, tells us "the solution" to problem 2. It turns out to be terribly simple AM-GM applied almost directly to the problem statement giving a one line solution, after making a substitution $(1 = \overbrace{\frac{1}{k-1} + \frac{1}{k-1} + \cdots + \frac{1}{k-1}}^{k-1})$. There are complaints that the paper is disgusting, primarily problem 2, and a proposal that this is a terrible paper goes up among the UNKs, getting 4 votes (UNKs 1,2,5 and 6). We realise that this paper will not have done a very good job at differentiating medallists with the likely 0–7 polarisation, and realise that tomorrow's problem 5 will be the decider for medal boundaries. We can only hope tomorrow's

paper allows more room for differentiating people as otherwise medal boundaries might be squished up. As usual, mathlinks trolls complain problem 2 is way too easy for IMO and shouldn't be on an IMO paper with its one line AM-GM solution. Most of our team strongly agree with half of that and also disagree with the other half. To solve problem 2 was simply about a silly trick that you either spot or not, unless you are as good as Andrew who found a calculus solution. It seemed less an IMO problem and more just a textbook exercise.

After speaking to other teams, we are reassured that only solving problem 1 seems to have been very common. Fellow only problem one solvers include Turkish gold medallist Ufuk Kanat. I make it my business to speak to the Chinese team at lunch, deciding to open by saying that my Chinese isn't very good, and sadly failing to say that. I manage to at least ask them how they had done, and it sounded like problem 3 had given them a rough time. On the other hand, speaking to the US team on the elevator, we ascertained that they had probably beaten China with 4 solutions to 3(2). They used some advanced technique of probabilistic combinatorics with the Lovász Local Lemma. Hopefully, the Chinese team would be beaten for once . . . .

We take a walk along the beach, and some of us race up the hill, Kaimyn winning easily followed by Andrew. The walk takes us to a seafront café and we are treated to some more of the sugary treats of Argentina, like the famous alfajores. By the 2012 poster, there are some more amazing facts up about 2012 submitted by contestants: 2012 is not 1, 2012 is not 2, 2012 is not 3, . . . so by induction, 2012 is not a natural number. At dinner, we once again have trouble finding a table to sit down for the team. Despite the hotel's very large capacity for halls and halls of eating tables, there are simply too many teams per number of tables. We are told that the hotel has found a solution – every table will be labelled with one country name, and only that country can sit there. This means that each team will be allocated their very own table to sit on. Sadly, Andrew manages to spot a problem no-one else notices, by using the pigeonhole principle: there are still a few times more teams than tables, and hence to assign all the teams to tables of their own, at least one table will have at least 2 teams fighting each other for it. At least fighting will make mealtime more interesting.

Day 2 – Segundo Día – Wednesday 11th July

We wonder where the medal boundaries will place us

In the morning, we take breakfast as usual, and there seems to be more than just jugs of milk by the cereal stand. Matei unfortunately manages to pick up the jug of lemon cordial and pours it over his chocolatey cereal, rendering it too sour to eat. Luckily, everyone else has avoided it. We expect that there will probably be a geometry on the paper today, and if so, it must be problem 5 or 6. Since most of us aim to solve problems 4 and 5, half of us want a geometry problem 5 and an easy problem 4, and the other half want a geometry problem 6 since they don't like geometry.

The problem 4 is another algebra problem, and a functional equation with many cases, resulting in one expected solution, and some other strange solutions. It involves lots of induction and cases which you have to be careful over, and writing up the solution takes some time. It seems that this is a strong point for the UK – we came joint second on this question after Turkey, though the number of full solutions at the IMO was even less than for problem 2! The equation to solve involves a factorisation that I promised myself I wouldn't forget too quickly at BalkMO – Heron's formula: $\sqrt{s(s-a)(s-b)(s-c)} = \frac{1}{4}\sqrt{(a+b+c)(b+c-a)(c+a-b)(a+b-c)} = \frac{1}{4}\sqrt{\sum_{cyc} 2b^2c^2 - a^4}$. This recognition provided a quick and short solution to problem 2 at BalkMO 2012. I remembered this only after solving most of problem 4, and the factorisation makes it clear why the main solution works. Many top countries have dropped many marks on this problem, and we find out later that there is some frustration towards the strict co-ordination on this problem, with missing the

checking of one case leading to a 0+ mark-scheme rather than a 7− scheme. Luckily all of us have been thorough.

Problem 5 is a geometry, involving a special configuration that the team just discussed the day before of a circle tangent to two other circles. This discussion doesn't help us towards any solution, but we find out afterwards that there are some very short solutions. The paper looks much better than yesterday's, but we aren't too pleased, with only Josh solving problem 5 and Matei and Andrew getting good progress on problem 6.

At lunch, we find we have not been assigned tables, and we find tables as we normally do – by getting there early or late.

Rec Room – Sala de Recreo – Wednesday 11th–Thursday 12th July

The party begins and we forget about the IMO

After the IMO, the rec room was to be opened until 4am or later each day. Some members of our team took rec room closing time to be bedtime, and had very little sleep indeed. The late sleeps also contribute to a lot of memory loss and confusion of days. Overall, more time was probably spent in the rec room than everywhere else combined.

From Wednesday onwards, a circus school opened where you could learn many kinds of acts. There was a set of depictions of positions that teams of gymnasts might perform, a few unicycles, and a box full of circus equipment. James took to the spinning discs on sticks, while I spent most of my time the next few days learning to juggle rings. James signed us all up (except Andrew who had won his T-shirt already) for the Mission Impossible style Laser T-shirt Challenge, where you have to enter a dark room full of lasers and smoke, and you have 3 minutes to get past them and grab the T-shirt. We were warned that the winning strategy may be to enter naked, with lanyards, hoodies, and bulky bits of clothing all having set off the alarms already. James went first, carefully climbing over some and crawling under others, and finally reached the end and grabbed hold of the T-shirt. At this point, he was told that he had to stand up to win. Like a scene from a comedy show, as he got to his feet holding the T-shirt, the pole holding the T-shirt fell backwards into the laser beams, setting off the alarms and disqualifying his attempt. Lots of laughter and argument ensued, which eventually got James his T-shirt. Over the course of the night, all of us but Josh have won an IMO T-shirt.

We get back to our rooms rather late and are greeted by a note reminding us that "damage inside the rooms will apply a financial penalty. Also, any inappropriate behaviour will be raised before the Discipline Committee who will apply the appropriate penalty. ... NH Gran Hotel Provincial" We find out a few hours later the same day (after some sleep) that another team was kicked out of the hotel for drinking and smoking and leaving the hotel unaccompanied by a guide, which is disallowed under IMO rules. Apparently one of their female team members was found retching and vomiting everywhere. We speculate whether they are now on the streets. Our guide suggests they might be one of the bands of musicians on the roadside.

Over Thursday, we mainly stay in the rec room doing our own stuff – we enter for some of the many tournaments and play matches. Suicide chess, a version where you have to kill all your own pieces and capture is compulsory if possible, becomes a nice alternative to Playtest as a game which needs minimal thought. Sadly the minimal thought only lasts until the endgame – in a game I played against Matei, lots of bad play with my knights left Matei with just a pawn and me with more than half my pieces remaining, including 6 queens. It took over half an hour of thought before I could set up my pieces into a winning position. Over lunch, we discuss some more trivia and note that we UNKs have had a whole year of leaders and deputies at maths competitions all of whose first names begin with the j/soft g sound: James Cranch, James Gazet, Geoff Smith, Gerry Leversha, and Jack Shotton. Once again, we stay awake late past midnight.

Aquarium – Acuario – Friday 13th July

A day of wet, wet, water

We get up just in time to leave for the Aquarium, though some people have to be woken up with urgency due to the departure time being moved ahead by one hour. Annoyingly there was a long delay anyway after breakfast just waiting for the coaches to the Aquarium. I have accidentally left my lanyard (with my name tag and official ID) in the rec room yesterday so have some time to go look for it. Andrew kindly comes along and helps search. We search all over the place, and eventually I just get a handwritten ID on my less official lanyard. Finally, we are taken outside onto a bus. Commenting on the hotel's logo (**nH**) and the British flag's inbuilt capacity for a distress signal (turn it upside down), Sam wonders whether turning Hu upside down is a distress signal for my family.

At the Aquarium we come up with variants on throwing things on the ground. Most of us laugh hard at James's one with the coffee: and I brew it on the ground!! We get to see sea lions set in some serene scenery. This scenic serenity was also home to fish and dolphins. We get an introduction via a film in Spanish about a turtle who tries to live in a wide variety of habitats from the seaside, the bottom of the sea, the rainforest and the Antarctic, and in each case gets driven out by humans (cars, oil spill, loggers, whalers respectively). Andrew comments on the nature of the exaggerated plot-line and Finding Nemo style graphics that don't look serious: "If I'd seen that film somewhere else, I would have thought it was mock propaganda. The difference with seeing it here was that I knew it wasn't mock." or words to that effect.

At lunch, after waiting an hour or so in queues and hence missing shows, Bev and Matei finally get their vegetarian pastas. In the meantime I comment that the fast food that James, Sam, Josh and I got was (comparatively) fast. Some wordplay erupts spontaneously. Sam suggests that the fast food is actually stationary (stationery), and James denies that he could use it to write. In surprise, we laugh a bit, and James ruefully suggests that we could have done more by playing on write/right and then right/left or right/wrong. Once Matei finishes eating, we pressurise him to strike up conversation with the Romanian team who are sitting nearby, given that Josh has spoken to the Hong Kong team and I to the Chinese team, and so he does.

The eventual highlight of the trip was the shows. These involved crazy dolphin acts and growling sea lions and a Venezuelan IMO contestant pretending to be a sea lion – the sea lions liked it so much that they kissed him. We play 163 again and again (a countdown style game where you make 163 with all of the 6 numbers represented by playing cards from Ace (1) to King (13) and the operations $+, -, \times, \div$ and exponentiation) until it got boring, with most of us (especially James Aaronson) getting too familiar with the possible tricks you might use. When we leave, there is a prolonged burst of torrential downpour, and we are all drenched before managing to warm up inside the coach. Over the next few days, it becomes quite sunny once again.

The evening (or rather post–midnight) activities include the cake giving celebration where people with birthdays have a song sung for them and are given cake. We note, in preparation for Sam's birthday which is tomorrow/today, that it is way past midnight before the cakes are given, when their birthdays have already passed. Also, Nancy (AUS 2) wins the Set tournament, winning a special T-shirt.

Happy Birthday – Feliz Cumpleaños – Saturday 14th July

Congratulations and Celebrations

As usual, late nights mean that we don't wake up at the same time. Today is Sam's birthday and he receives a gift from Bev and a card signed by us at lunch. Given the choice to go ice skating, Sam opts for us to go join the Australians and for a short time the South Africans. Despite the rink being located inside a café and hence being very small, several games of tag begin. In the confusion that ensues over the next half hour or so over who is it (at one point, Sam gets tagged $\times 3$), we all end up being tagged multiple times with the help of James who tags anyone he can reach. This is one of James and Josh's first times at skating, and they are accomplished enough by the end of the hour to be able to skate round consistently enough without holding on to the sides.

Evening activities (i.e. after dinner, which is from 8 to 10) include a big chess event where an International Master plays about a dozen games against contestants simultaneously. He gets through several games in the time and remains undefeated, even against John (AUS 5) who is in the final of the chess tournament, though there are a few draws. One of the most exciting events today is James Aaronson's match in the final of the Ta-Te-Ti-To tournament (or a e i o to James). This game is like noughts and crosses, but instead of being 3×3, it is all about getting 4 in a row on a $4 \times 4 \times 4$ board. The extra dimension makes this much harder. He has done some analysis of the game with James Rickards (CAN 4) (who is joining some of the team at Trinity College,

Cambridge this October) and discovered a general winning position: a right-angled triangle on an empty plane. He has done some research too, and knows that instead of the game being a draw, it is a first player win. In an exciting match where James lost his first game (where he was the first player), he came back to win 3–1. Therefore, surprisingly, 3 out of the 4 games were second player wins.

The other exciting event is of course Sam getting his birthday cake past midnight. Most of the team eat some of the cake. James receives a well-earned Ta-Te-Ti-To winner T-shirt, while Sam gets his "I had my birthday at the IMO" T-shirt. Many other tournaments take place today, and a Finnish contestant recites 500+ digits of 2012! to win the memorisation competition. Soon, the IMO's Got Talent show drives some people away from the rec room, but certainly not Andrew who loyally stays up piecing together more of the puzzle, though he eventually realises that it will be impossible to finish.

Back to IMO results, James finds out that he has got two points on problem 5 leaving him in the awkward position of getting almost half of his marks from geometry. We hear the news about team results gradually over the IMO and some of the following information we only found out later. We are pleased that of all countries, it is South Korea that come top for their first time this year, with six gold medals and full marks on problems 1,2, and 5, more than making up for their 18-year low of 13th last year. China sits in second place by a sizeable margin just maintaining their dominance, with the USA only 1 mark behind. China have now come in the top 2 every IMO since 1988, other than their 6th position in 1996 (when even the UK beat them!) and 1998 when they refused to compete in Taiwan. Canada have achieved an all time high of 5th, jumping from 17th last year. Yet other countries have had minor disasters with problem 2 and 4 tripping them up. Hungary have scored below 100 marks for the first time in history, Japan's 17th is a record low if you exclude two 20th positions in their first 4 years of competing, and even Germany have dropped to an all-time low of 31st. At least this means that we have come top of Western Europe, joint with the Netherlands, with the two Dutch borderline golds doubling their gold medal count to 4 in history.

Medals and Photos – MEDALLAS Y FOTOS – Sunday 15th July

Cracking a bottle

We find out in the morning what the medal boundaries are, and that all of us have secured medals. The medals are as usual distributed approximately in the ratio Gold:Silver:Bronze:No medal = 1 : 2 : 3 : 6 among the 548 contestants. We get to finally meet Geoff at a restaurant to eat steak, and some more awards are given out. Andrew gets the Golden Pen for writing the hardest to mark script worth 7 on problem 2, and Matei gets the Sceptre of UNK which will prevent him from making false statements for one year.

At the closing ceremony, we are sadly segregated by score at the IMO. There are similarly sad goodbyes to the Australian team, two of whom are sitting near me – they are leaving immediately after the ceremony, and we probably won't see them again. The speeches are very short, with only one joke about why 2012 is such a special number of a special year: because $8 \times 10^{2012} - 1$ is prime, and we receive our medals in reverse order. First, honourable mentions don't get mentioned, then bronze, silver, and gold medallists go up to collect their medals. Most of us manage to hold our flag correctly, and we notice that South Korea, the winning team, also have a flag which looks initially to have reflective symmetry, but doesn't. Despite James's disappointment over his bronze medal, he still manages to beat a member of the Chinese team just as he did last year with his gold – we all feel sorry for the Chinese bronze medallist who is in a team with 5 gold medals. Andrew, our sole gold medallist, beats a person from every country but South Korea. There is a small cheer for Teodor von Burg of Serbia who rises to the top of the IMO Hall of Fame and a standing ovation for Jeck Lim of Singapore, the sole contestant with all the marks. At the end, we were shown a video telling us of the beauty and culture of Colombia, and the IMO flag is formally passed on to the Colombians, who will be hosting next year's IMO.

After the ceremony, we take many photos with other teams, including South Korea (I was unlucky in my attempt to steal a gold medal from them), and Argentina. In the evening is the IMO's Got Talent Final and a closing dinner. This time, we are actually assigned tables for the event, but Pakistan is assigned the same table as the UK. There are only enough seats for 11 people on each table, so there are clearly problems involved with this. Luckily the Pakistani contestants don't turn up though their leader opts to sit with us after learning Matei is a fellow Romanian expat too, and we get our seats. The dinner is a great place to distribute our gifts that we brought such as cards, pens and BMO1 booklets, but the loud rock music party at the end causes us to run away. At this point, the team splits up in several directions. Some us go to sleep, but more than half of us stay up all night partying so as not to have to get up at 6am in the morning the next day. In fact, more than 3.14159% of the team end up not having gone to bed for 2 nights in a row.

There and Back Again – IR Y VOLVER DE NUEVO – Monday 16th July – Tuesday 17th July

Home, sweet home

It is the earliest start we have had for at least 2 weeks today, and we are apprehensive of the 30-something hour trek home. We all sign a British flag for Javier, our guide, who was unable to make it to see us off, not having an Adam Goucher to wake him up. Andrew receives a T-shirt for being the Most Valuable Person on the 24,000 piece puzzle. Surprisingly, he is then asked whether he has any recommendations for anyone else who should be the Most Valuable Person too. This seems rather contradictory unless the T-shirt awarders think that everyone is all equally valuable. Another surprise is that Josh also turns up with an IMO T-shirt. After all he hadn't got past the lasers, nor been in a gymnastics team arranged in a particular position, nor probably any of the other ways you could get a T-shirt. Josh tells us that they had been handing out spare ones to people, and he had taken one. We congratulate him, but some of us feel less special now about getting an IMO T-shirt. There are a few goodbyes to the New Zealand and South African teams.

We go to Buenos Aires by five hour coach. We all sleep a bit on the coach. During the journey and afterwards most of us spend a lot of time thinking about solving the 163 problem that the Canadians had been discussing: make 163 with 4,5,6,10,10,10 and no exponentiation. We know it is possible as the Canadians concluded it wasn't possible until they put it into a computer program they wrote and out came a solution, but we are continually frustrated. Matei gets 1/6 away, but that is the closest we achieve. The only hint that we have is that the solution is even harder than the solution for 1,1,1,1,12,13: $(13 + \frac{1}{1+1}) \times 12 + 1 = 163$. We are taken to the airport by school bus (courtesy of St. George's college). Upon arriving at the airport, Bev sorts out an issue of me checking in, after the Iberia website refused to accept me. While waiting in the quite empty airport, some teenage girls, saying they love our accents, want to take a photo with some of us, or at least with James Cranch. Instead, we think the appropriate action is to eat some lunch at a pizza restaurant. We play long games of liar's poker while waiting for baggage drop to open. There is some confusion as Iberia people tell us to join the very long check-in queue despite knowing we have already checked-in. Bev sorts this all out calmly, and we drop off our bags.

We bump into some other teams at the airport like the USA team. The Austrian team give us some gifts of frisbees, and we proceed to security. There is a very long queue for this that snakes around a Falklands conflict exhibit and much further. This setting of Argentina's international airport for such a display seems somewhat surprising as a tourist airport, and I can only support the sentiments of James Cranch in his report: all the Argentines we met during the IMO were very friendly and hospitable and this made the event a great place to be.

Just before getting on the airplane, we finish off a second game of liar's poker. In this game, we have the fortune to end up with six players on −1 cards. All alliances break down at this point and the game becomes a vicious dog eat dog game dominated by luck. Matei manages to claim success in the end. When we leave Argentina, it is actually relatively warm, despite being the middle of winter. However, this in no way prepares us for the heat that hits us in the Madrid summer. By the end of the flight, it is tea-time, and the jet-lag feels funny, having slept for most of the flight, sleeping right through noon in British Summer Time. Some delays means we miss our connecting flight, and we take the next plane home. The flight is relatively short, and the familiar British scenery is reassuring, particularly as we fly over some grassy Olympic rings. The temperature is also familiar – the British summer seems less warm than the Argentine winter we have just left. At Heathrow, a man with a 2012 Olympics board, noticing my lanyard, almost motions for me to go with him. We go to baggage collection, and all our bags are there on the conveyor belt, a bit surprising given our flight change. Soon it is time to go – James gives us our certificates, we say goodbye, and go home and sleep.

Disclaimer: A lot of effort was put into making this report completely factual. If there are any errors or mistakes, I blame Sampson's sneaky koala-napping drop-bear appendix-hugging antics.

Acknowledgements – Reconocimientos

Lots of people were required to make this event possible and to give the contestants involved such a good time. Below are just a few of them but lots of thanks should go to all those involved.

- Stephen at St. George's College, for turning up whenever we needed him.

- The Argentine Mathematical Olympiad Foundation for such good organisation.

- Javier, our guide, for his enthusiasm and commitment to keep us happy.

- James and Jack for leading us to the top of Western Europe.

- Geoff, for all his work in encouraging the development of mathematical ability in young people.

- Bev, for looking after us both at the IMO and behind the scenes (and for my seat on the flight home!).

- All the people who train the UK team, for helping us get medals.

- All the volunteers at the UKMT, for their hard work in stretching students and making maths lessons more fun. It seems amazing that this organisation in its fully-fledged form of running all the UK maths challenges, team challenges and olympiads only dates back to 1996!

- The rest of the team: James, Sam, Andrew, Josh and Matei for having a good sense of humour.