Final Reflection on My 2025 Summer Enrichment Experience at AwesomeMath, Combinatorics 1.5

By Alexei Kadyrov

While sharing many similarities with the program I did last summer, Mathcounts with Proofs was a lot more enjoyable, yet still as informative and interesting as Algebra 2.5. Like last year, I did a lot of my program on my laptop, spent a really long time on all of my homework, and learned a lot from the lectures. However, as will soon be made apparent, this program felt more approachable than last year's, and I think I gained a lot from it.

Also, like last year, the format of the class is the same, with the class starting at 6 PM with a 1.5 hour long lecture, then a ten minute break, then a problem session, around 40 minutes long, where our class would be split into several smaller groups, two to four people, to work through a small set of assigned questions, anywhere from three to five, before we would rejoin 10 minutes before the class ended to present our solutions and go over any questions that the class didn't get as a collective.

Starting off with the first week, I had a very rushed introduction to the program. My family was just returning from a trip to Boston, and the car trip back home overlapped with the start of the first class, so I had to sprint inside my house halfway through the class to try and keep up with the lecture. Due to this rushedness, I also had to eat dinner in the middle of class, mostly during the break, which would become a common trend throughout the class. Other than that, every other day this week was more normal, and I was able to fully focus on the content at hand. This week focused more on understanding the basics of combinatorics, like its main principles and simple counting techniques. However, as the name of the class suggests, all of these concepts, as well as varying properties that come with them, were derived from proofs, making it a lot more difficult than other classes where I had learned some of the material. This made the most difficult part of the lectures, in my opinion, the examples, which came right after we discussed the basic definitions. I was still getting used to the ideas behind combinatorics, and there were people in the class who had already looked over the problem set and answered questions before they were even on the lecturer's whiteboard, which really rushed the time I had to understand and try the problems for myself before the instructor went over them. This week, of all three weeks, was the roughest in this regard, but I was still able to get by, especially with the assistance of our very helpful TA, and, by the instructor's prompting, explained the examples I solved unassisted. As a direct contrast to the lecture's examples, however, the problem session after the lecture always went smoothly than the lecture. No matter how confused I got during the lecture, the problem session always eased my confusion, and I was able to answer all of the assigned questions and present at least one of my solutions afterwards. It wasn't as if the problems were easy; they weren't, but the material just clicked after the break. The homeworks varied a lot in difficulty, with some questions taking me a really short amount of time to see a path to a solution, but a vast majority of them took a lot of time and effort to solve, with very few needing a hint from the TA to keep going. I also started to go to office hours consistently to try learning the

material even more in-depth with the TA's assistance. Finally, to end off the week, I took the first test and, while there was no class average provided, from the instructor's comments on my test, I did pretty well. Overall, it was a fun and challenging week, and I look forward to the next.

This second week went much like the first week, but with harder topics. Now, the instructor was building off of the basics to combinatorics we covered last week, and extended to more complicated problem-solving methods that tend to show up frequently in competitions. Most of the material was new, too, because, even with three of the topics being concepts I had previously learned, they were extended to be more combinatorically-focused, greatly increasing the difficulty. Like last week, I kept up with the lectures, struggled through the lecture's examples as they were more combinatorically focused, but pushed through them with the help of our TA, and had a really good time in the problem session of each lecture where I continued to both solve all of the assigned questions and present at least one of them to the class each day. The homework difficulty also increased as compared to last week, resulting in me having to spend a lot more time and think even more creatively to find solutions, but I was still able to answer the vast majority of the questions. This also made solving the homework a lot more enjoyable, despite the challenge, due to the creativity involved. This week was also interesting as I missed one of the class days for a tennis tournament I had signed up for, but I was able to make up the lecture and finish the homework on time. Finally, the test this week was a lot harder than the first, and I also took it with a little bit less sleep than last weeks as I had to wake up early to get the test done within the due date which led to several dumb mistakes costing me valuable points, so I did slightly worse than the first test. However, the solutions I submitted were complimented by the instructor during the grading process, including the problems where I was correct throughout the entire question, but made an unfortunate error in the last step. A more challenging week than the first, but still enjoyable, and the third week was one to look forward to.

This week was probably the best week in the program, especially for me. The topics continued to get more challenging and continued to involve more original thinking to solve, but a lot of the concepts this week clicked for me, even more than they did last week. While there were several lectures last week that really confused me, the lectures this week made more sense to me. This led to activities like me practically solving examples for the class, as compared to just giving some contributions in previous weeks, understanding the examples completely and, in the problem sessions, not only solving all of the questions but helping my classmates understand the questions in the smaller group sessions before we went back to the main group where I started presenting at the very least two questions a day as compared to one. I solved several problems during the problem session this week that I was proud of and received praise from my instructors, and all of the homework questions were solvable. This was a really, really fun week despite the increased challenge of the later lectures. This all culminated on the final day of the program where I got a private message from the TA of our class stating that he and the instructor of the class decided that I was good enough to apply to be a TA for the summer program next year, and told me that they would be submitting recommendation letters to the AwesomeMath program head for it to happen. Simply lovely.

A couple of weeks later, I received my certificate of completion for the program, marking the official end to my AwesomeMath experience this summer.

Overall, this is a really fun and challenging class for anyone who wants to improve their math skills, especially for competition math. In high school, combinatorics is probably the least covered subject in these competitions, on a similar level to number theory, meaning that anyone who learns and understands combinatorics will get a slight advantage in competitions. I found that, throughout this class, many of the problems and examples we tackled were similar to difficult questions I had seen in previous competitions that, before, I had no chance to answer correctly. Now, after covering the material behind these questions, enhanced by the proof-based nature of the class, I do. The structure of the class is also optimized for learning with peers, especially compared to Algebra 2.5 last year, with group communication being highly prioritized, seen in cases like the small group style of the problem sessions. This class was a fun experience and, of course, being recommended to become a TA next year is a cherry on top.