
Daily Gathers

Empire Polynomials: Monday Daily Gather With Jonah

By Lindsey

Monday's daily gather was very special: it was on 7/22, or 22/7, also known as approximate pi day! We celebrated with many approximate pies, and we also celebrated Emi's birthday with a singular approximate pie (and some approximate candles).

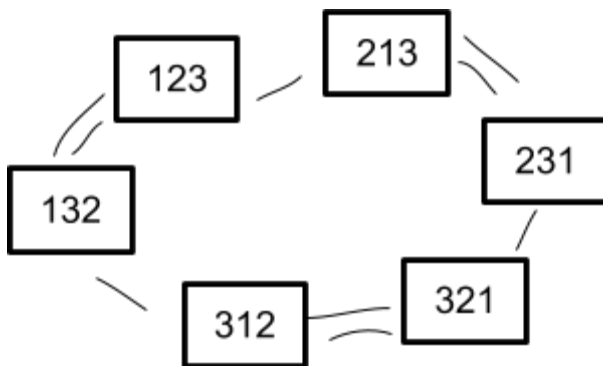
More importantly, we learned about empire polynomials! What are those? Well, we started with a question of counting: how many ways are there to color an empire with k colors, such that no two cities connected with a road have the same color? A big example-empire was drawn. The class stared in thought (or was it confusion?) at the dystopia. However, with some smaller specific examples, we were able to come up with a neat and clean strategy that generated some polynomial to answer our question. Now it was time to come back to the original dystopia! And our strategy... didn't work. We had to make multiple cases for colors being the same or not in two separate cities. However, it wasn't too bad. The class was able to reduce the amount of cases to two, and then we could add the possibilities for both.

Soon we were introduced to some odd operations: "road destruction" and "megacities." We were asked to find properties of these functions, and soon, we were able to get a fantastic formula involving these two functions. The number of ways to color an empire is equal to the number of ways with some road destroyed, minus the number of ways with that road as a megacity! While our pies were approximate this day, we were able to develop precise and satisfying mathematics.

Laser Cut Permutations

By Taryn

Jonah is trying to design a new puzzle; however, this game requires pieces. The pieces must each have a permutation of the set $\{1, 2, 3, \dots, n\}$ on them. However, laser cutting is very expensive. In order to minimize costs, the pieces should be cut in an order which allows there to be only one change from each piece to the next and for that change to be the swap of two adjacent terms. The pieces for the set $\{1, 2, 3\}$ would look like this:



In this chart, one line signifies that the first two terms are swapped, and two lines signifies the second two terms are swapped. Alice challenges us to find the order or orders in which the set $\{1, 2, 3, 4\}$ can be cut. How should the chart best be organized? As we split off into groups, various students try many strategies and organizations. The strategies from the previous set are quickly shown to be obsolete; new techniques are needed. Alice provides balloons to those groups who would like to visualize the chart in a less 2-dimensional format. After finding many interesting hexagons and being mind blown by the wild shapes made by these simple permutations, the MathILy-Ers float off to dinner with their balloons.

For daily gather on Wednesday, we watched math movies. When we walked into the room, a riddle was written on the board: Jim's colleague John has 4 kids: James, Julia, Jordan and J____? This turned out to be a lame attempt by Jack to get people out in word assassin with his word "colleague". As expected it failed miserably. We started the movies off with an episode of numberwang, a MathILy-Er classic. That's numberwang! After our weekly dose of "let's rotate the board," we moved onto a video on dihedral kaleidoscopes. The video related to the week of chaos class reflection groups. The next video we watched was related to another week of chaos class: Markov Chains (R.I.P. JD). While we never actually got to the strategy part of the video, we started to learn how to optimally play Monopoly. After short segments of "Caroms" and "Poor Horatio the Half-Boy", we watched the theater of the mathematically absurd. This video was a skit about developing proofs. To end off the daily gather, we watched a seemingly endless video about equidecomposable polygons. I would explain it, however, I fell asleep during the video. Yeet. That was daily gather.

I took a step forward, sweat falling from my face and sizzling on the still flaming scales of slain fire dragon that lay before me.

"Good work, team!" whimpered Priscilla, our healer. Her lips had gone pale and her face was turning all shades of purple, but other than that, she looked fine.

"That's one small step for man, one huge leap for OUR POCKETS, We're gonna be rich!" exclaimed Nosferatu as he ran around, not a care in the world and not a dent in his armor. Freaking Mages.

"You literally only cast 3 spells," asserted Samantha, our Ranger.

"No, I didn't," cried Nosferatu.

"Yes, you did," said Samantha.

This went back and forth for a good minute before this argument (or was it just a contradiction) was stopped by a booming voice. We looked back to see God (his real name was Cole or something but we had abandoned that name long ago). We immediately got up and started on our way to the nearest town, Cooks Corner.

After just an hour of walking, we came across three people blocking our path. In these areas, with the exception of adventurers like ourselves, there were only three kinds of people: monks, bards, and spies. Monks always tell the truth, bards always lie, and spies can do either. Also, monks hate other monks, bards hate other bards and spies hate other spies. Thus, they never are around others of the same kind as them. Because of this, we knew that we were looking at one monk, one bard, and one spy.

The first person stated, "I am not a spy."

The second stated, "I am a bard."

The third stated, "If you ask me, I'd say the second person is the bard."

"Okay, don't help us," blurted Nosferatu, looking at Cole. Nosferatu spent a minute in thought before stating, "I think the second person is the spy as neither a bard or a monk would ever say that he is a bard." Cole nodded and a wave of excitement washed over Nosferatu's face.

“That would make the first person the monk, and the third the bard,” Priscilla chimed in as the three people blocking the path moved out of the way. Delighted, we continued down the path. After a couple hours of walking, we started hearing strange noises behind us. Cole turned around to look but was immediately turned to stone. We looked at each other, horrified, the color drained from our faces. After 5 seconds of dead silence, the stone statue of Cole started to rumble and break, finally revealing Cole inside.

“I think Medusa is behind us,” said Cole, stretching a little. “I’m fine, but if any of you turn around and see her, you will die, so just be careful. Let’s pick up the pace.” Of course Cole wasn’t scared of Medusa. In fact, he could probably take her out with one hand, but if any of us looked back, we would be permanently turned to stone. Thus, we continued onward. We arrived at a fork in the road with one person in front of each road. They just stood there, unmoving. We were unsure what to do. Thankfully, we had Cole. Cole, with the ability to read minds, was able to tell us how to get past them.

“One of these paths leads to a town and the other leads to a necromancer’s lair. Among these two people, there are no spies, however, we only have one question to find the right path.” Although Cole could defeat the necromancer, we could not head backwards if we went down the wrong path as Medusa was still chasing us. Thus, we had to solve this riddle.

“We should ask one of them what the other person would say is the safe way!” exclaimed Samantha. “If we ask the bard, he will point us to the necromancer’s lair as he will lie about the monk, and if we ask the monk, he will point us to the necromancer’s lair as well, since he will tell the truth about the bard. No matter who we ask, they will point to the road leading to the necromancer’s lair!”

We quickly agreed to follow this plan and the person on the right pointed towards the road on the right. We went for the path on the left and made haste, continuing our travels. After about a day, we saw a tiny town, Cooks Corner. We rushed towards the town, however, our path was blocked by three snake-like figures, the Shapeshifting Gang. They were quite famous for having an unsolvable riddle. In 3 yes or no questions, one must figure out which was Truth, who acted like a monk; False, who acted like a bard; and JD, who acted like a spy. If you couldn’t figure it out, they would eat your face off. However, there was a twist. The Shapeshifting Gang would only answer with “ze” or “re”. One of these meant yes and one meant no, however, no one knew what was what.

We were completely stumped. We pondered the question for hours, but none of us could think of an answer. Except for Cole, of course; he was able to get the answer mere seconds after hearing the riddle. After thoroughly giving up, we asked Cole for the answer.

“Fine,” sighed Cole, turning to the person in the middle. “If I asked you if the person to the right of you is JD, would you say ‘ze’?”

“Ze,” stated the Shapeshifter.

“Well, now we know that the spy cannot be the person on the left,” Cole reasoned.

“Why do we know that?” asked Nosferatu, as confused as everyone else.

“Think of it this way. What if the person in the middle was the monk?” Cole asked. “Well, he would tell the truth. If the person to the right of him was the spy and ‘ze’ means yes, he would say yes which is ze. Similarly, if ‘ze’ means no, a monk would still answer ‘ze’ either way. Now imagine if the guy in the middle is a bard. If ‘ze’ means yes, the bard would lie and say ‘yes,’ which is ze. If ‘ze’ means no, the bard would lie once again and say ‘ze’. Either way, if the spy was to the right of the middle person, the bard and monk would have both answered ‘ze’ to the question asked. And if we asked the spy, the person to the left is obviously not the spy. Thus, in all cases, the person to the left is not the spy.”

As we tried to wrap our heads around the superior logic of Cole, he calmly went up to the person on the left.

“If I asked you if the person on the right is the spy, would you say ‘ze’?”

“Ze,” answered the shapeshifter.

“Well, now we know that the person on the right must be JD, as it doesn’t matter if the person I just asked is a monk or a bard because, by similar logic to the first question, the answer to the question of whether

the person on the right is the spy must be 'yes.'" Cole's perfect logic continued. He then went back to the shapeshifter on the left.

"If I asked you if the person in the middle is the monk, would you say 'ze'?"

"Re," answered the shapeshifter.

"Well you must be the monk then, making the one in the middle the bard."

After this statement, the Shapeshifters moved out of the way, allowing us to pass.

"How did you know?" asked Priscilla.

"Well, the logic is similar to the first question, except now it's reversed," stated Cole. "If he was a monk, he would tell the truth. If 'ze' means yes, he would say 'no', which is re. Similarly, if 'ze' means no, a monk would still answer 're' either way. Now imagine if the guy in the middle is a bard. If 'ze' means yes, the Bard will lie and say 'no' which is re. If 'ze' means no, the bard will lie once again and say 're'. Either way, if the person answered 'ze', the other was the monk, and if they answered 're', the other person is the bard.

"Absolutely BRUTAL," exclaimed Samantha. "They were destroyed by facts and logic!"

We were finally able to enter the town. However, upon entering the town, we realized it was empty.

The End.

FriDaily Gather – Swimmin' in the Ocean, Causin' a Commotion

By Brandon

This Friday Emi took us on a David Attenborough-esque tour through the strange and wonderful world of narwhal behavior. Narwhals are strange creatures with bodies of area 0 and 1-mile long horns ... also of area 0. Naturally, being very long, they don't want to interrupt the rest of the sea creatures with their horns, and when swimming, would like to sweep across as little area as possible. To this end, we examined how much area a narwhal would need to cover when swimming to different places in the 2 dimensional ocean. For instance, we examined how much area was required for a narwhal to move from a line to another line parallel to it. As it turns out, a very polite narwhal can turn a distance as small as they'd like and travel very far, then turn back, to take up as small an area as they want. We then examined how much area a narwhal requires to survey the ocean (or, how much area is required to see 180° of the ocean, since a narwhal can see backward), so the narwhal can find friends. As it turns out, one can cut an isosceles triangle with a 60° angle and a 1-mile altitude from that angle into infinitely small slices, and then stack the slices on top of one another, so that the narwhal can start at one end and get to the other while covering as little area as they'd like. Repeating these three times gives an almost area-less survey of the entire ocean! Thus, narwhals can be as polite as they'd like.
