

BY THE NUMBERS: THE ART OF PROBLEM SOLVING

BY OMAR SHAMOUT

Neima Ghandian '19 has always been good with numbers, but his sense of curiosity often drove him to dig deeper into what he learned in math class.

"When a teacher would say, 'Do this equation,' I would say, 'Why would we do that?'" Ghandian said.

That passion to grasp the bigger picture still propels Ghandian in his studies. The 24-year-old Sacramento native transferred to UCR as a math major in 2017, and he hopes to continue his academic career in graduate school and work with colleagues to understand and further develop the connections between math and the sciences, including physics, chemistry, and engineering.

A member of the "Mathletes" team in high school, Ghandian enjoyed competing to solve difficult math problems, and it was there that he first learned techniques to approach complex calculations in ways that made them easier to figure out.

These techniques, which Ghandian refers to as "critical thinking," were honed even further in community college, where Ghandian took an honors math class and read "The Art of Problem Solving: Volume 1" by Sandor Lehoczky and Richard Rusczyk; and "Proofs and Refutations: The Logic of Mathematical Discovery" by Imre Lakatos, which he received as gifts from his high school Mathletes teacher. By the end of the class, Ghandian



Neima Ghandian taught other undergrads through the R'Course program.

said he had developed a new way of learning that changed his life.

When the professor first taught a skill in class, he would give the students a simple problem followed by an "absurdly difficult" homework assignment, albeit one that required the exact same techniques to figure out, Ghandian said.

"It was then that I knew I wasn't studying correctly, and I needed to change my studying ways to introduce more critical thinking," he said. "Once I did that, all of my course work became much easier."

When he got to UCR, he noticed professors often had to review mathematical concepts at the beginning of the quarter because students had already forgotten what they learned in previous classes.

He decided to create a course that would help students learn problem-solving skills they could carry with them in a variety of different disciplines.

"I wanted to construct a class that allowed students not only to think critically, but to learn how they should

learn," Ghandian said. "A great student has to engage the material, think critically, and see what generalizations they can get from what the teacher has taught, so they can have a much larger umbrella of problems the professor could ask, and they'd be able to solve."

Ghandian applied to teach a class of his own through the Office of Undergraduate Education's R'Course program. These 1-unit classes are designed by UCR undergraduate students for other undergraduates. While students teach the classes, each course has a faculty instructor who provides mentoring and support behind the scenes. R'Course student, or peer, instructors are also required to take an education course to learn about classroom facilitation.

"The R'Course program empowers students to develop leadership skills, explore creative topics, and experience curriculum creation," said Thomas Dickson, assistant vice provost of Undergraduate Education, who oversees the R'Course program. "Neima is a stellar example of an R'Course peer instructor. He took his love for math and found a way to make it into something fun and engaging for all majors."

Ghandian's class, which he dubbed "The Art of Problem Solving" because it followed in part the material outlined in the book, was offered in spring 2018. More than a dozen students completed the course, and Ghandian, an aspiring college professor, said he hopes to offer it again this year.

"I really enjoyed learning how to be an effective teacher and speak in front of students," he said.

The second week of Ghandian's class included a lesson on modular arithmetic, which serves as the foundation for divisibility tricks. These often come in handy for Mathletes needing to solve problems quickly in their heads.

Ghandian's favorite is the rule for 11: To figure out if a number is divisible by 11, add and subtract digits in an alternating pattern from left to right. If that answer is divisible by 11, then the original number is too. For example, if we use this method with the number 319, we get $3-1+9$, which equals 11. Therefore, 319 is divisible by 11.

Can you figure out in your head if the following numbers are divisible by 11?

POP QUIZ

A 3,434

B 613,261

C 1,234,321

(Answers found at the bottom of page 6)