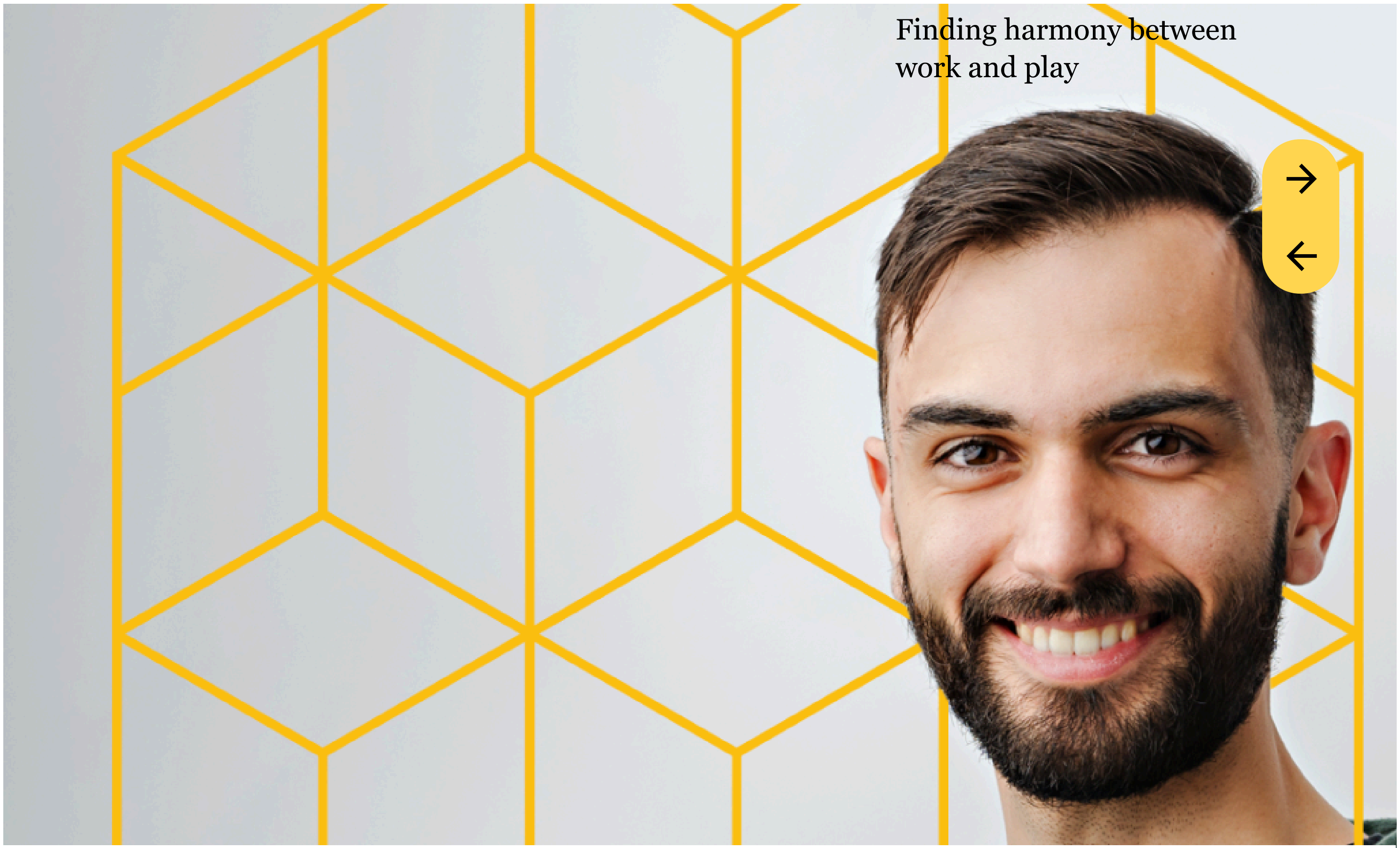
Nicholas Richardson

MMATH GRADUATE, APPLIED MATHEMATICS

Finding harmony between work and play



MATH

Nicholas Richardson knows that feeling well. As an avid musician, who sings a cappella and plays multiple instruments, including French horn, accordion, piano and guitar, his research in the Faculty of Mathematics has allowed him to take his passion to a whole new level.

Over two years of master’s studies, he explored the mathematics of music — a topic that brings his extracurricular and research interests together into a project with promising real-world applications in diverse areas like medicine and seismology.

Bringing theoretical math “down to earth”

“I chose to go to Waterloo, because I was really big into math contests in high school, and I always saw University of Waterloo at the top,” Nicholas says.

At first, he was fascinated by big theoretical physics questions like “how old is the universe?” and “where did we come from?” Waterloo was the only place he knew of where you could get a Bachelor of Mathematics degree in Mathematical Physics. The further along he got in his studies, though, the more he was drawn to Applied Mathematics.

“I’ve taken pure math courses and they’re fun puzzles and problems. But to focus on a problem over multiple years, I wanted to do something a bit more down to earth where you get to see how it could be applied down the road.”

A series of courses towards the end of his undergrad focused on the connections between music and math swayed him from theoretical physics over to applied math.

“Those courses showed me how much interaction there is between music and math, whether through acoustics, modeling, digital audio storage or manipulation. The algorithms themselves and then also how they can be used in music as expressive toolkits are really fascinating to me.”

The impact equation

Nicholas chose to stay at Waterloo for his master’s because he wanted to work with his current supervisor, Professor Giang Tran. His master’s thesis, which he defended successfully in May 2022, looks at a problem called signal decomposition.

Signal decomposition involves analyzing a signal by breaking down the different components or layers within it — for example, a single audio file with multiple instruments.

Nicholas’s research proposes a new method for tackling the challenge, a technique he sees as being applicable to a variety of real-world contexts. The method could be used in medicine to diagnose heart or brain conditions based on signal patterns. Or it could be used by seismologists to analyze and interpret seismic waves from earthquakes.

With so many possibilities to explore, he’s continuing his studies at the University of British Columbia where his doctoral research investigates “other applications and other kinds of interesting problems that use the same mathematical toolkit.”

Tuning in to community

At Waterloo, Nicholas found a balance of autonomy and connection that empowered him to pursue his unique research interests in a supported environment.

“You have the freedom to choose what you want to research. There’s no dedicated group for mathematics and music, but I was able to do it anyway. I’m not sure I would be able to do that at any other university.”

He says staff and professors in the department of Applied Mathematics were always willing to help. Even during the pandemic, weekly meetings with a small research group of graduate students kept him feeling connected to “a very positive, welcoming community.”

The UW A Cappella Club was another important source of commu d “a big part of the university experience” — since he auditioned in firs Canada’s largest university a cappella organization, the club is ma nore than 200 members and 6 different a cappella groups.

“A cappella is a blast. Everyone is so nice, it’s very community oriented. You get together and sing at least once a week, so it’s just a great break and contrast from the heavy math and physics I was doing.”

Throughout his six years at Waterloo, he performed and competed locally and internationally, and helped host both the International Championship of Collegiate A Cappella (ICCA) quarterfinals and Canadian A Cappella Conference (CanACC) at Waterloo.

While music is Nicholas’s main passion outside of school, his advice for incoming graduate students is to explore the diverse extracurriculars available “for whatever you're interested in,” as well as one-off events organized by the Graduate Student Association (GSA).

> “It’s an environment that makes it really easy to be a grad student and not just have your head down the whole time.”

MEET VEGA FROM THE FACULTY OF MATH

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