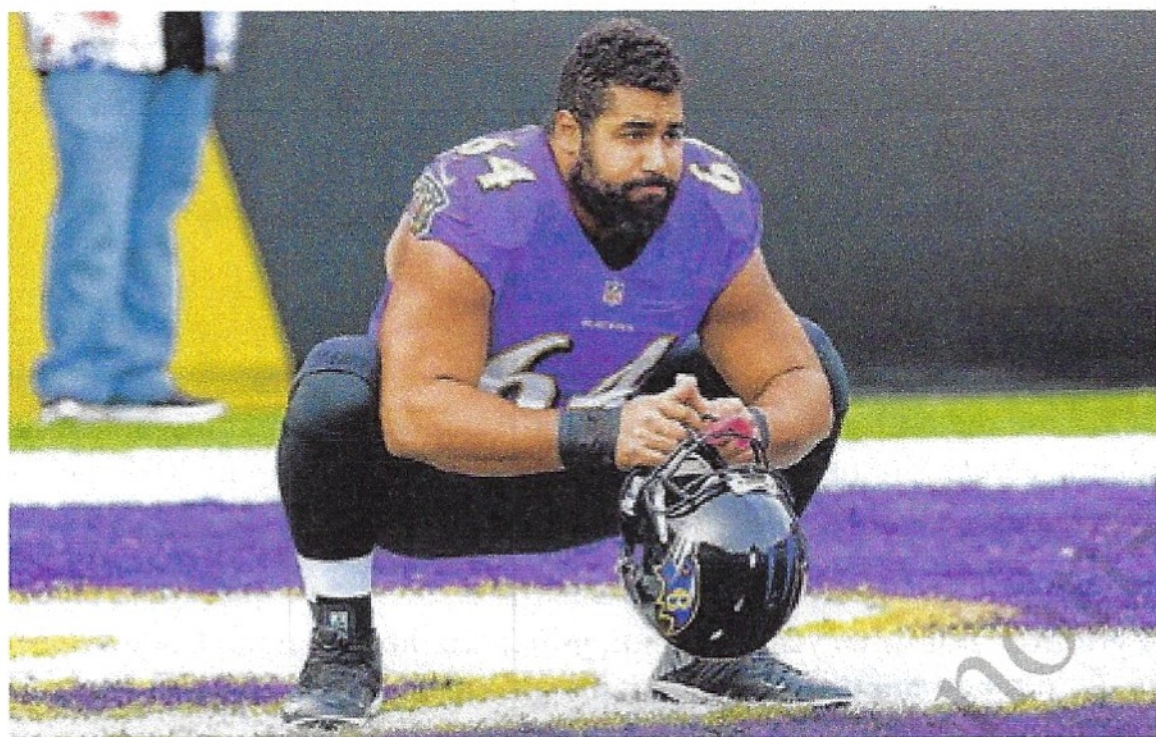




MITCH STRINGER/ USA TODAY SPORTS/ REUTERS Offensive lineman John Urschel gave up his NFL career with the Baltimore Ravens to study math at MIT.

The Former NFL Lineman Who Solved a Decades-Old Math Problem

BY ANDREW BEATON

A **FORMER NFL PLAYER** named John Urschel decided to do some light reading this week, and for him that meant leafing through the latest math papers from OpenAI about topics such as the Riemann hypothesis.

"Oh my lord," he thought. "I was absolutely floored."

Urschel was blown away by the findings because he happened to understand the hundreds of proofs better than nearly any human on the planet. Nine years ago, he traded the National Football League for the Massachusetts Institute of Technology. And Monday, instead of studying abstract play designs, he was publishing some impenetrable language of his own to prove a decades-old mathematical conjecture.

Urschel's paper, titled "On the Growth Factor of Random Matrices," is one in a deluge of AI-assisted proofs that mathematicians have achieved in this new era when they can combine their genius with supercomputing power. But within this community of brainiacs, there isn't a single person quite like the 35-year-old Urschel. After three years with the Baltimore Ravens, the offensive lineman who was listed at 6-foot-3 and 313 pounds ditched his helmet to become a professional egghead in 2017. And he hasn't regretted it for a moment since.

"I feel like I bet on myself in a big way," Urschel says. "I'm living my best life right now."

Long before Urschel became an assistant professor at MIT studying matrices, spectral graph theory and other subjects that sound like gibberish to just about everybody, he was an overachieving kid attending Penn State.

While playing for the Nittany Lions, he did more than pursue an ambitious major by studying math and win the prize widely known as the "academic Heisman." By the time the Ravens drafted him in 2014, he had already earned his masters.

But after a year protecting Joe Flacco, Urschel started to miss his life crunching numbers. While he felt that his analytical background was useful to him as a football player—for instance, he says it helped him learn the playbook—it didn't quite scratch his intellectual itch.

That's when he decided to apply to become a doctoral student at MIT, the school he had always dreamed of attending. He began moonlighting there in 2016. And even though he was technically a Raven at the time, he spent his offseason training with the Division III MIT Engineers.

Only when the next NFL season began, Urschel came to realize that he had made a terrible miscalculation. The one variable he hadn't taken into account was time. Between the hours Urschel spent fending off nose tackles and studying *eigenvalue* problems, he barely saw the woman he would marry.

"In hindsight, it was a horrible decision," Urschel says. "What was I thinking?"

The next year, Urschel decided not to go through it again. Chasing the NFL and MIT had proven too much, and putting his brain on the Ravens' offensive line felt like it could hurt his academic career. So instead of showing up to training camp in 2017, he decided to become a full-time student again. Four years later, he earned his PhD, and two years after that, he was back at MIT as a professor.

Along the way, Urschel didn't completely forget about the gridiron. For three years beginning in 2020, he sat on the College Football Playoff selection committee. He still tries to carve out time on Saturdays to watch his alma mater Penn State and now Virginia Tech, where his former college teammate is now the offensive coordinator.

But more than anything, Urschel is a math guy now—his latest proof is proof.

Urschel's paper tackles a conjecture that has existed since the 1990s and that he first became interested in while an undergraduate. It concerns Gaussian elimination, a popular way of solving linear systems that you might remember from high school. For instance, take these two equations: $2x - y = 0$ $x + y = 3$ Adding the two lines together simplifies to $3x = 3$. Therefore, x equals 1 and y equals 2. This fairly straightforward method is also used by computer programs in nearly every field to solve far larger systems of equations. The issue is that small rounding errors with this approach can theoretically compound to make the answer useless. Even though mathematicians had suspected this almost never happens for typical problems, they had never fully proven it—until Urschel did.

Urschel also had an assist in his research. His acknowledgements cite the help of OpenAI models and says that he welcomes any questions about the role of AI, which is upending his entire field.

But supercomputers haven't dented the passion that this football-player-turned-mathematician has for math. He compares it to his enjoyment of chess: The computers are better than the humans, yet he still enjoys the pursuit of finding the right move.

"I really want to understand the *why* of things," Urschel says. "AI doesn't ruin the *why*."

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