

Data for Good

Tackling Trillion-Dollar Problems

TIM CHARTIER

Our technological world enjoys benefits from the unfolding digital revolution. Data analytics enables doctors to diagnose and treat disease in ways that were previously impossible and, in some cases, inconceivable. Colleges use data to increase retention rates through data-informed advising and scheduling. At the same time, our world suffers from technological dangers. Hacking has compromised businesses and their clients and exposed emails thought to be secure. Identity theft is an ever-present reality.

How can we harness the power of our digital world, while protecting ourselves from its threats? This was the mission of D. J. Patil, the first chief data scientist of the United States, a position created by President Barack Obama in early 2015.

I interviewed Patil to learn more about his job involving math in the West Wing. Patil's comments have been edited for clarity.

Chief Data Scientist

Consider the task of being the first deputy chief technology officer for data policy. You are faced with a vast quantity of data related to a large variety of national issues. Where do you start?

When I asked Patil, he put it this way: "The hardest thing about being in the White House—and I'm literally overlooking the front of the West Wing entrance—is to really gain perspective on what you should work on. Everything is critically important. There's a person at the end of every problem."

As Patil began to organize his thinking at the start of his new job, the presidential science and technology advisory group noted that he was considering problems in the billions of dollars. Patil was offered the valuable advice that his job was "to think only about the prob-

Over the final year of the Obama administration, the Mathematical Association of America (MAA) and the White House Office of Science and Technology Policy (OSTP) cultivated a relationship around mathematical problem solving. The OSTP and D. J. Patil, deputy chief technology officer for data policy, invited the MAA and the U.S. International Mathematical Olympiad Team to celebrate Pi Day at the White House in 2016, and the association supported the White House's first Active Learning Day campaign on October 25, 2016. Tim Chartier spoke with Patil on October 4, 2016, as President Obama's second term was winding down. As of this writing, the position has not been filled in the new administration.

lems that are a trillion dollars and up." This realization pointed him naturally to trillion-dollar problems like health care, the criminal justice system, and climate change, which his office addressed.

He pondered what other guidelines should help direct his work. He came up with two more: "Does the problem impact more than half the population of the United States? Then there are certain problems that affect a population that has no recourse. Our job is to make sure we stand up for them. That's our framing. Those three things: half the U.S. population, one trillion dollars and up, or a populace that has no recourse."

With this structure, Patil and his office began meeting people who were face to face with the issues in order to better understand the problems. He noted, "The best way to do this job incorrectly is to lock yourself in a room and just try to think about the problem.



D. J. Patil, the first chief data scientist of the United States.

That does not work. Mathematics is getting to a place where it has an unbelievable impact, and it has the power to transform society. We have to go back to making it a much more collaborative process.”

Realizing such an impact is undoubtedly difficult. Patil noted that for him and his staff, “surprising ‘aha’ moments” often come through the process of “scout and scale.” Scouting uncovered existing work on a problem of interest. Then, they determined if and how such a process could scale.

For example, “Miami-Dade, Florida, saved literally \$10 million [by coordinating mental health services and its criminal justice system] in the first year by just passing a spreadsheet around. They found people that are being cycled through the system rather than getting the help they needed. We’re not talking super-sophisticated stuff. So when you take that model and you try to make it work across the nation, which is what our data-driven justice initiative does, we’re just taking something everybody else has already figured

out in little pockets and helping communities.”

Patil said his training in mathematics supplied him with a wealth of tools for the problems that faced him. He recalled one incident: “We were under a very serious cyber attack. I said, ‘OK, can we get the time series of when the attacks are happening. We need to do a fast Fourier transform on this to understand if we’re seeing any periodicity.’ We had literally minutes to do this because we were under attack.

“I have a dozen versions of that story where we’ve had other attacks, and I’ve had to build a very fast differential equation that says, ‘This is what the clock looks like, and this is how much time we have.’ Mathematicians singularly have that tool set that they can deploy in a MacGyver moment.”

An Unlikely Path to Success

Who is D. J. Patil? Until January 20, he was a data scientist working out of the West Wing on national issues of massive scale. He’s a technological MacGyver wielding his mathematical duct tape. As such, it

D. J. Patil (left) and Phaedra Chrousos of the Office of Citizen Services speak onstage during TechCrunch Disrupt SF 2015 in San Francisco, California.



Steve Jennings/Getty Images for TechCrunch

would be easy to imagine Patil being among the mathematical elite in his youth, excelling at the American Mathematical Competition or vying for a place in the Mathematical Olympiad. That is not Patil's story.

"I was never given an opportunity to fall in love with math," he said. He remembers school math classes as focused on worksheets rather than an appreciation of the subject. He recalls failing an assignment because he used a less than or equal sign between quantities rather than a less than sign.

Thus, he came to mathematics late in life. "My girlfriend in community college was taking a calculus class. So I went with her to listen and learn. It was this very stunning moment—the beauty of math more than anything else. Then I went to the local library and checked out all these books—all math books—and effectively taught myself high school math in a few days. That sparked this 'Wow!'"

That spark led him to immerse himself in mathematics, eventually acquiring a bachelor's degree in mathematics from the University of California, San Diego, and a PhD from the University of Maryland in applied mathematics.

Later, he served as a faculty member at the University of Maryland and used open data sets published by the National Oceanographic and Atmospheric Administration to improve numerical weather forecasting. Patil's business accomplishments include serving as head of data products and chief scientist of LinkedIn.

Math for Civic Engagement

Just as Patil found a place in mathematics, he sees a place for today's students in the civic engagement of

data analysis. He said, "If you want to make material change and see the impact of the change that you are doing, the number one way to make that happen is to do it for your community. Make your own town better." See the sidebar (on page 21) for Patil's suggestions.

Patil noted that data can and should be used for good. "Math is an incredible force multiplier. A lot of people are really scared by it—and we often use words that amplify the fear rather than making the math feel safe and feel acceptable. Math and data should never be used as a weapon. They should be used to start a conversation and to have the dialogue. That's when math works best. That's when data works best. You have a conversation to get to better answers. You have to know that your first job is to make everyone feel safe and know that you're not going to wield this power in a way that is going to harm them. But it is there to empower them."

Want to be involved at the local or national level? Patil suggested honing the following skills. "Learn how to communicate your work. Without the ability to communicate, you're doing only half the work. An understanding is not sufficient. The three things I ask people are: 1) What do you want them to take away from what you're saying? 2) What actions do you want them to take? 3) How do you want them to feel?"

Patil emphasized the need to be grounded in the theoretical aspect of a field, but he also encourages students to "take a number of classes in other areas in which you would not expect data to be relevant. Take the classes where data is going to be leveraged. Take classes in the humanities. Because data—almost all data problems—interact with a human or a human condition."

Dig into Data from the Grassroots

Patil shared the following resources to get readers started using data to help communities. Get local, and make a difference!

- **The Opportunity Project** (*opportunity.census.gov*) was launched to catalyze the creation of digital tools that use federal and local data to empower communities with information about critical resources, such as affordable housing, quality schools, and jobs.
- **National Day of Civic Hacking** (<http://bit.ly/CivicHackingDay>) leverages creativity, technology, design, and innovation to strengthen communities.
- **Code for America** (*codeforamerica.org*) is a nonpartisan, nonpolitical organization founded to address the widening gap between the public and private sectors in their effective use of technology and design.
- **U.S. Digital Service** (*usds.gov*) is a startup at the White House that uses design and technology to deliver better services to the American people.
- **Technology Transformation Service** (*gsa.gov/tts*) has the mission of improving the public's experience with the government by helping agencies build, buy, and share technology that allows them to better serve the public.
- **NOAA Data Access** (*ncdc.noaa.gov/data-access*). Patil used NOAA's publicly available data to "figure out a bunch of stuff." Readers can start there to begin exploring and discovering.

Moreover, Patil argued that it is time we bring a study of ethics into the mathematics and data science curricula. "It is not that we should tell people what is right or wrong. We need to have a conversation and create a language framework to have that discussion. I was lucky that a part of my undergraduate curriculum included philosophy and ethics. As a result, I developed a very strong ability to have conversations with other people to talk about 'How do we think about long-term implications?'"

"Mathematicians are being blamed for the financial collapse. Mathematicians are being blamed for some of the things that can go wrong with algorithms—not just in finance, but in medicine and discrimination in artificial intelligence. We shouldn't say, 'Oh, it's just the algorithm's fault.' We have to own that—in the same way that civil engineers have to take responsibility for a bridge and not just say that 'it's just the materials.' We have to take ownership of the end-to-end aspect of these problems, and that requires a much broader training."

Patil's Future

I asked him what he would miss about his White House job.

"The thing that I'm going to miss most about this job is the ability to walk up to somebody and just say, 'What would you want the president to know?' It's a question I've asked inmates, hairstylists, cashiers, airline attendants. There's nothing that says that you have to

have the White House label on it. You just have to say, 'What's the most important thing that you're thinking about these days?'"

What does a chief data scientist do after the White House? Patil's honest answer gives a sense of the demand and great responsibility associated with his office: "Take a nap. Take a very, very long nap. And wear only sweats."

That nap probably won't last very long. Patil's energy and vision will lead him to ask the people he meets what is important to them. He hopes he isn't the only one asking them or using a mathematical tool kit to tackle their problems. ■

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