

The Magic Behind the Music

Fatemeh Pishdadian mixes her expertise in computer science with her passion for music in her work as an audio machine learning and digital signal processing engineer at Apple.

As an undergraduate student in Iran, Fatemeh Pishdadian's (PhD '20) interest in engineering sparked a curiosity about how systems work. That curiosity led her to computer science, which became a passion.

Pishdadian already had another passion: music. From an early age, she played piano and sang in a choir. "I had a conflict between these two worlds, super technical and musical," she says. "I wanted to find an interdisciplinary program that reconciled audio music processing and engineering."

Her desire to combine these two disciplines eventually led her to Northwestern.

After earning a bachelor's degree in electrical engineering at Ferdowsi University of Mashhad in Iran, Pishdadian came to the United States to pursue a master's degree in electrical and computer engineering at George Mason University. While there, she worked on audio processing and automatic music transcription.

When she learned about Northwestern's Interactive Audio Lab, she knew it was the perfect place to pursue her PhD. Led by Professor Bryan Pardo, the lab invents technologies that transform how people generate, authenticate, manipulate, separate, hear, and understand sounds, with a focus on music and speech.

"Professor Pardo is a musician and a computer scientist, and many of the people working in the lab played instruments," she says. "They were brilliant computer scientists, and all the research was about music signal processing. I've always been at the intersection of electrical engineering, computer science, and signal processing. It was a very long journey, but for me, the lab was home."

In the Interactive Audio Lab, Pishdadian's work focused on isolating different audio streams from a recording—a single voice in a crowded café or the sound of a violin in an orchestral piece. "That kind of problem always fascinated me," she says. "I remember a lot of very cool, stimulating discussions with Professor Pardo and my lab mates. It gave me the best kind of collaboration and environment to think about this problem and dig into it."

During her time at Northwestern, Pishdadian also became interested in audio perception, auditory systems, hearing health, and psychoacoustics, the study of how humans perceive sound. Today, she continues that work at Apple, where she is an audio machine learning and digital signal processing research engineer. In her role, she develops audio processing and speech enhancement algorithms for hearable devices using signal processing and machine learning techniques.

Pishdadian enjoys the hands-on, problem-solving nature of coding and algorithm design. "When you put your headphones on and use noise cancellation or when you talk on the phone and your speech quality is enhanced—these are examples of different audio processing algorithms that are part of everyday technology," she says. "With anything that has microphones and speakers, there is some magic going on behind the scenes."

From distinguishing different streams of audio to separating speech from noise, Pishdadian continues to build on the research that fascinated her at Northwestern, leading her into new areas of discovery. "Every day, new tools are emerging, and it keeps you busy," she says. "I enjoy learning. In computer science and in machine learning in particular, it's just ongoing."

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