dana randall / the mathematics of passion

After listening to Georgia Institute of Technology Professor Dana Randall talk for just a few minutes, one thing is certain: Randall is not your ordinary mathematician. She is young, energetic and hip. Randall is also obviously very smart and drawn to mathematics for reasons other than an interest in number-crunching. She loves the beauty of puzzles and finding answers to theoretical questions.

But, perhaps, the most interesting aspect of Dana Randall is that she understands the modern perception of mathematicians and desires to change it. She wishes the world to see that there is more to her (and her colleagues) than the stereotypical view many have of people who study advanced mathematics.

While this goal may not come out of Randall's mouth during the Arnold Ross lecture she will be giving at Fort Discovery later this month, her general relaxed atmosphere tells it all. Mathematics need not be the dull pursuit of a career in taxes and accounting.

In order to better understand Randall, it is necessary to gaze into what drives her as a person and as a mathematician. The title of her upcoming lecture at Fort Discovery is Domino Tilings of the Chessboard: an Introduction to Sampling and Counting. To many, the title alone may not quite explain what to expect. In order to relay what she studies, Dana Randall begins with a simple description. If a person were to take three diamond shapes and fit them together it would form a hexagon that looks like a cube. When multiple diamonds are placed around each other, it creates "something much more general," Randall says. "A sea of boxes." Using these diamonds to cover or "tile" an area, the question arises as to what the final configuration will look like. According to Randall, "there is actually lot of order. In a perfectly tiled area [the diamonds] do not look random." There may appear to be randomness to the tiles but order shows through in the pattern. "As a mathematician I want to know why order happens," Randall says.

"How many ways can I *cover a chessboard* with two-inch by one-inch diamonds?"

Studying Computer Science led Randall down this path towards finding an answer to why the random creation occurs and what it looks like. She understands that many people want to see a practical application in today's modern world for the study of such puzzles. For this, Physics provides motivation for many of the theories Randall works with on a daily basis. Imagine each diamond as a diatomic molecule (a molecule formed from two atoms) and a more practical reason begins to emerge for the study of randomized algorithms. Understanding diatomic molecules and their relation to one another could help "determine the physical structure of certain crystals," Randall explains, including energy. This is why physicists study the random configuration of molecules.

Very simple rules dictate complicated work, Randall explains. She explains this further by using the example of water freezing to ice. If a person was to look microscopically at water, there doesn't seem to be a big change as the temperature is lowered past the freezing point, but macroscopically they would see disorder of the particles above freezing and order to the particles when the water transforms to ice. This type of phase transition is what we see very often mathematically.

Others also want to exploit order by using the idea of random sampling. By understanding the way molecules configure themselves, scientists hope to replicate this type of behavior through the study of nanotechnology, a field that has gained momentum over the years and fascinated many in the medical fields especially for the obvious practical applications.

Professor Dana Randall understands that when she shows pictures and diagrams of the mathematics she studies, people will be convinced that order is happening in these patterns. But she also enjoys to "study the aesthetics" of puzzles in her work with Computer Science. The pursuit of knowledge is fine and dandy but it also needs to be exciting and fun.

Looking at the patterns fascinates Randall. For problems "each one is a puzzle," she admits. There are cool patterns to the order she studies, and that is what draws her in. She enjoys the thrill of solving problems. This is where the title of the Arnold Ross lecture comes in. "How many ways can I cover a chessboard with two-inch by one-inch dominos?" she asks the attendees. The simple answer is that there are an "awful lot of ways," she laughs. What her study boils down to is seeking a formula for explaining and figuring out how many ways those dominos can be laid out on the chessboard.

Beginning her study of Advanced Mathematics in high school, Randall learned early on that the common view of mathematicians is wrong. "It's hard for people not to see a sterile dry image" when thinking of math. She and her colleagues view work as "sitting around with friends and trying to solve puzzles," she says. In this, mathematicians are like anybody else. For this reason and her attitude towards life, Dana Randall, in many ways, can stand as a representative to the larger world outside her field of study as to what the typical life of a mathematician is really like. The answer being simply that she's not a television stereotype, but a person who enjoys the mystery of solving puzzles and discovering answers to tough questions. She challenges herself on a daily basis with her work and for that Randall has made a great career out of doing what she enjoys.

It is the "beautiful captivating questions" that drive Randall and allow her to enjoy the cool, fun, and (not necessarily) applicable side to theoretical mathematics. When she began working in her field there was not a connection to Physics, but now that door has been opened in the last fifteen years and "we have a new set of tools at our disposal" Randall says.

In the end, Randall's goal in Theoretical Computer Science is to understand "what can you efficiently solve with a computer?" She looks for a way to categorize the problem when it can't be solved efficiently too. Studying the n x n imaginary chessboard, mathematicians do know ways to count the number of tilings, but for very similar sounding problems, no one knows the answer. Randall looks to "develop an algorithm to solve these problems efficiently."

"I wear many different hats," Randall concludes about herself and what she does on a daily basis as a mathematician. She looks into the problems motivated by Physics and wonders if there is a way nature is computing these things. "I believe there are answers," Dana Randall says, and the unending quest for that elusive equation shines in her voice as a passion, as an obsession, as a job, and simply as a means of having fun.

by **D.H.L.** *photo of Randall and her daughter* **COURTESY OF RANDALL**

plan to go

date **OCTOBER 29**

venue **FORT DISCOVERY**

the show **THE ARNOLD ROSS LECTURE by the American Mathematical Society:** Dana Randall: *Domino Tilings of the Chessboard: An Introduction to Sampling and Counting*

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