**ERIK DEMAINE:** I think fun is a very important part to life in general, and in particular, work. Maybe not so common to view it that way, but I think if you have fun, if you enjoy, and if you're passionate about what you do, then you'll do it well. And you'll be super-productive. And people will love you for it.

And so my guiding principle in the research that I do has been to always pursue what I view as fun. And sometimes it's things that are very relatable as fun, like games and puzzles. Sometimes it's more obscure things, but I personally find them really fun. And maybe they're more practical. And so it's also nice to have a mixture.

But in teaching, I think learning should also be fun. My dad raised me this way when he was homeschooling me-- and that always, you should learn what you're curious about. And so conversely as a teacher, I want to make material really interesting and intriguing and just fun to learn about, because I think students will be more excited and engage more with the material if they enjoy it. Seems natural.

And so in this class, I really tried to bring lots of fun examples-- I mean, maybe there are some more serious problems that people have proved hard, and then there's more entertaining problems that people have proved hard. So I often cover both. But given the choice, I would prefer the one that's more entertaining and something that people can relate to, like, yeah, I played that video game. And it was really tough. And now we can actually prove that it's tough, then that's what makes it exciting.

And so it's really nice-- I mean, I view teaching as kind a entertainment of sorts. I think it's nice to have that as a goal. And if people are entertained, they'll be engaged. And they'll learn the material. And they'll care more deeply about it and hopefully do research in the field and all that.

When I was younger, when I was a graduate student, a lot of my more senior colleagues, other professors, would warn me that it was maybe dangerous to pursue fun things, that people would not view it as serious. And maybe you won't get a job when you graduate. And I kind of ignored those people. And it was a bit of a bold guess. But it worked out well for me. And later, those same people apologized for making that suggestion.

I think, again, if you do things you're passionate about, you'll do them really well. And you'll be very productive. And so you can make up for the topics being more recreational by showing that they're really powerful and really deep mathematically. And that's turned out to work for me.

Since being at MIT, it was, again, like well, like, tenure. Will people appreciate the fun side of things? And I do lots of serious things in addition to lots of fun things. But it worked out. I got tenure. And in fact, I think it's an important part of who I am.

One analogy is to Martin Gardner. He's sort of an idol of mine. I never got to meet him, although we corresponded a little bit. And he is called the father of recreational mathematics. He wrote a column for *Scientific American* for decades. And it really influenced a lot of present day mathematicians and computer scientists to get into the field, because they read this column. And it's talking about open problems, but in a very accessible way. He wasn't really a mathematician. He just learned from mathematicians that he knew and wrote about the cool problems, very accessible problems, and fun problems, that people were working on and what kind of solutions they had.

And so Martin Gardner's kind of a model-- although I do it more in the teaching side than in the writing side-- of a way to engage new people into the field, get people excited about science, and technology, and mathematics. And I think MIT appreciates that a lot, that by working on fun problems, you can reach a broad audience. And when we proved *Super Mario Brothers* as NP complete, all the newspapers were covering it, like, wow. Hard Nintendo games really are hard. You know, mathematicians proved this thing everyone knew. It sounds funny, and so it makes for good press.

And I think people are intrigued by, oh, what does that mean? Then they can go and read the paper or take this class, and it covers how do you prove something like that? And how do you actually-- it's really fun to prove that *Super Mario Brothers* is hard. You basically construct little levels that build a computer. So you build a *Super Mario Brothers* level that represents an entire computer. And that's a fun thing to do. And I think it can get a lot of people excited about computer science.

When I first came to MIT, I used this as a principle to get new graduate students started. So they're trying to find a problem to solve. They don't really know what they're interested in. So often, I'll suggest a game or a puzzle. Hey, let's prove this hard. One of the first ones was *Tetris*. That was done with two MIT students back in 2003, I think, just after I started.

It's like, I've always been curious about *Tetris*. It seems really tricky. And then together, we proved that it was hard. And that was their first paper. And it got them kind of psyched up and ready to solve more problems. They don't do hardness of games anymore, but it was like a nice warmup to build their confidence and show that they can do this.

So I think a lot of these problems are it's hard just made easy. It becomes quite accessible. One of the things that really made me happy about this class is-- I teach a lot of advanced theory classes. And each one of them has a final project at the end. And this class also had a final project. And there are many types you can do. But the type I'm always most excited about is to solve an open problem.

And in this hardness proof class, most of the student solved an open problem. Compared to any other class I've taught or seen, many more students solve the open problems, because a lot of them are relatively accessible. You can take a game or puzzle that just you like playing and you have expertise in, but no one else has tried to analyze mathematically. And now, suddenly, you can bring these new tools to it and prove your result and write a paper.

Fun is like the hook that gets you excited about the research, the problems, and the material. So we analyze a lot of games and puzzles. And most of them, to kind of keep it interesting, we analyze real world games and puzzles, like video games that people play. And one example is *Super Mario Brothers,* where we can prove that it's NP hard to figure out whether you can solve a given level. So there's no good algorithm to, given a *Super Mario Brothers* level, figure out how to solve it.

This, I guess, becomes particularly relevant once you can make your own custom levels. So with the upcoming release of *Super Mario Maker*, now people can actually build their own levels. This'll be really fun from a research perspective, because we can take all the levels that we've designed. When we design them, we just arrange them as pixel art, so that you can see the level, but you can't actually experience the level.

And in order to actually experience the level, you'd have to modify the ROM of the game. And it's very tricky and technically annoying, and maybe also illegal to do that. *Super Mario Maker* suddenly makes it accessible that everyone can make custom levels. I think it also makes the results more relevant. It says, hey, if you download a new level, figuring out how to solve it is going to be a real challenge.

And I think this is a big reason why people find video games fun, because they find them challenging. I think if a game is too easy-- there are exception but if a game is too easy, it gets boring pretty quickly. And when there's this nice-- when you can set the difficulty of the problem so it's not impossible, but at least it's a big challenge to solve it, I think that's where you get the sweet spot in having fun.

And this whole area of hardness proofs gives you a mathematical way of analyzing games and puzzles to show, yeah, they are really challenging. They're hard even for computers to solve them. So for humans, it could be also really challenging.