

Speaker 1:

This is *ACM Bytecast*, a podcast series from The Association for Computing Machinery, the world's largest educational and scientific computing society. We talk to researchers, practitioners, and innovators who are at the intersection of computing research and practice. They share their experiences, the lessons they've learned, and their own visions for the future of computing. We have all heard of the concept of traveling around the world in 80 days. Our next guest has lived that idea multiple times. Jennifer Widom is an accomplished researcher with significant contributions in the world of databases and data science, and today is the dean of the school of engineering and the Fletcher Jones professor in computer science and electrical engineering at Stanford University. Jennifer, welcome to *ACM Bytecast*.

Jennifer Widom:

Thank you very much. Pleased to be here.

Speaker 1:

I'll start with my leading question, asking you to maybe introduce yourself and tell us what drew you into this field of work.

Jennifer Widom:

Sure. I had a rather unconventional I'd say journey into computer science. I grew up in Santa Cruz, California, a wonderful beach town, not a very academic high school. So my passion in high school actually became music, and when it came time to select a college, I chose to go to music school. I'm pretty sure at this point, I'm the only dean of engineering anywhere who has a bachelor's degree in trumpet performance, but that's actually what my undergraduate degree is in. Late in my music education, I just sort of randomly took a class called computer applications and music research. And it was a class in the music school about using programming to analyze music, and it was my first exposure to computer programming. I have to say, it'll reveal my age, but I used punch cards in that class. It was sort of the end of the punch card era.

Jennifer Widom:

But I really enjoyed the computer programming in that class. I did continue and finish my music degree. But towards the end of my undergraduate, I started to take a few more computer science classes, and I ended up going to graduate school in computer science, and eventually earning my PhD. After that time, I went to the IBM Almaden Research Center. That was my first post PhD job, and I spent five years at IBM Almaden. It was a terrific research lab. That's where I really cemented my interest in databases and information management, working in the terrific database group there.

Jennifer Widom:

And then after those five years, I was hired as an assistant professor at Stanford and began my career. That was back in 1993, so I've been at Stanford for about 27 years now, most of that

time just as a regular faculty member doing research, teaching, a bit of university service, some professional service. Eventually became chair of the computer science department, and then sort of made a decision to continue in some administrative roles, so I was an associate dean for a couple of years, and now dean of engineering for about three and a half years.

Speaker 1:

Superb. I mean, that's an incredibly unique journey. I certainly haven't heard of any computer science engineering school dean starting off in the arts. Do you feel like that part of your journey gave you some sort of an edge when you made your transition to being a researcher? Traits like diligence, or patience, and doggedness, do you think that those are common to both fields?

Jennifer Widom:

Well, that's a great question. People do feel there's a link between at least music and mathematics and logical thinking. And there's certainly some correlation in people who like to do both. I actually thought probably the most direct effect was that as a music performance major, I learned to overcome fears of performing in front of lots of people. And so when I became a researcher, and started giving conference talks and ultimately teaching large courses, I actually think the performance background I had helped with that aspect.

Speaker 1:

I think that's an incredibly valuable insight that you share. I think irrespective of whether you're in academia, in research, or in industry, I think that ability to convey your ideas to an audience is so crucial as you sort of progress along your career journey.

Jennifer Widom:

I certainly agree. I think communication is so key, and I've certainly learned that as well in my role as dean.

Speaker 1:

Right. Do you think though, given how you started and you made this transition, how likely do you think it is for students to pursue a more unconventional path like the one you did, into computer science today? It seems like the degrees are getting more and more specific earlier on in the curriculum.

Jennifer Widom:

Yeah. So that's a really good question. I actually believe pretty strongly that people shouldn't pigeonhole themselves too early, and that there are opportunities to change. I certainly feel at Stanford, students aren't asked to declare their major until their second year, the end of their second year. And I think that's really great, it allows people to explore. I think it also helps a lot with diversity in the computer science field because I think some people gain that passion a little later than others in their interest in computer science. So we definitely see people choosing it

later on. I think getting a bachelor's degree and then switching, it does require some work. As you say, the field is getting very specialized, and so there is a fair amount of transition. But I still think it's quite possible to do that. And I do think becoming a, say, software engineer, if you have a background in another field, it can be extremely helpful in many aspects of your career.

Speaker 1:

Would you like to elaborate, maybe from music to computer science, how you saw that journey, and how it aided you in being a better maybe researcher?

Jennifer Widom:

Yeah. Again, I just think having a background in arts, just knowing how other people think, having empathy for different sides of education, different sides of professional jobs, can always be helpful. I would say actually in the present time, one thing that's I think come out is that some understanding of ethics, of society, is becoming more and more important for people who are building software and software systems, and making decisions. So I think in the present time, my music journey was quite a while ago, in the present time, I think there's a lot to be said for people getting a broad education in that side of things, ethics, social sciences, and so on.

Speaker 1:

Terrific point that you bring up there. I'd like to go back to what you said a little bit earlier where getting that broad education in some ways also brings in diversity into these fields. And in many ways, similar to you, people might think about applying computer science or data science into a field of interest to them. Would you say then that as you progress along, and you started in industry with IBM research, but did you find as you went into academia, engaging with industry on these sort of applied research projects was crucial to your career journey? Would you care to talk a little bit about what might have been the motivation for some of those?

Jennifer Widom:

Yeah, absolutely. Certainly for all of the research that I've done, it has been important to me to know that it's grounded in real problems. And so keeping a connection with industry has been very important. For me, conversations with people who are actually out there working in the software field has definitely guided some of the research that I've chosen to do. When I see there are gaps and you really need a concentrated research effort to make progress in those areas, and then just having the confidence that the research will actually be practically relevant has been very important. So I've kept up conversations with friends in industry, both in large companies and in startups throughout my career.

Speaker 1:

Great. Would you say, Jennifer, that is a result of personal motivation? Do you think there are ways in which we can encourage both industry and academia around the world to pay more attention to these engagements?

Jennifer Widom:

Yeah. That's a great question. I think I'm a little spoiled in a way because I'm here in the middle of Silicon Valley. So it hasn't been hard for me. It's been very natural really to have regular relationships with industry and vice versa. So companies often reach out, and I do think it is quite important. It's different I think in different fields of computer science, so my particular field, databases, has always been quite connected with industry. So again, that made it quite natural for me, the combination of the geography of where I am and a field that just has always had quite a strong connection between academia and industry. I think in some other fields, maybe and other universities, it's a little more effort to do that. But I think it's very valuable. I think many researchers have gotten great research areas, research problems by talking to people in industry.

Speaker 1:

Absolutely. I think there's just that sharing of knowledge across the problem spaces that you're encountering versus what somebody in industry might. I mean, the motivations for pursuing a certain problem might be slightly different, but I think that common pool of knowledge is super important. Right?

Jennifer Widom:

Yeah, that's right. Also, it's a matter of timescale. And industry, one has to show results very quickly, where academics is often looking further out, and bridging that timescale is often the challenge, I would say.

Speaker 1:

Right, right. I completely understand what you're talking about. And what I also noticed as I was studying your sort of career journey, one aspect of it that stood out was the fact that the sharing of knowledge that you have was something that came very early to you, very early entry into the field of MOOCs, or massive open online courses. You were a pioneer in that journey. What was the inspiration for you to get into that field?

Jennifer Widom:

Yeah, so the MOOC story is kind of interesting. The three MOOCs that came out of Stanford that got a lot of press and people thinking that higher education was going to be upended was in the fall of 2011. But a little before that, people at Stanford had been talking about things like flipped classrooms, the idea of recording all your lectures in small segments and having students watch them separately, and then focusing the classroom on interactive exercises and more interaction, was already being explored. So actually, I had already spent several months taking my introduction to databases class and converting it to a more flipped classroom style, so I had already created a whole bunch of videos.

Jennifer Widom:

And I had also been using a quizzing system for a while that had been developed by my colleague, Jeff Ullman, which was an online quizzing system that would actually automatically generate different instances of quizzes. And so I had those materials at the ready when in, I believe it was August 2011, one of my colleagues, Sebastian Thrun announced that he was going to put his artificial intelligence class out on the web for the world for free. And another of my colleagues, Andrew Ng, said, "Well, why don't I do the same with my machine learning class?" And then they invited me to put my database class out there. And since I had all the material ready, I could just start getting going on that. And so it took me a day or two to decide whether to take the leap because I knew it would be a lot of work, and I was the computer science department chair at the time. But I did decide to take that leap, and I did additional work to it to make my class available across the world.

Jennifer Widom:

I created some automatically checked programming problems. I reorganized the videos, put out reading materials. And then every week, I made a video just sort of talking to the students. That experience of putting my class out and having thousands and thousands, or tens of thousands of people around the world so excited about doing the class was really probably one of my most invigorating experiences in my career, honestly. It was very exciting time.

Speaker 1:

Yeah. It sounds terrific because especially when you're getting into something new, the [inaudible 00:12:40] is always: How much extra time do I need to spend? The fact that you actually took that leap, obviously you reaped some great rewards from it. Do you feel like there were any early sort of challenges, whether it was preparing to present this course, or adoption? I mean, clearly, from the numbers that you talk about, it was obviously very popular from the get go. But even assessment, did you have to conduct online assessments? Was that different from how you would do it for a class that you would see more regularly in person? Did you have any specific metrics that you used to measure your progress?

Jennifer Widom:

Yeah. So when I offered the course, I said right from the start, and the same was true of most MOOCs at that point and time, that I wasn't going to be providing any certification. There were many quizzes that were checked, and like I said, automatically checked programming exercises. And the students did effectively get a score. I had a couple of exams. I think there was some fairly significant cheating on the exams. But I said from the start, this was not something where I was going to be certifying students or ranking students at all. I wanted students to want to be doing it, and that was my philosophy, and has been ever since.

Jennifer Widom:

So I basically gave them materials for their own self assessment, but they really had to be self motivated. They did get a PDF at the end of the course that said, it's called the statement of accomplishment that said they finished the course. Some of them complained that the PDF didn't say it was a Stanford course. And then others pointed out that the PDF had Stanford all over it. It said, "This is not a Stanford course. You didn't get Stanford credit. You are not a Stanford student." So there were different expectations, but I was aiming for the student who was really self motivated and just wanted to learn the material. And there were many, many, many of those.

Jennifer Widom:

And my MOOC is still out there and still in active use. It's moved around platforms, as certain platforms have closed, or I didn't want it to be on a for profit class platform, so I moved it to nonprofits. It just transitioned to the edX platform just in the last few months, and seeing a lot of activity there. So even nine years later, it's still being used, and it's still the original material. I'm very fortunate that the field of databases, the core educational component of databases is very, very stable, so it hasn't gotten outdated yet.

Speaker 1:

Got it. Yeah. I mean, I think what better metric than just the longevity of something that you put out way back in 2011, right?

Jennifer Widom:

Right. Still thousands of people.

Speaker 1:

That's amazing. With that kind of a response, Jennifer, did you feel like I'm going to do a lot more of this? I'm going to put out a lot more MOOCs. And do you feel like others were inspired to do the same?

Jennifer Widom:

Well, I can tell you, I certainly didn't say, "I'm going to put out a lot more MOOCs." It's kind of like writing a book. People either write, they write one book, or maybe lots of books. But a lot of people after the first experience say, "Wow, that was a lot of work. I'm not going to do that again." And the MOOC was a great deal of work. I really put my heart and soul into it. And I loved it, but it's not something I would probably do another time. But many people were inspired after those first three courses to create MOOCs, lots and lots of people. And I think most people find it extremely rewarding. Most people will take their core expertise, mine happened to be databases, and will create a MOOC around that, and will get a fair amount of uptake.

Speaker 1:

Got it. So the whole movement of MOOCs, putting content out there and the adoption, did you feel it took off in the way that you envisioned it would when you first started?

Jennifer Widom:

Well, it's interesting. I think that for individual people, faculty, it did probably because my experience was just one of great reward having so many people have access to these materials, and to be so grateful. And I think for many individual faculty, that's what happened. What didn't happen, which surprised people, is it didn't really upend higher education. These courses were available. A lot of the people who took the courses or still do are working professionals who want to increase their skillset or their knowledge. Definitely some uptake in places that don't have access to good education. But it hasn't fundamentally changed higher education. And some people thought it would. People were concerned about universities being put out of business, and that really hasn't happened, at least not to date.

Speaker 1:

Got it. And I think it's interesting that you say that because I think as practitioners, we do rely a lot of MOOCs, like you said, to enhance our skills, to foray into a new area of expertise that we may not know much about. And so it's a huge, huge benefit I think to people who are in industry and looking to sort of expand their horizons.

Jennifer Widom:

That's right. And when we run surveys, we find that's a lot of who's taking the courses.

Speaker 1:

Right. Yet today, we're all in this mode of sort of online education. Right? Across the world, given the current situation. Do you think that MOOCs have a better chance now to sort of impact education and the academic pursuit of a degree?

Jennifer Widom:

Yeah. So that is a great question. Everybody has that on their mind right now because all the universities around the world have suddenly gone online. And the question really comes. What's going to happen once the pandemic is over? And are we going to just go back to the way we were? Or are suddenly, is this going to be what upended higher education? I think we're going to have the same discussions. And honestly, I don't know that the upending is going to happen now either. I think we may see more people willing to teach online. We may see more MOOCs available, but it's not clear who will be taking those once things get back to normal. So I'm just cautious.

Jennifer Widom:

I feel like we're going to have some of the same conversations we had back around 2012, 2013, when the New York Times put out a whole section on whether higher education was going to be

upended. And in the end, it wasn't really. So I think it's open, but I wouldn't guarantee we're going to see a major shift even now. It may also depend on how long the pandemic keeps the universities from being back to normal. And I do think that might be something that causes some small universities to have a great deal of difficulty staying open, so we'll see how that plays out.

Speaker 1:

I think a large part of the higher education process is really the collaboration, the kind of people that you interact with in person, the projects that you work on. And that I think is a large part that's missing when you're in this online education mode. So I concur with what you're saying. It remains to be seen.

Jennifer Widom:

Yeah. That's absolutely right. And those were a lot of the discussions that were had back in 2012 and 2013, trying to separate the on campus experience, the extracurricular experience, the working with and living with peer experience. That's a major part of college education that you don't get through MOOCs. Of course, there are many people in the US who have a different type of college experience that maybe is more similar to taking online courses. But the conventional university, there's a lot going on aside from just the courses.

Speaker 1:

Jennifer, I'd like to sort of talk to you a little bit about another part of your career, and I would feel like an amazing career is incomplete without talking about your year of teaching around the world. For those listening, Jennifer spent a large part of her sabbatical in 2016, 2017, traveling the world and offering free short courses in data science and related topics. I'll start with the question at the top of my mind, very simple question. Why? Why did you do it?

Jennifer Widom:

Yeah, that's the right question to start with. You know, I had a sabbatical. And I guess I felt I wanted to do something a little bit different. A typical sabbatical for someone like me would be to go to MIT, or Berkeley, and spend a year doing research with people at a different university, just in a somewhat different environment. Or if you're a humanities professor, you probably just stay home and write a book. I just really felt I wanted to do something different. I wanted to have some impact. And so I've always been a passionate traveler. I and my family have done a lot of travel around different parts of the world. And so between my passion for travel and the experience that I had with the MOOC, how rewarding it was to have people all over the place taking the online course, I decided to launch what I called a MOIC, that never caught on, but massive open in person course, a MOIC.

Jennifer Widom:

And my idea was simply that I would travel, and instead of delivering online courses, I would show you and give the courses in person. And during that year, I went to I think 16 or 17 different developing countries. And I would be typically a week, and I would give a short course in data science, usually all day, every day. I also decided that another sort of specifically Stanford thing that we have is something called the D school, or the school of design. And it's actually about design thinking. It's kind of a methodology for problem solving. And so it's a unique Stanford asset, and so I also became trained by them to do one day workshops in this approach to creative problem solving. It's completely different thing for me, but I thought if I'm going to these countries, that's something else I could bring to those countries.

Jennifer Widom:

So in a typical week, I would spend four days doing a data science short course, very intense, and then a one day design thinking workshop. It was a lot of fun, very rewarding. Different countries were obviously very different. Students were very different. I intended to do it for about nine months. At about the six month point was when I was offered the dean role at Stanford, so I had to cut the endeavor a bit short. But I've actually been doing it ever since. So I, every summer, I've gotten to tour three new countries continuing that same pattern of about four days of data science short course, and then a design thinking workshop. And it's really rewarding for me, and hopefully as well, useful for the students I've been teaching.

Speaker 1:

Absolutely. I would say, what a rich and a terrific resource for a young student to have, to have somebody from outside of their immediate realm, and somebody at a distinguished university pursuing a career in database research, or with that kind of a background, to be able to have access to somebody like you is terrific. Would you say though then, the MOICs, I'm wondering, why hasn't it taken off? Do you think that the economics is something that is playing a part there, that it's just hard for people to find the time or the finances to travel around the world and do this?

Jennifer Widom:

Yeah. So it's certainly, it takes a certain set of efforts and support to do this. It was definitely not an easy endeavor. And I do want to start by saying actually, ACM was quite helpful for me in this endeavor. They helped me connect through some of the student chapters in different places. They actually helped with a little bit of funding initially, so ACM was helpful. Another professional organization in my research field, it's called VLDB, Very Large Databases, has an endowment. And they were helpful with some funding. Stanford was helpful. So just pulling together the funding itself to do it because many of the places I was going can't afford to contribute much. So there was the funding aspect.

Jennifer Widom:

And then there was just travel logistics, working with the hosts, sensing who would be a good host and who wouldn't. It's quite the effort. And one also has to be willing to stay in places that aren't that comfortable. So some of the places I went, I think you'd want to be a pretty experienced traveler to just deal with some of the things, the places I stayed, and the difficulties just with basic things like electricity and internet and things like that. So it's definitely challenging, I would say.

Speaker 1:

Right. What did you feel, Jennifer, that you most sort of got out of that experience that supposing there was a bunch of new people that were interested in this, what would your advice be to them? Why should they do it?

Jennifer Widom:

Well, I think that for me, because I teach something quite practical, the data science course that I offer is really very much based on tools and techniques, I really think that many of the people I'm teaching are able to use that in the future. And so for me, that's the real reward, that they're learning something not just for the intellectual interest, but also because they're going to put that to work. And so I think having a topic like that is quite important. I mentioned I also do the design thinking workshops. And those are geared towards people learning how to do problem solving in a team based fashion, specific methodologies for approaching problems. And many of the people in those workshops do say that it's helped them have a little bit of a different mindset when they're working on problems. So I'm hopeful that I'm having real impact in the future for these people, and that's really I think the most important thing. So identifying something one has to offer, that really will be impactful is important.

Speaker 1:

Right. Did you find at all that the way computer science is taught ... I don't know if you got any insights into the way CS is taught in some of the places that you visited is different. Did you find that you had to change your method of instruction to be more effective?

Jennifer Widom:

Yeah. Well, so one thing is that there's definitely ... So different places were at, I'd say a different place in terms of computer science education. So some of them were still very traditional teaching their introductory course in C, and it was sort of a rite of passage to get through it. And some people said they hate programming. And then others had sort of embraced the more modern inclusive style of teaching programming. And some of that really is even about what language is taught first, to tell you the truth. I think teaching a more friendly language is more inclusive. And so I would find some places where people were actually sort of averse to programming. And I had to say, "You can actually do some pretty cool things, and it's not torture," so that varied quite a bit.

Jennifer Widom:

The other thing that varied a lot was just the basic skills of the students. So I did expect them to know how to program, and then I was focusing on data analysis tools. And so I had, over time, I had to really craft my materials so on the spot, and literally on the spot, I could adjust the difficulty level based on what I was seeing in the students.

Speaker 1:

Got it. It's amazing because I feel like students having access to professors like yourself from around the globe unlocks these amazing opportunities for them. Do you see at all folks from industry, and a lot of our listeners are practitioners, who have build knowledge, may not have the teaching experience, but do you think that would add value to students? Because I feel like a lot of the knowledge that we've built over the years of experience that we've had in our career could actually have some value to these students.

Jennifer Widom:

Oh, sure. So you're talking about industry people getting in the classroom and teaching students.

Speaker 1:

Right.

Jennifer Widom:

Yeah. There's undoubtedly value in that. We often have industry people guest lecture or guest give a course at Stanford. And I just think having someone from industry talk about what it's really like can be immensely valuable for students.

Speaker 1:

Yeah. I hope that our listeners can take a leaf out of your book and pursue this option because I really believe that there's a wealth of knowledge that can be shared from the folks that are working on cutting edge problems in companies that they're in.

Jennifer Widom:

Absolutely.

Speaker 1:

I want to go back to something that you said earlier, which you travel personally. I mean, travel seems to be a part of your ethos. And I'm an avid traveler, and I've read your blogs and admired the detail and the thought that goes into planning your travel. How did that begin? When did the interest in exploring the world start?

Jennifer Widom:

Wow, that's a great question. I did, when I was a kid, my family lived in France for a year. I'm a faculty child. Many faculty turn out to be faculty children. And so our family would go around on sabbatical to various places. And so I did live abroad for a year when I was young. But I'd say it began more around after graduate school, started a bit of travel. A lot of my travel began with outdoor activities, so backpacking, scuba diving. Scuba diving was a hobby that quickly brings one to a lot of far flung destinations. So I'd say it just sort of ramped up through my adult life. When my children were still at home, they're grown now, we did a lot of travel as a family. Again, a lot of it around outdoor activities, adventure, and so on. So it's always been a part of my life. And I can tell you, this pandemic is pretty challenging in terms of thinking about the future that way. So it'll be a new one for me to stay home this long.

Speaker 1:

For sure, for sure. I think it's on all of our minds. But you also took a year off as a family to see the world. I know many parents today are so anxious with the disruption in schooling this year. Right? And yet, you made that choice consciously. So what was your philosophy to your children's schooling and education at that time? Was that ever a concern?

Jennifer Widom:

Yeah. That's a great question. We decided relatively early that we would like to spend a year traveling with our kids. And so we picked their ages very carefully. And so when we started our year of travel, they were 10 and 12, and then 11 and 13 obviously when we finished. And that was fifth grade and seventh grade. And we actually decided those were moderately dispensable years of education in the public schools. And so we did a bit of schooling while we traveled, made sure they got through their math, for example, so that they could go on to the following year. So when they came back, they did go on to the next grade. But we weren't too formal about it. And when you travel long-term with your family, you start to meet other families who are doing the same thing. And there's definitely a variety of philosophies, but ours was a little bit of the, let's make sure we do the crucial things, and the rest will work themselves out. And that seems to have been okay.

Speaker 1:

That's wonderful. Any special moments through that year of travel that felt like, oh, my gosh, this was totally worth it?

Jennifer Widom:

We thought every moment was worth it. It's interesting. It's now about I guess 11 years ago, or 12 years ago, yet, all of us, including our kids, remember so many details of just about every day, that I would say every moment of it was worth it.

Speaker 1:

That's amazing. I'm so happy to hear that. Definitely very inspiring for those of us listening to think about it because you've combined your passion for travel with your skills and your ability to give to the world by doing the sabbatical that you did around the world teaching. And I think that's a dream for all of us. How do we combine our passion for something with something that is useful and a way for us to give back to the community? So thank you for the inspiration.

Jennifer Widom:

Yeah, absolutely. I'm grounded this summer. I was supposed to be in Ecuador, Colombia, and Nepal, so I guess those will be put off until next summer. But actually, in a couple of weeks, I'm going to do a virtual travel teaching class for a university in Peru that I did visit in person a few years ago, so I'll be doing a data science short course for them via Zoom.

Speaker 1:

Wonderful. And we look forward to this pandemic and its travel restrictions sort of coming to an end so you can be on the road again adding tremendous value to all of these students around the world.

Jennifer Widom:

Certainly.

Speaker 1:

Jennifer, for our final bye, I'd love to hear from you. What is it that you're sort of most excited about in the field of computing over the next maybe five years?

Jennifer Widom:

Sure. I think I have a new viewpoint as dean of engineering. So I was of course in computer science fully until I moved into this administrative role. But as dean of engineering, one of the interesting things is that we have nine departments, and I've learned a huge amount about fields I never knew anything about. Material science, I knew nothing about, chemical engineering, bioengineering. And I'm also learning about other fields across the university. And I guess what really jumps out at me is how critically important computing and data science most specifically, I would say, are to all of these fields.

Jennifer Widom:

So I think probably the biggest thing over the next five years is how computing is going to be used to change the way people do research across so many different fields. And I think as computer scientists can partner with people in other fields and help bring computing and data science and machine learning to discoveries in those fields, that's going to be one of the highest impact things that happens. And I think that's going to be true not just in universities, but in industry as well. It's just so prevalent now, and so many advances can be made when you put computing to work.

Speaker 1:

Thank you, Jennifer. That's a very, very apt summary of the field of work that you've been in, in the past, and a view into the future. And I completely agree with you. This has been an amazing conversation. Thank you for taking the time to speak with us at *ACM Bytecast*.

Jennifer Widom:

My pleasure. It's been enjoyable. Thank you very much.

Speaker 1:

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