Jessica Bell:
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. We're all 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. I'm your host, Jessica Bell.

Jessica Bell:
All right. Welcome to *ACM Bytecast*. And today we have a really interesting guest. I will let you introduce yourself. Please say who you are, what you're doing now, and any sort of fun facts you have about yourself.

Shwetak Patel:
Great. Hi, my name is Shwetak Patel. I'm a professor at the University of Washington in computer science. I'm also director of health technologies at Google. Interesting fun facts about me is that I was a trained electrician and plumber while I was in grad school, which informed a lot of my research back in the earlier days. So people don't realize that I can do construction, and something that ends up being a good conversation piece for people.

Jessica Bell:
Oh wow. Is that part of why you ended up going into tech? Did you find that through construction or was there another sort of thing leading you into tech?

Shwetak Patel:
No, not really. I mean, part of it was. So when I was growing up, my parents were in the hotel business and so I shadowed them a lot in terms of fixing things in the rooms and that kinds of stuff. So I was always very hands-on and kind of mechanically minded. So if somebody would have guessed they thought I would be a mechanical engineer or some way. But computing was a passion for mine from when I was little, but it was just something that I like to be hands-on. So which you see a little bit in my research. But at the same time, it's just something that I was interested in. Did a little bit of work for Habitat for Humanity, helping build houses.

Shwetak Patel:
I grew up in the South, and so that Habitat for Humanity is a pretty big organization there. And then I just like to work on more mechanical things like HVAC, plumbing, and it was just kind of an interesting thing for me. But little did I know when I was a grad student, that stuff would be really helpful for my research. So when I did a lot of electricity and water sustainability research all that stuff actually ended up being very helpful.

Jessica Bell:
Interesting.

Shwetak Patel:
Yeah.

Jessica Bell:
Interesting. That's really cool. I always find it really interesting when people who are in computer science also have a very deep interest in a physical or hand-based either hobby or things that they really love. I really love cooking. And I actually find that there's some relationships between how I learn a new recipe or a new technique cooking, and how I learn a new sort of thought process or solution or something like that. So that's very interesting to hear.

Shwetak Patel:
Yeah. Yeah.

Jessica Bell:
Okay. So if the construction stuff kind of... Okay, you're good at puzzles. You like how to figure things out with your hand. Tell us a little bit about how you then decided, "Oh, okay. I actually am really interested in computers and computer processing," and maybe you can tie that into how you've came about your grad school research.

Shwetak Patel:
Okay. No. Yeah. I mean, I was always fascinated with computing kind of when I was little. I was fortunate enough to have access to a Texas Instrument [TI-49A 00:03:01] computer, where I was doing a little bit of coding on it. My parents immigrated from India, so I was born in the US. But when they immigrated to the US they didn't know much about computers. We're lucky that we got our hands on one of those, but my parents obviously didn't have access to computers in India, or didn't have much knowledge about them. So I was just kind of tinkering myself with... Which is a lot of computer scientists my age have done is they kind of figure it out themselves. But because I was also hands-on, I also like to build them and rebuild them and then build electronics. And RadioShack back in the day was actually an electronics components store where you can actually go and buy components and build things.

Shwetak Patel:
So early on, I was more of a computer engineer than a computer scientist. I was more interested on the hardware side of things, but then I realized the flexibility that software could provide in terms of what you could do on top of the hardware. So when I was little, I did a lot of that kind of stuff, entered technology fairs, science fairs. And so I've always had this kind of mixture of software and hardware. But when I went to undergrad and grad school, I decided to go down the computer science path. Because for me, I was like, "Well, I think computing is really going to be the center of a lot of things in society." And then that's what happened. I mean, some people would've guessed, I would have been a mechanical engineer, some would have guessed a doctor because I was very interested in more of the areas of social impact and that kind of stuff.

Shwetak Patel:
I was drawn to computing, but throughout my undergrad and graduate career, I still had my hands in hardware too. So right now, I do a lot of work at the intersection of hardware and software. And more and more of it's on the software side, but I really love the intersection of the two. The duality and the interplay between hardware and software. So not picking one or the other. I mean, I could've double majored in computer science and electrical and computer engineering at Georgia Tech, where I got my undergrad and my PhD. But I said, "Hey, I'm just going to get the computer science degree, but I will take the courses and do work in electrical engineering as well." So over that course of study, I kind of got a knowledge of both, even though my formal degrees are in computer science.

Jessica Bell:
Okay. Okay. And tell us a little bit about what you focused your research on in your sort of graduate degree career, and sort of what led you to being interested in those topics.

Shwetak Patel:
Yeah. My influence in graduate school was actually influenced by my undergrad experience. So at Georgia Tech, I worked with professor Gregory Abowd, who at the time was doing a lot of interesting research in smart home technology. So at Georgia Tech in Atlanta, we built this home from the ground up called the Aware Home. So this was back in the day where smart home technology was just at the cusp of kind of being ubiquitous. And so grants from the National Science Foundation, and even from the State of Georgia to build a home from the ground up, to be a test home for doing research in this space. So this included things like smart home technologies, but also more importantly, eldercare, looking at remote patient monitoring, those kinds of use cases. I really got gravitated to that. Remember, I mentioned that I was really interested in home infrastructure and construction and hardware, and then you've got to build sensors for the home.

Shwetak Patel:
"Oh, that's kind of cool. I can build hardware. Oh, and there's software on top of that, where you can do machine learning." And so I said, "Whoa, that's the convergence of all three things that I'm interested in. This is awesome." So that kind of spilled into my graduate studies as well, looking at building new sensors and building software to support those sensors to do interesting things with them, that have a socially meaningful impact. So it could be eldercare, health care, sustainability. So that's kind of where I really got excited, it's like, "Look, I can build hardware. I can do the machine learning signal processing on top of that. And by the way, I can apply these to social and meaningful problems." And so that's where a lot of my initial research was really around how do you build sensors that are low cost and easy to deploy so you can get to scale, right?

Shwetak Patel:

I mean, if you build sensors that are very customized and expensive, you just are never going to have an impact. So I was looking at how do you build simple sensors where you can use machine learning as the secret sauce to glean more information from it? So one of the early technologies I worked on, that also was some of the work I did as a professor at UDub was monitoring the energy usage in a home. So instead of putting a sensor behind every single appliance, what are some other ways we can do this that's easy to deploy. And so we figured out a way that you can actually monitor the electrical power line with a single sensor, and you can actually listen electrically to the electromagnetic interference in the power line to say, "Hey, that was a toaster that turned on," or, "That was a TV," or, "That was a light switch," and use machine learning to disambiguate what got turned on and off.

Shwetak Patel:
And so at the end of the day or week or the month, you can provide feedback to the homeowner or the users about their energy usage, and they can make decisions about how to reduce their overall footprint. Because one of the challenges is you don't really know. Things are out of sight, out of mind. A DVR is running, but you don't know how much power it's consuming. So it's like, how do you get that information in front of people to enable behavior change applications? But the challenge was that you're not going to install a thousand sensors in the house, and people don't even replace their smoke detector batteries, let alone a sensor that's going to monitor some power uses on the appliance. So the idea was could we use machine learning to kind of get close enough, it doesn't have to be perfect, but with one sensor. And so that's where a lot of our initial work around sustainability and leveraging existing infrastructure to do sensing, that's where a lot of that stuff was born, was from our energy work back in the day.

Jessica Bell:
Very interesting. So hearing this and hearing your sort of love and interest in the hands-on part of all of this, can you talk a little bit about then why you decided to go into academia instead of perhaps working at a startup that does smart home or building the software or the platforms for these kinds of things. Yeah. Talk us through that process.

Shwetak Patel:
That's interesting. Yeah. I mean, it's a great question. It's actually the number one question I get in my office hours for new students. And just as I go through my journey here, I mean, if I fast forward all the way, I was able to do all of that. So remember, I'm professor of the university of Washington. I'm a executive at Google, and I also did three startups that were related to smart homes. So I kind of did it all. And part of it was because I was an academic. Because I went down that path. For me, academia gave me the intellectual freedom to explore interesting new areas. And hey, if something interesting comes out from a novelty standpoint that I can spin out a company or maybe license it to industry, or maybe work with industry on a sabbatical or take a little bit of a leave. The playground is my academic role.

Shwetak Patel:

And I always think about the university as a playground to do really fun, exciting, cutting edge work, and industry has a way to scale it and get it out there, right? and so I felt that I wouldn't be hamstrung if I were a professor because I can set the research agenda. I can get students excited about the things I'm working on, and then try to figure out how to get it out there and scale it. So it was a good starting point because there's a lot of different paths technology can take in terms of how you have impact with it. You can open source it, you can create a company, you can license it. There's a lot of different things you can do. And I think the university provides you that flexibility as a starting point to innovate without question, and then try to figure out when it makes sense to scale it out. So that's really the reason was, I could literally have my cake and eat it too, so to speak. But it was the intellectual playground I needed to start from.

Jessica Bell:
Yeah. I mean, academia is not exactly known for its flexibility within that, do you think it has to do with the flexibility of where we are within tech right now? Or specifically computer science? Or why do you think that you've been able to have flexibility in a historically inflexible career? And then a second part of that question would be, do you think academia is going more towards this type of interdisciplinary type research? Or do you [inaudible 00:10:20] specifically like, "Oh, that's just because computer science happens to be in this interesting reflection?"

Shwetak Patel:
Yeah. That's a great question. So I'm very impact driven. I've been very lucky, my students [inaudible 00:10:31]. We write best papers, and those are great. But for us, for my students and myself, we're always focused on the impact. So how do we get this thing out there, so people can benefit from it? And sometimes in academia, it's hard to have that impact because our funding models, the way that our teams are structured, it's hard to have that impact. You don't have quite the engineering team, or you might not have the right resources to be able to get it out there, right? And so for me, I was always impact driven. How do we get this stuff out there? And so I fundamentally just thought about the problem space differently, but I think computing in general is changing because right now you're starting to see more and more intersections of academia working with industry for all kinds of reasons.

Shwetak Patel:
One is, industry has access to some of the resources that are tough to get in academia. You think about quantum computing, you need a quantum computer, right? If you think about a lot of the deep learning work, some of the GPUs or the clusters and those kinds of access of high performance computing infrastructure, you can work with industry and you can apply your topics to some industry relevant areas. If you think about access to hardware or really complicated sensors or hardware, you have to work with industry there. But an industry also benefits, because academics are really good at looking at the 5, 10, 15 year vision. Now you have a roadmap that you can provide industry, so it actually goes both ways. So I think it's the

convergence of very interesting technology that's coming out, but at the same time industry being more and more willing to work with academia to be able to innovate on top of it.

Shwetak Patel:
The other benefit is that we can hold industry, but we can innovate in the unique ways, right? So industry often have their roadmap and have their business models, but we can start to innovate in different directions to actually potentially pivot road maps or maybe introduce new concepts that may not have been on their critical path. So it actually can go both ways. And that's how I've looked at it is that, I need to work with industry to be able to scale the work that we're doing or it just stays on the shelf.

Jessica Bell:
Yeah. Yeah. I'm glad you brought up impact because I think particularly in your specific field, impact is an interesting question, because while we can learn so much with these new sort of massive amounts of data that we're gathering, whether that's new kind of technology on sensor or new ways of harnessing and gathering that data. So on the flip side, how do you as an academic think about impact that could potentially be negative impact, and share with us your thoughts on [inaudible 00:12:54] that negative impact and some of the ways that you sort of consider that within your research?

Shwetak Patel:
Yeah, that's a great question. I mean, the unintended consequences, we've seen a lot of examples of that, right? And so the way I look at impact is multiple ways, right? And depending on the project, you can define it in different ways, right? I mentioned open sourcing, licensing, startups, there's all different kinds of ways to have impact. But when I look at impact, it's how can you translate the work to a point where it can be adopted by industry or society and it has that benefit? But also looking at impact that you've also gone deep enough to help understand what those unintended consequences and the challenges are, so that when somebody were to integrate that technology into a product or an industry, that you've created a framework that they've thought about those kinds of areas.

Shwetak Patel:
So when we do our research, we do think about things like health disparities, inequities, looking at unintended consequences, looking at the security privacy side of the question. I mean, it's hard to tackle all that simultaneously, and in fact, there are other researchers that are way better than I am at that. But if I can uncover, at least make that... And we're not going to hide it, it's just saying that we're going to uncover those things and provide a scaffolding around, "Hey, there's a research opportunity here and galvanizing a field around it," I think is impact for us, because, hey, we've actually put a lens on something that could be a problem down the road. Now let's have the research community kind of put some effort around that.

Shwetak Patel:

So I think being able to identify those early on is impact in my mind because you've at least got researchers thinking ahead of any type of major issue that could happen. And obviously there are things that you just can't predict, but I think that's part of the impact equation is that you're able to tackle the problem broadly enough, that you have both the positive and negative societal impacts of your technologies.

Jessica Bell:
Right. I'm always curious too, so I actually don't have an academic background in computer science whatsoever, I have a social science degree. And so I'm always curious, I wish that I had gotten into computers earlier, so that I could connect some of the stuff that I was doing in social science to computing. And I think academia could potentially be a wonderful playground for the inner disciplinary mixing of a new technology coming out of a computer science engineering type group degree with the context that something like social science brings. Have you seen any of that kind of work? What are your thoughts and opinions on that? Do you think that, for example, computer science degrees need to integrate that more or... Yeah. Just talk a little bit about your thoughts with that.

Shwetak Patel:
Yeah. That's a great question. So my group in general is very interdisciplinary, we work across the board with collaborators who are not in computer science, so for that obvious reason, right? When we think about technology adoption, making sure technology is not going to create a bigger inequity gap, right? And you introduce a technology and it only helps a small portion of the population, we're contributing to that. Looking at technology, how it gets adopted or societal norms that are changing, how do you adapt the technology to the norms? And right now, obviously, technology is advancing so rapidly, it's a hockey stick, right? You talk about the hockey stick of all this stuff, right? But then social norms are not adapting fast enough, right? So you've got your changes that are happening, that are relatively flat, right? But at the same time, technology is this hockey stick and you can't keep up.

Shwetak Patel:
You do have to have these collaborative efforts with social scientists and looking at, even in specific domains of things like healthcare, public health researchers and those kinds of researchers who have a good lens and a perspective on this historically, to be able to see well, what can we do now to be able to have that direct impact. I always call it an impedance mismatch. There's always an impedance mismatch from the technology being developed to the actual social and societal needs. And you can always force it. Technology, you can always force it in there and there will be a portion of the population that will adopt it. But I think you've got to figure out that impedance mismatch. And some of the research that we've done, we try to take that head on where we do the formative work to figure out who can benefit the most from this. Focus on technology that will impact the people the most, rather than looking at just the early adopters, right? That's the easy thing to do.

Shwetak Patel:
Look at the [inaudible 00:16:55] technology, the early adopters will use it. But why not constrain ourselves from the get-go where it's like, "Hey, it's the individuals that need it the most might not have the bandwidth, might have older generation phones. How do we retrofit this stuff?" Focusing on those kinds of things actually can move the needle more, I would think. And so those are the kinds of things we do. That's why a lot of the stuff we do is more what I call retrofit type stuff. I'll go to the student and say, "Hey, we've got to get this pulmonary algorithm on the phone, working on everything that's a feature phone onward. You can't just assume it's going to be the phone of last year or better. It's got to be 10 years old or better, right?" Something like that, where you've got to be able to have that broad lens in terms of who could benefit from it.

Jessica Bell:
Yeah. Yeah. Okay. So I'd like to pick up the thread and change it a little bit. You mentioned your current research group, and you sort of started talking a little bit about the healthcare work that you're doing. So let's talk out what you're doing now, what are some of your projects? Talk about that.

Shwetak Patel:
Yeah. A lot of the work that done at the university has really been around looking at this wave of notion of remote monitoring, patient monitoring, looking at care at home, just how to enable a better healthcare experience, where right now the healthcare experience in general is this, you might have a yearly or biyearly visit with a doctor, and that's the data that's generated, right? And from that data you have to basically predict what might happen or what might the next course of action. But now with sensor technology, you can start to get a better pulse on one's health and physiology. And then you can actually start to apply machine learning techniques that could actually presymptomatically detect something's happening. That's the holy grail. And so one of the things we've been looking at is, it's going to be hard to build all those sensors and people are going to wear something all over their body. I mean, that's going to take some time.

Shwetak Patel:
But the thing that people have the most affinity to right now is the mobile phone. There's actually more phones than people in the world, which is quite an interesting statistic. But if you think about it from a global health standpoint and just globally, people have access to phone. Phones have a primary use case of communication and access to information. But if you can bring in healthcare into the phone, you have a high probability of compliance, you have a high probability of access and those kinds of things. So we've been looking at how do you leverage phones not just for like, "Oh, here's a checklist for things that you can do for your health," but how do you use the sensors that are already on the phone? Which are already ubiquitous. I mean, every phone has a speaker, microphone, you get to talk on it, right?

Shwetak Patel:

More and more have cameras. More and more have accelerometers. How do you use those beyond for just telephoning and gaming, for healthcare? So we've had a number of projects where we use all those sensors for all kinds of physiological monitoring. So instead of doing a respiratory measure once a year, or maybe every time you go to a doctor's office, you can do one daily, weekly. You can be reminded to do one, so you can get ahead of any conditions that might be happening. And so that's what we've done in the last six years. That's a lot of work that the students have done is turning phones into medical screening tools that can enable people to take the healthcare into their own hands.

Jessica Bell:
Right. Right. I'm glad that you mentioned the global impact of it because that was going to be my next question is, healthcare is so radically different if you look at countries all over the world. And it's very interesting to hear that you're thinking about this in a more global thing. What do you think some of the challenges are between applying this technology depending on where someone is on the globe? What are some of the things that you think about within that problem space?

Shwetak Patel:
Yeah. I mean, there's a lot of different challenges there. I mean, one of the things we did was we purposely focused on the global health side just because that provides the constraint that I think if you can solve that, or at least make progress there, it could have impact domestically as well. I think solving the domestic problem is sometimes harder to translate to emerging countries or developing countries. And so I think solving the global health, some of those, I think, could apply to everywhere, and so we purposely provided that constraint. And we co-work very closely with the Gates Foundation on a lot of this stuff. But I think some of the challenges is access to technology, right? I mean, yes, there is a significant amount of smartphone penetration globally, but if you look at it, those are two or three generation older phones. And so networking is still a challenge, right?

Shwetak Patel:
You can't assume that you're going to go to the cloud every time you do and build an algorithm, so you have to do local compute. It allows us to really think creatively about, "Hey look, these are the models we are constrained with. These are the phone specifications we're constrained with. Oh and by the way, in countries where air pollution is higher, the microphone is going to get gunked up with dirt." And so these constraints all were part of our design early on. And so we had to solve all those kinds of things first. But also how healthcare is administered is very different, right? In the US versus other parts of the world where... We do a lot of deployments in South Africa and India, where you have community health workers who are the frontline of defense, so you have to empower them.

Shwetak Patel:

Whereas in the US, your primary care physician is your frontline of defense. So it's just depending on who and how you empower and how that data... If you have a phone that can do this triaging, well, how do you connect that with a caregiver, right? So that was the other things that we have to sort out. But we're trying to just get the fundamental thing sorted out, which is what can we glean from the phone so we can get some physiological information about an individual to help them through their journey.

Jessica Bell:
Right. Right. Interesting. So let's say I'm a student and I'm in starting my early computer science career and I'm unsure what's happening with academia versus industry. Kind of this interest in social good, but I also really love the computing side of it. I'd love to hear your thoughts on how people should think about moving through their both academic and or non-academic career. And if you have sort of lessons learned from your movement up through that process.

Shwetak Patel:
Yeah. I would say, a direct computer science path. Everything's computer sciences, undergrad, PhD, faculty position, it's all computer science. I also have a double appointment in electrical and computer engineering at UDub as well, but in general it's all computer science, right? But either through osmosis or through just reading or whatever, I gained a lot of knowledge in energy and sustainability and healthcare. But with these days, there's so many opportunities for minoring and dual degrees and double majors, and even some universities have really unique degrees you can piece together yourself. I think bridging computing with, as you mentioned, sociology or public health or looking at these other sectors where I think it's really bringing in the public and the individual, the user, just society together in your kind of the way you approach a problem. I think it's just such a unique perspective that I think a student could be very successful with that.

Shwetak Patel:
I went down a conventional technical path, but brought in some of the other things. But I think the benefits that we can have for students that have this kind of broader mindset is going to be really, really great. I think computing could be where you can center around. The thing I always remind my students and just others about is that computer science is not going to solve all our global problems. I mean, yes, we love computer science and computing. It's great. I think of it as the instigator for change. So it's the thing that can allow us to think differently about a problem. It can scale, maybe scale a solution. It can maybe accelerate the development or the implementation of a solution.

Shwetak Patel:
It can make things faster, or it can allow us to scale it, right? It's the instigator for change and the thing that's going to allow us to scale it. But computer science by itself is not going to solve a societal problems by no means, right? And so I think people that think at the intersection of computing and these socially relevant problems and how you can actually get it adopted by

society, is a really powerful position to be in. I encourage students to be at the intersection of these fields, especially now when there's a lot of opportunities for impact right now.

Jessica Bell:
Right. Right. Right. And it brings in that sort of question within computer science of diversity, both of thought and of background, right?

Shwetak Patel:
Yeah. Exactly. Exactly. Yeah.

Jessica Bell:
Sort of coming to a reckoning with that and where we're seeing, Oh really, when something is too homogeneous, whether that's diversity of background, ethnicity, gender, or what you've [inaudible 00:25:00] your contact type thing. So I'd like to hear a little bit about you sort of as someone who's now shepherding in sort of a new generation of what you do to sort of push that envelope [inaudible 00:25:14] people who have been either under underrepresented, support [inaudible 00:25:17] or backgrounds that have been underrepresented. And how do you think as a topic we can be better about this.

Shwetak Patel:
Yeah. That's a great question. I mean, this is something that this field has been struggling with and trying to figure out what we can do to just get broader representation in general. Because as I mentioned, we're applying some of these technologies to healthcare and sustainability and social justice. I mean, and that requires, really, everybody's perspective together coming in. And so the way to do that is to inspire the next generation students, and just kids that are coming up to look at, computing it's not just gaming or it's just the internet or communication. It's this tool now that can be used for applied across the board, right? And luckily, my group is very applied and so we can send this message at the high school level, at even the elementary school level.

Shwetak Patel:
So my group does a lot of outreach work just because it's got this applied component to it. So we host high school students, both need-based... So students that are in programs that might not have a competing program or don't have really access to technology classes, but also merit-based students. Students that did really well and mix them up in a summer program where they do research with my grad students. And some of these students actually end up publishing papers in career science conferences. It just tells you the talent and the creativity, even at the high school level. We do a lot of outreach at the elementary school level as well, just to get students thinking about the broad applicability of computer science, and just trying to break their mental model of what computer science is or what they think it is, right?

Shwetak Patel:

And so that's one. The other one is, I personally do a lot of work in just beyond this, the technical side of things, but looking at policy, looking at things that impact computer science in other fields. So I've done a lot of stuff in that space where we want to make sure that policy is advancing, so that we take into account some of the advances in computing. And as I mentioned, some of the research that we do, we try to make sure that as a principal, try not to create a larger disparity or an equity gap because of the things that we're building. So those are just some areas that we emphasize just practically. And the outreach is something that we've benefited a lot from as well.

Jessica Bell:
So as we're getting towards the end of our session here, I'd like to sort of dive into two sides of a coin, which is the future. And I'd like to know first... Or actually you can answer in whatever order you'd like to. The thing I'd like to know is specifically to your field and the type of researching that you're pushing forward. What kind of scares you about it? What keeps you up at night? What are those big issues that you don't think are solved yet that you're like, "This needs to be solved before this field can really be effective and move on and not be detrimental." And then on the flip side of that coin, I want to know what is the thing that is the most exciting you think about the future of your field specifically?

Shwetak Patel:
Yeah. I'll start with the exciting. And this is something I alluded to earlier is that, I start to use the word using computing and even electrical and computer engineering as tools for what we're doing, right? Initially, in computer science, a lot of it was fundamental research to basically get to the point where we are now. But this notion of democratizing computer science in the sense that the tools that are out there to build a piece of hardware or prototyping a little sensor within Arduino or even building software. There's so many more tools that we can get more and more people to participate in developing, or at least contributing or even adapting what their work is to bring in a little bit more computing. It's just super exciting. If you think about right now during the whole pandemic, we had makerspaces where you had fabrication labs or pivoting to protect PPE, right?

Shwetak Patel:
I mean, it's just a matter of minutes notice, computing was able to enable a lot of this stuff, right? And we, independent of all the remote learning in the virtual classrooms, that was all computing base. But I think everybody can now do something in that space because we're just trying to build tools that is trying to become more and more ubiquitous. I think that's exciting. The downside of that is that, "Wow, how do we make sure that there's high quality I'll put out there, and how we make sure that it's done in a safe and ethically sound way." And those are some of the things we have to think about. So I think that kind of leads me to the thing that scares me is that, which I alluded to earlier too, is that society is moving at a glacial pace, at the same time computing is moving very rapidly.

Shwetak Patel:
So when you have a new technology that comes around the corner, it's so hard to really understand the unintended consequences until it happens. It's like, "Man, we're so in a reactionary mode right now. So how do we get to a point where we're not just firefighting all the time. So that's the thing that scares me is that computing is moving so fast that we just cannot keep up with the societal norms and the changes and the expectations. And that's the thing that kind of scares me. So related to that is also, how do we think of computer science education, right? I really think we need to rethink computer science education that has this broader perspective on not just the technical, but the broader societal impact, but also how we engage with industry as well.

Shwetak Patel:
I think we're at a point that we can take a step back and reinvestigate what is an undergraduate degree in computer science look like. What does an actual PhD in computer science should look like. Because I think the way computer science education will look 10 years from now, it's probably going to be very different just if we look at how industry engages deeply with academia or the duality there and the interplay between the two. I think we just need to just kind of take a step back and just double check that.

Jessica Bell:
Yeah.

Shwetak Patel:
Yeah.

Jessica Bell:
Yeah. Awesome. That was a really interesting peek into the future. Yeah. So okay. In our last couple of minutes, is there anything that you would want to sort of have people know about your field? Is there anything that you think there's a big misconception or sort of an action item you want to pull out?

Shwetak Patel:
Yeah. I think my final words are just directed to the students and the young researchers that are looking at computer science in the field. My call to action really is that, look, we have the tools we have the technologies, the world is in your hand now to basically leverage whatever you can for social good. I mean, we're looking to the next generation to hopefully build these technologies in a way that is going to have meaningful societal impact. And my entire career was all around applied research. And being applied, that's not a bad thing. And focusing on applying these things for what you're interested and passionate about, it should be the goal, right? And so I just encourage students to think broadly about computer science and go where your passion leads you.

Jessica Bell:
Great. Well, I want to thank you so much for joining us today. I think it was really wonderful to learn what you're doing, where you came from and sort of the exciting things happening in the healthcare tech space. I'm excited to see what happens.

Shwetak Patel:
Great. Thank you so much.

Jessica Bell:
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