Fostering Diversity in Software Engineering

Featuring Grace Lewis, Ipek Ozkaya, Jay Palat, and Nathan West

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Grace Lewis: Hi, and welcome to the SEI Podcast Series. My name is Grace Lewis. I am a principal researcher at the Software Engineering Institute. Today I am joined by my colleagues Ipek Ozkaya, Jay Palat, and Nathan West to discuss the diversity crisis in software engineering. Ipek, Jay, Nathan, welcome.

Okay. Let's start off by telling our audience a little bit about ourselves and the work that we do here at the SEI, and our own experiences with diversity. Have any of you witnessed the impact of diversity, or maybe lack of diversity on a project? The audience would be interested in hearing that.

Let me start. I am a first-generation American, born to immigrants from Colombia, South America. I received an undergraduate degree in software systems engineering from Icesi University in Colombia. I moved there as a junior in high school. Long story, maybe for another one of these. I have a master's degree in software engineering from Carnegie Mellon University and a PhD in computer science from Vrije Universiteit in Amsterdam. At the SEI, I'm a principal researcher and I lead a team called Tactical and AI-Enabled Systems, where we do research in tactical edge systems, in software engineering for AI systems, and in the intersection of both, on how to deploy AI systems on edge devices. Although not very diverse in terms of gender, we do have a very, very diverse team that I'm very, very happy to lead. It's diverse in terms of age, backgrounds, where we went to school, where we grew up, what languages we speak. And I really appreciate this diversity, because I am a strong believer that diversity goes beyond gender and race.

The more varied the minds we have on a team, the more diverse solutions we get, the broader solutions that we get. And it's also from a social perspective, it's also just so much fun. Every day I think I learn something new about somebody. Some language that I had no idea they spoke. Someplace where they lived. Some food that they love eating or preparing. So, diversity to me on teams is good, both from a technical perspective and also a social perspective. How about you Ipek?

Ipek Ozkaya: Thanks, Grace. Well, my name is Ipek Ozkaya, and I came to United States in 1998 from Turkey. I did my undergrad obviously in Turkey, and my undergrad is from Middle East Technical University, in architecture. What drew me to the United States was, as quite a number of first immigrants, is the graduate studies. So I did my studies at Carnegie Mellon University. Did both my master's and PhD in a field called computational design, which actually took me to software engineering. And, as I was doing my graduate studies, I interacted significantly with colleagues at the Software Engineering Institute, as well as a lot of colleagues on campus doing software engineering, and then I joined the SEI.

At the SEI, I'm a technical director of a directorate called Engineering Intelligent Software Systems. We all work together in the area. You talked about the Tactical and AI-Enabled Systems. Another body of work that I lead and closely work in is in software architecture, design, analysis, and outreach.

When it comes to diversity, I think I first experienced it as an immigrant, rather than as a female. That actually was a different experience. When you come to a different country, you speak a different language. People can't pronounce your name. The first thing they [want to] know is, *Where are you from?* You say from Pittsburgh. *You don't sound from Pittsburgh.* I'm like, *What does it not sound from Pittsburgh?* And it took a while for me to get really comfortable with that. That was probably my very first experience in terms of diversity. And of course, being a female, who's a minority in the field, I've seen some of it, but always in a positive way. And I know we'll talk more about it. And I could not agree more with you, I think. While we have to improve and we should improve at the SEI in our teams, we're, I think, in a more of a luckier aspect of that. Our teams do really strive to be diverse, and we include different perspectives. And I completely agree diversity has gender, background, ethnicity, but it also has, how you grew up. What is your experience? It should not be only the same kinds of universities that are represented in our teams, where do they come from and how they have been educated. So I think we all try to take a close look into that and bring that to light.

Grace: That's great. Nate, what is your story?

Nathan West: Yeah. Thanks Grace. So hi, my name is Nathan West. I am a software engineer, first of all, and I work with Grace mainly on the Tactical and AI-Enabled Systems team. I'm

very, very early in my career. I graduated in 2019 from Virginia Commonwealth University. And I am from Fairfax, Virginia. And I guess diversity has really always been a part of my life, growing up in an area where there were not many African-Americans.... Well, let me back that up, there were not many Black Americans, because I believe that difference, that distinction is important. There were not many Black Americans where I grew up. And I first noticed diversity when I was in third grade and moved to public school. And that was my first introduction of me being different, or not fitting the norm. But I think diversity plays an extremely important role in the workplace. Just how…just in terms of how people feel about themselves and their competencies. Whether or not they can believe in themselves to get different things done. But I guess we'll expound on this more, but I truly believe diversity is very, very important.

Grace: Jay, tell us a little bit about yourself.

Jay: Sure. Thank you, Grace. So my name is Jay Palat. I am a senior engineer at the SEI. I work for the Emerging Technology Center. Our goal is to take new technologies and help deploy them into the field, and figure out what's ready for prime time and what's really still under development. My background…I am a first-generation American as well. My father was from India, and my mother from the Philippines. So, it was an interesting perspective to be in the middle of three cultures growing up. My father had certain traditions, my mother had different traditions, and then we were learning these traditions in America, right? And, so, trying to figure out how to bridge those different communities was an interesting part of my growing-up experience.

I have been in the software industry for over 20 years now, so I've had experience working at very small companies—so like, round-A-level start-ups, all the way up to large companies like IBM. And [I've] been able to work with a diverse number of teams, of different kinds of compositions. I think the experience of working with so many different people in so many different environments has really helped shape my ability to think about the world. It helps open up perspective, and it gives you new ways to approach problems and perspectives on how to think about things.

Grace: Okay, great. Okay, so the catalyst for today's roundtable is a recent special issue of *IEEE Software* that focuses on diversity and inclusion in software development, presenting research results and best practices for making the field equitable for all. It is well documented that industry does not provide evenhanded participation conditions. Dimensions such as geography, gender, socioeconomic, politics, age, ethnicity, and disability shape who can participate in creating technology, which is unfortunate. Let's talk about these dimensions and how they impact software projects. Ipek, you are the editor in chief of *IEEE Software*, and you wrote a very powerful piece, very recently, for that issue called, "Mom, Where Are the Girls?" based on an experience with your daughter, which was great to read. Can you tell us a little bit about what

the special issue of the journal has to say about these dimensions, and how they impact software projects?

Ipek: Sure, thanks Grace. And when we decided to feature such an issue…and I think I have to make sure that I give credit to the guest editors on this show, which will link, I think, from the podcast. And it's open access and everybody can actually read it. It brings together individuals from different parts of the software engineering industry. I'm going to read their names, if you will allow me. Khaled Albusays, Rochester Institute of Technology; Pernille Bjorn, University of Copenhagen; Laura Dabbish from Carnegie Mellon University; Danae Ford, Microsoft Research; Emerson Murphy-Hill, Google; Alexander Serebrenik, Eindhoven University of Technology; and Margaret-Anne Storey from University of Victoria.

We know some of these as our colleagues, being from different universities, different countries, different organizations, they actually had the idea, let's really look into the research, what is going on. Because, we all have our perspectives and experiences in going through, but we perceive it from our perspective. What does data say? What does the research say about this? And how do we look into the relevant aspects? And I think the articles that were featured in this issue bring together really different perspectives.

For example, what has been going on in terms of gender diversity in open-source systems? How are different races perceived in terms of the software engineering experiences? What happens with gender in COVID? These are all different dimensions of software development and software engineering as practiced, that affect not only gender, but different aspects of the diversity. So that's, I think, what was powerful about the issue. And you mentioned my own editorial, I think it touched people because it was actually a real experience that I had with my daughter. But I never perceived myself as a minority until my daughter pointed out when she was three and a half, looking at the photos of a class that I was teaching and asks, *Mom, where are the girls?* And I thought, *They are there, let's find them.* They weren't there. There were 27 students and there were only two girls. And that's actually when I started really paying attention. And the whole point is like, we don't know how to pay attention in the right way sometimes, even ourselves who might represent some of these groups. And the data and the research in this area can really show us how to actually step back and engage with it in the correct way. So that's really what the issue was about and what it brought together.

Grace: That's great. I highly encourage everybody to read that article. It was extremely interesting and I enjoyed it, especially because I know her daughter, so I could easily imagine her saying that. Another point that I would like to discuss today….So Black and Hispanic workers continue to be underrepresented in the STEM workforce, according to key research. While Blacks make up 11 percent of the U.S. workforce overall, they only represent 9 percent of STEM workers. According to the National Center for Women in Information Technology, women make

up 47% of all employed adults in the U.S., but as of 2015, they only hold 25 percent of computing roles. How does the lack of diversity impact workforce culture—I'm going to ask Nate this time—and what can be done to address these shortfalls? What do you think?

Nathan: Yeah, so I think the lack of diversity plays a very big role in the workplace culture because for me personally, as a Black American, if I enter spaces where I don't see myself represented, it makes me feel as if the organization is…it shows that the organization is, one, either not necessarily trying to make that or build that bridge to that community, that underrepresented community that needs to be represented; or it comes from the lack of resources that that underrepresented community has. And they don't know necessarily about all of the vast opportunities that STEM brings. Because for me, personally, I did not know computer science was a thing until I got to college. And I told my counselors from middle school and high school that this was my interest, like computers were my interest. And I didn't know that programming was a thing. It can play a very big role in those underrepresented groups feeling like they are a part of something. And I think what we can do to address these shortcomings is just reaching out more to these communities and providing them with programs, activities, opportunities to understand what this field can bring to their lives. And just the amount of fun that they can have with just coding, building robots, and things like that. So, yeah. I just think just reaching out more is very important. And I'm very happy of some of the work that the SEI has been doing to reach out to these communities, like attending the NSBE [National Society of Black Engineers] conferences and things like that. So, yeah.

Jay: I will say, just to build on something that Nate said, is, going out to interview and talking to companies who don't show diversity, where all the employees kind of look like each other, that also is a signal that the company itself hasn't really understood the power and the strength of diversity. If you have everyone thinking in the same way and working from the same mindset, you don't get the full ability of a diverse crowd to think through problems. You're all thinking about the problem the same way, or very similar ways. And that gets you stuck in a rut a little bit. I found that even technically, if you start going to companies that don't have a lot of different ways of thinking about things, their solutions tend to be very tight and very limited. Because they're not thinking about wider solutions or real-world problems or other kinds of issues they could be running into, that additional perspectives would help them get.

Grace: I totally agree with that. Even the thinking of different schools, right? If you hire everybody from the same exact school, that took the same exact course, with the same exact professor, I think every solution is going to look exactly the same, don't you think?

Jay: Yes. On the one side, people like doing that because it gives you a shorthand. You can all speak about the same references, you can think about the same thing, and everyone kind of moves. And so conversations happen very quickly, and you're densely packing information there. But the minus side is taking time to explain to other people, to share that perspective, gives you better perspective on what you're talking about. So, it helps the individuals share as they communicate these ideas, it makes them work a little bit harder, but it makes the overall solution a lot better.

Grace: Absolutely.

Ipek: Building on what you said Jay, it's also important because there is a comfort zone, and it's almost like the opposite. We want to increase diversity, like Nathan was saying, you want to see people like yourself, so that you feel that you can succeed. On the other hand, there's the overdoing it, which actually can happen with hiring of the people from the same background and all. So there's that, I think, personal comfort zone, and how do you really hit it at the right place? So you take the most advantage of it without jeopardizing actually the benefits. So that's actually, I think, the harder problem.

Grace: Great. So I was going to pick on Jay, because Jay said that his father is from India. In India, education is extremely, extremely, extremely important. And I'm sure that that was ingrained in you, you have to have an education, and I can just imagine that was the case. So part of the diversity shortfall in the technology workforce, it starts in the educational pipeline. How can this issue, in your opinion, be addressed at the secondary and university level?

Jay: So, I think there's a lot of different factors coming in. And the pipeline starts a lot earlier for university. I mean, down into elementary schools, we're now seeing kids who are taking programming classes. But to try and sustain and manage that pipeline, I think, is very difficult. When raising my daughter, it was interesting finding apps on the app store, that you could find even very early programming challenges, where it wasn't talking a lot of code, but introducing concepts of functions or loops, control structures. It was introduced at a very young level. But how to maintain those things, how to grow that interest, how to make sure and sustain it, is a very difficult challenge.

The plus side is, I think, organizations are starting to come up that help in these areas. So, for my daughter, there was an organization called Girls Who Code. And there's a set of books and things that go along with it that support the community. I think the development of a lot more of STEM-related resources seem to be distributing themselves a little bit more. I will say, I think one of the hard things we learned watching COVID is that not all the resources are being evenly distributed. As we've looked at what happens to schools in different areas, when you couldn't go into school, how do people get laptops? How do people get internet connections? [These]

became a very big struggle across different communities. So, I think there's even infrastructure problems that need to be addressed, and I know there's some work happening there, but getting to equity of access to some of these things is one of the big challenges, even before we get to the later levels at university.

Ipek: Jay, I think you touch upon an incredibly important point. We always think high school and middle school students are the ones who really need the access. But, you're right, they start observing a lot earlier. And I think…the example that I gave in my story is like, she was three and a half. So like having resources and examples, as well as making it a natural part of growing up is, I think, very important in terms of being able to increase diversity.

Grace: Nathan, I think you were going to say something. So—

Nathan: Yeah. I actually have some experience in this area, because I've worked at an organization called CodeVA where we taught kids from K through high school computer science concepts and programming. And I think what we learned is that keeping arts as close to technology as possible, increases the interest in wanting to continue. And especially with the younger crowd. We were in this program called Critter Code, where the kids, around like five to seven, would sew their own stuffed animal and then use it in a video game that they created themselves, with the Scratch programming language. And to see their level of interest and just fascination with programming continue on to this day, I think the activities like that are very, very beneficial in keeping the younger crowd close to technology.

Grace: Yeah. That's a great story. That's right, you did a lot of volunteer work with that organization, that was super cool.

So, an important goal of our podcast is to transition research into the community. If I am making an effort in an organization to increase diversity, or on a software engineering project, for example, where should I begin? What resources are available to me? Anything that you would recommend to read? I'm going to start with Ipek.

Ipek: So, I think first of all, understanding where you need to really focus on diversity is important. I think there is…I'm actually grateful, as a female, a software engineer in the field, that there's so much attention into increasing diversity for females. But I think there's so much…so many aspects of it that we're not giving attention. For example, Black Americans or some of the other nationalized immigrants. Or other areas, LGBTQ communities. So, diversity has really significant different aspects. I think it starts with knowing where you need to really pay your attention to. So that's probably number one. Number two, one of the things that I actually found out myself firsthand while I was researching for this issue is, large companies such as Google, Microsoft, all of them that are big employers of software engineers and

computer-science specialists, have started publishing their data. So, they are looking into how they're doing, and every year they make this available. And I think a lot of organizations can learn from this. And it's not necessarily there are always best practices, but what others are doing, what their challenges are and how they're tracking, might also help organizations to reflect back on some of their experiences. And as Nathan mentioned, there are actually organizations, as well as Jay mentioned, one that [his] daughter is using, how these organizations can become sources for hiring, is another one I think that organizations can look at. So those are some of the ideas that are at the top of my head. And, also, we should have some reflections and some resources that are included, that might help listeners who are actually interested in improving their practices in this area.

Grace: That's great. How about you, Jay? Any resources that you would recommend?

Jay: So, I think there's a lot of resources out there. I think one of the important things that I think people recognize, but it's worth pointing out, is this isn't a solved problem. And so people are trying different approaches right now. Some are working, some are not. And it's a little bit of doing experiments, trying things out, and then sharing the results. I think that was one of the things that Ipek brought out, that is really important, is people are starting to share their data. And it's important to make sure that everyone's learning from these experiences and being able to leverage them in new ways. I did see an interesting article recently that was talking about the ability to set up mock interviews. They are for communities that don't have experiences with it. So disadvantaged communities or people who don't have a lot of role models who are doing these types of jobs, getting into the interview practices are difficult. They're arcane and a little hard to understand sometimes. So, going through mock interviews can really help communities that are underrepresented, and really get an even footing when doing the interview process. The article was referencing that sometimes, around like five mock interviews, can really reduce the gap of a candidate's eligibility. They get used to the flow of the questions and know what to expect from the interview process.

Grace: That is great.

Ipek: Jay, actually, you brought to my mind an interesting thing. And I don't have any specific names for this, but one resource for software engineers is Twitter. But quite a number of, actually, senior experienced engineers who want to volunteer, I've seen, that actually make open calls. *I'm going to mentor you. I'm going to help you in terms of doing code reviews or mock interviews.* Some of these are resources also [that are] becoming more open, and individuals are willing to give their time and feel that they have expertise in this area are actually sharing these. So those might also be areas where individuals, who are looking into improving their skills, might look at.

Grace: That's great. Nate, any resources that you would recommend?

Nathan: Well, I'd like to just echo what Jay said as well. Jay and Ipek. Because, I've found that like with mock interviews, it can be very, very…or, the interview process, it can be very, very nerve-racking, and to be able to have these mock interviews with these engineers at these top-level companies, can really give individuals who are underrepresented or don't feel confident in their own skillset some confidence in knowing that they can do it, they can push forward. But another resource that I would like to share is just, find what organizations in your local communities are building out programs to increase diversity within the STEM field. Like mine specifically was CodeVA, and I believe there is a national organization called code.org, which has smaller chapters scattered throughout the United States. So just look to your local communities to find that.

Grace: Yeah, absolutely. Absolutely. So, those are all great resources. I would like to add a couple. So, one is the book by Carol Frieze and Jeria Quesenberry. In fact, we did a previous podcast that went out, where I had the pleasure of interviewing them, so two females that I've known for a very long time. They wrote a book called *Kicking Butt in Computer Science: Women in Computing at Carnegie Mellon University*. And this book is very close to my heart, because I was a part of that movement. I was one of the founding members of a group that still exists today, called Women@SCS, that started just when the study that inspired this book was coming out, and when there were very, very few females in computer science and at CMU. And it was just amazing what they did because, and I think this is important and this is why I'm sharing it in this section. Because it's not about making it easier, it's not about, *Oh, let's make the classes easier so*…or *Let's make the work easier so we*…. No. It's about changing the culture. And that's exactly what they did, because nothing changed [in the curriculum]. The only thing that changed is the culture. And the main thing, going back to what Nathan said, is that people started seeing more people like them. It was really that simple. And so, changing the culture and me being a part of that, I really loved that experience in that time of my life. So that is the one book I would strongly recommend, because it's a very powerful story. s a very powerful story.

The other is an article that I recently came across, published by builtin.com. It's called "Types of Diversity in the Workplace You Need to Know." I was actually surprised that they identified 34 unique diversity characteristics, which was…I mean, I've always been a proponent of, *It's more than gender and race*. But 34, and it really widened my perspective of what it means…of what diversity means. And I'm not saying that everybody has to implement diversity and these 34 unique characteristics. But it's definitely a broader way of looking at it. And finally, I would like to give a shout out to Professor Margaret Burnett, from Oregon State University. She is doing amazing research in inclusive user-interface design. Because it's something that you don't think

about, but even sometimes designing user interfaces, we have these biases when we design. So, I would strongly recommend to look at her research. Her name is Margaret Burnett, again, from Oregon State University.

And with that, Jay, Nathan, Ipek, thanks for being here and talking about this work. And to our listeners, thank you for joining us today. We will include links in our transcript, to all resources mentioned in this podcast. This podcast is available on the SEI website at sei.cmu.edu/podcasts and anywhere else you get your podcasts, including iTunes, YouTube, Stitcher, and SoundCloud. As always, if you have any questions, please don't hesitate to email us at info@sei.cmu.edu. Thank you.

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