Episode 13: Celebrating Women Innovators: Two Trailblazers Who Are Advancing Technology
Host: Nicole Huesman, Intel
Guests: Denisa Constantinescu, University of Malaga; Maura Tokay, Science Systems & Applications, Inc.

Nicole Huesman: Welcome to *Code Together*, an interview series exploring the possibilities of cross-architecture development with those who live it. I'm your host, Nicole Huesman.

So many women have advanced science, technology and other fields of innovation. Today we speak with two who are using the Intel DevCloud for oneAPI to further innovation.

Denisa Constantinescu is a PhD student in AI & Robotics, and a researcher in the Computer Architecture Department at the University of Malaga. She is using Markov decision processes to enable computers to make autonomous, intelligent decisions, useful in many disciplines, including robotics, automatic control, economics and manufacturing. Hi Denisa!

Denisa Constantinescu: Hi Nicole. Thanks for having me here.

Nicole Huesman: And Maura Tokay is a lead software programmer at Science Systems and Applications, Inc., and a computer scientist within the Department of Agriculture. She recently got her Master's degree at the University of Maryland, Baltimore County. She is applying meteorological data, machine learning and AI analytics to predict crop yield for corn, wheat and soybeans. Maura, great to have you with us!

Maura Tokay: Thank you for having me, Nicole. It's nice to be here.

Nicole Huesman: Maura, Denisa, let's do some quick myth-busting first. We still hear so often that there are fewer women in tech because they're either not as interested or not as capable, neither of which is true. And you're both living proof of that. Can you talk about how you found your way into tech? Maura, let's start with you.

Maura Tokay: Well, I always loved math, so I'd signed up to do computer science and I didn't know anything about programming. When I got to the University of Brazil, I got to do an internship to work in this space agency in Brazil. So, that's where I started doing programming. And after, I got an internship to come to NASA. So this is how my, I started it backwards. I was working different projects from the rainforest in the Amazon to water management in North Africa, Middle Eastern. So it's always trying to use technology to improve peoples' understanding of nature.

Nicole Huesman: That's excellent. And your work is so important, especially as we think about climate change and congratulations on your recent masters.

Maura Tokay: Thank you so much.

Nicole Huesman: And Denisa, what about you?

Denisa Constantinescu: Well, I grew up in the countryside in Romania and I turned out [to be] a bit of a nerd. I mean, I'm in love with nature, with art and with science too. So it was quite hard for me to choose a career. In the end, I picked up the thing that I thought would bring me more opportunities in the future. So I went to the Polytechnic of Bucharest and studied automation and systems engineering. After graduating, I worked for a little bit in Thales Group in the railway department in the research and development team. I like it quite a lot, but I thought it would be best for me if I continue my education. So I decided to go to Malaga, Spain and do a Master's. I didn't stop here. After the Master's, I ended [up] doing a PhD too, and now I'm actually considering teaching. Of course, I went into tech, but not giving up totally my other passions. In my free time, I like painting, cooking, gardening. I always try to pick up a new language. For instance, I came here to learn Spanish.

So I'll tell you about the little strange experience that I had here in Spain. Because when I started in Romania, we were about like 30 to 40% girls in the classroom. But here in Spain, I was the only girl.

Sometimes I had foreign classmates, but never Spaniard classmates. In my department, it happens the same. There are just very few women, and we all agree that this is a problem. So we started a girl's tech camp here in my faculty for 13 to 18 year old girls. And we asked them at the beginning, what do you want to do with your life? Do you have any plans to do a career or something? And most of them didn't know what they wanted to do. And very few thought about a career in STEM. During the camp, they learned both tech and soft skills. They learned how to make their own web pages, video games, worked in teams, and made really, really cool projects. At the end of it, more than 80% said that they wanted to study something related to computer science or something at the intersection of tech and another field like bioengineering. And this is a very remarkable result, I believe, because we have so few women in this field and we can see that they are very capable, very creative, they can make awesome projects. But the only thing that they're lacking is I think role models or someone or something to tell them, Hey, this is also an option for you. And if you like it, you think you're capable—and you are—take it.

Nicole Huesman: It's so important to have role models to spur us on and to really contribute and to spur us further into the things that we're most passionate about and in the projects that we work on, right?

Denisa Constantinescu: Yeah.

Maura Tokay: It is. This field is really hard because the majority is men. So when you find a woman in tech, you need to band together because they can relate to somebody. They can relate to your problems.

Nicole Huesman: Absolutely. So one of the things that's really so incredible is that both of you are working on such incredible projects. Let's dive a little bit deeper into each of your different projects and the things that you're working on. Denisa, can you start us off and give us a little more detail there?

Denisa Constantinescu: Yeah, sure, absolutely. I'm doing my research for my thesis on automated decision-making and I'm particularly interested in mobile robot navigation in social environments. My work consists of improving the algorithms for implementing these autonomous navigation part and also the programming models to make it possible, given the hardware that we have on mobile platforms. So I have to take advantage of all the resources that I have on board of a robot, which is normally a CPU, GPU, system on chip, and make the autonomous navigation possible with those resources. I need to meet both energy efficiency requirements and also run time limitations that they may have so that my navigation module is useful in practical applications. For instance, assisted robots in health care settings, or even imagine a scenario where you have to explore for people that might be cramped in an accident.

Nicole Huesman: So are you talking about, like, emergency response?

Denisa Constantinescu: Yeah, exactly. So we need to have real-time capability of our system and also as much autonomy as possible. So we must be very careful of the energy footprint of the code.

Nicole Huesman: So Denisa, you mentioned this whole idea around heterogeneous computing and working with CPUs and GPUs and FPGAs, and all of these different accelerators. What is that like? What has your experience been? I know you're using things like the Intel DevCloud. Can you talk a little bit about what your experience has been?

Denisa Constantinescu: Yeah, sure. I started using OpenCL and TBB to program the GPU with OpenCL and TBB for the CPU. And it was quite a struggle at the beginning because you have two different programming models and you have to kind of marry them together. And last year, I figured out that there is a new API coming up—it's oneAPI for programming all devices using the same interface. And this made my life much easier, both for coding and for debugging. About this cloud platform: I didn't use

it so much at the beginning because it wasn't there, but when it appeared, it helped me a lot to test new features because since last year when I started using oneAPI till now, oneAPI has evolved quite a lot, and it's hard for me to keep up with the latest updates and install all the time, the environmental, my laptop. So I like to test the new features on DevCloud, see how they work, and if I find a stable solution, then I emulate the same environment locally. For me, it's basically a sandbox, it's quite useful.

Nicole Huesman: That's excellent. Thanks for sharing. And Maura, can you talk about what you're doing in your project with crop yield prediction and how things are going there?

Maura Tokay: Sure. So I found this data set at the USDA Department of Agriculture that you had 20 years of data for the meteorological data and planting and harvesting out in the fields for soybean, wheat and corn. So I'd started to try to see if, using the meteorological data, I'd be able to predict what should it be the yield for those crops? That's the first part.

The second part is trying to figure out which variables were more important to determine the yield, and then maybe do a further study to see if the impact of climate change would impact the crop yield. I already finished the part where, yes, I can predict the yield using only meteorological data with 800% accuracy, which is pretty good for […]. In other fields it might not seem as much, but when you talk about plants, that's a lot. I found, too, that the parameters that had more impact on the yield was temperature—that I expected—but the second one was relative humidity, which I expected to be precipitation.

So my next step is build a data set where I increase one degree Celsius for the whole season, two degrees Celsius, to see what's going to be the outcome for the yields. I expect the harvest is going to be worse because the plant is going to be under more stress, but [this is] just my hypothesis. So this is where I'm going to.

And I use the DevCloud to do all my development. Why I want to use the DevCloud is because, depending on where you work, you have limitations on what you can install on your local machine, or you need somebody else to do that for you because of security restrictions. So being able to do the whole system in the DevCloud really facilitated for me because I didn't have to rely on anybody to install and test the features I needed. So it was great. In the beginning, it was a little challenging, but then I got support from the engineers and they show me the path to create the environment I needed to do my project.

Nicole Huesman: That's fantastic. It's great to hear. Denisa, what have you found is one of the most helpful aspects of either the unified programming model with oneAPI or the Intel DevCloud?

Denisa Constantinescu: Well, I like them both, but oneAPI really helps me a lot because it's much easier to program my algorithms. I only have to do it once and it works for the CPU and the GPU, and maybe sometime in the future, if I want to include an FPGA or a different device, the same code is portable. So I only have to change a small parameter saying where this code is going to run and that's it. So from the point of view of portability, oneAPI is for me personally, very, very useful. Also the code is much simpler to write and to debug because error messages are more verbose than using the different programming models such as OpenCL.

Nicole Huesman: I noticed that you had experienced using unified shared memory, is that correct?

Denisa Constantinescu: Yes. That's the USM feature of oneAPI and it only works for now for Intel processors that have both the CPU and the GPU on the chip. So if other manufacturers will support the same feature, this would be portable for them as well. I use that feature mostly because we program

mobile robots and you cannot have a discrete GPU on board—that would be very energy consuming. Maybe they would use, like, 200 watts, which is way too much for a mobile device. So an Intel mobile processor is, I think, the best option for now, because it has this feature of unified shared memory and the CPU and GPU pair it's potent enough for most use cases.

Nicole Huesman: So, great news is that some of the advanced capabilities like unified shared memory are being incorporated or contributed to the SYCL 2020 provisional specification, or have been, and so I think you'll start to see their wider adoption. So it's great that you are seeing value in USM.

Denisa Constantinescu: Yeah, I sure hope so because it would give me more flexibility on what devices I can use, and on the programming as well.

Nicole Huesman: Well, let's shift a bit then and talk about what's next. What are you most looking forward to? Maura, why don't we start with you.

Maura Tokay: I'm looking forward to applying more machine learning to try to solve problems in earth science. I've also been working with earth sciences—that's where my passion is. For certain regions, you don't have enough data or it's not the way you want, so I can see machine learning being very useful for things like water resources, or climate change. So in the future I'd like to be applying more of machine learning for these cases. So let's see what the future holds.

Nicole Huesman: Thanks, Maura. Your work is so important. And Denisa?

Denisa Constantinescu: Well, in my case, I'm learning and experiencing heterogeneous and low-power programming models, and well, we've got this oneAPI initiative that's coming up, which is really great because you can program CPUs, GPUs and FPGAs using the same interface. But I was thinking we had on the same chip, the CPU, the GPU and the FPGA functionality, and with the unified shared memory for all three of them on the same chip, that would be really awesome. Both for the programmers and also in order to get a wider range of applications that you could have on a mobile device, or even as a more powerful device, doesn't have to be a mobile device. These chips that I imagine embedding—all three types of processing units and the memory too—could be just tacked together in order to make a supercomputer. It could be a building block or a unit, in itself.

Nicole Huesman: And it's so exciting to see all of the innovation happening in hardware and software together. It's a really exciting time to be a part of all of this.

Denisa Constantinescu: Yes.

Nicole Huesman: Both of you are working on such amazing and such important projects. It's been so fantastic to talk to both of you today, and to hear more detail behind what you're working on. And we really look forward to catching up with you three months, six months, from now and seeing where you are and how things are going. And so, I'd love to extend the invitation to come back on the program and share more with us.

Denisa, where can folks go to learn more about what you're working on?

Denisa Constantinescu: The best place, I think, is my personal web page, denisa-c.com. I keep my updated CV there with links to all my work, also stuff about my hobbies, like paintings and dressmaking, whatever, you can find it there.

Nicole Huesman: And Maura, for you, where can listeners go to learn more?

Maura Tokay: You can go to devmesh.intel.com/projects/predicting-corn-wheat-and-soybean-yield.

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Nicole Huesman: I should also do a quick shout-out to all of the other innovators that are using oneAPI and Intel DevCloud. You can find their projects on Intel DevMesh as well. And then for all the folks out there who want to try oneAPI on the latest hardware and test your code, Intel DevCloud for oneAPI is a great place to go.

Maura, thank you so much for joining us today. It certainly has been a pleasure.

Maura Tokay: Thank you for the opportunity. It was great to share my work with you.

Nicole Huesman: And Denisa, it's been so wonderful to have you on today's program, and so great to hear about the work that you're doing.

Denisa Constantinescu: Thank you so much for inviting me. It was really great to learn about Maura's project and see what others do with oneAPI and with these new tools that are coming up. It's very inspiring. Thanks.

Nicole Huesman: I should also mention that the inaugural oneAPI Developer Summit is coming up very quickly here, November 12th and 13th. And Denisa you'll be presenting there, correct?

Denisa Constantinescu: Yeah, that's true. I'll be telling you more about my project and about how I'm using oneAPI to program autonomous mobile navigation and make it easier for others to code their autonomous decision-making problems on mobile platforms.

Nicole Huesman: And for all of our listeners, thank you so much for joining us today. Let's continue the conversation at oneapi.com. Until next time!