EPISODE 89

[INTRODUCTION]

[0:00:10.8] SC: Hello and welcome to another episode of TWiLM Talk, the podcast where I interview people doing interesting things in machine learning and artificial intelligence. I'm your host, Sam Charrington.

This week on the podcast we're featuring a series of conversations from the NIPS Conference in Long Beach, California. This was my first time at NIPS and I had a great time there. I attended a bunch of talks and of course learned a ton. I organized an impromptu roundtable on building AI products and I met a bunch of wonderful people including some former TWiML Talk guests. I'll be sharing a bit more about my experiences at NIPS via my newsletter which you should take a second or right now to subscribe to at twimlai.com/newsletter.

This week through the end of the year, we're running a special listener appreciation contest to celebrate hitting one million listens on the podcast and to thank you all for being so awesome. Tweet us using the #twiml1mil Everyone who enters is a winner and we're giving away a bunch of cool TWiML swag and other mystery prizes. If you're not on Twitter or want more ways to enter, visit twimlai.com/twiml1mil for the full rundown.

Before we dive in, I'd like to thank our friends over at Intel Nervana for their sponsorship of this podcast and our NIPS Series. While Intel was very active at NIPS with a bunch of workshops, demonstrations and poster sessions, their big news this time was the first public viewing of the Intel Nervana Neural Network Processor, or NNP. The goal of the NNP architecture is to provide the flexibility needed to support deep learning primitives while making the core hardware components as efficient as possible, giving neural network designers powerful tools for solving larger and more difficult problems while minimizing data movement and maximizing data reuse. To learn more about Intel's AI products group and the Intel Nervana NNP, visit intelnervana.com.

In this episode I'm joined by Sara Jennings, Timothy Seabrook and Andres Rodriguez to discuss NASA's Frontier Development Lab or FDL. The FDL is an intense 8-week applied AI research accelerator focusing on tackling knowledge gaps useful to the space program.

In our discussion, Sara, producer at the, FDL provides some insight into its goals and structure. Timothy, a researcher at FDL, describes his involvement with the program including some of the projects he worked on while on site. He also provides a look into some of this year's FDL projects including planetary defense, solar storm prediction and lunar water location.

Last but not least, Andres, senior principle engineer at Intel's AI Products Group, joins us to detail Intel's support of the FDL and how the various elements of the Intel AI stack supported the FDL research. This is a jam-packed conversation, so be sure to check out the show notes at twimlai.com/talk/89 for all the links and tidbits from this episode.

[INTERVIEW]

[0:03:38.8] SC: I am really excited to have a chance to talk a little bit about this program that you're all involved in and share it with the folks listening to the podcast. Welcome, everyone.

[0:03:50.1] TS: Thank you. Happy to be here.

[0:03:50.3] SJ: Thank you.

[0:03:51.9] SC: Absolutely. Why don't we get started by just kind of going around the table and doing intros. We'll start with you, Sara.

[0:03:58.3] SJ: Great. I'm the producer for NASA Frontier Development Lab, which means I get the really cool job of working with the researchers for different challenges over the summer throughout our program. Previously I've worked in emerging tech and innovation at XPRIZE where I did prize design and operations and I've done a lot of work with the private space industry as well.

[0:04:18.6] SC: Awesome. Andres?

[0:04:21.2] AR: Yeah, thanks for having me here. As engineering — machine learning and software engineering with various customers to understand their workloads and build solutions for them, and I work with a lot of other Intel teams to provide, to build the solution for our customers. The solutions may be anywhere from designing models for their particular problems, so deep learning models or optimizing their algorithms so that they run efficiently on Intel architecture. I've been working on AI for about 13 years and it's an exciting area to be, especially over the past four years, five years to see the tremendous growth and interest for the community in this area.

[0:05:04.6] SC: Absolutely. How about you, Tim?

[0:05:06.6] TS: I'm, as you mentioned previously, during my Ph.D. at the University of Oxford, I come from quite a mixed multidisciplinary background. I've studied under engineering, computer science and communication systems and that's given me quite a broad view of technology and also the machine learning field.

Right now I'm focusing and I'm super entrusted in verification of learning in multi-agent systems so that hopefully we can have better specification about these learning agents so that they might be able to deployed and used in public realms, because the minute it can be a little bit risky to put something out that learns without knowing what it could learn. That's my focus there.

Yeah, I was super happy to go along to the Frontier Development Lab over the summer being based in NASA. That was a great opportunity and a great experience and I'm happy to be continuing involvement with that going forward.

[0:06:00.9] SC: What was your role with the program?

[0:06:02.5] TS: I was a researcher there. I applied through the normal means, to the application process. Got to meet James and Sara first online and then in person. There were a number of projects that were involved at the Frontier Development Lab and I was involved in one of those, which was the exploration of lunar water and volatiles.

[0:06:18.9] SC: Okay.

[0:06:20.4] TS: Actually, I'll talk a little bit I guess about that now.

[0:06:23.6] SC: We can dig into that in a second. For now, it probably makes sense to get a little bit more context on FDL as a whole and what the mission is. Sara, what can you tell us about FDL?

[0:06:33.2] SJ: Yeah. FDL is an applied artificial intelligence research accelerator, and it was kind of started with the premise of bringing back the Apollo of interdisciplinary teams compared with rapid innovation. During that time, they would bring together the coms team with the life-support team and propulsion team all in the same room so that they could work on advancing things faster.

That was really where this started from. It started in 2016 with Asteroid Grand Challenge where they mostly focused on planetary defense problems and now we're moving on to your three because the program has been so successful. We bring together researchers from AI fields and we pair them with planetary scientists and we work on challenges that are of interest to NASA.

[0:07:23.4] SC: I've heard this description before, and every time planetary defense is said, I think of like defending us against aliens. What does that mean to you?

[0:07:33.4] SJ: Yeah. The challenges that we focused on were asteroids and long period comments for this past year, so it's mainly detection and understanding them a little bit better. So if there was an asteroid that was coming towards us, we'd have a little bit more of understanding of mitigation strategies, things like that.

[0:07:50.7] SC: Okay. It actually is protecting us from things that are hurling towards us from space. Tell us about the program. What's the structure of the FDL program and how is it organized? Who's involved?

[0:08:06.7] SJ: Yeah. It is a public-private partnership. So it's with NASA Ames and hosted by the SETI Institute and then we are able to bring a lot of our private partners in which allows us to bring in researchers and mentors from around the world. It is an 8-week program that takes place out at NASA Ames in Silicon Valley where we bring in about 24 researchers and put them on teams of four for that 8-week program. It starts out with a boot camp where everybody gets an understanding about the problems and then it goes into brainstorming different approaches to work on solutions for them. Then they do rapid prototyping during that time.

Then after the program ends, the work doesn't end. We do a lot of continuity work, and Tim will talk a little bit more about what he's doing with Intel later.

[0:08:54.1] SC: Okay. The researchers that you've referred to, they're all or predominantly Ph.D. students or does it vary?

[0:09:00.3] SJ: It varies. We had a mix of Ph.D.s, post-docs and individuals in the industry that actually took sabbaticals from their job. We had an astronomer from Brazil. It's quite a combination and it's a really high-caliber of people that we bring in.

[0:09:13.6] SC: Oh, very cool. Tim, why don't you give us an overview of the types of research that the different teams worked on?

[0:09:20.7] TS: Sure. As I'm sure you're aware, there are a lot of excitement around the field of deep learning at the moment.

[0:09:27.0] SC: Really?

[0:09:28.6] TS: I'm not sure if you noticed. Yeah. I guess to start off with expanding on what Sara mentioned, was it seemed like the goal of the Frontier Development Lab was really to empower [inaudible 0:09:41.5] scientists who have been working on that field for a long time with these new technologies and enable them to achieve more than they've been able to previously.

We were very much looking — The boot camp was incredibly helpful to be talking with NASA scientists where they understand the game when it comes to space and what's been done and what needs to be done next.

[0:10:02.5] SC: Was that an area that you had any experience with going in?

[0:10:05.1] TS: I mean as a hobbyist. We're all nerds at the Frontier Development Lab. We all love a little bit of space for the Star Trek, for the Star Wars and stuff like that. I don't know. Yeah, as a hobbyist, from a space news, I was fairly aware of things but not to the depth of NASA scientists. Of course, they've been working on that field for 40 years. Throughout that boot camp week we really did come to understand what was going on and sort of did have to explore where we could contribute.

We had the artistic freedom to explore and do the prototyping and workout where our skills as individuals are aligned with with the needs of the group. Each individual team came up with their own custom solution to the problems they were facing. A lot of it — For my team, it was image classification. Similarly, for long period comments, looking at cameras situated around the world. Do you know what the name of — Is it the CAMS Project?

[0:10:57.0] SJ: It was the CAMS. Yeah.

[0:10:57.5] TS: CAMS Project.

[0:10:58.5] SC: CAMS Project. Okay.

[0:11:00.2] TS: Yeah. What the goal of that is, is to detect objects coming through the atmosphere and identifying when it is an object and it's not just a bat or a firebird that's going in front of the lens and doing that autonomously, because people have been doing that for 40 years by hand, which is incredibly arduous.

The asteroid shape modeling team, we're using variational auto encoders to try and transfer [inaudible 0:11:25.5] images, which were incredibly unintuitive into a 3D model so that the shapes of asteroids and the distribution of the shapes asteroids can be better understood. The team was working on Bayesian techniques to ensure that there is — To encode the knowledge of the scientist into a prior distribution so that the shapes that came out made sense.

The weather prediction teams, they were looking at predicting when coronal mass ejection might come out, which would be quite catastrophic when it does.

[0:11:53.1] SC: What?

[0:11:53.1] TS: Coronal mass ejection. When a magnetic band within the sun sort of snaps and it ejects a huge plume of hard plasma through the solar system. The earth luckily has magnetic field that protects us from most of that, but if we get hit by one or two or several waves, it can be quite catastrophic and damage satellites, of course. It could be dangerous for people on space stations.

[0:12:17.8] SC: How often does this kind of thing happen?

[0:12:19.3] TS: There was the Carrington Event in —

[0:12:22.0] SJ: The Carrington Event. Yeah, that was —

[0:12:24.1] SC: No relation to Charrington, my last name.

[0:12:27.2] SJ: No. Yeah. That was the last major one, but they happen quite frequently.

[0:12:30.9] SC: When was that?

[0:12:32.8] TS: I think it was around late 1900th century. So there wasn't too much electricity around by then, so it wasn't too damaging to that. It went largely unnoticed apart in Canada, I believe, is where it was noticed the most. That, like of course some great northern lights to show up so people are really loving that, but it would be a little bit more damaging now.

Yeah, I believe there are smaller events happening quite a lot and we're a small dot in the solar system. So a lot of the time they'll miss us, which is fortunate. In day-to-day life, they can affect things like GPS, mobile phone signals, things like that. We really need to have a prediction of when of these events might happen, and the way you do that is by monitoring [inaudible 0:13:17.6] images of the sun's surface where you can see.

The team there was using LSTM, which is a type of neural network, often used for neural linguistic programming. It's long-short term memory. That's what the LSTM stands for. That takes into account the long term history of the sun's activity as well as the short term. It's quite useful in financial predications as well.

We also had the other team, solar terrestrial interaction. They had a hard time.

[0:13:46.9] SC: Terrestrial interaction?

[0:13:48.7] TS: Solar terrestrial interaction.

[0:13:48.8] SC: Solar terrestrial interaction.

[0:13:49.9] TS: That's where it happens when the solar activity does hit the earth and how that might affect electrical companies, how that might affect markets and things like this. It's really difficult to get a hold of a lot of that data.

[0:14:05.2] SC: Just for that problem or for all of these problems that we've discussed?

[0:14:07.3] TS: Luckily, there is a huge relative public data for most of these things, particularly when it comes to looking at the moon. It's up there regardless. Fortunately NASA is a public entity. A lot of the data they do is available to the public, which is great for hobbyists.

The solar terrestrial interaction team were including as much data as they could from disparate sources, from insurance companies, from claims of damage that have been done to transform those things like this and trying to find a model to describe particularly what the cost of damage could be if one of these events happens. So they ended up using a wide variety of techniques and machine learning influence and bundling them together and see what they could come out with. I guess that's been at least the work that the team I was on was working on.

We had a good team. There's [inaudible 0:14:57.5] who is a — He does a lot of mapping problems and a lot of synthesis in maps and working on those. [inaudible 0:15:05.3] who does computer vision for Mars Rovers. We have [inaudible 0:15:10.2] who was one of those fellows from the industry who comes from a strong understanding of computer vision. Myself, and also we were supported by Tony [inaudible 0:15:19.1] who is a planetary scientist particularly interested in creative formations, which was incredibly useful.

[0:15:26.4] SC: What was your project?

[0:15:27.6] TS: The project was to find a way to facilitate the investigation and the quantification of how much water or volatile — We focused on water. Is on the lunar surface. There's potentially quite a lot. I was surprised to learn this, because there's a lot of discussion about maybe there's water on Mars. Maybe there's water on one of the moons of Jupiter or Saturn, but it seems there's quite a lot hope closer to home.

[0:15:57.2] SC: Sara, I'm curious from your perspective, why is — In one sense it's obvious that we'd be interested in exploring water in the moon, but how does NASA think about the reason why this is important and maybe you can also touch on some of the — How do we know there's water on the moon?

[0:15:57.2] SJ: Yeah. I can touch a little bit on that without overstepping. The reason NASA is focused on the moon currently is because with this new administration, we're focused on going back to the moon. The reason why we need to resource this is important, and Tim can also share a little bit more about that, is that those resources are very expensive to move from the earth into space. If you already have those resources there, then you could utilize them for fuel or for other things, potentially like settlements and things where you don't have to import those materials there. That's another way there.

[0:16:55.4] SC: Okay. I heard an anecdote about the first discovery of water on the moon. How do we —

[0:17:01.3] SJ: Yeah. It was the LCROSS Mission.

[0:17:05.1] TS: Some Apollo XV rock samples showed water in them, but there was a dispute of whether or not they've been contaminated and things like this. They were seeking for further evidence. There were a couple of missions, one from NASA and one from the Indian Space

Agency, which involved sending an impact into a crater on the south pole that never sees sunlight. I can explain a little bit maybe why that was the reason, why that was chosen.

The impactor once it hit the surface —

[0:17:35.1] SC: It's basically crashing a ship, a vehicle of some sort into the side of the crater.

[0:17:40.1] TS: Yeah, and the ejector plume that came out, all the dust that was kicked up. Spectral reading was taken of that and showed I believe about 4.6% water.

[0:17:49.2] SC: In the form of ice particles I imagine?

[0:17:51.1] TS: Yeah. I'm not sure, because the impact energy might have vaporized some of it. Yeah, its stable format would have been ice. Yeah.

Yeah, the reason that they were targeting permanent shadowed craters is because — If you consider that over the last four billion years, every meteor and comet that's impacted on the moon had the potential to contain some rare earth metals and some water. All of that has been deposited. Some if it will evaporate. Some of it will escape the atmosphere, but some of it will get stuck in the bottom of the crater that are at 40 Kelvin. Anything that goes in there freezes and get stuck there potentially forever. It's considered that might be the great wealth, the bank of resources there is available on there.

[0:18:34.3] SC: The role of your team was to basically figure out how much of these stuff might exist.

[0:18:39.3] TS: The goal of our team was to work out how we could contribute to the accessing of it using machine learning. We started off — Right now, as I understand, an objective would be to exactly investigate, understand how much there is, understand that it's economically viable to set up a base there or to send for the missions. The way you do that is with rovers, is with instantly resourced measurements .

We were looking firstly at looking at traverse planning. Rovers have to stay in sunlight or whole the time when they're solar powered, or for as long as possible anyway. They have to stay in direct communication with the earth a lot of the time. The moon is quite close, so usually it's still human operated when there's a rover up there. There's only a second or two delay. We were looking at that problem and then we realized that there was some other work that need to be done before to facilitate that sort of advancement.

[0:19:32.5] SC: What was that other work?

[0:19:35.0] TS: During the traverse planning we realized that the maps weren't in the highest quality that we had to come to expect. Naively, we've thought the moon is just above us. The map should be complete. But regions where there is permanent shadow, visual images are difficult to grab. Also, as the Lunar Reconnaissance Orbiter, which is where we took our data from. As that's over to the moon thousands and thousands of time and built a laser optometer, sort of height map readings, stitching and the composite images that are formed have created artifacts, which to a rover, in a rover's eyes, look like 20 foot cliffs and 20 foot ditches.

[0:20:13.2] SC: That aren't actually there.

[0:20:14.2] TS: That may —

[0:20:15.2] SC: May not be actually there.

[0:20:15.3] TS: Yeah, maybe there, but a lot of them aren't. You can just smooth over, because a rover is an expensive to put on the moon. You don't want it to fall down one of these ditches if it is real, but also you can do an automated plan until you've worked out which ones are real and which ones aren't. That became the focus of our continued work.

[0:20:33.6] SC: Okay. There was also an element of your work that involved trying to count the number of craters on the moon. Where did that come in?

[0:20:42.5] TS: The lunar surface. I supposed every time a picture of the lunar surface has been taken. There's no GPS, right? You don't know exactly where that photo is, Thankfully, craters being so abundant form a sort of fingerprint that allows you to uniquely identify what you're looking at, and by matching that visual image with the elevation model, then you can compare what's the artifacts might be in the elevation model with the visual images. Then if it's one but not the other, then you know it doesn't exist. If it's both, then you know, okay, that is a ditch I need to watch out for.

[0:21:16.3] SC: Maybe going back to more fundamental kind of space question, like how many craters are on the moon?

[0:21:22.7] TS: Oh, gosh! More than we could count.

[0:21:25.0] SC: More than we can count. Are these craters that were all created with the creation of the moon itself or are these craters a result of impact like comets or other things?

[0:21:35.2] TS: I believe there are 10 notable fresh impacts per day. We looked to around 40 to 100,000 craters, and now it was around a thousandth of the percent of the lunar surface.

[0:21:47.6] SC: Wow!

[0:21:48.0] TS: Yeah, they're coming every day, but I think a lot of it was historical. A lot of it has been in the past and it's come down a bit, but it's still going. There are still impacts every day. Yes.

[0:21:58.9] SC: Okay. Is the earth impacted that much by craters? Is it our magnetic field as you were describing earlier that protects us from that or do we get our fair share of those crater impacts as well. Certainly, the Earth isn't [inaudible 0:22:08.9] with craters like the moon is.

[0:22:11.1] TS: We do get a lot of things coming from the atmosphere. You might see a shooting star every now and again. That's a small meteoroid coming through the atmosphere. The atmosphere is another protective shield for us. The friction that the meteoroid comes as it's entering, it causes to burn up a lot of the time or break apart. We do have that minor protection. Yeah, the planetary defense team, they're looking at bigger asteroids that could be more deadly. I think it was 10 years ago we thought there were maybe 16,000 of these. Now, we know there's hundreds of thousands of potentially dangerous objects floating around the space. Luckily, we've gotten much better of modeling where these are and understanding which ones could be dangerous. It looks like we're in a clear at least for now.

[0:22:57.7] SC: So to kind of take a step back, you're trying to ultimately understand the available resources on the moon. In order to do that, one of the techniques involved was trying to understand — Actually, was trying to plan out the rover mission or provide information that would be used in planning a rover mission. In order to do that, we need to understand how the maps all fit together. In order to do that, we need to be able to identify the craters.

[0:23:30.0] TS: Yeah. This was a really a keystone that would open up the possibility for future work to go ahead.

[0:23:35.9] SC: Right. What were the techniques and challenges involved in identifying the craters?

[0:23:43.8] TS: Main challenges came to even understanding the problem. It took a — Thank God we had the prototype in progress. We only came to understand that problem by trying to do the traverse plans. When it came to it, I think we were five weeks in the program already. There were three weeks left, so we had a lot of late night sleeping on the data. For any machine learning algorithm, you need to give it training examples, right? You need to teach it as though it's going through school. We had to collect images, representative images of craters and come to an agreement of what a crater looks like so that we could feed that to our algorithm.

That was surprisingly difficult actually. We had five people on the team and several others were helping us label these images. To come to a consensus on which should be considered to be good representations of craters and which weren't and which were too ambiguous was a long process actually.

[0:24:39.8] SC: Meaning full-fledged craters versus dips in the terrain or something like that.

[0:24:44.9] TS: So one interesting thing that we came across was that, actually, hills look exactly the same as craters depending on the angle of the light. That was a little bit [inaudible

0:24:53.2] — after looking through thousands of these, everything sort of look like a hill and you weren't sure anymore, so you have to take a break every now and again to let your perception rest again. Yeah, it was the sheer number of training exams that we had to label ourselves.

[0:25:07.8] SC: How many of these craters did you personally labeled?

[0:25:10.0] TS: I look through $40,000. There was a bottle of scotch nearby. That definitely helped me through that process. Yeah, we got through that. Then once we got to that training data, then it went through the iteration process of developing a conversional neural network classifier. Thankfully, we had Intel Nervana and the technology there to help us go through that process quickly and we had the support of the Intel engineers to give us advice and support on how to use their framework most effectively.

[0:25:39.0] SC: Was there anything that came up as kind of unique about training a model in this situation that you wouldn't expect another applications of CNNs?

[0:25:49.7] AR: I would imagine one of the things that is unique compared to what usually finding academia you're focusing on to us, because one is — It's a binary, it's a crater or not. You're not trying to classify between thousands or hundreds of classes.

The second one, if you're also doing detection, you're looking for craters in large images. The project essentially has these two steps. First, can you classify craters versus non-craters, and second can you then detect them in a large image? I don't know if you have other things \\ [inaudible 0:26:29.6].

[0:26:30.7] TS: Yeah. One of the particular problems with a crater detection was that there's just so many of them and they're all overlaying on each other, and that's quite a difficult image classification problem. If you're doing facial recognition, for example, you don't expect to see a face and a face and a face and a face, or a cluster of faces altogether. That was definitely a challenge for the image classifier.

[0:26:55.0] SC: Andres, maybe you could give us some perspective on like why does Intel support a program like this? How does Intel think about engaging with programs like FTL?

[0:27:05.8] AR: Intel wants to advance science, and this is a great opportunity for Intel to partner both with researches, with NASA engineers, with the NASA program to advance science. In addition [inaudible 0:27:21.5] to democratize machine learning. So it was a great opportunity to work with engineers that many of them do not have a background in machine learning and give them the knowledge and the tools to use machine learning for a particular problem.

[0:27:40.1] SC: How did your team in particular get involved with the projects?

[0:27:44.2] AR: We were invited. One of our team managers received an invitation for Intel to participate, and we were very excited to jump on the opportunity. I went to the kickoff meeting and got to meet the researchers in the program and invited a couple of my colleagues to come and participate. One who couldn't be here unfortunately, his name is [inaudible 0:28:12.0] who was the main Intel engineer. He's a principal engineer with a strong background in machine learning and deep learning and he provided a lot of the mentorship and guidance that the engineers needed along with [inaudible 0:28:31.4] and they provided additional assistance, engineer assistance to the team.

[0:28:40.9] SC: You mentioned a moment ago kind of the unique challenges of this problem with regard to clusters of craters and craters and craters and all that kind of stuff. How did you overcome those problems?

[0:28:57.2] TS: Thankfully, the problem that were trying to solve was the core registration improvement of maps. As long as we could get a reliable fingerprint for an image that could be matched in the elevation model, then that would satisfy our goals. When there was particularly rough areas, then it didn't matter so much that maybe the quality of our image classifier suffered in those regions, because we're able to make up [inaudible 0:29:22.5].

It would definitely a problem for a research question almost, and when it comes to building an application in a short period of time, sometimes — Yeah, we had to make do with what we have and do it quickly rather than trying to bite off more than we could chew and then not contributing anything.

[0:29:42.5] SC: Right. How do you envision — I understand there's an ongoing role for you in particular in this project with FDL. How does it move forward?

[0:29:54.7] TS: Identifying the issues that we had with the time constraints. Yeah, we're all invited individually to continue to contribute if we would like to. I think for many of us, this really stood up our passion and our excitement about the whole field. Since the end of the project, I've been working to tidy up the code and make it publicly available and we've been working alongside the folks at Intel to improve the algorithm to be able to detect clusters of craters and craters within craters using newer techniques, single shard detector [inaudible 0:30:27.9]. Detector which allows you to identify lots of craters in the same image.

Moving forward, I supposed, we're looking forward to Frontier Development Lab 2018. We're going to be taking applications for that. Currently, up until March, and really what we're looking for is to see what ideas people come with and the ways that they can contribute to the continuation of this project.

[0:30:54.0] SC: Andres, were there any kind of unique properties of the Intel AI stack that lend themselves to solving this problem or that helped in helping these research teams advance their research?

[0:31:06.9] AR: Yeah. We have the four solution stack anywhere from — It started in the bottom with our hardware. We have our general purpose CPUs or processors. We're also developing a deep learning accelerator, specifically target for the [inaudible 0:31:23.5] that was not available in 2017 when these researchers were [inaudible 0:31:29.7]. We hope that they'll be able to use it the following summer, but we have our [inaudible 0:31:35.2]. In addition to that we have libraries that are optimized to run deep learning functions efficiently on our CPUs. You might have heard of the Intel Math Kernel Library. In addition, we have deep learning frameworks that we optimize such as Caffe, TensorFlow, MXNet, and we have an in-house framework called Neon, which was the framework that was made available FTL for the researchers to use.

Neon is unique in the sense that it's a firmware that's highly optimized, but Intel for both CPUs and GPUs so that you can get very high throughput and high utilization regardless of the hardware backend that you use. In addition to that, we actually have a Nervana offering called the Intel AI Cloud. It used to be called the Intel Nervana Cloud. This is a cloud where our partners can log in and easily launch their jobs and they have the tools to easily experiment with various models and various hyperparameters, meaning various knobs that you need often tweak in order to get your models to efficiently train.

I spent some time getting the engineers [inaudible 0:32:54.9] up to speed on how to use the tools, but once you spend a few days or even less, a couple of days, that you can start training your own models. You usually start by training a simple model like [inaudible 0:33:12.4], which is an all model that was developed a couple of decades ago, and you can do that your first day, your first couple of hours, you train that model on image recognition. Then you can actually modify it a little bit to start getting a baseline on how well does this work on our crater images and do I need to add more layers. Do I need to add more units or [inaudible 0:33:39.0] in its layer? Once you can do crater classification, then you can move into detection, which [inaudible 0:33:46.9] was talking about. Initially we use single shot detection algorithm or SSD. Later, newer algorithms that are better for this type of workloads where you have small craters, large craters and you don't have a diversity of classes you're trying to classify. That's going to be the next step of classifiers or detectors that we're going to be using.

[0:34:15.4] SC: Awesome. This sounds like an amazing program. Maybe we can close out by having you, Sara, tell us like for folks that want to learn more about participating in the 2018 program. Is there a site they can go to or what's the process there?

[0:34:32.4] SJ: Yeah. If you're interested in the program, you would go to frontierdevelopmentlab.org. Like Tim said, we do have our applications open. We're currently doing our planning for next year, and so our challenges should be launched here soon as well.

[0:34:46.4] SC: Okay. Tim, from you, any final thoughts or advice for folks that might be interested in pursuing, either getting involved in FTL or doing similar research?

[0:34:58.4] TS: Yeah. I'd say just go for it. I grew up in the U.K. I never imagined for a second that I could be working alongside NASA scientists or living on a NASA facility. Some of the programmers, absolutely excellent. If you're wanting to get involved in machine learning, start reading online, like take small goals, keep [inaudible 0:35:18.6] them. It's very easy to be like, "Should I learn this machine learning algorithm today or should I watch another season of my favorite TV show?" Short term goals, keep going for it and you'll be able to contribute in this new and exciting field as well.

[0:35:33.2] SC: Awesome. Andres, how about from you? Any parting thoughts?

[0:35:36.9] AR: Yeah. [inaudible 0:35:37.1] a lot of exciting work to advance AI and you can check out what we're doing at intelnervana.com in addition of developing these new deep learning accelerator. We've optimized if the frameworks [inaudible 0:35:51.8] to deep learning on CPUs. Today you'll see significant gains in performance if you had tried to do deep learning in CPUs a year ago or even six months ago. It's an exciting time. We want to democratize the use of deep learning, and most facilities have Intel's CPUs. We hope that they can be put to good use such as we did with FDL.

[0:36:22.5] TS: On that note, for the hobbyist, Intel doe have an AI boot camp that provides a lot of resources available for people to learn how to use Intel Nervana or Intel AI I think it's called now. Yeah, get involved and get their hands dirty with the finer points of learning machine learning.

[0:36:38.3] SC: Awesome. As well the dev cloud offering, which I did an interview. I forgot which episode it was, but we'll put that in the show notes as well. Folks can sign up for access to that too.

[0:36:47.9] TS: Thanks.

[0:36:48.9] SC: Awesome. Sara, Andres, Tim, thanks so much for taking the time to chat.

[0:36:53.9] SJ: Thank you. [inaudible 0:36:53.7].

[END OF INTERVIEW]

[0:36:59.8] SC: All right everyone. That's our show for today. Thanks so much for listening and for your continued feedback and support. For more information on Sara, Timothy, Andres or any of the topics covered in this episode, head on over to twimlai.com/talk/89. To follow along with the NIPS Series, visit twimlai.com/nips2017. To enter our TWiML 1 Mil context, visit twimlai.com/twiml1mil.

Of course, we'd be delighted to hear from you either via a comment on the show notes page or via a Tweet to @twimlai or @samcharrington.

Thanks again once again to Intel Nervana for their sponsorship of this series. To learn more about the Intel Nervana NNP and the other things Intel has been up to in the AI arena, visit intelnervana.com.

As I mentioned a few weeks back, this will be our final series of shows for the year, so take your time and take it all in and get caught up on any of the old pods you've been saving up. Happy holidays and happy New Year. See you in 2018. Of course, thanks once again for listening, and catch you next time.

[END]

