12 Dana Cobzas - Edited Audio/Edited Transcript

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SPEAKERS

Dana Cobzas, Dylan Cave, Brittany Ekelund

D Dylan Cave 00:00

We would like to first acknowledge that we are on treaty six territory, the traditional gathering grounds for many diverse First Nations, MÃ©tis, and Inuit, whose footsteps have marked these lands and whose presence continue to enrich our vibrant community.

B Brittany Ekelund 00:15

We'd also like to take a moment today in recognition of Black History Month. This month, you can check out Five Artists 1 Love at the Winspear on February 5, or you can visit the EPL Black History webpage at any time of the year to find resources and information on the contributions of black people have made and continue to make in the world. Also, keep your eyes peeled this month for local events organized here at MacEwan, or through the National Black Coalition Society of Canada's website. You can find links for all of those in the episode description.

D Dylan Cave 00:47

Hello, and welcome back to Research Recast(ed), the knowledge mobilization podcast. I'm Dylan Cave, and I'm here with my co host, Brittany Ekelund. Today's episode we'll take a peek behind the screen to take a look at computer vision, and we'll look at projects where computer science and mathematics meet medical imaging.

B Brittany Ekelund 01:04

Today we are here with Dana Cobzas, an assistant professor in the Faculty of Computer Science at MacEwan University, where she teaches coursework in machine learning, computer graphics and algorithms. Dr. Cobzas's areas of expertise are centered around imaging and computer vision with particular interest in mathematical models for medical image processing. She also has experience and interest in methods for medical image segmentation, registration, and noise reduction. So, um, let's start off-- if you could just Dana, tell us a little bit more about yourself and what attracted you to a career in mathematics and computer science.

D Dana Cobzas 01:44

I always loved mathematics. I, um, I grew up in Romania, so that's where I did my undergrad. And at that time, it was the, we didn't have a separate mathematics. It was like joint program mathematics and computer science.

B Brittany Ekelund 02:02

So from my understanding, part of computer science is computer vision. And that's something you actually have a large body of research in. So can you explain to us, uh, what exactly is computer vision?

D Dana Cobzas 02:16

So computer vision is the science of imaging. So we study both 2d and 3d images, we study the imaging process - like the prediction process, we study image filtering, um, so everything related to images.

B Brittany Ekelund 02:36

Yeah, I guess, like what I'm trying to get at is um, like for people that are not familiar with, like computer vision, or computer science, could you give us some examples of like, kinds of maybe technologies or ways in which computer vision is used or things that you study that like, would help us understand a little bit more about the mathematics involved?

D Dana Cobzas 03:00

So originally, computer vision was a very mathematical field. Now recently, for the last-- since all the deep learning explosion, it merged with machine learning. So I think it's a little bit hard to detangle now computer vision for machine learning, because a lot of machine learning algorithms are u sed in computer vision--

B Brittany Ekelund 03:18

[crosstalk] So, like AI?

D Dana Cobzas 03:19

Yeah.

B

Brittany Ekelund 03:19

Oh, okay.

D

Dana Cobzas 03:21

So basically, everything you have on your phone is computer vision, like face recognition, face detection, all the, the-- even the focus, the Google, the way, sorry, the Apple phone works now that it blurs the background, that's computer vision. Everything that you see, it has some part of computer vision in it--

B

Brittany Ekelund 03:42

[crosstalk] Okay. And that's really cool, because I had no idea, like I was kind of reading about computer vision and I was like, AI? Because I think people are familiar with the concept of artificial intelligence, right? And you see it in science fiction and pop culture a lot. Um, the research we're going to talk about today focuses on medical imaging in particular. So can you tell us a little bit about how you branched into this particular area of research?

D

Dana Cobzas 04:10

Yes, so I, um, I did-- So I did my PhD here at University of Alberta and then I stayed a bit in traditional computer vision. I did a postdoc in France, and then I came back and I, um, I was invited to participate in meetings with a group that was um-- the main PI was Ross Greiner. So he's at the University of Alberta and he works in medical imaging and I, I really liked the field and also one of the physicians. So we worked with a radiation oncologist at that time. So he-- I really liked the connection, this real-- connection with reality. So I, I was very motivated by that and also the feedback that we got from the, from the doctor and then I really liked that collaboration and the fact that we were doing something that could potentially be useful, and very real compared to my previous work, which was very theoretical, in a way, and even though it had applications, it was not so direct.

D

Dylan Cave 05:19

Yeah, that's that that makes total sense of like, wanting to do something with, you know, real practical uses. And so that's really interesting,

B

Brittany Ekelund 05:28

When you made this connection, and you started collaborating with these kind of, like biomedical researchers, did you have to, like learn, like some anatomy? Did you have to take a crash course in in learning how like, you know, structures of the brain, neuroscience, anything like that?

D

Dana Cobzas 05:47

Not formally, but this doctor, he was telling us a lot in the meeting. So it was very useful to, to have his constant feedback. So I had to learn a little bit of basic brain anatomy, a little bit of how structures work. And at that time, like I said, my first project was on brain tumors. So it was a-- he was a radiation oncologist. And I was learning a lot about that, and he had his theories. So it was really nice. I think it was very nice, how he would not understand the details of our methods. But he was able to - we were able to find a space where we could actually discuss things. So yes, I learned from him and I think he learned from us [Dana laughs].

B

Brittany Ekelund 06:30

Was it challenging at all to-- I mean, if your first project was medical imaging is looking at oncology and brain tumors, I mean, that's pretty heavy. Was it a challenge at all? Like, what was it like to, to kind of be working in a field where you're actually looking at people's lives and like people's brains?

D

Dana Cobzas 06:48

Yeah, that was pretty tough, actually, and seeing those big tumors, you have to detach that probably is just the process that all the medical doctors go through [Dana laughs].

B

Brittany Ekelund 06:56

[crosstalk] Yeah, but I mean they have years of experience [laughter].

D

Dana Cobzas 07:00

Yeah, it's sometimes is scary. It's just you don't have to think of it. Because obviously, we had no names. So, um,yeah, you'd have to detach from the meaning of the images.

B

Brittany Ekelund 07:14

Okay, so yeah, you did the project - oncology with radiologists. Um, but you've also collaborated with the Biomedical Engineering Department at the U of A, how did you connect with them? And can you tell us a little bit about how your collaboration with them started and the projects it led to?

D

Dana Cobzas 07:32

So, uh, I think they contacted me because they needed somebody to help with-- So, they aren't experts in imaging, but in acquisition.

B

Brittany Ekelund 07:44

[crosstalk] And what's acquis ition? Sorry.

D

Dana Cobzas 07:47

It's all the MRI. So there are physicists, most of the people at the BME, and they are experts in MRI, and other types of images. Like they have other specialists, but the the professor that I work with, uh, he's an expert in MRI, and they don't have expertise in in image analysis. And, yeah, that's why I think he contacted me. And then I was hired as a research associate, and I worked for him quite a lot - I forgot how many years [laughter] - it was the time when I had my kids. So it was kind of on and off, but for quite a few years until I came here. So probably about 10 years I worked for, for the BME people.

D

Dylan Cave 08:32

Wow. That's a that's a long standing working relationship. um, so for those of us at home that might not know the process of something like this. How does MRI work for those, again, who might not know?

D

Dana Cobzas 08:48

So there are different types of MRI. So like the restructured MRI, like where you kind of see how the brain looks, but then there is diffusion MRI, where you have directional magnetic field that is gonna take several images. So that is if you heard about diffusion tensor images, where they actually can visualize the brain fibers. So everything is based on physics and magnetization. So they take continuous signals that then they discretized into these digital images.

B

Brittany Ekelund 09:21

Okay.

D

Dylan Cave 09:22

I always wanted to go and get an MRI just to like, see what's going on up there. Because sometimes I think I'm not all there - I don't know if there's actually anything going on up there [Dana laughs] So I mean, I think maybe getting an MRI. Do they even do MRIs if you don't like need one?

B

Brittany Ekelund 09:35

No.

D Dana Cobzas 09:36

You can volunteer. I did twice [laughter].

B Brittany Ekelund 09:38

Oh, hey!

D Dana Cobzas 09:39

[crosstalk] Yeah.

B Brittany Ekelund 09:40

That's really cool. So you got to just like see your own--

D Dana Cobzas 09:42

[crosstalk] Yes. Mm hmm.

B Brittany Ekelund 09:43

Brain? That's really neat. Was that part of your study on MRI imaging of the hippocampus?

D Dana Cobzas 09:49

No, it was actually-- I was in an MS study at that time. So they needed the healthy volunteers to be able to compare with the MS patients. So that was the MS study that was part of.

B Brittany Ekelund 09:52

So I've seen your brain twice [laughter]. I mean, I think a lot of people, usually if you're getting shown an image of your brain, it might not be in the best of circumstances. So I think that that's really cool. So, Dylan, go volunteer for a study [laughter]. So yeah, can you tell us about your study on MRI imaging of the hippocampus please?

D Dana Cobzas 10:19

So the hippocampus that was a bit later project, it was another faculty from BME that I started to work more recently. So that is also um, so they develop a special type of imaging, that is a very high resolution image of the hippocampus. So it's not the full brain is just the part of the brain, but very high resolution. And it is a diffusion tensor. So it is a diffusion image, which is this directional image. And so hippocampus is a central part of the brain. So it's connected to many other parts. And one of the faculty there. I don't know if I should say names or not, I don't know, how is this thing going, but he's very interested in the study of hippocampus. And, yeah, so he asked us to study his images. And that was actually, I did it mostly after I came to MacEwan, the project.

B Brittany Ekelund 11:19

So what were you looking at, like they're taking the MRIs of the hippocampus - help us understand, like, what your role in that project was, were you developing a new kind of computer vision were you just teaching a computer to analyze the image, like what...

D Dana Cobzas 11:37

So we had to do our main, um-- our first task was to segment the hippocampus. So you have to isolate the structure, and we had several manual segmentations. And we actually did-- that was one of the deep learning algorithms that we applied, to be able to segment the hippocampus in a new image. So that was the first part of the project. And then the second part, that we are actually doing now, is uh, we want to study the shape of the hippocampus. So we want to study how the hippocampus is changing with aging. So all the brain, or-- our brain gets atrophied in time, and, uh, they want to be able to capture these changes as we age overall, which is very important, because then they can relate a person that has some symptoms or has a disease, and see how his hippocampus is different from the normal person.

B Brittany Ekelund 12:36

Yeah, so in your study on the, like the first part of this study, I was looking at the research paper, and I saw the word novel in there. So when I see the word novel, I think, a new method. So did this project identify like a new method for imaging?

D Dana Cobzas 12:56

Well, it's, it's, I guess, um, yeah, we can-- It's an, it's an incremental work, so it's not something revolutionary. But we just did some modifications of one of the architectures that was published. Um, so there are like, these deep networks are just some huge graphs, basically, that connects many, many nodes together. So this is called the architecture and then we just did a few modifications to adapt it for our data.

B Brittany Ekelund 13:29

So the second part, um, of the project, you said, is studying imaging on the aging brain. So can you tell us what just about this project? Kind of, you know, what, what you're hoping to find or what you're hoping to study.

D

Dana Cobzas 13:48

So we want to create a model of the aging brain. So you can think it's a bit like a function that, given an age, it can give you like, an average brain.

B

Brittany Ekelund 14:00

So like, you put in 34 years, and then the model would come up of what an average 34 year old brain would look like?

D

Dana Cobzas 14:08

Kind of yeah, with some sort of statistical boundaries. And in some-- it's referred sometimes as manifold learning. So basically, we are trying to learn the space of, uh, variability- brain variability.

B

Brittany Ekelund 14:22

Okay. And when you say we do you mean the researchers or you're trying to train a computer to, to [crosstalk] learn that--

D

Dana Cobzas 14:29

[crosstalk] Well, uh, yes Yes of course [laughter], thinking about the computer like, the-- we are thinking of how to-- what algorithms to use and how to change them, but then eventually, obviously, the computer is gonna execute that.

B

Brittany Ekelund 14:42

So you're training a computer to be able to know what the average brain at any age should look like?

D

Dana Cobzas 14:51

[crosstalk] Yes, kind of--

B

Brittany Ekelund 14:52

Yeah. Like what's next? What else is involved in this in this research?

D

Dana Cobzas 14:56

Well, uh...[sigh] so yeah, so we want to create this model of the aging hippocampus in our case. Or it could be any structure of the brain. And then I think the, the main purpose of this is just to study-- [inaudible] a hippocampus has very large variation between individuals, so it is a heterogeneous structure. And it's actually unknown how, exactly how, what change-- what is the the shape change with aging. Except for atrophy - it is known that the volume goes down. But it doesn't-- they don't know the details of what parts of it change, and how, if there is a pattern. Maybe there is no pattern. So that's one thing that we have to actually study. And these deep networks are highly nonlinear models, uh, that are able to capture this variability with a low dimensional number, like, for example, 10 numbers that can encapsulate the whole. This variability, we call it a latent space. So after we create this model, we can then look at, create-- then we can then investigate how a shape is different in a disease population. So they have similar images with ADHD, I think, and Alzheimer disease and other type of neurological disease. So that's one of the main goals after, that you are able to, to relate an individual or a population to this model of the healthy brain.

B

Brittany Ekelund 16:38

Would that like, essentially allow the software or the computer to, like predict or identify like, could you plug in a bunch of, of data and hen it could like flag individuals per se? Like...

D

Dana Cobzas 16:52

Yes, that would be one use, but also for for learning. So because the doctors don't know exactly what's different, you look at the brain and they, I mean-- some they have experience and they kind of see a little bit and, but in many cases, you can't see those changes. So, um...

B

Brittany Ekelund 17:11

Like, not with a human eye?

D

Dana Cobzas 17:13

No.

B

Brittany Ekelund 17:13

Okay, so if you, you create the software, and it can actually see things that like a human could not see. So like tiny changes in the shape or volume?

D

Dana Cobzas 17:26

Mmhm.

B

Brittany Ekelund 17:26

Okay, I get it. [laughter]

D

Dana Cobzas 17:29

Yeah, so it's also, it's also for research purposes I guess, not necessarily. And eventually, maybe it leads to other things. But it's also kind of a discovery type of research.

D

Dylan Cave 17:40

You could use it for like, this is mostly diagnosis type of, of imagery that they're trying to produce for you to try and figure out what's what's happening in your brain. And I mean, this could lead to to more more things for, um, diagnosis, like the diagnosis as well as the, like uh treatment options, I guess, moving forward.

D

Dana Cobzas 18:03

Yes, probably understanding the disease. I mean, many of those diseases. MS is still not very well understood. And many other diseases are not very well understood. So I think it leads to both understanding the disease a bit more, and then maybe how to treat it or early diagnosis or other things.

D

Dylan Cave 18:23

Yeah, I mean, something that, like I said, though, like, I want to go get an MRI, because I just like, you know, I want to see what's going on up there. But what if that was part of like a, you know, a regular, regular thing if it was more accessible for for people, and we could diagnose these things a lot sooner than, Oh, it actually just, there's a breaking point and now it might be too late for treatment. So... but this is really cool work that I think will help, help that.

D

Dana Cobzas 18:52

Yeah, I hope. And it's very beautiful. Like it's a lot of mathematics involved. And I love it also from a theoretical point of view. So...

D

Dylan Cave 19:02

I love that.

Brittany Ekelund 19:03

Yeah. Uh, maybe we will take a short break, here.

Dylan Cave 19:08

Here. We'll take a short break.

Brittany Ekelund 19:09

[music starts] We'll be right back. [Music stops] If you've been following us on Instagram or seen us around campus, you might have noticed that Dylan and I like coffee a lot. Um, so luckily for us, there's a great coffee shop just a stone's throw away from our studio. Bean Around the World has everything you need - great coffees, sweet and savory snack options and chill vibes. They even have an indoor swing set so you can connect with your inner child as you wait to caffeinate. Plus, they're a coffee shop for the people offering a 10% discount with student ID. If you're interested - and you should be - they're located just a block north of Allard Hall in downtown Edmonton and you can also find them on Instagram at b-e-a-t-w underscore Edmonton. Check 'em out!

Dylan Cave 19:58

[music starts] Welcome back to research recasted, the knowledge mobilization podcast. Dana, thank you so much for joining us here today, we talked a little bit about your work in medical imaging [music fades out] and you mentioned earlier that you think it's important to develop automatic methods for analyzing and interpreting medical images. Why? And can you help us explain a little bit more about that?

Dana Cobzas 20:23

Okay, so I think it's important-- So I actually work, I can give an example, I also work with radiation oncology, sorry uh, radiation-- this radiologist from, from the UofA hospital that specializes in hip dysplasia, which is the disease that you identify in small babies. So he's actually-- he has very visionary ideas. And his vision is to try to bring expertise to remote communities, for example - so you have these babies that are in a place that maybe doesn't even have an ultrasound machine, or has an ultrasound machine but doesn't have experts to actually run it. And then they have to fly to Edmonton to test their baby. So the help with-- of this imaging technologies would be to actually be able to both guide people that are not experts to, to do an ultrasound, and also to interpret it - to give like, initial diagnosis, and then maybe trim out some of the people that will not need to take the trip to Edmonton. Or the opposite, they would identify cases that maybe needs to be treated, and they have to come for treatment. So I think it's most-- it's it's helping doctors to both to interpret images, and to use them for diagnosis and guide them in both their, uh, diagnosis and treatment.

Brittany Ekelund 21:58

So in a situation like this, um-- I'm just trying to understand, when you say help with diagnosis, do you mean that like, say, in a remote community, someone could take a picture of the baby, and then a computer could interpret that image and flag if there was something off? Like, I'm just trying to--

D

Dana Cobzas 22:21

[crosstalk]Yes so they will take an ultrasound. And so one, one main-- one first problem is that, if they don't have people that are fully qualified to take this ultrasound in a very expert way, you could guide them like I--

B

Brittany Ekelund 22:36

Like the computer could guide?

D

Dana Cobzas 22:37

Yeah--

B

Brittany Ekelund 22:38

[crosstalk] Like, how would it...

D

Dana Cobzas 22:40

[inaudible] Just because they can analyze the image that is taken up to that point and say, Okay, you have to take another image, a bit more to this side [crosstalk] or something like that--

B

Brittany Ekelund 22:48

[crosstalk]Okay, like.... The computer could say, like, wrong, try again.

D

Dana Cobzas 22:52

Yes, exactly.

B

Brittany Ekelund 22:53

[crosstalk] So, it's like Operation [laughter]- like, it buzzes and it tells you--

D

Dana Cobzas 22:56

[crosstalk] Yeah. Something to guide the-- I guess it could be a nurse or I don't know, somebody that is not necessarily a radiologist, obviously, they are expensive specialists, no? So, and not accessible everywhere.

D

Dylan Cave 23:10

Well, that's very cool.

B

Brittany Ekelund 23:11

Yeah. And then like, what's the, what's the second part of that?

D

Dana Cobzas 23:14

[crosstalk] So the second part would be the diagnosis.

B

Brittany Ekelund 23:14

[crosstalk] So the diagnostic?

D

Dana Cobzas 23:16

So, uh, that's why we do this, we do this methods that are able to, to diagnose or classify - we call them classifiers. So basically, based on data that is annotated by experts, you can learn how a healthy versus disease image looks like. And then you're able to do this in an automatic way with a certain confidence level that, um, then you can you can give a flag, you know, if somebody potentially has this disease. Uh--

B

Brittany Ekelund 23:51

So, now that I understand that, I mean, that's really amazing, like that technology to be able to give kind of more access to medical information, and especially, I mean, in early life is incredible.

D

Dana Cobzas 24:08

[crosstalk] Yeah. Yes, it is, actually. So he, um, yes, the-- the radiologist that I worked with, he is developing those methods, I mean, with his team.

B Brittany Ekelund 24:20

Yeah. And I mean, already with the project that you've done on like the aging brain, and the hippocampus. Is this a technology that, if it successfully developed there, could be applicable to like a wide variety of medical imaging?

D Dana Cobzas 24:38

Yes, yeah. So, all those metals that we develop are-- they could be applied to any kind of structure. Obviously, we do-- the brain has certain characteristics because it has a bit less variability than the other parts of our body.

B Brittany Ekelund 24:54

What does that mean when you say the brain has less variability?

D Dana Cobzas 24:57

Oh, it means that, just because it's encapsulated in our heads, they look more similar.

B Brittany Ekelund 25:04

Okay. Okay, so there's less variation-- [crosstalk] Between persons.

D Dana Cobzas 25:07

[crosstalk] Yes. Exactly.

B Brittany Ekelund 25:08

So like people's hands might look very different--

D Dana Cobzas 25:10

[crosstalk] Or especially the inside of our body [laughter] looks much more different.

B Brittany Ekelund 25:14

Really?

D Dylan Cave 25:15

Dylan Cave 25:15

That's, that's super interesting [laughter]

Brittany Ekelund 25:16

Yeah, I would have thought it would be like the outside stuff that looks-- [crosstalk] A lot different.

Dylan Cave 25:19

[crosstalk] I guess it depends on how much you'd like jump on trampolines as a kid - how much it moves stuff around [laughter]--

Dana Cobzas 25:23

[crosstalk] How much muscle you have--[laughter] How much fat, how much-- Yeah, because I work with another project with a lady, also from oncology, that was interested in the abdominal images, she wanted to measure actually the ratio between muscle and fat.

Brittany Ekelund 25:38

Okay.

Dana Cobzas 25:39

And then I notice how much variability we have on the inside [laughter]. But the brain is-- I mean, if you look at the brain, it looks kind of the same, though. So it's a bit less variability. You'll notice atrophy, and obviously some lesions like the MS. If people have lesions, obviously, you'll notice that but otherwise, it's kind of looks the same.

Brittany Ekelund 26:01

So when we we talk about computer vision then, if the brain has less variability, is it then easier to apply these algorithms and get a more accurate result?

Dana Cobzas 26:12

It is a bit easier, yes. Because you can capture it in a bit less numbers, you can say, so you can create a model that has less parameters.

Brittany Ekelund 26:27

Okay, um, well, thanks for sharing that with us. Moving on, there is another project I wanted to talk about. It's called the shape project. And it's about faces. So can you tell us about that project?

D Dana Cobzas 26:42

Yeah. So that's a very interesting project. So the project is, on shapes. Which , shapes are, if you think-- they are kind of the skeleton, the outside of a shape. So, for example, the shapes can be interpreted as meshes, or represented as meshes. So basically--

B Brittany Ekelund 27:03

And is a shape different from like-- isn't a shape, like a square or a triangle, or a circle. Okay.

D Dana Cobzas 27:09

Yes. But it's different than an image. Now, an image is an array of pixels - it has like, a two or three dimensional square that every every pixel has a value, whereas a shape is represented by some 3-D location of points is like a graph.

B Brittany Ekelund 27:31

Okay.

D Dana Cobzas 27:32

So basically, you represent, uh-- it's a bit like in graphical models. You probably have seen those meshes, where you, or when you work with any kind of blender or any kind of modeler, you see the shape without being rendered with texture. And so that's basically how we represent shapes. I mean, there is a mathematical theory of shapes. But practically, that's how, at least I I work with them as meshes.

B Brittany Ekelund 27:57

Yeah, which I think people might know, like, have you ever seen a movie where they're like, making something on a computer screen?

D Dana Cobzas 28:03

Mmhm.

B Brittany Ekelund 28:03

And it's, it's, yeah, it looks like a mesh that like shapes into things. Mmhm. Okay.

D Dana Cobzas 28:08

Yeah.

B Brittany Ekelund 28:08

So the project is on shapes, um, and what is the project about?

D Dana Cobzas 28:14

So it's just, uh-- our project is again, about representing those shapes and trying to understand the low dimensional space of a certain type of shapes. And so it is, it is exactly like working with images, except you have a bit of a different structure now, because you have this graph structure where every point has some neighbors, but they are not necessarily arranged in a grid. So we had to apply all the original algorithm that were developed for images to this more irregular structures, which were graphs. And our-- so we, the project that we worked - again, on the hippocampus project - that's our kind of main motivation, but I had a student that did a side project that was very successful on analyzing faces.

B Brittany Ekelund 29:10

Okay.

D Dana Cobzas 29:11

So, um...

B Brittany Ekelund 29:13

Which must be very difficult.

D Dana Cobzas 29:15

Um, yes it sounds very difficult [laughter]. So we will read a database - a public database of faces - so basically, just the scans of people that were converted to those meshes and they had various expressions. So they were, I think there were 12 people and 12 expressions like smile, or, I don't know, all kinds of expressions with a face. And then what we were looking at-- we were looking at trying to represent this space of shapes and relate to those basic parameters that are the 12 expressions.

B

Brittany Ekelund 29:56

Okay, so--

D

Dana Cobzas 29:57

Yeah, so how, if we can actually identify these directions of variability in our encoding,

B

Brittany Ekelund 30:05

so I guess, trying to understand that. So were you trying to see if you could have a program actually know if someone had a particular expression or feeling?

D

Dana Cobzas 30:20

Yes. So that was one goal, like this is called classification. So basically having a face mesh, if you can say if it's an expression, but on the other hand, what's the big power of those methods - that are called the auto encoders - is that you can also generate new faces that never existed. So probably all of you probably know about all these applications where you can generate people that don't exist-- [crosstalk] Like deepfakes and stuff? [crosstalk] [inaudible] Yeah, exactly.

B

Brittany Ekelund 30:50

Okay.

D

Dana Cobzas 30:51

So that's what we actually-- my student was able to do that. And I was actually really impressed by his results. So we were able to detangle those dimensions, the 12 expressions, and then be able to generate new faces with a particular expression.

D

Dylan Cave 31:10

I have to go back. What is deep fakes?

B

Brittany Ekelund 31:13

Uh, well, I'm not an expert on deepfakes, but it is something that comes a lot up a lot in communication studies, because obviously - journalism, accuracy - like knowing what is real and what is not. Um, so deep fakes are kind of like, you can create a basically like almost facsimile of a person, but it's not real, like you could create like a video of President Obama making a speech through-- I don't know if it's different technologies, or if you're taking different clips and like blending them together, but they're called deepfakes. Because, I mean, a lot of them are almost seamless.

D Dylan Cave 31:54

Okay. [crosstalk] So it's basically-- [crosstalk] Yeah.

B Brittany Ekelund 31:56

People have found a way-- do you, ike, can you help us explain what a deep fake is [laughter] from, I guess, the mathematical, like computer vision point of view?

D Dana Cobzas 32:09

Yeah, so it is it is exactly this. So it is this, what they're called either variational auto encoder or GaNS? They are generative adversarial networks. And those models are able to represent, um-- so you have a lot of training data--

B Brittany Ekelund 32:25

Yeah.

D Dana Cobzas 32:25

People that uh, you take-- I mean, most of them are done on images or video, but I guess we adapted for this other type of data. So you train with this huge amount of data. And then the model is able to learn how a person is supposed to talk, say something, smile, or-- and then they also can create totally new people that--

B Brittany Ekelund 32:48

That don't exist.

D Dylan Cave 32:49

So scary [laughter].

D Dana Cobzas 32:50

That is the website is called this, this person doesn't exist and you can just refresh it and it just gives you a new person, but those people don't exist. They're just, uh, computer generated. So we have these huge networks that - the deep networks - that they learn from data so if you give them enough samples of how people are supposed to look like they are able to create new people. They will be-- people think they will be able to create music, literature, books, uh--

B

Brittany Ekelund 33:20

Like, all AI.

D

Dylan Cave 33:22

This sounds--

B

Brittany Ekelund 33:22

[crosstalk] Yeah.

D

Dylan Cave 33:22

A lot like Skynet, and I'm scared [laughter]. Like, I'm genuinely worried. This person does not exist - I have this loaded on my screen--

B

Brittany Ekelund 33:30

Yeah, Dylan is looking at it right now [laughter].

D

Dylan Cave 33:32

I keep refreshing- these pictures are so like real!

B

Brittany Ekelund 33:35

Well, that's crazy to me, because like you can't even get like decent CGI in a movie, but we can fully create people and deepfakes and we need to apply this technology to the cinema immediately. [laughter]

D

Dylan Cave 33:50

Well, they've done certain CGI as I suppose, and movies - going on a tangent a little bit - and I was I was at Coachella the year that Tupac performed.

Brittany Ekelund 33:59

Oh, the hologram!

Dylan Cave 34:00

The Tupac hologram. And I tell you, I was probably 30 feet away from the stage and it was so convincing. Somebody next to me was like, Hey, man, I heard that's Tupac's cousin. Like they-- everyone was totally convinced that you know this was a real person performing on stage and that's live that's not on a digital screen. That's not anything that's that's in front of my face. That's an illusion.

Brittany Ekelund 34:26

So with this-- [crosstalk] Anyways... [laughter] Yeah, but with this shape, um, like program - would you call it programming or software?

Dana Cobzas 34:36

[crosstalk] Method or I don't know--

Brittany Ekelund 34:37

[crosstalk] Yeah.

Dana Cobzas 34:38

[crosstalk] [inaudible].

Brittany Ekelund 34:38

With this shape method, would you be able to create a three-dimensional--

Dana Cobzas 34:42

Face.

Brittany Ekelund 34:43

Face?Just floating in the air? Okay, holograms coming soon to MacEwan. Research Recast(ed) holograms. [laughter] So yeah, so what's next for the shape project? um, like are there any plans? Is it still in progress? Any plans for the future? Any applications maybe?

D Dana Cobzas 35:01

Yeah, so we want to apply it for the hippocampus data now. So we, and any other brain structures. So the the BME professors are very interested in this. Um, and yeah, so we will see what we'll discover. So we want to see, to, again, characterize this variability of hippocampus with age mainly, but then other parameters might be discovered, uh--

B Brittany Ekelund 35:27

What would integrating this method with your, like work on the hippocampus in the brain, like, how would it work? How would you use the Shape Method in that context?

D Dana Cobzas 35:41

Um, I think it's not very different. So we will still use the variational auto encoder, it's just that we have to - we call it conditioning by age - so we have to kind of make-- introduce this new variable into the system. So whereas the faces, they had the expressions, which are discrete, in a way, variables, whereas age is something continuous, so I think that's the only difference. So, but it's really, from a mathematical point of view, is not very difficult to do this conditioning. So, it's just that a lot of other works need to be done for pre-processing the data. So yeah, we have a bit of work in pre-processing this hippocampus shapes and isolate them from images, make them into meshes, and getting them ready for this algorithm.

B Brittany Ekelund 36:39

Well, that's really interesting. So thanks for sharing that. And we're going to go to another quick break, and then we'll be back to talk about some segmentation. [music starts]

D Dylan Cave 36:51

Thank you for joining us. This has been another episode of Research Recast(ed), don't go anywhere. We'll be right back to finalize this wonderful conversation. And we'll see you then.

B Brittany Ekelund 37:03

[music stops] In case you didn't know, February 11, is the International Day of Women and Girls in Science. So, if you're a woman or a girl who's interested in STEM, or you know a woman or a girl who is interested in being interested in STEM, we're going to drop a couple links in our episode description. Follow up with those to check out some programs across the country and find local events in the community and get stemmed. [music starts] We're going to talk about the MS segmentation challenge. And if you don't know what that is, join the club. Dana is going to tell us all about it. um, take it away! [music fades out]

Dana Cobzas 37:50

Yeah. So we participated-- I had two students that from MacEwan that participated in this MS segmentation challenge. So it is, was part of the MICCIA conference. MICCIA is the main medical imaging conference. Obviously, everything was virtual this year, but the conference was in Strasbourg. So the team that organized the conference for the challenge is from, uh, from a research institute in [inaudible].

Brittany Ekelund 38:19

Okay, so this is an international challenge.

Dana Cobzas 38:23

Mhmm.

Brittany Ekelund 38:23

Okay.

Dana Cobzas 38:24

Yeah.

Brittany Ekelund 38:24

Do they do it-- like, is it an annual thing? Or is it a one time...

Dana Cobzas 38:28

Every year there are quite a lot of challenges. So the way they work is that they put together a data set. In this case was brain scans of MS people and it was, is very well annotated by medical experts. I forgot-- I think there were two medical experts that did the annotation for this lesions. So the goal of this challenge was to detect new lesions. So it was actually a temporal sequence. So scans of the same person at several times. I think we just had two times this time. But anyway, so we were-- the task was to identify new lesions that were not present at time one, but were present at time two.

Brittany Ekelund 39:13

Okay-- So that would be kind of similar to some of the research we talked about earlier, where, like, you can't just look at the scans and one of your students could be like, Oh, there! Like, that wasn't there last time. So, is it kind of trying to teach a machine or a computer to identify something that we couldn't see, like, with our eyes?

D Dana Cobzas 39:13

[crosstalk] Yeah. [inaudible] Sometimes, I guess you can see-- this just trying to automate the system.

B Brittany Ekelund 39:44

Okay. So it's trying to automate.

D Dana Cobzas 39:45

Yeah.

B Brittany Ekelund 39:46

Okay.

D Dana Cobzas 39:47

So, um, yeah, so we participated. So we had a time where we could train our methods. So we use a very similar method to the hippocampus segmentation and... Yeah, so we had the time to-- we got the data, we trained our method, and then we had limited test data set that we could test our results. But then the, at the time of the challenge, a completely new data set was given for testing.

B Brittany Ekelund 40:15

Okay, so you got some data, you're allowed to train your method. And when you say train your method, do you mean like create a program?

D Dana Cobzas 40:22

Yes we first created a program, and then training means learning. So basically, is this process of training your network. So you, you have to get the values for all the parameters of your method.

B Brittany Ekelund 40:37

Okay. And then you teach it to be able to do that-- [crosstalk] Automatically. [crosstalk] Okay. So how many student?

D Dana Cobzas 40:43

Two students.

B Brittany Ekelund 40:44

So it was you and two students?

D Dana Cobzas 40:46

Yes.

B Brittany Ekelund 40:47

Okay. So tell us like about the experience? How did it go?

D Dana Cobzas 40:52

Oh, it was, uh-- they were really excited. Students are always excited with this kind of things - competition, challenges - and so they were very motivated to participate, and--

B Brittany Ekelund 41:01

Did they have to - sorry to cut you off - did they have to like audition? Did you choose the students by hand? Did they apply?

D Dana Cobzas 41:08

Oh, no. I was working with them already.

B Brittany Ekelund 41:10

Okay.

D Dana Cobzas 41:10

So I just told them about the challenge. And then they were kind of excited and wanted to do it. Okay. So--

Okay. So

D

Dylan Cave 41:16

A bunch of keeners. [laughter]

D

Dana Cobzas 41:18

[crosstalk] Yeah [inaudible]. [laughter] Yeah, so and then... So then at the competition, they it was kind of nice that-- obviously, because it was organized in Europe, we had to wake up at 5 a.m. to watch the video--

D

Dylan Cave 41:34

[crosstalk] Oh my god. [laughter]

D

Dana Cobzas 41:35

And we even requested this time, because we had to - so it was afternoon time for them, so uh, and then-- Yeah, so we were watching all the results live. And I was very surprised. They did very well. So we didn't win the competition. But, because, yeah, it's a lot of very famous [inaudible]-- We did quite well. So we were the first Canadian team. So we, first of all, we we ended up kind of in the probably the first half. But we were the first among the Canadian teams.

D

Dylan Cave 41:54

[crosstalk] But you still did quite well!

B

Brittany Ekelund 42:07

And there were four?

D

Dana Cobzas 42:11

I can't recall exactly. About four Canadian teams, I think.

B

Brittany Ekelund 42:13

[crosstalk] From across the country.

D Dana Cobzas 42:15

Yeah, and big universities. So, I was really proud of our team from such a small university that they made it. Yeah.

D Dylan Cave 42:26

[crosstalk] That's big news. [crosstalk] That's really great.

B Brittany Ekelund 42:28

[crosstalk] Yeah, go MacEwan! Yeah, you're doing all of this research. You're also teaching quite a few courses, here at McEwen. So how do you balance all of those responsibilities? And how do your roles as a researcher and a teacher interact?

D Dana Cobzas 42:43

Balancing is hard. I just take it day by day-- [crosstalk] I'm surviving. [laughter]

D Dylan Cave 42:47

[crosstalk] Me too! [laughter]

D Dana Cobzas 42:49

I tell my friend, once the semester starts, I just feel like I'm in a roller coaster, I go in one end and then in December, I wake up in the other end. [laughter] So that's kind of how it feels. And unfortunately, I can't do so much during the term. But I pick up in the spring and summer. And just because it's so exciting for me. I'm, I'm always get excited with the research. I normally start reviewing the literature, getting up to date with what was happening in the last year, then getting in touch with my collaborators and students and trying to get some things starting for the spring and summer months. Yes.

D Dylan Cave 43:29

You know, I think that might be a common misconception among among the general population at the universities where, you know, our professors just have the summer off, and they just like get to enjoy their vacation.

B Brittany Ekelund 43:40

They're on a three month vacation. [laughter]

D Dylan Cave 43:42

In reality, a lot of our professors are doing a lot of scholarly activity during that time.

D Dana Cobzas 43:49

Yeah.

D Dylan Cave 43:49

Yourself included. That's when you get to have the time to do those really important research tasks.

D Dana Cobzas 43:55

Yeah, because you need the peace of mind and you need a continuity, you can't just-- research is not something that I wake up in the morning and I say, Okay, I'm gonna do research today.

B Brittany Ekelund 44:05

Yeah.

D Dana Cobzas 44:05

So you need to read you need to get into the-- it's usually a much higher level than your courses and find the right students and then try to have a schedule for them, try to think of projects and all that stuff. So, it's definitely something that if you don't enjoy it, you're not gonna do it, I think--

B Brittany Ekelund 44:26

I mean, I think what you need to do is create a program [Brittany laughs] to do research on it's own. Do you think that that, like, is a possibility in the future - that there will be fully like artificial intelligent-- like AI researchers?

D Dana Cobzas 44:46

Um, I don't know.

D Dylan Cave 44:49

There Probably is.

D Dana Cobzas 44:49

Yeah, I don't know.

D Dylan Cave 44:51

Or at this university do you mean?

D Dana Cobzas 44:53

I think all these programs are you can they can learn but the thing is that to create the algorithms, so I don't know if they maybe who knows, um, if in the future, they will just create themselves. [laughter]

B Brittany Ekelund 45:06

I mean, that's like the science fiction thing, right is that the computer just starts teaching itself, and then it's learning and then humans are doomed. But I'm just wondering. Yeah, could you if you could teach a computer to teach itself?

D Dana Cobzas 45:22

I don't know. [crosstalk] Yeah, who knows.

B Brittany Ekelund 45:24

[crosstalk] Or is that a good idea?

D Dana Cobzas 45:26

Yeah, it's the same, I always-- like when I talk with these medical doctors, they don't like the when people say that all the AI is gonna replace the doctors. And because it's not true, so it's just a helping tool. So you could never probably never replace a medical doctor. But you can help them. So it's probably the same in any field. Hopefully, we don't-- we still need people that can create music or art or otherwise.

D Dylan Cave 45:57

We did talk a little bit about this with one of our past guests, Robert Andruchow and Isabelle Sperano, in user experience design. So taking these these programs that you know, computer

Operand, in user experience design. So taking these these programs that you know, computer science has created and things like that. And then we talked about the the dilemma of having cashiers and self checkouts, it's like, well, it might eliminate the cashiers job, but it's actually created 10 other jobs, that's programming these machines to do these things. So I think it's very, very relatable. And I think user experience design can work in your work as well, making sure that the interface that the doctors are using is easy to use and helpful to them as well.

B Brittany Ekelund 46:46

Absolutely! Um, well, I think that that is all of the questions that we had for you. But at the end, we do like to leave the floor open to our guests. So um, yeah. Do you have any maybe advice for researchers or students that are interested in working in medical imaging and computer science? Or do you want to give any shoutouts? Do you have an idea for a new project that you want to talk about? This is basically this space for you to leave us with some last information-- [crosstalk] Whatever you like [crosstalk] Or knowledge? Yeah.

D Dana Cobzas 47:22

Um, I don't know what to say, I guess. For the students, I-- they should not bypass the math courses. So that's one thing. One, one main advice that I give them? I think it's a mistake, to not take enough math courses is to something that is so established that they, everybody should know a little bit--

B Brittany Ekelund 47:50

Well, you were saying in Romania, that actually Computer Science and Mathematics, when you are going to school--

D Dylan Cave 47:56

Hand-in-hand.

B Brittany Ekelund 47:56

Were together, like you couldn't separate them.

D Dana Cobzas 47:59

Well, not-- at the beginning, yes, that's true. But now I guess things are different. They're also--

B Brittany Ekelund 48:04

So a student could theoretically go into computer science and not take all the math?

D

Dana Cobzas 48:10

Now?

B

Brittany Ekelund 48:10

Yeah.

D

Dana Cobzas 48:11

I think-- I don't know. I don't, I'm not--

D

Dylan Cave 48:13

It probably would be really hard. [laughter]

D

Dana Cobzas 48:14

But not so advanced math. So I did a lot of math that I always find useful. So, um...

B

Brittany Ekelund 48:24

So do the math!

D

Dana Cobzas 48:25

Mm hmm. Well, that's [inaudible]--

D

Dylan Cave 48:26

[crosstalk] In my, in my world we-- In audio and stuff in the physics of sound we work on like logarithmic scales, and I might actually have to upgrade my math to take a course that I'm in next semester called acoustics.

D

Dana Cobzas 48:39

Mmhm.

D

Dylan Cave 48:39

D Dylan Cave 48:39

We talk about the the algorithms that we use to measure the speed of sound and, you know, the, the rate that sound decays and things like that. So we'll see if I see if I, if I have to upgrade or not.

D Dana Cobzas 48:56

Yeah, and then I don't know, don't be afraid of research. Research is, it is really amazing. It's very catchy. And I'm actually really glad a lot of my summer interns, they are now-- they applied or they will apply for grad school at the, mostly at the UofA. But I had quite a few that are already in the program. So, um, I think is really nice. I mean, it's not I mean-- I agree that of course, finding a job is eventually the the goal for every young person, but yeah, research is also something that is-- you can take a little break if you feel that call. So it's it's very nice, I think.

B Brittany Ekelund 49:40

I think so too, and and after, you know, I've now spoken with so many researchers, it's really like having a body of research and having a thing that you kind of explore all the facets of is really interesting and nice. I feel like if I had something like that it would give me great purpose. Like many of these projects are jumping off points. So really, if you can find that one, project and spark that passion, like you may have a lifetime of, of learning and researching and creating software that changes people's lives. So it's really, really interesting.... Anything else?

D Dana Cobzas 50:23

No, not I can think of [Dana laughs] Thanks a lot for inviting me.

D Dylan Cave 50:26

[crosstalk] It was amazing.

B Brittany Ekelund 50:26

[crosstalk] Well, thank you so much for being here.

D Dylan Cave 50:28

Yeah. Thank you so much for joining us. Um... I'll just yeah, let's do it. [Outro music starts]

B Brittany Ekelund 50:34

Well, it's time to pull the plug on today's episode of Research Recast(ed). If you enjoyed the conversation and you'd like to learn more about Dana and her research, please follow the links in the episode description.

D

Dylan Cave 50:51

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B

Brittany Ekelund 51:09

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D

Dylan Cave 51:19

Research Recast(ed) is hosted and produced by me, Dylan Cave, and Brittany Ekelund.

B

Brittany Ekelund 51:24

That's me!

D

Dylan Cave 51:25

Music sound design and editing by Dylan cave with research, copy editing and scripting by Brittany Ekelund. Our executive producers are Jason Malenko and Ray Baril.