

WEBVTT

1

00:00:00.000 --> 00:00:00.900
for being here.

2

00:00:02.040 --> 00:00:02.580
Morgan Elowe MacLeod: and

3

00:00:03.750 --> 00:00:06.420
Morgan Elowe MacLeod: Being our you know entertainment for the day.

4

00:00:07.560 --> 00:00:08.490
Morgan Elowe MacLeod: and

5

00:00:09.840 --> 00:00:12.000
Morgan Elowe MacLeod: yeah as as we go.

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00:00:13.110 --> 00:00:18.870
Morgan Elowe MacLeod: Remember that you can feel free to send us a
private message.

7

00:00:20.250 --> 00:00:30.510
Morgan Elowe MacLeod: On the chat and sort of get in queue for for to ask
a question it doesn't have to be your whole question just a word or two,
I have a question about whatever topic.

8

00:00:34.140 --> 00:00:34.410
yeah.

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00:00:36.420 --> 00:00:37.950
Morgan Elowe MacLeod: So so Nick did you want to go ahead.

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00:00:38.760 --> 00:00:39.540
Sownak Bose: Sure yeah.

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00:00:40.740 --> 00:00:53.010
Sownak Bose: Okay, great so thanks all for joining so it's our great
pleasure and honor to welcome Dr Brian on who is presenting today's ITC
colloquium.

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00:00:53.760 --> 00:01:06.420

Sownak Bose: To Brian is a staff, scientists and researchers at fermilab and the University of Chicago where a significant portion of his research and data is dedicated towards figuring out.

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00:01:07.020 --> 00:01:24.240

Sownak Bose: The many ways in which we can improve the way in which we make scientific discoveries through the use of contemporary methodologies like machine learning and artificial intelligence as applied to a very wide range of topics in cosmology and astrophysics.

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00:01:25.530 --> 00:01:36.900

Sownak Bose: An important part of this process is combining these techniques with rigorous statistical methods as well, and this forms a significant component of Dr knowles research.

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00:01:37.770 --> 00:01:45.630

Sownak Bose: He is a leader, also in advocating for and addressing issues of inequity and under representation in academic communities.

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00:01:46.140 --> 00:02:00.090

Sownak Bose: And he co created the academic stroke for black lives in June 2020 and is and works towards driving a large number of anti racist efforts and developing justice oriented communities.

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00:02:00.750 --> 00:02:14.370

Sownak Bose: And now, many of these elements will be blended together in his talk today, which focuses on the implications of artificial intelligence on both astronomy and society so Brian if you're ready, please take it away.

18

00:02:15.090 --> 00:02:19.350

Brian Nord (he/him): Oh yeah Thank you all so much thanks for the great introduction and the invitation.

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00:02:20.790 --> 00:02:25.260

Brian Nord (he/him): I was uh I was telling folks here that I couldn't sleep this morning, so I was watching.

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00:02:26.130 --> 00:02:33.240

Brian Nord (he/him): While I was doing some work, I was watching some documentary on artificial intelligence and I just reminded about how sort of disappointed I am in the way that.

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00:02:34.080 --> 00:02:45.330

Brian Nord (he/him): A lot of the lot of the public discourse occurs on on artificial intelligence and how people talk about it being magic and talking about these things learning and etc, etc, and that is to say.

22

00:02:46.410 --> 00:02:59.490

Brian Nord (he/him): That is not what this talk is going to be about i'm not worried about yet i'm not worried about robot overlords i'm really worried about how we as humans and as groups of humans decide to use these tools, whether it's in science, or society.

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00:03:00.960 --> 00:03:04.110

Brian Nord (he/him): So that's that's the framing for the talk and I guess I also, I also want to say.

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00:03:05.130 --> 00:03:09.990

Brian Nord (he/him): While we're while we're getting vaccinated while things like that are happening I just got my first, the other day.

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00:03:11.460 --> 00:03:18.600

Brian Nord (he/him): You know it's, this is still pretty extraordinary pretty extraordinary time and so thank you all for your energy, even though it's like it's still a you know it's still draws on it.

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00:03:20.370 --> 00:03:29.490

Brian Nord (he/him): So in this little choose your own adventure discussion I took my usual the narrative that i've been working on for the last several years and sort of.

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00:03:30.810 --> 00:03:33.360

Brian Nord (he/him): pulled out the pieces that I thought would help us have a good conversation.

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00:03:34.650 --> 00:03:39.630

Brian Nord (he/him): And what I would I want to do is continue to motivate this discussion in.

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00:03:40.500 --> 00:03:47.730

Brian Nord (he/him): Not and again, not in the evangelist sense, but in the sense that there's a there's a conversation occurring in the Community, right now, and in scientific community as especially.

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00:03:48.480 --> 00:03:58.170

Brian Nord (he/him): As as the size and complexity of our data sets grow and that's that's because our instrumentation is growing and complexity which is driven by our scientific questions.

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00:03:59.220 --> 00:04:07.440

Brian Nord (he/him): we're we're witnessing the data set screw by orders of magnitude between projects like sloan dark energy survey lstm to name things in the optical domain.

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00:04:09.270 --> 00:04:21.450

Brian Nord (he/him): And in this current era which I would say is marked by the time frame around 2015 2016 people are now the conversation is now around how dramatically.

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00:04:23.640 --> 00:04:32.580

Brian Nord (he/him): What how dramatic is and is necessary, the evolution in our computational tools or mathematical models to address these increased complexities.

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00:04:33.120 --> 00:04:46.050

Brian Nord (he/him): And so I think what might be fun for us to discuss today is how these things work a little bit why why they're not magic what the challenges are for using them in multiple venues.

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00:04:46.980 --> 00:04:55.440

Brian Nord (he/him): And, and maybe and combined with that, like what what the permission that I that I think it's given me to dream, a little bit about the future of what science looks like.

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00:04:57.720 --> 00:04:58.830

Brian Nord (he/him): So what is.

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00:05:00.570 --> 00:05:04.680

Brian Nord (he/him): Sometimes I do that well, sometimes I don't you caught me I don't know you be the judge.

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00:05:05.880 --> 00:05:16.710

Brian Nord (he/him): I get I get different responses different times so it's it's you know, is it a learning computer it's a neural net processor that's you know that's true, although, in this case he's saying it's a cpu but usually it's a gpu.

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00:05:18.450 --> 00:05:28.140

Brian Nord (he/him): So, so we have all these words surrounding these kinds of tools and these kinds of algorithms, but I think it's good to remind ourselves that they are still mathematical models.

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00:05:29.070 --> 00:05:36.150

Brian Nord (he/him): So we can write them down, just like we do other mathematical like physically motivated mathematical models as there's some variable that we want to predict.

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00:05:36.480 --> 00:05:46.830

Brian Nord (he/him): via a function and an input variable via a function that takes in an input variable and some parameters P and we're often trying to figure out what P is so that we can best predict what Why is.

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00:05:47.940 --> 00:05:50.820

Brian Nord (he/him): In in physically motivated models, you might take these blue dots.

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00:05:51.180 --> 00:06:00.270

Brian Nord (he/him): And if that's luminosity on the y axis and mass on the X axis, you might say, Okay, I have, I have some physical intuition for something that's been built up over the years.

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00:06:00.660 --> 00:06:08.310

Brian Nord (he/him): In my wet neural network that expects there to be a line being drawn through those points and that's our model, so we have an A and a B is our parameters.

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00:06:09.480 --> 00:06:20.700

Brian Nord (he/him): The major difference, I think, between those two between sort of traditional models physically motivated models and statistical learning is that except for what goes into the data that's used to train them.

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00:06:21.570 --> 00:06:28.320

Brian Nord (he/him): There is not very much if any physical intuition inside those models inside statistical learning models.

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00:06:30.000 --> 00:06:34.170

Brian Nord (he/him): So the weights these parameters are mostly arbitrary.

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00:06:36.570 --> 00:06:47.880

Brian Nord (he/him): And so I mentioned training of these training of these models and what does that mean we often talk about learning, which is you know the nomenclature here is really kind of terrible and obfuscating.

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00:06:48.990 --> 00:06:56.010

Brian Nord (he/him): But if you if you think of training under on that, like training me and my freshman year chemistry class here to wake up and clap.

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00:06:57.300 --> 00:07:05.370

Brian Nord (he/him): we're always training on historical data, and I think that's important to remember so Kathy so like there's there's this.

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00:07:08.550 --> 00:07:17.340

Brian Nord (he/him): there's this thinking that there can maybe be some predicting of things that these models have never seen before, and and and most of the tools that we're using in deep learning and Ai.

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00:07:17.730 --> 00:07:23.880

Brian Nord (he/him): it's using historical data it's using data has already been say it's observed and then labeled as galaxies and stars.

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00:07:24.330 --> 00:07:28.740

Brian Nord (he/him): or it's even historical in the sense that it's simulated and based on the things that we already know.

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00:07:29.250 --> 00:07:38.370

Brian Nord (he/him): And so that's what we say when that's what we mean when we say learning that's what training is and and Kathy fields, who wrote weapons of mass destruction she's really sort of.

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00:07:39.060 --> 00:07:44.190

Brian Nord (he/him): She didn't coin that but she's been one of the people who's been really careful about pointing that and pointing that out.

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00:07:46.290 --> 00:07:56.970

Brian Nord (he/him): So a little bit about how deep neural network works which I think is just important to baseline all of us, so we have a sense of why it works, even if.

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00:07:58.980 --> 00:08:05.550

Brian Nord (he/him): Even if it doesn't get into the the full set of issues interpreter ability, I think I think this helps so if you're if you're.

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00:08:07.140 --> 00:08:16.830

Brian Nord (he/him): If you're using a neural network where so each of these little black circles, is a computational neuron that contains some function in it which I think i'll get into in a second I will.

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00:08:18.180 --> 00:08:26.550

Brian Nord (he/him): what's happening is that you send an image in and sets of these individual layers of these neurons or sets of these layers learned.

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00:08:27.510 --> 00:08:40.560

Brian Nord (he/him): A sense different kinds of features in the images so it's typical that the first couple of layers will learn things learn again i'm lot of these all these terms i'm using air quotes so they'll learn things like edges straight lines.

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00:08:41.070 --> 00:08:50.700

Brian Nord (he/him): And then later they'll learn circles and squares and then later this is this kind of the important bit at some point they'll learn out enos to learn.

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00:08:51.630 --> 00:09:02.430

Brian Nord (he/him): The nearness of that and that and that tends to be where humans have trouble discerning what things really are and that's that I think that represents part of the power of these tools.

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00:09:03.870 --> 00:09:05.070

Brian Nord (he/him): i'll, be it still limited.

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00:09:06.270 --> 00:09:09.360

Brian Nord (he/him): So how do they work let's say you wanted to train.

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00:09:10.770 --> 00:09:18.960

Brian Nord (he/him): On some labeled data of citizen Giorgos so you have these you have these pictures of cats and dogs that go in and it's been labeled by humans.

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00:09:19.320 --> 00:09:28.740

Brian Nord (he/him): And they are sent into this like like we send the idea in their sent into this input layer and each of these little circles is computational neuron contains a.

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00:09:29.640 --> 00:09:33.480

Brian Nord (he/him): And this is again is this is the crucial point, it contains a nonlinear function.

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00:09:34.410 --> 00:09:53.970

Brian Nord (he/him): Such that the combinations of through through the layers the combinations of information that's coming in, is is is is captured in an overall nonlinear function and that that is one of the key pillars of why these things are powerful so that's why I can capture so much.

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00:09:55.980 --> 00:09:57.210

Brian Nord (he/him): So much nuance in the data.

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00:09:58.440 --> 00:10:04.110

Brian Nord (he/him): So you send this information in after you've you've initialized the say there's there's a random whiteness computational neuron.

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00:10:05.250 --> 00:10:11.850

Brian Nord (he/him): In each of these they're all and they're all independent you've sent this information in this image in and.

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00:10:13.860 --> 00:10:22.380

Brian Nord (he/him): At the output layer the network makes a guess about whether it's a whether it's a cat or a dog and depending on that prediction why predict.

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00:10:22.710 --> 00:10:27.000

Brian Nord (he/him): and comparing that to why truth there's some loss or some error associated with it.

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00:10:27.540 --> 00:10:34.320

Brian Nord (he/him): And a procedure called back propagation which was one of the big things that was sort of discovered or invented.

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00:10:34.650 --> 00:10:45.600

Brian Nord (he/him): In near this modern era of Ai that allows these things to to work so well sends information backward through the network to update the weights, so that this is the fitting procedure that is often called training or learning.

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00:10:49.080 --> 00:11:05.580

Brian Nord (he/him): So that's a deep neural network that I just showed and that lives in the Center of this this diagram here, which is from Ian good fellow joshua benji and carville some of the sort of modern grandparents or parents or whatever you want to call it inventors of key things and Ai.

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00:11:06.810 --> 00:11:15.930

Brian Nord (he/him): Deep learning is at the Center here and it's what's used in a lot of tools are a lot of contexts, I should say and and as we go outward we get into this.

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00:11:16.950 --> 00:11:29.550

Brian Nord (he/him): Maybe not in these in these first few layers here, not so fuzzy but in this outer layer we get into what Ai is, which is sort of the most buzzword East and the fussiest of the things that are defined here.

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00:11:31.470 --> 00:11:34.770

Brian Nord (he/him): And the this this overall Ai.

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00:11:35.850 --> 00:11:43.290

Brian Nord (he/him): sort of analysts here is the idea that knowledge bases themselves can be largely captured.

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00:11:44.400 --> 00:11:52.050

Brian Nord (he/him): and whatever whatever system, it is that does, that is, is what you might call Ai and then it gets more and more and more specific.

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00:11:52.500 --> 00:11:59.760

Brian Nord (he/him): But we use it, we have all these terms and like deep learning and machine learning and representation learning they do tend to me in specific things but I when people.

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00:12:00.840 --> 00:12:05.040

Brian Nord (he/him): I think when when we talk about it and to kind of recap, some of the initial thoughts.

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00:12:05.550 --> 00:12:18.750

Brian Nord (he/him): I I usually just think that these are all things that are classes of algorithms that that build models driven primarily by the data so coming back to what the differences between physically motivated models and these data driven models.

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00:12:20.460 --> 00:12:26.430

Brian Nord (he/him): So, how did we get here, or like, why are we able to be doing what we are now which i'll get into.

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00:12:27.600 --> 00:12:28.470

Brian Nord (he/him): In just a moment.

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00:12:29.850 --> 00:12:44.610

Brian Nord (he/him): It took us so mcollough can pits put together the first computational neuron in the 1940s and so it's taken us, you know about 80 years to get to where we are there were a few Ai summers that were.

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00:12:45.420 --> 00:12:52.650

Brian Nord (he/him): separated by pretty severe Ai winters and those Ai winters I think my understanding is that they were driven by.

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00:12:53.220 --> 00:13:06.420

Brian Nord (he/him): sort of hubris there, there are a lot, there was a lot of over promising in terms of what these systems can do, and I think that's an important part of our conversation and our Community, are we over promising right now and I and i'll click the button.

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00:13:08.100 --> 00:13:11.220

Brian Nord (he/him): spoiler alert, yes, I think we are, to a significant degree.

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00:13:12.960 --> 00:13:19.980

Brian Nord (he/him): And as an example, one of the first, I think it was in the first summer a bunch of.

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00:13:21.660 --> 00:13:32.820

Brian Nord (he/him): bunch of computer scientists bunch of Dudes got together and said hey this summer let's meet in Dartmouth and let's figure out this whole Ai thing they literally thought that in three months, they were going to like solve this problem turns out.

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00:13:35.190 --> 00:13:43.500

Brian Nord (he/him): And it really took it took several spurts here is as i'm as i'm implying with these different parts of the triangle to.

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00:13:44.490 --> 00:13:52.470

Brian Nord (he/him): develop the algorithms so that you could actually efficiently train and optimize for the for the right weights to do the to do the good predictions of cats and dogs.

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00:13:53.160 --> 00:14:05.190

Brian Nord (he/him): And it was really too slow in a lot of cases until we had graphical processing units to do that, and then the the other, the third big ingredient is having lots of that historical data to make that possible.

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00:14:07.800 --> 00:14:12.270

Brian Nord (he/him): So what does this look like, so what i'm going to like to do now is just show a few examples.

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00:14:12.780 --> 00:14:27.720

Brian Nord (he/him): and have a sort of a broad discussion of how this is being applied in astronomy and i'll give a few examples from what our group is doing and then then i'll switch over into the social implications and we can kind of see how how these different things parallel each other.

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00:14:30.330 --> 00:14:40.140

Brian Nord (he/him): So my I would claim that if we all said Okay, this is just silly we don't need to spend a lot of time trying to figure out how to get all their stuff into Google collab.

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00:14:40.740 --> 00:14:51.540

Brian Nord (he/him): let's just stop let's just stop trying to build the algorithms further develop them let's use what we have, I think that we would have a pretty clear when when it comes to classification of objects.

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00:14:52.950 --> 00:14:59.940

Brian Nord (he/him): So if we're looking to find more of the things that we already know exist, then I think we're good I think like we can do this faster.

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00:15:00.870 --> 00:15:14.190

Brian Nord (he/him): than, then we could before, and that would be fine, I think it gets to be a really sticky wicket when you try to actually measure things from images and and that'll come along by the by the end of this little section here.

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00:15:17.940 --> 00:15:24.420

Brian Nord (he/him): i'm just going to give some highlights, I think, to give a sense of where where these things can go if you.

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00:15:26.700 --> 00:15:36.570

Brian Nord (he/him): yeah what what kinds of advances can be made with some of the i'll say in this case some somewhat simpler tools, but maybe maybe deployed in a way that.

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00:15:38.040 --> 00:15:52.110

Brian Nord (he/him): considers some of the nuance challenges so, for example, Alex has been leading work in detecting galaxy mergers, for the

last couple of years and we've been working with folks at space telescope and she showed a year or two ago that.

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00:15:53.250 --> 00:16:02.850

Brian Nord (he/him): If random forest where the sort of state of the art method at the time, at least demonstrated in simulations that with with a very pretty shallow deep neural network.

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00:16:03.390 --> 00:16:10.740

Brian Nord (he/him): You can get 10% increases and completeness and purity at, for these are in these emerges at high redshift like well as well above one.

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00:16:13.140 --> 00:16:20.760

Brian Nord (he/him): I mentioned training on historical data, and so we want to think about okay great we can train this stuff in simulation and you know the right answer when you go and.

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00:16:21.060 --> 00:16:30.090

Brian Nord (he/him): test it on simulation But what if you wanted to use it on real data, so you have to take into account the fact that your domains are different in ways that you.

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00:16:32.130 --> 00:16:33.420

Brian Nord (he/him): I would say it's virtually.

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00:16:34.740 --> 00:16:45.480

Brian Nord (he/him): Well, I won't say impossible, but it's really, really hard to know all of the differences between your your target domain and your source domain so like between your real sky data and the data and the simulated data.

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00:16:46.020 --> 00:16:53.220

Brian Nord (he/him): And so you have to use tools like transfer learning and domain adaptation to take it to that next step, otherwise.

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00:16:54.060 --> 00:17:05.700

Brian Nord (he/him): you're almost certainly going to have significant biases I mean you can you can still get significant biases even with domain adaptation so Alex lead this a little bit larger group in training on simulations and applying the spss data.

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00:17:07.110 --> 00:17:16.320

Brian Nord (he/him): it's a technique called adversarial domain adaptation which we can we can talk about adversarial stuff a bit of people want and we could get about a 20% increase in accuracy.

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00:17:17.460 --> 00:17:27.660

Brian Nord (he/him): So a couple of years of work and yeah you'd be the judge if these 10% these 20 20% increases are worth that time I think that's that's part of this conversation like we're putting this work into it, is it worth it.

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00:17:30.750 --> 00:17:45.780

Brian Nord (he/him): Over the last year to a former undergraduate Jen Lin now graduate student at uc has been leading an effort to try to better classify sse clusters in in simulated microwave data.

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00:17:46.620 --> 00:17:58.020

Brian Nord (he/him): And he did a cool thing, where he combined a neural network and and match filter methods which led to an increase in completeness of about 26% and detections.

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00:18:00.660 --> 00:18:05.010

Brian Nord (he/him): And that was so Nick Wang and can you elaborate Ruse they part of that too.

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00:18:07.050 --> 00:18:20.610

Brian Nord (he/him): So I want to get back to for the final part of the science here, I want to come back to why why we are and should be worried, or why I am and we should all be a little bit worried about directly applying these tools to measurements of things so.

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00:18:23.700 --> 00:18:26.550

Brian Nord (he/him): There are there's a we can.

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00:18:28.290 --> 00:18:36.870

Brian Nord (he/him): If we know what the input errors are are the errors on inputs are to a system to some physical system, then we can propagate those errors through.

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00:18:38.220 --> 00:18:46.830

Brian Nord (he/him): The question is, do current techniques and machine learning and deep learning can they do that accurately, can we get out error bars that are interpreted.

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00:18:47.130 --> 00:18:53.550

Brian Nord (he/him): In the way that we expect them to be or that we're and we're used to them being from our physical physically intuitive models.

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00:18:54.150 --> 00:19:07.710

Brian Nord (he/him): So joelle Caldera who left our group to work at Google last year because that's what happens he actually went into software engineering, he was he didn't really want to do much more machine learning and in academia it wasn't my fault I swear he told me so.

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00:19:09.510 --> 00:19:19.920

Brian Nord (he/him): But so we we wanted to do this comparison and you know we saw some people doing using some deep learning tools in and applying them to astronomy data.

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00:19:20.670 --> 00:19:28.950

Brian Nord (he/him): And, but there wasn't a lot of discussion in the in those items about okay do these aero bars mean anything, they just sort of showed, you can make them small.

126

00:19:29.250 --> 00:19:39.240

Brian Nord (he/him): And so we said okay these systems are way too complicated let's do a physical pendulum where we can simulate it and add an error bars and know kind of everything that's going on in it.

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00:19:40.560 --> 00:19:49.110

Brian Nord (he/him): And so the idea is, if you to compare these different axes of uncertainties on machine learning language in the in the jargon, which.

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00:19:49.770 --> 00:19:57.570

Brian Nord (he/him): The literature is not super well contained here surprise, surprise, as far as we're seeing in the overlaps of these fields.

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00:19:58.440 --> 00:20:08.460

Brian Nord (he/him): Elliot torque and epistemic or the way that people tend to define uncertainties machine learning and Allah torque is really noise in the data and epistemic uncertainty is really the fidelity of your model.

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00:20:09.210 --> 00:20:23.640

Brian Nord (he/him): And these these map a little bit the best we could do is to to frame this as to think of them as statistical uncertainty

being not being mapped in noise in the data and systematic being mapped and noise in the data and noise in the model itself.

131

00:20:26.040 --> 00:20:38.190

Brian Nord (he/him): This is a little bit of a complicated plot so i'm going to describe it, but we can come back to it, so what we're seeing on the X axis is that analytic prediction of the uncertainty on the gravitational constant g.

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00:20:40.350 --> 00:20:46.890

Brian Nord (he/him): And on the X axis is the uncertainty prediction straight out of three different deep neural network models.

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00:20:47.370 --> 00:20:53.070

Brian Nord (he/him): So your best you're going to do best if all these are sitting along the dashed line here you want them to be one to one.

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00:20:53.760 --> 00:21:04.650

Brian Nord (he/him): So what we did is we said okay let's let's put a noise in the period of one to 5% and then one to 10% and then one to 20% and then we and then say okay do these recover the uncertainty.

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00:21:05.220 --> 00:21:14.070

Brian Nord (he/him): And you can see that none of the deep learning models really well recover the uncertainty until you know until you get up to around 10% uncertainty.

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00:21:15.090 --> 00:21:27.060

Brian Nord (he/him): And, and our best explanation for this, which I think still holds up is that, just like when you train neural networks, it has to see a wide variety of things to predict a value, it also has to see a wide variety of uncertainties.

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00:21:32.610 --> 00:21:36.060

Brian Nord (he/him): So sort of thinking, I alluded to.

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00:21:37.980 --> 00:21:40.020

Brian Nord (he/him): My my feeling more permitted.

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00:21:41.580 --> 00:21:46.200

Brian Nord (he/him): In this in this moment to kind of think think about the future and think about how.

140

00:21:47.280 --> 00:22:01.830

Brian Nord (he/him): If we if we do solve some of these problems and maybe even if we don't solve this this big uncertainty problem, but if we do, then what what could be part of the future of applications of machine learning, and so my group is working in a couple of different avenues to study how we can.

141

00:22:03.240 --> 00:22:08.190

Brian Nord (he/him): lessen the impact or lessen the need for humans in the loop when it comes to planning.

142

00:22:08.880 --> 00:22:15.390

Brian Nord (he/him): sky survey observations, so we have a couple of projects that are using reinforcement learning and also using some unsupervised techniques to.

143

00:22:15.930 --> 00:22:29.670

Brian Nord (he/him): not to have to be for the telescope eventually live, but before we're going to do some survey scheduling ahead of time, but eventually live reorder re re point the telescope without human intervention to meet an objective more efficiently.

144

00:22:31.230 --> 00:22:45.990

Brian Nord (he/him): And then, building on that actually we just started a really fun proposal this week to think about can we actually how much, and maybe how soon can we fully automate the the scientific the entire scientific process.

145

00:22:47.100 --> 00:22:52.020

Brian Nord (he/him): we're even or even thinking about how can we generate interoperable new hypotheses.

146

00:22:53.520 --> 00:23:02.250

Brian Nord (he/him): In an automated way and we have, we have an interesting idea I don't know if it'll be a good one, but again we're gonna we're gonna play a game with a pendulum and we'll we'll let you know if it if it holds up there.

147

00:23:04.800 --> 00:23:18.450

Brian Nord (he/him): And so there is a growing community of people thinking about this in a couple of different contexts, a lot, a lot of it is really in the machine control aspects so self driving telescope self driving biology labs things like that, and we had there was a.

148

00:23:19.650 --> 00:23:33.510

Brian Nord (he/him): workshop last fall, I think the report is coming out soon from the it's called the do you future scientific methodologies

workshop and they there was a sub sub group of us that they they asked us to think about what self driving facilities might look like in 30 years so.

149

00:23:34.920 --> 00:23:43.590

Brian Nord (he/him): You know needs must, I think, is the message i'm getting from do either things are very expensive and we need to start thinking of new ways to work on this.

150

00:23:44.280 --> 00:23:58.200

Brian Nord (he/him): So let me spend two or three minutes now on what's going on what I what I the patterns that i'm seeing in society, and I think you know people that have been around much longer in this field that i've been that i've been learning from what patterns they're they're seeing so.

151

00:23:59.220 --> 00:24:12.720

Brian Nord (he/him): I would claim that even, even if the hype continues to grow I don't think Ai is going to go away and it's kind of everywhere, for better for worse, so telling us what to watch.

152

00:24:15.180 --> 00:24:22.890

Brian Nord (he/him): Translating things for us instead of going from English to German to Spanish thing the machines are learning an internal language to go directly from English to Spanish.

153

00:24:23.460 --> 00:24:30.390

Brian Nord (he/him): Beating us at games like starcraft it would definitely beat me, I can tell you that go, I think the.

154

00:24:30.960 --> 00:24:38.250

Brian Nord (he/him): One of the best go players in the world, said I don't really need to play anymore, because they were beat three times in a row bye bye deep mines alphago.

155

00:24:39.210 --> 00:24:45.540

Brian Nord (he/him): And you know, maybe we'll have a self driving car I think that's one of the things that's had big hype and it's unclear like when that will actually happen.

156

00:24:47.610 --> 00:24:59.250

Brian Nord (he/him): And, as I said, i'm not worried about your robot overlords I am i'm not worried necessarily about you know how having this entire system yet and doing stuff to us, but I, but I don't think it takes that.

157

00:25:00.630 --> 00:25:07.170

Brian Nord (he/him): to cause concern or to cause us to really need to think hard about how these systems being used because humans are doing a good job of.

158

00:25:07.680 --> 00:25:16.230

Brian Nord (he/him): linking all of these systems together and that's what I want to give an example of that now and I and the end the question i'm i'm thinking about here and asking is how are we.

159

00:25:16.740 --> 00:25:32.130

Brian Nord (he/him): going to live together with these intelligent systems and robots that it's it is humans and robots living together but, but the important thing to remember here is that humans are still controlling the robots and that that's where our agency is in terms of individuals and a society.

160

00:25:33.450 --> 00:25:42.840

Brian Nord (he/him): And so we've talked about the promise briefly, and now I want to talk about the peril and and I think surveillance is a is a real thing and it actually has been a thing.

161

00:25:43.290 --> 00:25:49.710

Brian Nord (he/him): For a couple of decades now, because if you look at the trajectory of companies like Google and Amazon.

162

00:25:50.160 --> 00:25:57.090

Brian Nord (he/him): they've been collecting our data, with or without our consent for really for you, for decades, we basically didn't understand the value proposition of our data.

163

00:25:57.450 --> 00:26:12.540

Brian Nord (he/him): And so we were like oh free email go ahead scrape it and so they've been they've been using that to take take from us give back to us something but, but it was sort of an unfair unfairly presented proposition at the time, I would claim.

164

00:26:14.160 --> 00:26:23.640

Brian Nord (he/him): If you look at Amazon they're in some ways they're going a step further, at least with physical surveillance, you can literally buy glasses earbuds rings that all have microphones in them.

165

00:26:24.150 --> 00:26:32.970

Brian Nord (he/him): that are linked to alexa and these things if they're on their list they're literally listening all the time because that's how they know that you would say alexa do this.

166

00:26:34.170 --> 00:26:44.610

Brian Nord (he/him): And then there's a new company came out two or three years ago called clear view Ai where they they actually broke the terms of service of social media and they they basically scraped all of your data like literally.

167

00:26:45.060 --> 00:26:48.120

Brian Nord (he/him): Like there are probably people on this phone call whose data they scraped.

168

00:26:49.500 --> 00:26:57.570

Brian Nord (he/him): on Facebook so taking your information, and your pictures, putting them into a database learning what you look like so that then if.

169

00:26:57.960 --> 00:27:11.220

Brian Nord (he/him): If a law enforcement agency came by and said hey we have a picture of a suspect does that match any of the pictures and, like, I think I haven't really started with them, but i'm pretty sure it's some kind of you know auto encoder clustering algorithm that.

170

00:27:13.440 --> 00:27:20.640

Brian Nord (he/him): That said, oh that's this person, and then they then they know who, that is, they can find your name now and we have no say over that yet.

171

00:27:22.560 --> 00:27:32.460

Brian Nord (he/him): A lot of these tools are being especially facial recognition tools are being trained on bias data sets so the labeled faces in the wild as a standard training set for facial recognition.

172

00:27:32.880 --> 00:27:42.570

Brian Nord (he/him): I don't know if this one particular still being used, but it was used for a while and, as you can tell it it's trained on primarily men and primarily light skinned people, so if we think about biases between.

173

00:27:43.680 --> 00:27:51.720

Brian Nord (he/him): Real data and simulated data that is certainly there when it comes to different skin colors different ethnicities.

174

00:27:52.620 --> 00:28:07.620

Brian Nord (he/him): And so, then they use this information, so they scrape it all, then they train their models and then they surveillance is popping up and has been popping up everywhere there's facial recognition being used in schools and airports in sidewalks in the UK.

175

00:28:08.850 --> 00:28:17.820

Brian Nord (he/him): And then they use this to try to say things about who we are and this is particularly egregious because a lot of these things are being built by.

176

00:28:18.390 --> 00:28:26.820

Brian Nord (he/him): Computer computer scientists who like literally like exactly know better, and they know that this is not the right thing to do, but they continue to do it because they want to say Oh, I can predict your gender.

177

00:28:27.390 --> 00:28:35.130

Brian Nord (he/him): I can predict your sexuality, I can predict your your political motivation and it's just like it's literally both like ethically wrong and like just functionally wrong.

178

00:28:36.360 --> 00:28:48.690

Brian Nord (he/him): And then they tell us based all information what to buy what to watch where to go, who, to date, like literally there's machine learning in map applications that like will redirect you based on what it knows about you.

179

00:28:49.830 --> 00:28:55.380

Brian Nord (he/him): And yeah so all these things are biased against in law cases against black people.

180

00:28:58.920 --> 00:29:04.560

Brian Nord (he/him): and telling people who don't like who can attend university is another example, fortunately, this was this was thrown away.

181

00:29:05.880 --> 00:29:14.280

Brian Nord (he/him): who's incarcerated or who should be incarcerated, so there are multiple people have been sent to jail be through fish recognition literally because it's biased against black people.

182

00:29:16.050 --> 00:29:18.090

Brian Nord (he/him): And so I guess i'll just finish by saying.

183

00:29:19.440 --> 00:29:27.660

Brian Nord (he/him): You know, as as a scientist, I feel personally responsible because I want to fundamentally improve these algorithms for galaxy recognition.

184

00:29:27.930 --> 00:29:37.800

Brian Nord (he/him): But you know you throw a good idea up in the archive somebody's going to take it and use it somewhere else, and so I think that it's time for us to sort of examine our roles and responsibilities, these contexts thanks.

185

00:29:39.030 --> 00:29:39.840

Brian Nord (he/him): Sorry went over a little bit.

186

00:29:42.870 --> 00:29:46.860

Sownak Bose: Thank you very much, that was really very exciting and.

187

00:29:47.880 --> 00:29:51.420

Sownak Bose: I will press my virtual applause button as i'm sure everyone else okay.

188

00:29:51.480 --> 00:29:52.530

Morgan Elowe MacLeod: Thank you so much.

189

00:29:53.160 --> 00:29:54.030

Sownak Bose: One way or the other.

190

00:29:55.380 --> 00:30:09.420

Sownak Bose: So I think there's a very large number of topics of discussion that you brought up in your top Brian and, as I mentioned in the chat if people want to ask something please feel free to just drop me a message.

191

00:30:10.470 --> 00:30:15.090

Sownak Bose: With just maybe a word about what what more your questions about know call upon you, but just to.

192

00:30:15.510 --> 00:30:23.640

Brian Nord (he/him): kickstarter, so I would also say like if if there are things here that people disagree about or have new information like i'm also excited to have that conversation so like I.

193

00:30:24.420 --> 00:30:30.450

Brian Nord (he/him): While I while i've been doing this stuff a while I think there are lots lots of other probably more experienced experts and i'll just i'll just say that let's yeah.

194

00:30:30.660 --> 00:30:31.440

Brian Nord (he/him): let's let's jam.

195

00:30:33.060 --> 00:30:33.480

Sownak Bose: Great.

196

00:30:34.500 --> 00:30:48.180

Sownak Bose: So I wanted to kick start the conversation with one of the statements that you brought up right at the beginning, which was that a lot of these algorithms are essentially these data driven procedures.

197

00:30:49.380 --> 00:30:54.150

Sownak Bose: And you know, building on historical data and so on, and I think you, you probably touched upon this.

198

00:30:54.600 --> 00:31:08.640

Sownak Bose: A little towards the end of your science section of the talk, but I was wondering what you thought about the application of these technologies in the reverse direction where you're using the technologies to actually inform the kinds of data, one should take.

199

00:31:10.620 --> 00:31:18.360

Sownak Bose: which may be goes along the lines of designing surveys strategies and and things like that, so I wanted, if you wanted to share something about that.

200

00:31:19.110 --> 00:31:24.030

Brian Nord (he/him): yeah I think they're there are a couple of different avenues, and I might try to touch on interpret ability.

201

00:31:27.630 --> 00:31:34.050

Brian Nord (he/him): I think, so the way that i've been thinking about this and deciding what data to take i've been thinking about how.

202

00:31:34.890 --> 00:31:43.890

Brian Nord (he/him): When when I watched my colleagues plan the dark energy survey, they would generate a simulation that, had it was very slow.

203

00:31:44.580 --> 00:31:56.130

Brian Nord (he/him): And so, that means that they had to choose a certain level of fidelity that would give them a sense of, say, the depth if they if they did this over these nights and and their overall depth, then you look they look at plots that showed depth.

204

00:31:58.110 --> 00:32:00.870

Brian Nord (he/him): And for for the next month and.

205

00:32:02.070 --> 00:32:08.640

Brian Nord (he/him): You know, throwing the moon take out the moon, and things like that, and that that I remember just meetings and meetings and meetings about.

206

00:32:10.080 --> 00:32:15.420

Brian Nord (he/him): Like looking at these plots and and actually trying to interpret them and then saying oh that one looks pretty good.

207

00:32:16.260 --> 00:32:27.540

Brian Nord (he/him): And I and That to me is like that's you got to do what you gotta do, but now if we have an opportunity to to have a deeper connection or just even a direct connection between.

208

00:32:28.500 --> 00:32:34.650

Brian Nord (he/him): That some output of a depth of a metric like depth and then feed that back in.

209

00:32:35.190 --> 00:32:48.780

Brian Nord (he/him): Then I think there that's a great opportunity to not have to do that if there's enough computing power to run the simulations enough times to have a good training set and then to redirect and then to schedule the telescope so there's there's been a little work in this area.

210

00:32:51.360 --> 00:32:57.390

Brian Nord (he/him): And economy and some folks at princeton they they did a little bit of reinforcement learning mixed with.

211

00:33:00.120 --> 00:33:07.860

Brian Nord (he/him): Gender genetic algorithms to show that in a in a simulated context you can you can do this, you can do this quite a bit better.

212

00:33:09.270 --> 00:33:12.180

Brian Nord (he/him): And I think what we're trying to build on is.

213

00:33:13.560 --> 00:33:22.200

Brian Nord (he/him): We also we're also using reinforcement learning algorithm so quickly reinforcement learning is when you, you have an agent running around in an environment and there's a specific.

214

00:33:22.980 --> 00:33:33.030

Brian Nord (he/him): metric that it that gives it a reward then when it stops running into the wall and starts going around the wall it knows that it has reached that reward and so it keeps doing that it does it.

215

00:33:33.690 --> 00:33:40.890

Brian Nord (he/him): It does it better, and these have been shown to that that reinforcement learning as part of the algorithm that was used in in alphago and it's part of what's used in.

216

00:33:42.360 --> 00:33:53.190

Brian Nord (he/him): The starcraft ones alpha star, so I think that those are going to give us the question is how much efficiency increased I think those things are going to give us a significant enough increasing efficiency America.

217

00:33:55.830 --> 00:33:56.880

Brian Nord (he/him): yeah maybe i'll leave it there.

218

00:33:58.170 --> 00:34:02.970

Sownak Bose: Thank you, and I think along similar lines on I had a question about self driving.

219

00:34:03.000 --> 00:34:05.730

Sownak Bose: telescopes on or do you want to ask yes.

220

00:34:06.060 --> 00:34:12.720

Ana Bonaca: Thanks so much for, if I can double up on the end this strategy of how to quit machine learning to good news.

221

00:34:13.980 --> 00:34:31.560

Ana Bonaca: I was wondering if you could tell us a little bit more of the kinds of applications in those machine learning has been self driving telescopes and kind of discount your your talk today comes right after the talk, we heard yesterday from the empty director and like one of the.

222

00:34:33.150 --> 00:34:44.010

Ana Bonaca: Projects they are working on now is improving the efficiency of the telescope so just kind of wondering what kind of role machine learning what would have that aspect.

223

00:34:44.610 --> 00:34:55.380

Brian Nord (he/him): yeah um so the way that i'm thinking about this, because I think it's it's a really I think it's a really complicated problem, and I think it's it's it's dangerous in the sense of.

224

00:34:58.620 --> 00:34:59.190

Brian Nord (he/him): The.

225

00:35:02.190 --> 00:35:10.830

Brian Nord (he/him): week when you have enough of the pieces in a in the scientific looper and any loop that can move together at the same speed that's when they can really be linked.

226

00:35:11.790 --> 00:35:25.050

Brian Nord (he/him): But that means that you can't break the loop, and if you break the loop then you're, then the system is going to break and so when I say dangerous, I want to One example is like you can't break this multi millionaire multi billion dollar instrument.

227

00:35:27.000 --> 00:35:33.990

Brian Nord (he/him): And so I think it's the way that i'm thinking about is developing these things in stages, so, as I mentioned, doing some scheduling first.

228

00:35:34.560 --> 00:35:43.200

Brian Nord (he/him): And then having that done ahead of time, then you test it we know you know, a guy in out West some rich guy has a telescope and might, let us do some testing on it.

229

00:35:43.530 --> 00:35:49.410

Brian Nord (he/him): So we want to do some scheduling and then, then we want to try to do it in situ, or you know live.

230

00:35:50.880 --> 00:35:51.540

Brian Nord (he/him): and

231

00:35:53.220 --> 00:36:00.060

Brian Nord (he/him): And there's the end there's the aspect of just scheduling and then the telescope does what it needs to do and then there's also live maybe.

232

00:36:01.110 --> 00:36:01.680

Brian Nord (he/him): Having.

233

00:36:03.930 --> 00:36:19.200

Brian Nord (he/him): being tapped into the actual telescope operations control system and being able to tweak tweak all those pieces and actually the latter is what a lot of particle accelerator folks are looking at because that's where the that's where the trouble is there, all these knobs to turn.

234

00:36:20.670 --> 00:36:31.110

Brian Nord (he/him): And just just to get the beam to stay up consistently it's all of that, and so get it, but you got to have guardrails and you got to develop these things I think in the stages, so you know one one thing to do is develop.

235

00:36:32.340 --> 00:36:42.240

Brian Nord (he/him): develop the machine control thing first and then and then, once you once you're confident of that then maybe you link in together automatically deciding what next simulation to run or what next.

236

00:36:43.470 --> 00:36:48.960

Brian Nord (he/him): What next analysis to do, and I think you know if you think about the complexity of different telescopes.

237

00:36:50.010 --> 00:36:58.290

Brian Nord (he/him): And i'm not i'm not sure I mean i'm i'm i'm kind of making a bet of my energy and time that Ellis St will benefit from this.

238

00:36:59.040 --> 00:37:14.310

Brian Nord (he/him): But, but I also think you know if you look at multiplex spectroscopic surveys 4000 fibers eventually people are thinking, maybe 10,000 or whatever like like I i'm pretty sure we're going to be able to benefit from machine learning for those Oh, and then the next stages.

239

00:37:15.360 --> 00:37:16.080

Brian Nord (he/him): What about.

240

00:37:17.370 --> 00:37:18.840

Brian Nord (he/him): federation of telescopes.

241

00:37:20.130 --> 00:37:26.610

Brian Nord (he/him): So, like this the smart telescopes at at sort of low, though, and then the next phase is what about multi messenger.

242

00:37:28.620 --> 00:37:30.720

Brian Nord (he/him): You know if you can, if you can keep building these.

243

00:37:30.990 --> 00:37:35.100

Brian Nord (he/him): Things and wrapping wrapping these things around the system, then there's a chance that we can.

244

00:37:36.300 --> 00:37:40.320

Brian Nord (he/him): Keeping humans in the loop at the right places, you know there's a chance that we can speed, a lot of things.

245

00:37:41.400 --> 00:37:46.050

Ana Bonaca: Can you, like all of us a lot better on this aspect as you're.

246

00:37:47.370 --> 00:37:56.040

Ana Bonaca: mentioning all of this areas for improvement, I was thinking of the say like a full audit that happens, I think, fairly regularly that other.

247

00:37:56.670 --> 00:38:08.250

Ana Bonaca: Science programs get interrupted at telescopes to follow up like events, and so they see like it's a conversation in the Community to have this sort of centralized.

248

00:38:09.690 --> 00:38:19.980

Ana Bonaca: entity that coordinates the these this follow up so you know empty and and Magellan and tech are not all observing kind of the same part of this guy.

249

00:38:20.580 --> 00:38:30.000

Brian Nord (he/him): I don't think so I haven't heard of was I may be on the little panel next month that NASA that may discuss this kind of thing but.

250

00:38:31.020 --> 00:38:38.490

Brian Nord (he/him): I haven't heard my friends of space telescope talking about it in any depth and I feel like space telescope would be the place where they'd be having some of that conversation.

251

00:38:39.570 --> 00:38:41.310

Brian Nord (he/him): And you know, of course, in no way Oh, but.

252

00:38:42.360 --> 00:38:47.580

Brian Nord (he/him): I haven't heard a big big discussions cuz I don't know if we've proven from the Community side.

253

00:38:48.210 --> 00:39:00.690

Brian Nord (he/him): I don't know if we've we've even given like enough of a very simple numerical on sites that it's worth their time, so I think we need to do some demonstration or tests before they'll probably spend even spend that much time talking about it it's my guest but.

254

00:39:01.950 --> 00:39:02.160

Brian Nord (he/him): Thanks.

255

00:39:03.210 --> 00:39:04.140

Ana Bonaca: Thanks that's.

256

00:39:04.560 --> 00:39:11.910

Brian Nord (he/him): And, and you know, there are people that you know tax are making decisions, their algorithms to do to have tax, and so I think also what.

257

00:39:12.570 --> 00:39:17.640

Brian Nord (he/him): When I say when I when I put words like intelligent or like try to say that we can do this in an automated way.

258

00:39:18.600 --> 00:39:31.410

Brian Nord (he/him): There still has to be humans, for at least for now like writing down with the metrics are writing down the policies that go into these things, because it besides besides a reinforcement learning algorithm figure out a policy for where to point a telescope.

259

00:39:32.730 --> 00:39:47.220

Brian Nord (he/him): Aside from you know I don't I don't quite, I imagine, but I don't quite see very in the very near future, an algorithm creating a policy about who gets to do these things, and who gets to use them who gets to decide so that's a whole nother conversation.

260

00:39:50.130 --> 00:39:50.520

Thanks.

261

00:39:51.690 --> 00:39:59.640

Sownak Bose: Great and I think that response segues nicely into the next category of questions that people are asking and.

262

00:40:00.180 --> 00:40:07.530

Sownak Bose: I think one of the really interesting aspects of this model free, such as the interplay between how humans operate and how the machines operate.

263

00:40:08.250 --> 00:40:23.130

Sownak Bose: And so, Nelson had a question about essentially the manner in which these models try to fight fight how to the solutions in the same way that humans do in some sense so Nelson do you want to unmute and ask the question.

264

00:40:23.160 --> 00:40:24.000

Nelson Caldwell: yeah um.

265

00:40:25.050 --> 00:40:34.380

Nelson Caldwell: I just wondered, you are talking about these models, as if they're monolithic, but I can only explain this in a comic way.

266

00:40:35.250 --> 00:40:40.050

Nelson Caldwell: So that would be you know in baseball they're talking about going to getting rid of vampires and having.

267

00:40:40.530 --> 00:40:47.190

Nelson Caldwell: some kind of a system called balls and strikes, but you can imagine let's suppose apple does one version and Google does another version.

268

00:40:47.580 --> 00:40:57.300

Nelson Caldwell: And you get to compare it and you can have arguments between the two virtual umpires so you know this is real important things in the legal aspects of your talk.

269

00:40:58.560 --> 00:41:06.450

Nelson Caldwell: You know people use different expert witnesses and court cases, who both of them claim to be experts, one can imagine doing that, with these.

270

00:41:06.960 --> 00:41:18.450

Nelson Caldwell: automated identification of the culprits as well, saying well this this model said that that was not the criminal so anyway, I just wonder, do you have any comments on how.

271

00:41:19.140 --> 00:41:30.900

Nelson Caldwell: Society could use different models to at least then present the results in the way that we do as humans that humans disagree, why, why should models disagree in some aspects as well.

272

00:41:32.070 --> 00:41:33.090

that's a good question.

273

00:41:34.470 --> 00:41:35.160

write this down.

274

00:41:37.470 --> 00:41:37.950

Brian Nord (he/him): yeah.

275

00:41:40.800 --> 00:41:54.930

Brian Nord (he/him): I think my my head my brain first went to adversarial networks and adversarial systems and so generally I mentioned earlier adversarial domain adaptation that's that's one of the.

276

00:41:56.580 --> 00:42:07.800

Brian Nord (he/him): Examples that i'm most readily aware of where there is a disagreement that is used for the benefit of faster modeling so generative adversarial networks literally take.

277

00:42:08.430 --> 00:42:20.040

Brian Nord (he/him): Two neural networks in parallel, one is generating an image and one is asking or testing it to see if it's a thing, and once they and, once this one can't tell the difference between.

278

00:42:20.490 --> 00:42:26.460

Brian Nord (he/him): The generated horse and the real horse, then it gets into this equilibrium, and this is great.

279

00:42:27.150 --> 00:42:39.900

Brian Nord (he/him): And it's been shown to the These are the things that generate faces that look very, very human that we almost can't tell apart from real human faces but they're highly unstable and highly non interpretive like the rest of neural networks and so.

280

00:42:42.000 --> 00:42:50.130

Brian Nord (he/him): Maybe I think you're right, I mean I think that's what's going to happen right like you're gonna you're gonna have to have.

281

00:42:51.870 --> 00:43:07.410

Brian Nord (he/him): Well, I you know i'm not I don't design I don't do baseball so i'm saying you have to have this so I don't want to have that much hubris, but it would make sense to me that you would have multiple things that are trained or.

282

00:43:08.430 --> 00:43:11.700

Brian Nord (he/him): Set up from distinct vantage points.

283

00:43:13.290 --> 00:43:20.820

Brian Nord (he/him): To have a variety of say viewpoints that are then compared, but then who does the comparison is there, like a mega empire that's a human.

284

00:43:21.120 --> 00:43:24.540

Brian Nord (he/him): Right or is and the or is there some optimization system so.

285

00:43:27.330 --> 00:43:32.580

Brian Nord (he/him): And then, this ties into things like self driving cars, if there are two cars.

286

00:43:34.620 --> 00:43:40.590

Brian Nord (he/him): And one is has one insurance can be one has the other, are they going to have dueling insurance bots that try to figure this out.

287

00:43:41.220 --> 00:43:54.000

Brian Nord (he/him): One thing that kind of worries me is and you mentioned that the models are non monolithic but the thing that worries me is that humans for convenience want some amount of monolithic system if that's the right word.

288

00:43:55.080 --> 00:44:02.880

Brian Nord (he/him): We would want this all to be run by apple so that we don't have to have this really hard conversation about arguing about our rights.

289

00:44:04.470 --> 00:44:17.700

Brian Nord (he/him): So I that's that that is maybe one way, where I place where I kind of see it going and not a great direction unless we have regulation, unless we have more of society like actually understanding the nuances even of what you're talking about.

290

00:44:19.080 --> 00:44:21.060

yeah thanks yeah.

291

00:44:24.840 --> 00:44:29.370

Sownak Bose: And so the next couple of questions, so we have kind of touching upon.

292

00:44:29.910 --> 00:44:45.210

Sownak Bose: Maybe the more societal or ethical implications of many of these algorithms and what role we as astronomers can perhaps play in in this process and so becky never had a question along those lines so becky do you want to go ahead and ask a question.

293

00:44:45.960 --> 00:44:53.070

Rebecca Nevin: Sure, I don't think this is fully formed as a question, but I wanted to just throw some thoughts out there and get your thinking on this.

294

00:44:54.810 --> 00:45:10.170

Rebecca Nevin: So i've been following ethical Ai on Twitter and specifically relating to Google and the people who have recently been fired by Google if people don't now there's a whole division within some of these big tech companies to do.

295

00:45:11.940 --> 00:45:19.680

Rebecca Nevin: Well, they call it ethical Ai I think it's debatable I don't exactly know what that division is doing or exactly what that means.

296

00:45:21.150 --> 00:45:28.200

Rebecca Nevin: But I know that part of that is looking at interpret interpret ability of models so i've been thinking a lot about.

297

00:45:30.360 --> 00:45:40.020

Rebecca Nevin: In astronomy we like to know why models are making predictions that they're making and so that's kind of the role yeah nice exactly.

298

00:45:42.300 --> 00:45:48.990

Rebecca Nevin: yeah so in astronomy we like to think about we're doing maybe better because our main things interoperable.

299

00:45:49.560 --> 00:45:55.680

Rebecca Nevin: But I wanted to know what you thought about the interplay between interpret ability and ethical Ai.

300

00:45:56.310 --> 00:46:03.720

Rebecca Nevin: Because I thought about your example of okay we're putting things on the archive and maybe tech companies are learning from that.

301

00:46:04.380 --> 00:46:18.390

Rebecca Nevin: But I don't think necessarily because something is interpreted will automatically makes it ethical and so I wanted to see what you thought about that and then also maybe what you thought about should we have standards for what we do as astronomers.

302

00:46:19.560 --> 00:46:26.250

Rebecca Nevin: Or if you had predictions for things you'd like to see and papers related to interpret ability.

303

00:46:27.330 --> 00:46:29.580

Rebecca Nevin: Questions actually like three questions.

304

00:46:31.620 --> 00:46:33.780

Brian Nord (he/him): I think I heard to so i'll go with the two that I heard.

305

00:46:34.500 --> 00:46:36.690

Rebecca Nevin: i'll do it i'll do it, I can't wait yeah just go through whatever.

306

00:46:37.920 --> 00:46:39.090

Brian Nord (he/him): So your point is I.

307

00:46:39.270 --> 00:46:39.990

Brian Nord (he/him): Your point about.

308

00:46:40.020 --> 00:46:45.990

Brian Nord (he/him): interpreter ability not leading directly or it never it not leading.

309

00:46:47.430 --> 00:46:56.280

Brian Nord (he/him): Inevitably, to ethic ethically is, I completely agree with that the, the problem with the discourse at the moment is that.

310

00:46:56.670 --> 00:47:01.290

Brian Nord (he/him): And this is what this is what I hear a lot of people saying I was saying these documentaries, I was watching this morning and.

311

00:47:02.130 --> 00:47:10.080

Brian Nord (he/him): Even there's there's an article out there were a dude in the air force under the last administration, who is in charge of acquiring and.

312

00:47:10.980 --> 00:47:16.830

Brian Nord (he/him): sort of designing the showcase of weaponry in the air force he's quoted in a news article is saying oh.

313

00:47:17.220 --> 00:47:23.460

Brian Nord (he/him): You don't have to do anything with these algorithms you just set them and then let them go and they learn how to do the entire world, and I was like dude.

314

00:47:23.850 --> 00:47:32.790

Brian Nord (he/him): That is the that is almost the longest thing you could have said and that's someone who's in charge of stuff and so it's not clear to me if that's the way to actually think about it.

315

00:47:33.300 --> 00:47:41.760

Brian Nord (he/him): Or if that's the line that they're giving but the the discourse is that there is magic in these things, the magic same magic if you want to call it that, at the same.

316

00:47:44.370 --> 00:47:49.800

Brian Nord (he/him): same nuance that that we think we have in our brains, you know and.

317

00:47:51.120 --> 00:48:02.460

Brian Nord (he/him): it's still like that that's not true and it still comes down to the choices we decide to make as a society, and so I think I consider my role, personally, as a scientist to.

318

00:48:05.220 --> 00:48:12.510

Brian Nord (he/him): Make the algorithms as one of my role my technical role is to make the algorithms as interpreted as possible so that we're ready.

319

00:48:13.770 --> 00:48:20.820

Brian Nord (he/him): When when we're ready to support policy and regulation that we can point to things and say Okay, this is what we know about the model.

320

00:48:21.480 --> 00:48:33.480

Brian Nord (he/him): And this is how we need to use it, so that, so there, there is some leverage about being able to say something useful in a in a given context and being able to know what what thing is happening, but I also.

321

00:48:34.590 --> 00:48:36.450

Brian Nord (he/him): I don't I don't believe in the inevitability.

322

00:48:37.380 --> 00:48:47.040

Brian Nord (he/him): I don't know if this is a thing, but i'd like I i've been thinking of what I hear people talk about a lot of technology, it seems like there is this sort of doctrine of inevitability out there, this attitude that.

323

00:48:47.760 --> 00:48:52.020

Brian Nord (he/him): Because it exists, we have to keep using it, and you know, we could not use the thing.

324

00:48:54.210 --> 00:49:04.500

Brian Nord (he/him): And, and I think if we decided yes let's stop at classification or let's see if we were able to decide as a society that we're not going to do facial recognition that we don't have to and actually there's evidence of this.

325

00:49:06.240 --> 00:49:18.240

Brian Nord (he/him): So at least 13 cities through collect through coalition building and collective action have banned facial recognition in municipal system so like COPs in these cities are not allowed to use facial recognition, so it can be done.

326

00:49:21.090 --> 00:49:34.830

Brian Nord (he/him): And then your second question about what what maybe standards, we should have in astronomy I think I think there's one thing that we should be doing that is done in other aspects of astronomy that we should have really clear benchmark data sets.

327

00:49:36.030 --> 00:49:44.970

Brian Nord (he/him): So that we can communicate clearly about how how good the tools are and it's not just playing the sort of ping pong game of oh my models better my balls better but wait about what's your data set like that.

328

00:49:45.120 --> 00:49:53.310

Brian Nord (he/him): That can be a useful game to play and it's useful effort, but it should be done in a really consistent context, like the you know the great oh eight things that are great the great.

329

00:49:54.870 --> 00:50:05.520

Brian Nord (he/him): Be cleansing things that were done back in the day, so in that aspect, and my group is working on that a little bit, but it's it's kind of tough because it's a it's a complex ball of wax and you don't want to go you don't want to over scope too much.

330

00:50:07.350 --> 00:50:12.090

Brian Nord (he/him): And maybe on the paper side so so there was a meeting in ring Berg Germany.

331

00:50:13.590 --> 00:50:25.140

Brian Nord (he/him): Winter oh 19 and so josh peak and Michelle in the makkah and I have been working on a document that would kind of be.

332

00:50:25.650 --> 00:50:33.120

Brian Nord (he/him): This is the kind of thing that may be paper should have to be to maximize utility when it comes to me show the learning because.

333

00:50:33.600 --> 00:50:40.890

Brian Nord (he/him): 2016 2017 a lot of us are writing papers there's like look neural network and classify stars and galaxies like those papers had to be written.

334

00:50:41.460 --> 00:50:52.050

Brian Nord (he/him): But if you're just showing the efficacy and then not going in interpret ability at all you're like that I think we're past that era of that being a paper that is as valuable as the Community as it could be.

335

00:50:53.220 --> 00:50:57.150

Brian Nord (he/him): And so there are tools like attention and saliency estimators.

336

00:50:58.920 --> 00:51:10.920

Brian Nord (he/him): There, there are there are lots of sensitivity analysis that you can do to try to at least understand what the systematic effects on the model are like this epidemic what's what's the epidemic uncertainty.

337

00:51:11.190 --> 00:51:21.450

Brian Nord (he/him): Under variations in the data, even in the training set, so I think that that's that's the space where we're in like if you're that if you're doing a deep learning problem and you kind of got to show all of those pieces more.

338

00:51:27.180 --> 00:51:34.320

Sownak Bose: that's terrific i'll take it as a positive reflection of the morality of this group that hasn't been lots of questions about the.

339

00:51:35.970 --> 00:51:39.930

Sownak Bose: And so the next one comes in, from Morgan so whenever you're ready.

340

00:51:40.110 --> 00:51:40.560

yeah.

341

00:51:41.730 --> 00:51:52.950

Morgan Elowe MacLeod: And I think this ties in nicely with what you were saying so i'm curious if we can talk a little bit more about this thread, you were you were leading us to about.

342

00:51:54.840 --> 00:52:01.170

Morgan Elowe MacLeod: sort of systematic and or realistic estimates of uncertainty.

343

00:52:02.580 --> 00:52:08.250

Morgan Elowe MacLeod: Especially on data which may not, you know ever perfectly matched the training data.

344

00:52:09.840 --> 00:52:11.220

Morgan Elowe MacLeod: And I think.

345

00:52:12.810 --> 00:52:18.210

Morgan Elowe MacLeod: So there's two things that I two threads that I guess, I wanted to follow up on them, and the first was.

346

00:52:19.230 --> 00:52:30.360

Morgan Elowe MacLeod: We talked a little bit about like uncertainty and this sort of like human role and made me think a lot of like Naomi rescues arguments about merchants of doubt, how expert.

347

00:52:30.390 --> 00:52:31.080

Brian Nord (he/him): witnesses.

348

00:52:31.110 --> 00:52:35.130

Morgan Elowe MacLeod: have been used to like inflate doubt and I wondered how.

349

00:52:36.240 --> 00:52:39.750

Morgan Elowe MacLeod: You know, I think that will be really interesting to see play out.

350

00:52:41.490 --> 00:52:57.210

Morgan Elowe MacLeod: When our expert witnesses are slightly more digital but but it, but it feels like some of the same tensions will be in place because we'll be saying you know, there are still be systematic unexplored possibilities, I think, as scientists like.

351

00:52:58.860 --> 00:53:05.340

Morgan Elowe MacLeod: I certainly my like gut reaction whenever there's something or result that i'm surprised by.

352

00:53:05.760 --> 00:53:24.330

Morgan Elowe MacLeod: I think I tend to like look for the reasons that it might be wrong before my like slow mind is able to adjust to like this new reality right and that's just like part of being human but also it like reflects the fact that we inflate the value of uncertainty as humans.

353

00:53:25.590 --> 00:53:28.170

Morgan Elowe MacLeod: And like maybe there's.

354

00:53:30.090 --> 00:53:39.360

Morgan Elowe MacLeod: You know, some small chance of uncertainty statistically, but like ethically and may carry more weight than that percentage, and I think.

355

00:53:39.930 --> 00:53:48.180

Morgan Elowe MacLeod: You know, in many cases in in sort of humanistic cases this is a situation where, as you said something, a role that.

356

00:53:49.080 --> 00:53:56.400

Morgan Elowe MacLeod: computer scientists and you know people who are working directly with data can play is to make algorithms transparent.

357

00:53:56.850 --> 00:54:06.780

Morgan Elowe MacLeod: So I was picking up on that thread that you were saying and a role that people who are trained to make humanistic decisions like social scientists humanists can can weigh in on.

358

00:54:07.320 --> 00:54:19.830

Morgan Elowe MacLeod: The other part if the algorithms are as transparent as possible, but I guess I wondered like what's the parallel construct within a question that, at least at face value is more purely scientific so.

359

00:54:20.220 --> 00:54:21.240

Morgan Elowe MacLeod: As we think about like.

360

00:54:21.450 --> 00:54:26.880

Morgan Elowe MacLeod: Our uncertainties in our classification of galaxies.

361

00:54:29.670 --> 00:54:36.000

Morgan Elowe MacLeod: There the human implication of that is much more indirect at the very least.

362

00:54:38.070 --> 00:54:45.930

Morgan Elowe MacLeod: So I mean our classification of galaxies affects people's lives, but you know it might affect your life and my life more than most people.

363

00:54:49.200 --> 00:55:02.340

Morgan Elowe MacLeod: But I guess, I was curious about like who the arbiters of that human decision making can be and how do we make those those sorts of value judgments that lie on top of them certainty.

364

00:55:03.630 --> 00:55:10.140

Morgan Elowe MacLeod: If that's something that you're thinking about or or if the first goal is transparency, and then we can have that conversation.

365

00:55:11.910 --> 00:55:16.620

Brian Nord (he/him): I think I think these things are happening in parallel so.

366

00:55:18.780 --> 00:55:32.430

Brian Nord (he/him): My my lack of training in science and technology, studies and in sociology and history of science, means that like yeah i'm reading i'm reading these books and maybe Actually, this is a good point good time to put this up.

367

00:55:34.320 --> 00:55:44.160

Brian Nord (he/him): So reading these books to understand from that side how these things work and and at least so that you know i'm dangerous enough that I could say things that don't make sense.

368

00:55:44.250 --> 00:55:47.790

Brian Nord (he/him): Right, I could I could answer this question in a way that's way out of out of my lane.

369

00:55:48.270 --> 00:56:03.810

Brian Nord (he/him): And I think instead, what the right thing for me to do is try to work with rehab Benjamin and software noble like they and I like I don't need to teach them anything about the algorithms like that's also not my lane for that, because they know how that stuff works, but I think.

370

00:56:05.310 --> 00:56:17.880

Brian Nord (he/him): You know if I as I talk about these things in public, as any of us do, and as we, as we build up coalition's of people to maybe help educate the public, I think we do need to learn a lot from folks who are in those spaces.

371

00:56:18.420 --> 00:56:28.050

Brian Nord (he/him): So that so that we actually yeah so I don't want us to repeat the mistakes of our culture at least i'll say the physics culture in.

372

00:56:28.410 --> 00:56:39.750

Brian Nord (he/him): In sort of believing that we, we can be experts in everything without being trained in it and so that's where i'm at that starting point of learning from these folks and not not imagining that.

373

00:56:40.890 --> 00:56:50.700

Brian Nord (he/him): I that I really understand how to make these humanistic level decisions and, while i'm doing that i'm trying to improve some of the models for for the uncertainty quantification yeah.

374

00:56:51.810 --> 00:57:01.050

Brian Nord (he/him): yeah so I don't know if people know about the snowmass P five process in physics it's like the astro to Kato process so it's it's kind of taking place in an extended version.

375

00:57:01.590 --> 00:57:10.260

Brian Nord (he/him): Right now, through late 2022 and a couple of us are getting folks together to write a White Paper, or maybe do some other things that.

376

00:57:10.980 --> 00:57:18.600

Brian Nord (he/him): Asked Questions and point toward point toward some maybe some activities and efforts that the physics community can do in concert with.

377

00:57:18.870 --> 00:57:30.510

Brian Nord (he/him): sociologists to try to address some of these high level questions or not even high level some of some of these really, really important questions so, and if anybody wants to collaborate on that stuff like that White Paper or other things i'm i'd be excited to chat.

378

00:57:32.910 --> 00:57:34.860

Morgan Elowe MacLeod: Thanks also for bearing with my.

379

00:57:35.880 --> 00:57:39.090

Morgan Elowe MacLeod: question which was posed much longer than like if it's like the.

380

00:57:39.090 --> 00:57:43.890

Morgan Elowe MacLeod: fact that my thoughts are not fully articulated right but, but thank you.

381

00:57:45.630 --> 00:58:02.640

Sownak Bose: Again, and since, since you did bring up the transparency of algorithms I think it will hand the last question of the day to Evan Bauer, who has a question regarding how we develop and share new methods for Ai into the future, so whenever you're ready.

382

00:58:03.120 --> 00:58:09.690

Evan Bauer: yeah I was really interested in well, you seem to be suggesting you the end of your talk that we should be careful.

383

00:58:10.020 --> 00:58:20.790

Evan Bauer: If we're developing these sorts of methods about releasing them out into the wild because of their very real potential for misuse i'm hoping i'm not mischaracterizing what you're saying there but.

384

00:58:21.600 --> 00:58:26.010

Evan Bauer: At the same time it my sort of immediate reaction to that is like well you know.

385

00:58:26.670 --> 00:58:36.510

Evan Bauer: astronomy and particle physics, even if all of us started working on Ai full time and releasing everything out in the wild that's kind of a drop in the bucket compared to what Google is doing or Facebook video.

386

00:58:36.600 --> 00:58:48.330

Evan Bauer: Even these companies just individually have more resources they're pouring into this or the God and they're also working on, you know more dangerous stuff stuff you know, having to do with our social lives God even weapons, you know thinking about.

387

00:58:48.750 --> 00:58:56.370

Evan Bauer: Ai in the loop with weapons that can kill people, and so I kind of wonder like Should we really be that concerned about.

388

00:58:57.570 --> 00:59:07.950

Evan Bauer: classifying galaxies or developing methods to classify galaxies and, of course, you know, maybe new developments can come from any angle, but yeah just wondering what your thoughts are in that context.

389

00:59:08.370 --> 00:59:16.230

Brian Nord (he/him): Now that's a really good point and I went down this rabbit hole, with a few colleagues and I, they were also very patient with me and trying to as I tried to figure out if.

390

00:59:17.610 --> 00:59:21.690

Brian Nord (he/him): If there is any leverage that I would have to prevent people from using a tool and.

391

00:59:23.520 --> 00:59:31.740

Brian Nord (he/him): And I was pretty sure the answer would be no but I went down the rabbit hole to try to figure it out anyway and yeah I don't think that I agree with everything you said so I don't think that.

392

00:59:34.440 --> 00:59:34.770

Brian Nord (he/him): We can.

393

00:59:36.330 --> 00:59:42.570

Brian Nord (he/him): I don't want I don't want to i'm not going to contradict myself here I don't believe that as a society, we have to use these tools, but I also don't believe that.

394

00:59:43.950 --> 00:59:52.980

Brian Nord (he/him): If I do something that I can really stop people from using it, if I may, if I write something that's better So what does that that turns into for me.

395

00:59:53.760 --> 01:00:03.630

Brian Nord (he/him): just a question of what my responsibility is and what I think my community's responsibility is, and so it back during the day atomic the early atomic age.

396

01:00:04.680 --> 01:00:09.120

Brian Nord (he/him): What were what were people's responsibility if they if they felt like they had to develop this technology.

397

01:00:10.620 --> 01:00:12.090

Brian Nord (he/him): What was their responsibility.

398

01:00:13.290 --> 01:00:20.160

Brian Nord (he/him): Despite that, or like that went along with it and I it's not that there is like a proof I don't think there's a perfect answer here I think it's.

399

01:00:21.720 --> 01:00:23.130

Brian Nord (he/him): I think it's nuanced I think what.

400

01:00:24.420 --> 01:00:31.650

Brian Nord (he/him): What are we going to decide, is our role if we're contributing to this, even if it's a small contribution, because a seemingly small contribution could have a larger effect.

401

01:00:34.650 --> 01:00:35.280

it's a good question.

402

01:00:38.700 --> 01:00:39.660

Sownak Bose: Thank you very much.

403

01:00:40.710 --> 01:00:46.710

Brian Nord (he/him): So I can I really quick if you're interested in this stuff please, this is, this is a 500 page report.

404

01:00:47.310 --> 01:00:56.820

Brian Nord (he/him): So I don't I don't know if i'll ever get through it, but I would suggest if you're interested in this checking this out, so

this final report from the National Security Commission on artificial intelligence came out a couple of weeks ago, or a month ago.

405

01:00:57.900 --> 01:01:00.270

Brian Nord (he/him): And, and you can see the headline there that.

406

01:01:01.410 --> 01:01:04.830

Brian Nord (he/him): is chaired by google's Eric Schmidt, which is important to know.

407

01:01:06.030 --> 01:01:20.100

Brian Nord (he/him): And it looks like there could be a significant movement toward much more autonomous weapons systems in the near future, so if you want to stay stay abreast of the latest this is this, I think, is some of the some of the latest.

408

01:01:24.150 --> 01:01:24.690

Sownak Bose: Great.

409

01:01:25.740 --> 01:01:34.920

Sownak Bose: Thank you very much, Brian and I think there's lots of very interesting reading material for all of us to engage with, and especially the ones that you've highlighted in utah.

410

01:01:36.120 --> 01:01:40.680

Sownak Bose: Well, thanks everyone for your questions and it's been a very interesting discussion.

411

01:01:42.180 --> 01:01:52.890

Sownak Bose: And i'm glad it's been recorded, so that you know when our elite with our robot overlords eventually do control a second look at all this fanciful conversations that we had back in the past.

412

01:01:53.640 --> 01:01:54.720

Morgan Elowe MacLeod: will know who to blame.

413

01:01:55.200 --> 01:01:55.560

Brian Nord (he/him): that's right.

414

01:01:56.820 --> 01:01:58.920

Brian Nord (he/him): Thank you so much, this is a lot of fun, I appreciate it.

415

01:01:59.430 --> 01:02:12.660

Morgan Elowe MacLeod: Great but, in all seriousness, thank you, and thanks for I mean we ended on a sobering nope but then fun to think about, but the sort of possibilities and perils of scientific progress right progress.

416

01:02:15.930 --> 01:02:17.640

Sownak Bose: All right, thanks everyone for attending.

417

01:02:18.120 --> 01:02:19.020

Morgan Elowe MacLeod: Thank you.

418

01:02:19.410 --> 01:02:20.130

Sownak Bose: Thank you very much.