**Interviewee:** [00:00:00] Okay.

**Interviewer1:** [00:00:01] Good, could you confirm it on the record that you allowed us to tape and transcribe this interview?

**Interviewee:** [00:00:07] Absolutely. I allow you to transcribe the interview.

**Interviewer1:** [00:00:12] Great, thank you. So we have one general question for this interview, which is what are they bugs, problems, challenges that you faced when developing a machine learning deep learning systems and by that we mean all kinds of bugs more even the small technical ones and yeah. But like any problems that you had When developing a deep Learning System is in the scope of our interest. So if we could start from that and if you have anything on your mind to tell about that, that would be great.

**Interviewee:** [00:00:43] Okay. So I think that the most general thing that comes to my mind is that when developing let's call them applications or solutions or however you want to call them, for for clients. The usual thing is we start from determining what's the best approach for the solution which in turn requires us to go for the literature and find the most suitable framework or Library that's been developed for a specific task for instance Beat.

I mean the specific tasks such as if it's a problem of classification, then we look for an implementation of a classifier that suits our needs. If it's a object detection problem same thing. If it's a segmentation problem same thing and so on and this has one clear implication that is that at least part of the software is not something that is developed in-house, but it's rather something that is downloaded from GitHub and possibly adopted to some extent and these of course implies that it's something that needs to be understood meaning that most of the time those are implementations from let's say relatively famous and or common algorithms and therefore they have quite a lot of activity on the GitHub meaning that any bug that is found is usually dealt with the in a reasonable amount of time.

However, of course, this is not always.. It's not a product that we buy from from a company. So I mean that it's not perfect. And also the documentation is sometimes not ideal. So there is usually the very first step is trying to understand how the that piece of software works. And that's usually, say, the first obstacle that we face, however, and then the second one is that of course, we usually at least to some extent need to adapt the software that we find to our needs. For instance, he needs may be different. I don't know but it goes in different degrees of how much we need to work on what's given to us meaning that maybe we just need to change, you know, how the output files are saved or something maybe a bit more complicated such as slightly changing the architecture of the of the network which of course is the different step and so well, these are the most the most common things that we have to do when when using this kind of solutions.

**Interviewer 1:** [00:04:39] Okay, so I have a one question. So what kind of problems where you're trying to tackle when developing deep learning or machine learning systems and by that I mean like image classification speech recognition. So what are the problems that you were..?

**Interviewee:** [00:04:58] Okay. So without breaking the very very expensive [NDA?].

**Interviewer1:** [00:05:05] Okay

**Interviewee:** [00:05:05] No,No absolutely, I would be as generic as I can. No, no, I'm joking. But of course I can tell you roughly what kind of problems we face also because they're very very typical ones. Well, mostly it's about object detection.

We have something about segmentation or the computation of the optical flow when it's about of course video action recognition in a video and recently we have been experimenting with the against the GANs - Generative Adversarial networks. I don't know if you're familiar with that.

**Interviewer1:** [00:05:55] Yes.

**Interviewee:** [00:05:55] Okay, sorry.

**Interviewer1:** [00:05:56] No, no, that's fine.

So when you were developing the systems you use existing data sets to train your not network or did you have to collect your data?

**Interviewee:** [00:06:09] Usually the way it goes is that we most of the times we start from pre-trained network so we download the weights and then we do a fine tuning on the final layers. So we [can read,??] A textbook transfer learning.

**Interviewer1:** [00:06:27] Okay, so you do not have to deal with any training data in your experience?

**Interviewee:** [00:06:34] No, actually, I mean, we do, we do have to train its the fine-tuning. For that, of course, we need the dataset to perform the fine-tuning.

**Interviewer1:** [00:06:48] I see. So do you have to pre-process this training data in any way?

**Interviewee:** [00:06:56] It depends on the projects. In my experience, let's say not too much meaning that we just have to maybe I don't know maybe in some cases. Like do some cropping but most of it is actually done by.. It's done automatically so we don't really.. I mean, for instance, I just have to give an example that I don't know if it may be considered pre-processing but when we use the data augmentation, those things are actually handled by about the script itself is not something that we really do manually and also, I don't think it's going to be really considered pre-processing. Working with images.. We don't really.. We don't really do that.

**Interviewer1:** [00:07:53] Okay, so you said that you do cropping and that's automated? So the decision to do cropping, was it caused because without cropping it was not performing well, or.. Why do you need to crop it, lets say.

**Interviewee:** [00:08:10] Sure. No, actually that's that is something that is done in some cases when.. In some very very specific cases when we have data sets where we need to single out maybe specific parts of the image. So it's something that.. It's not done as part of some kind of correction, because we saw that the the training was not going well or whatever is it done because that was the case of a sort of pre-processing that needed to be done because it just made sense to it on the contrary It did not really make sense to do it without it.

**Interviewer1:** [00:09:00] It's a part of the image that you're actually interested in. Do I get it right?

**Interviewee:** [00:09:04] Sorry, what?

**Interviewer1:** [00:09:06] The part that you crop is just the part of the image that you're actually interested in.

**Interviewee:** [00:09:11] Yeah.

**Interviewer1:** [00:09:12] Okay, i see.But in general you did you ever have any problems related to training data?

**Interviewee:** [00:09:23] In my specific experience, no, but for instance, I have colleagues that had some issues because they had trained data that was not really correctly labeled because honestly, I don't know exactly the specifics because it was not the project I was working on but I heard complaints so to speak so, okay.

**Interviewer1:** [00:09:52] Okay. Thank you for sharing that with us. So did you ever use existing datasets and I'm not sure.. You did not tell us if you collected that training data to yourself or you used an existing dataset.

**Interviewee:** [00:10:06] So, it's a bit in between because, I mean, I don't really.. The data that I collect are only those for the fine-tuning but I mean in a way let's say that since of course the weights that I use come from pre-trained network that of course used some data some datasets just I mean the most of the time it's ImageNet, by the way. Or something like that - those big famous datasets that are used for every training of every big model out there. But, however, it's not something that I never really needed to download. The data itself, I mean.

**Interviewer1:** [00:10:57] Okay, but so when you used it, did you ever had problems with these existing datasets?

**Interviewee:** [00:11:06] I ain't never really.. I never really used it, that's the point.

**Interviewer1:** [00:11:10] Okay, I see, I see.

**Interviewer 2:** [00:11:12] But what about the data you collected for the fine-tuning. So you collected it manually as we understood?

**Interviewee:** [00:11:22] What do you mean by manually?

**Interviewer 2:** [00:11:24] By yourself, I mean.

**Interviewee:** [00:11:26] No,no, of course. So in one case I actually had the data provided by the the client. And in other cases I had to design software so that the client could label data and provide us with the dataset needed for the training.

**Interviewer1:** [00:11:53] In cases when you had people's labeling data. Did you have only one person who were doing it or did you have more than one person?

**Interviewee:** [00:12:04] So now, since this is related to the project that is ongoing and it's not actually something that I know, to be honest. I honestly don't know how they're handling it or if they're handling it, by the way. I hope it's more than one, for their mental sanity, but..

**Interviewer1:** [00:12:28] Okay. Okay, so about model structure. Have you ever faced problems related to the wrong model structure and by that, I mean the number types of layers their dimensions and etcetera.

**Interviewee:** [00:12:44] No, because for the problems that we had to solve the we used very very classical architecture. So as far as I'm concerned, I just used a network that was already designed and I just really had to select the number of, sorry, the shape of the very final layer. So that was it, but it was not really something that I could Define as a working on the structure because I mean that's the very least thing you can do with the network.

So, however, no, that's the answer.

**Interviewer1:** [00:13:25] Okay, so you said that you were doing some parameter tuning so I will ask if you ever had problems related to hyper parameter tuning.

**Interviewee:** [00:13:37] Yes, I mean that for instance for a very specific project in which I was using the implementation of Faster R-CNN. There are few parameters that need to be tuned based on essentially the size of and the shape, the general ratio of the objects that you want to detect in an image. And since at first the very very first thing that I did was just running with the default parameters, but they were actually designed for a data set to where the objects that are detected are a bit different in terms of both sides and shape. So the very first time it didn't really.. I mean it's still worked because it was a relatively easy problem, but there were issues in some cases that I thought could be tracked down to that kind of choice for the hyperparameters.

And so I went back and I changed them and I think I saw bit of an improvement even though it's not completely possible to tell because when I implemented that change, I also implemented something else, I added a bit of a data augmentation mimicking kind of noise that I thought could have helped. So I'm not sure to what I can attribute the improvement.

**Interviewer1:** [00:15:10] Okay, did you ever tuned hyperparameters like number of epochs, learning rate, batch size? Do you remember any cases when changing one of them has helped the model a lot?

**Interviewee:** [00:15:27] No, not really. I didn't really tamper with those specific parameters too much.

**Interviewer1:** [00:15:34] Okay, and about loss functions, do you use usually a predefined loss function or a custom written one. Did you have any problems about the use of a loss function?

**Interviewee:** [00:15:48] Usually I tend to use the ones that comes by default with the with the algorithm that I'm choosing. So I mean for instance for the Faster RCNN there is a specific loss function which is defined on a combination of different losses because it's a little bit complicated architecture. So it has a few different things that end up composing the final loss function, but again I didn't do that much editing on the original algorithm. So I just went with what was there.

**Interviewer1:** [00:16:42] Okay, and about hardware. Where do you train your models and did you ever have problems related to hardware?

**Interviewee:** [00:16:53] So I usually train my models on on GPUs and more specifically I have an Nvidia card. I think it's RTX 2080. And most of the times I specifically didn't have problems which were clearly caused by faulty hardware or something. But again, the the very same very unlucky colleague had issues with that.

**Interviewer1:** [00:17:42] Okay, do you remember any details about these issues your colleague had?

**Interviewee:** [00:17:46] A lot of cursing. So, essentially, well for some reasons we really think it could be tracked back to the the video card. The computer did shut down by itself. Which of course is bad for very obvious reasons. That's the main one that I think I can remember.

**Interviewer1:** [00:18:25] Okay. So, thank you, I have another question. Did you have a case, let's say you had your training data, you had your model structure your trained, you got some results and then you were like, okay, I can do things to improve this model. And you did and you got a better, let's say accuracy. Do you remember any of the steps that you have taken at any point when you were developing this systems?

**Interviewee:** [00:18:53] Well, as I told you before there was the change in the in those very specific hyperparameters for Faster R-CNN and the introduction of the bit of data communication to help generalizing on a very specific type of noise and prevent overfitting.

**Interviewer1:** [00:19:16] Okay, anything else?

**Interviewee:** [00:19:20] Nope, I wouldn't say.

**Interviewer1:** [00:19:25] Okay, so when developing these kind of systems, is there any type of errors that you get like way too often? And you know [inaudible] that you remember? Like any kind of bugs, like nothing fancy, any kind of box?

**Interviewee:** [00:19:47] No worries, honestly, no because luckily, I mean, it might seem a bit.. But the point is that whenever I find the bug or something that I do wrong. I end up with finding the solution and so far the way it happened is that I only made that mistake once or possibly twice because after the second time, I usually remember why that thing is going wrong and so I just fix it. I just know how to do it properly after the second time.

**Interviewer1:** [00:20:31] Yeah, but I mean. Of course, there are solutions to the bugs that you're producing but we just want to know about the bugs themselves.

**Interviewer 2:** [00:20:40] Even if they happened only once or twice...

**Interviewee:** [00:20:47] Okay. Well what I remember is, okay, sometimes they're related to maybe the failed or failed installation of the GPU drivers. Other times..

**Interviewer1:** [00:21:12] Could you repeat?

**Interviewee:** [00:21:14] Yeah. Sometimes they are due to a faulty installation of the GPU drivers.

**Interviewer1:** [00:21:22] Okay.

**Interviewee:** [00:21:23] Or maybe sometimes they're due to the implementation of a given algorithm being implemented on a specific version of libraries just you know Pytorch or whatever. The thing is that of course these things are evolving quite fast. And sometimes we are following more than one project at once and this means having multiple versions of the same library. And this of course means that sometime I have the wrong version of the library for the the wrong version of the of the algorithm and then I have to find out why something that was working before doesn't work anymore and it's just most of the time it's just related to some Library being updated but not being retro compatible and therefore breaking the code. But, these things are usually things that if you just type the if you enter the error message on Google most of the times you end up with a with the correct solution because it's something that is relatively common.

**Interviewer1:** [00:22:41] Okay, so you were telling that you're worked on these systems for object detection.

**Interviewee:** [00:22:48] Yep.

**Interviewer1:** [00:22:49] So was it like an image classification kind of problem?

**Interviewee:** [00:22:54] No, it was an object detection, meaning essentially like finding object on the images.

**Interviewer1:** [00:23:02] Okay.

**Interviewee:** [00:23:03] So it's essentially drawing bounding boxes around a specific object on an image and guessing what kind of object it is. Such as there is a car and you draw a bounding box around the car. There is a person and you draw a bounding box around the person.

**Interviewer1:** [00:23:24] Okay, and was there like a limit on.. Like of course there was, but how many different kinds of objects were you're trying to detect?

**Interviewee:** [00:23:37] Roughly in the hundreds.

**Interviewer1:** [00:23:41] Okay. So maybe while we were talking you you remembered about any other kind of problems that you have faced in your experience?

**Interviewee:** [00:23:56] So taking into account that I've been working for one year in the.. anywhere actually, so the amount of bugs that I have encountered are relatively small, just for the fact that I have not been working in the field that long, that's that's the point. I was trying to think of something else but, no.

**Interviewer 2:** [00:24:33] One small question. Have you ever trained your models on multiple GPUs?

**Interviewee:** [00:24:42] No, not yet.

**Interviewer 2:** [00:24:45] And did you ever have problems related to sending your data to the GPU or any bugs related to GPU usage, except for the installation problems you told us before.

**Interviewee:** [00:25:02] The only issue was sometimes misjudging the amount of space that the specific model requires. So we lost one person.

**Interviewer 2:** [00:25:13] Yes, no problems. I'm adding her.

**Interviewee:** [00:25:18] Shall I continue or wait?

**Interviewer 2:** [00:25:27] One second. Yes, could you please continue?

**Interviewee:** [00:25:45] Okay, as I was saying that the only other thing I can remember is in misjudging how much space I have available on the GPU in terms of memory, of course, and because it's pretty the only hard limited we have but that was just a matter of.. I mean, you immediately tell because the model doesn't fit in the memory.

So okay, I will have to do that on a different GPU or I will just have to reduce the batch size, but that was not really.. I would hardly consider that as a problem.

**Interviewer 2:** [00:26:22] Yes, but still such things are of interest for us so thank you.

**Interviewer1:** [00:26:28] Tell us more.

**Interviewee:** [00:26:30] Yeah, I'm sorry. I really am running out of problems.

**Interviewer 2:** [00:26:45] And one more question, did you ever face bugs connected with dimensionality? Of the layers. I know that you used the predefined models, but maybe you just gave the model some wrong input when you trained your last layers..

**Interviewer1:** [00:27:07] Like the dimensionality of the input ,of the output.

**Interviewee:** [00:27:09] Okay. I was trying to remember. Okay. Yes, maybe. Again, sorry, I didn't really classify that as a bug. So something that happened maybe once is that, of course, if you are.. It's it's different when you're working with the RGB data or grayscale because, of course, the number of channels is different - is its three in one case and one in the other. So sometimes I just mixed up the two and.. But again it was just running it, you could clearly see that there was a three where there should have been a one or vice versa. So it was something very easy to detect and it caused just a couple of minutes rewriting a couple of lines of code. So that that's why I really did not remember that as a bug because.

**Interviewer 2:** [00:28:22] Thank you, it just that's what try to cover all the possible problems and bugs from really like logical problems to the tiniest, you know bugs, to present a full picture.

**Interviewee:** [00:28:37] Okay.

**Interviewer 2:** [00:28:40] Thank you.

**Interviewer1:** [00:28:42] If you don't have anything else to add will just ask you some background questions and we will leave you alone.

**Interviewee:** [00:28:48] Okay, no worries. Yeah, I think I'm done on this side.

**Interviewer1:** [00:28:56] Okay. So one question is what is your current position at your job?

**Interviewee:** [00:29:04] I am an underpaid senior data analyst.

**Interviewer1:** [00:29:11] Okay.

**Interviewee:** [00:29:12] It is a data scientist,but I don't remember honestly my title but I do remember the first part.

**Interviewer1:** [00:29:18] But you work in industry, do you?

**Interviewee:** [00:29:20] Yes.

**Interviewer1:** [00:29:21] Okay. So what is your overall work experience and specifically your experience in machine learning and deep learning.

**Interviewee:** [00:29:32] Sorry, I missed the first part of the question, sorry.

**Interviewer1:** [00:29:37] Yeah, I was asking what is your overall work experience and your experience in deep learning and machine learning development ?

**Interviewee:** [00:29:44] Okay. So in terms of My overall work experience, I would say the four years of PhD plus one year of postdoc.

**Interviewer1:** [00:30:02] Okay

**Interviewee:** [00:30:03] And this one last year in Industry.

**Interviewer1:** [00:30:06] Okay

**Interviewee:** [00:30:08] And specifically in deep learning it's essentially just this one last year in the industry.

**Interviewer1:** [00:30:16] Okay, and what type of deep learning networks have you developed/implemented and by that I mean supervised, unsupervised, Reinforcement learning and etcetera?

**Interviewee:** [00:30:26] Sorry, I've missed again the first like two or three words of the question.

**Interviewer1:** [00:30:30] So what type of deep learning networks have you developed or implemented?

**Interviewee:** [00:30:37] Okay, so now developed and implemented is a bit of a big word for me. But let's say I worked or tampered with or have broken sometimes.. Mainly I've worked with the as I said object detection Network. Yeah, networks for object detection, so Faster R-CNN.

I tried to run the [inaudible] CNN then I've worked a bit with the Generative Adversarial Networks. What else, most of the times it's been just, I mean, generically speaking the Deep convolutional neural networks.

**Interviewer1:** [00:31:31] Okay, and one last question which programming languages and Frameworks have you been using so far?

**Interviewee:** [00:31:39] So of course, I would say, cause I guess that's the answer that everybody gives you, the main programming language I use is python. I've been working with the.. I mean. I'm assuming you were asking about deep learning Frameworks.

**Interviewer1:** [00:32:01] Yes, like tensorflow, keras, pytorch.

**Interviewee:** [00:32:04] Okay, so mainly Pytorch. And bit of tensorflow. And once Cafe but luckily I managed to stop doing that and that's pretty much it because again, I've been in the industry for only one year, so I didn't for instance used Theano because it had been buried by then. So those are the ones that I have been using a bit.

**Interviewer1:** [00:32:40] I see okay, so I think we're done with our questions. Thanks a lot for your time, and I hope we did not disturb you too much by [inaudible] telling us about ..

**Interviewee:** [00:32:51] No worries. No worries.

**Interviewer 2:** [00:32:52] Thank you very much.

**Interviewer1:** [00:32:53] Thanks a lot, have a nice evening.

**Interviewee:** [00:32:54] Welcome. Have a nice evening, bye.