**Interviewer 1:** Yes, so could you just confirm it on the record that you allow us to tape this and transcribe?

**Interviewee:** Okay. I allow recording.

**Interviewer 1:** Okay, great. So I would start with some background information questions. So the first one is what is your current position at your job? I'm guessing that you're a freelancer developer, but yeah.

**Interviewee:** Yeah, I'm a consultant so I work independently. Multiple clients.

**Interviewer 1:** Okay, could you tell us about your experience, overall experience and experience in deep learning/machine learning systems in terms of years?

**Interviewee:** Well, I mean, I started studying deep learning, let's say around 2016. Yeah more or less. I mean, I have done some work on deep learning, but it's not the only thing I do, so, I mean, it's something one part of it. So, I mean, perhaps my idea is that deep learning is still a bit too, I don't know it's still not mature in all areas. So some areas are great, but some are still need more definition if, yeah...

**Interviewer 1:** Okay, so could you give us approximate numbers about your overall experience and experience in deep learning systems?

**Interviewee:** Well, I mean have some experience. Let's say I have some sort of intermediate experience, we can put it that away. I'm not an expert researcher. But I have some understanding of most of the basic stuff.

**Interviewer 1:** That's useful. Yeah, but for statistics, we need numbers. So if you could tell us "teah, I worked on it around 2-3 years", that would be useful.

**Interviewee:** Well, I mean 2016 that's when I started studying.

**Interviewer 1:** Okay, so that's when you started working with this.

**Interviewee:** Yeah.

**Interviewer 1:** And your overall work experience?

**Interviewee:** So, that would be 7 years.

**Interviewer 1:** 7 years. Okay, thank you. So what type of deep learning networks have you developed/implemented? And by that I mean like supervised/unsupervised/reinforcement learning and etc.

**Interviewee:** What sort of networks?

**Interviewer 1:** Yes.

**Interviewee:** Well, hmm. Let's say, for image classification, I don't know, most of the typical networks: VCC(?), ResNet, Mobile Net. And for object detection I've worked with Yolo B2(?) .

**Interviewer 1:** Okay.

**Interviewee:** I've actually adapted the network because it was too big for a problem I was working on, so yeah, basically, but in the end the algorithm was more or less the same.

**Interviewer 1:** Okay, so what kind of problems for were trying to tackle using deep learning network, like image classification/speech recognition.

**Interviewee:** Well, in general, I've worked quite a bit on object detection, but yeah image classification also. And I've done some text classification.

**Interviewer 1:** Okay.

**Interviewee:** And yeah also named entity recognition.

**Interviewer 1:** Okay, and could you tell us which programming languages and frameworks have you been using while you were developing these systems?

**Interviewee:** I've used Keras and Tensorflow. And I've implemented this with demo videos and NCS(?), this is like some sort of hardware. It's actually a USB stick and that's a fairly cheap hardware, well in terms of price. And but yeah, the model was trained on Keras. So for entity recognition I used PyTorch. Yeah, and yeah, I guess for image classification I've used Keras and for text classification also. Sorry, I am taking some time because I'm trying to remember.

**Interviewer 1:** That's fine don't worry. Okay. So for this interview, we have one general question, which is what type of problems/bugs/challenges you have faced and we're interested in like conceptual bugs, like really small bug, all kind of error messages that you have seen in your experience and etc. So if you could start from there, that would be very useful.

**Interviewee:** Yes, let me think there are so many...

**Interviewer 1:** That's good if there are so many!

**Interviewee:**  I think, in general like on a high level idea, I mean to reply to this, I would say, yeah, if you want to solve problems that are a bit more complex than the, I don't know typical problems like image classification or whatever, so it's a bit more complex, then there's less and less resources available that are useful. So, I think that is one problem I find. For example, if you want to do object detection, it is very easy to apply an already trained object detector. But if you want to adopt it or change it, you practically have to train it from zero. So in that case, it would mean that you will have to train from zero ad ImageNet model. So it's probably becoming a lot more work. So in the end that's where I find most of the bugs. Or when I want to try more complex stuff the library start not working and, for example, libraries that are supposed to be very well supported, such as Tensorflow object detector API, that's how they call it. If you [inaudible] a bit the classes or, yeah, it doesn't work really great. I mean, even if you retrain the model for one class that was already trained, it works worse, so it's not so simple. I think that those would be the first problems, I would describe.

**Interviewer 1:** Okay.

**Interviewee:** But I mean, yeah, of course, it's not really bad in terms of okay, I have an error in my code, but conceptually it's a problem I would say.

**Interviewer 1:** Okay, so you said that for some cases you have to train your models from scratch? And did you use existing data sets to train your network or did you ever have to collect the data yourself?

**Interviewee:** Yeah, I mean normally you start with an existing data set, of course if there's data labesl you use that, but of course in some cases you need to label it, and I mean label field samples and see if that works. But yeah often, yeah, you need to look for an already labeled it.

**Interviewer 1:** Okay, so when training your models did you pre-process your training data in any way or do you remember any instances when you had problems with training your model, because you did not take necessary pre-processing steps?

**Interviewee:** Well, I mean, yeah, I mean those are very easy to see, so, I mean, if you make an error there, everything will be extremely wrong. So it is very easy to find but yeah, of course at some point I made some mistake like that. That's really not really a problem.

**Interviewer 1:** So could you tell us what kind of pre-processing steps, for example, you missed?

**Interviewee:** Yeah, let me think. Yeah, I really don't remember. Yeah, sorry.

**Interviewer 1:** That's all right. Do you remember any other problems/bugs related to training data that you had at any point?

**Interviewee:** Mhm. Sorry here. Yeah, I'm here. I'm just trying to think, because I mean I have to think of projects, I've done like a year ago, let me think pre-processing data bugs.

**Interviewer 2:** Training .

**Interviewer 1:** Training data bugs, like you have you do not have enough data, is a data you had was in some way wrong, you could not bring it to the desired format to train and etc.

**Interviewee:** One problem. I was working with an object detector with infrared images.

**Interviewer 1:** Okay.

**Interviewee:** And basically I had no infrared labeled data, s. I had to use like, I don't know, Coco(?) or whatever that was available.

**Interviewer 1:** Okay.

**Interviewee:** So so yeah, I mean, of course, the first thing I tried was to use the data as it came and just throw it in the network and that did not work bad. But I would say that will be some sort of error. I mean in terms of probably the pre-processing I was doing wasn't matching the healthy solution would be implemented. So yeah, that would be one sort of bug I've made and but in the end.

**Interviewer 1:** Yeah, so how did you fix it?

**Interviewee:** Yeah. I mean I just, what I've done really, first of all, I needed to lower the memory consumption, so just lower the parameters. So I tried training the model in grayscale.

**Interviewer 1:** Okay.

**Interviewee:** And then I used different data augmentation techniques to make the data more realistic to work in low light environments better.

**Interviewer 1:** Do you remember like how much gain in accuracy did you get after, you know, adding these steps? Like, approximately.

**Interviewee:** No, it was not again accuracy. I was trying to keep the same accuracy, but lower the memory. It probably reduced 3 times, because it's one channel.

**Interviewer 1:** Which parameters did you reduce 3 times, sorry?

**Interviewee:** I mean if you use 3 channels you have.

**Interviewer 1:** Ahh, okay, okay. Okay, so maybe we could talk about model structure. Did you ever have problems because you were using the wrong model structure? Like I don't know, number of layers, types of layers.

**Interviewer 2:** Number of nodes and maybe you just used the wrong model itself.

**Interviewee:** Yeah, I mean, that's probably likely, but I mean in practice it's very hard to try everything. But so yeah, I mean what I normally do is look for model that works reasonably well. I mean, I'm not being paid to work like, I don't know, 300 hours on trying all the models possible, customers kind of simply want a good model they can rely on. So yeah, I'm often more conservative in choosing models that I know that wor well. Yeah.

**Interviewer 1:** Okay, so you don't remember any problems related to, I don't know, layer dimension and etc. that you ever had.

**Interviewee:** Mmm, yeah, I mean, of course, this is something I try. For example, let's say I'm I worked in a text classification problem. And yeah, I mean I started trying one layer with x amount of hidden units. Then I added one more layer and realized it wasn't changing anything. So yeah, just remove that layer. So, I don't think that's really a big problem.

**Interviewer 1:** Yeah, okay. Thank you. You said that you worked on text classification problem? So what kind of classification you were trying to do?

**Interviewee:** Yeah, I mean it was simply supervised classification problem.

**Interviewer 1:** Yeah, but like what were your classes?

**Interviewee:** Oh the classes. Yeah. Yeah. It was some sort of retail company that they needed to classify products based on descriptions. So basically that was, I mean, it was a short text.

**Interviewer 1:** Was this one unsupervised or supervised?

**Interviewee:**  Supervised.

**Interviewer 1:** So your training data then it was labeled right?

**Interviewee:** Aha.

**Interviewer 1:** Was it provided to you or did you have to participate in the collection?

**Interviewee:** No.

**Interviewer 1:** Sorry, it was provided?

**Interviewee:** Yeah.

**Interviewer 1:** And in case of this training data, did you notice that the training data wasn't very complete, it was not enough or that the labels might have been wrong in some cases?

**Interviewee:** Yeah, yeah, of course. Actually, those were practically all the problems where I mean, there were some categories that have very little data. So, of course, those models wouldn't work.

**Interviewer 1:** Okay.

**Interviewee:** Yeah.

**Interviewer 1:** So what did you do to deal with the data for some categories being underrepresented?

**Interviewee:** Well, I mean, it wasn't only that, some categories were also represented like too much, so it had 70% of the data in like 3 categories and the rest have like nothing. So yeah, I mean, I simply did stratified sample and, I mean, under categories that had too many observations I simply cut them at some point. So, basically I limited the amount of sort of redundant data.

**Interviewer 1:** So you removed the portion of training data.

**Interviewee:** Yeah.

**Interviewer 1:** Okay. And about labels? Do you have a percentage in mind? Which percentage of these labels were...

**Interviewee:** I'm trying to remember what I really did, I cut the more common categories at some point and I left the data of the underrepresented ones.

**Interviewer 1:** Okay, and you said that you did stratified something, right?

**Interviewee:** Yeah, I did that for a train/test split, because if you do random sample, you might get, you don't know which proportion you might get of each category.

**Interviewer 1:** Okay.

**Interviewee:** So so yeah, that was a little challenge. I guess, I wasn't totally sure if that was correct, but I thought it was reasonable.

**Interviewer 1:** So yeah about the labels. Do you remember any percentage? Which percentage of them were wrong, for example? Or was it like very often wrong, just few examples.

**Interviewee:**  It wasn't that a big of a percentage, but yeah, I mean, I actually found the categories were wrong, when I found some categories were performing very badly. So I measure the accuracy like at the category level. Okay, so I found some are very very bad and I ask the client: "Hey, what's going on with this category?". That's it. They would say: "Okay put that one inside that one and that's it".

**Interviewer 1:** So you corrected the labels in the end?

**Interviewee:** Yeah, I mean, it wasn't that big of a deal. But of course it was a problem.

**Interviewer 1:** So could you tell us about the problems that you had, that actually to you were be kind of a deal?

**Interviewee:** Sorry?

**Interviewer 1:** Could you tell us about the problems that you think are a big kind of a deal in these kind of systems?

**Interviewee:** No, no, of course that problem, what I mentioned first was important and I mean the unbalanced classes, the lack of data for some categories, that was very important.

**Interviewer 1:** Also. I also understand you have to fit textual data into a model in this case. So did you have to, you know, pre-process this textual data somehow? Or did you just leave it as it is?

**Interviewee:** No, no, of course, I mean, yeah, you need to represented in some way for model consuming. And for this problem, yeah, what I've done was simply a bag of words representation. The model I used was to layer hidden network, I mean fully connected hidden layer. So it's more or less the fast text idea.

**Interviewer 1:** Okay. Did you somehow will how to deal with special characters in this text or there were no special characters?

**Interviewee:** Yeah. No. No, not that I remember. Okay, but in the end it's special character becomes a new column in the bag of words representation.

**Interviewer 1:** Okay, thank you. So I wanted to ask you about loss functions. Do you normally use a predefined loss function? Did you ever write a custom one? Any problems that you had to because you choose the wrong loss function or because the one you used wasn't implemented correctly.

**Interviewee:** No, I normally use and one that's already implemented.

**Interviewer 1:** Okay.

**Interviewee:** But, I did have some issues with, for example, a definition of softmax function. Okay, I had some sort of, yeah, numerical issues and that was actually a very deep value in network. So so yeah, I mean those are the things...

**Interviewer 1:** So did you use this softmax function incorrectly or was there a bug in the framework itself?

**Interviewee:** Well, I mean, I found an open source project that I started working with. And yeah, it was already in there. I mean it wasn't part of a framework but it was a part of this project.

**Interviewer 1:** Okay.

**Interviewee:** So yeah, that was actually quite hard to find.

**Interviewer 1:** So do you remember what the fix? Like what was the problem and what was the fix?

**Interviewee:** Okay. So the problem was with softmax. You need to be very careful with the values, with the the numerical issues, right. So you can't like simply define it as its defined in math. You need to do something else. And yeah, the solution was simply to use CyPy(?) definition. I mean, it was very simple solution. Yeah.

**Interviewer 2:** Sorry, I didn't understand the definition of what? Of softmax?

**Interviewer 1:** Yeah. So doesn't softmax output just, you know, basically calculate probabilities and then I output the one with the highest, right?

**Interviewee:** No, yeah, it's the input is any number and it outputs the probability, but the problem with a very big numbers or very small numbers, it could have numerical issues. So, I mean, you can try it if you want, just define it like mathematically, like how it is written and throw in there are a few very big or very small numbers. Like, zero point and 2000 and some number and...

**Interviewer 1:** Okay. So, the output of softmax function does not work properly for very small or for very big numbers.

**Interviewee:** Right.

**Interviewer 1:** Yeah in the project that you have used not in any of the frameworks. Okay. It's something general. So did you like change these small or big numbers into something else or?

**Interviewee:** No, what I simply done is just use a proper implemented function and that was the solution. Because, of course, you can't control the numbers inside the network.

**Interviewer 1:** Okay. Okay. Thank you. So I wanted to ask you about hyperparameter tuning. Did you ever have like cases when your model was performing not well because of the wrongly selected hyperparameter value, if yes, which values and, in general, which hyperparameters you think are more problematic to select values for?

**Interviewee:** Mhm. Okay. Yeah, I mean it's again hard to answer because, I mean, if I would know what I did wrong, I would not have done what I've done and...

**Interviewer 1:** But, no, maybe you did something wrong and then you corrected it. So now, you know.

**Interviewee:** Okay. Yeah, let me think for a second.

**Interviewer 1:** Yeah, of course.

**Interviewee:** [Pause] I mean, I think that of course the most important parameter is the learning rate. And that's where I would look first in terms of problems.

**Interviewer 1:** Okay.

**Interviewee:** But yeah, I mean I said some the first I mean, it's the the really only parameter I always tune. It's very hard to miss it. But yeah, I mean, of course you can't have bugs if you use very high learning rate or you could have model never training if it's very small.

**Interviewer 1:** Okay.

**Interviewer 2:** Sorry, one question. In your experience is it usually too high or too low? The learning rate.

**Interviewee:** Yeah, I mean, it's I mean if it's too high you simply, it won't convert ever.

**Interviewer 2:** Yes, but usually in your experience, just as a statistic.

**Interviewee:** I mean what I try to do is, of course, is the highest learning rate possible, because you know that also affects the time the model is trainig. But I mean, yeah in reality, I mean what we learned this is a very important parameter for other models. It's important, but it's really not that important, for example, if you are using GVM (?) . So yeah, I think it's important that it's always probably the only thing everybody worked on always. So I doubt there are many bugs there.

**Interviewer 1:** Okay, I wanted to ask you about hardware. Where do you usually train your models and have you ever encountered problems/bugs/errors related to hardware?

**Interviewee:** I would said that's one of the problematic points. I mean, I there's a trend that hardware is always growing and growing and growing. And there's a point in which you can't re-train models with the, I don't know, what you have in your house basically, so so that's perhaps one problem. What I use I have is GPU in my computer, in my house. I actually never needed anything else. So it's not a problem for me, but I do see that this trend I just mentioned.

**Interviewer 1:** Okay. So in your overall experience, is there any kind of errors or bugs that you know, you're seeing appear too often?

**Interviewee:** Mistakes I do too often... Well, I mean that's....

**Interviewer 1:** Or you have done at least once at some point.

**Interviewee:** I am perfect.

**Interviewer 1:** Noooo

**Interviewee:** Really if I knew what bugs I'm doing, I wouldn't do them again.

**Interviewer 1:** No, but it's not how it works. So you do a bug, then you learn how not to do it and then you don't do it, but you have done it at some point. I would guess. No, but if you don't remember that's fine.

**Interviewee:** Give me a sec, I'm getting a call. So yeah, more or less how much time do we have for the call, just to have an idea, because I have a client that is calling.

**Interviewer 1:** I think er will be done in five minutes maximum.

**Interviewee:** Okay, cool.

**Interviewer 1:** The faster you tell us about bugs, the faster we're gonna be done.

**Interviewee:** Yeah, I mean I'm thinking of the projects. Maybe, okay, one bug that's something, for example, for time series problems a problem is how you validate the models, right? So I guess what I've done initially when I started learning was to simply do a train test split randomly. That was very wrong. Or do cross-validation. But yeah, I mean that's like, it's been some time since I've done that really.

**Interviewer 1:** How instead you should do this split, if not randomly?

**Interviewee:** Well, there are at least two ways to do it. Basically, to use different windows and yeah just do a split of, like splitting time like, here now until next year and then test on future data and then move that window. This is some sort of cross validation for time series.

**Interviewer 1:** Okay. Okay.

**Interviewer 2:** So do you have any questions left?

**Interviewer 1:** One, but you can go first.

**Interviewer 2:** No, you ask it and then I will.

**Interviewer 1:** Yeah, so I just wanted to ask a very general questions that let's say you have some training data, you are trying some model, you get some output and then you want to improve that accuracy. Do you remember any kind of steps you took to ensure that you can improve the accuracy of your model further?

**Interviewee:** So what steps I do to improve the accuracy like?

**Interviewer 1:** Yes.

**Interviewee:** Okay. Well, I mean in general. Yeah, I mean mostly what I think that can mostly help in, for example, structured data problems is finding more features.

**Interviewer 1:** Okay.

**Interviewee:** Or I need more data. So that's what I try to do the most. Yeah, I mean in terms of bugs, just thinking what you what you were asking for. Sorry. I'm jumping, just remembering. I think in general where I find most of the bugs is in the data pre-processing, but not in deep learning problems, because the pre-processing there, it's fairly straightforward, but in the structure data or time series, I think there pre-processing is harder. And if you're showing many tables and, I don't know, it's easier to make a mistake, but I think it's much harder to make a mistake if you're subtracting the mean of an image. So, that's mostly yeah where I always go back and check what I'm doing or not. So yeah, I mean for to improve the accuracy basically try different models, try to add more features. And, of course, accuracy is just a concept. I mean rarely use accuracy as a metric.

**Interviewer 1:** Aha.

**Interviewee:** But yeah, I think that's mostly what I'm doing.

**Interviewer 1:** Okay. Do you have anything else to add?

**Interviewer 2:** Me?

**Interviewer 1:** Ahh, you had a question.

**Interviewer 2:** Yes. As I understood, you use only one GPU for training.

**Interviewee:** Yeah, for the deep learning jobs I have done.

**Interviewer 2:** So the question is have you ever experienced any problems relating to sending data to your GPU or with memory? So, if you have estimated the memory on your GPU uncorrectly and tha data you were sending could not fit into it, and you had, for example, to change the batch size or something.

**Interviewee:** Yeah. Sure. Of course, I mean that's typical. I mean, yeah, but as you said, it's very easy to realize you don't have enough memory and you can change the network, change the batch size. Actually, the probably the hardest thing in deep learning is to install like the software for the GPU.

**Interviewer 2:** Okay.

**Interviewee:** That sounds a bit, I mean, I'm saying it's a bit ironically, but it's really a problem. I mean to install the software drivers...

**Interviewer 2:** No no, I know with GPU there are always problems. Maybe anything else related to it?

**Interviewee:** Yeah, I mean, for me it was mostly that, just setting it up. At the time I started working on this it was much harder, now it's a bit better, but it's still non-trivial. But I mean there are a lot more possibilities now compared to 2016, that's when I started learning about deep learning, so.

**Interviewer 2:** Okay. Thank you.

**Interviewer 1:** If you don't have anything else to add I think that's it.

**Interviewee:** Okay, cool.

Thank you. Thanks a lot.

Thanks for the call.