Simon Klüttermann

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Dear Dr. Tywoniuk,

I am currently looking for a PHD position, and the one you advertise here is quite interesting to me. I am interested in your position, since it allows me to combine the two fields I am interested in the most.
Finding a machine learning PhD position might be fairly easy, but combining them with a particle physics application is much more rare, and just adding theoretical approaches is enough to make me want to definitely apply.
And not only this, but you also want me to do jet physics and new physics searches, which I am interested in very much. I also think your dual supervision approach is a great idea, since I know how hard it can be not to have somebody to supervise you in your coding. Also teaching responsibilities are a must for me, since I thoroughly enjoy them. Finally I like to use my doctoral studies to learn a different language and I think your position would allow me to do so.

Considering what you expect from a successful candidate, I think I fit well into your group:
I finished my Masters degree in theoretical particle physics (This degree is sadly not attached, since it is currently still getting printed, but you find my grades in my CV and I send you a copy as soon as I have it), which includes knowledge of quantum field theory. I may have less experience in nuclear physics, but I always found it quite interesting. Even more strong might be my computational skill, as I am a competent programmer and I have at least some experience in most areas of machine learning. This includes a masters thesis between jet physics and machine learning. I am also able to work alone quite good, while also enjoying teamwork very much. I don't speak Norwegian, but I would like to learn it (learning a new language is a personal goal for my PhD studies) and I speak English quite well [1].
When talking about my former research, the most important part might be the already mentioned masters thesis. I wrote this thesis about the possibility of using anomaly detection to find jets that are not characterised by standard model interactions. I was working in a group who only recently started using ML and so I got a task that was as interesting as it was hard. I should use auto-encoder to classify anomalies and try to include a special kind of neuronal network (graph neuronal networks) into this auto-encoder. Graph networks make it hard to build an auto-encoder from them, so this took some time, in which I learned to write tensorflow networks that are more complicated than just stacked convolution(or dense) layers. My final code is available in a python package here. Given my graph auto-encoder prototypes, it became clear that the true difficulty does not lie in the application of graph networks, but in the initial idea of using an auto-encoder to find anomalous jets, since they were only able to find a specific set of anomalies. I spend the rest of my thesis producing an anomaly detector that is able to find much more general anomalies. You can see a nice comparison graph at the end of my abstract here.
I might not think that anomaly detection is ready to reliably find new physics jets, but the

[1] Considering your formal requirements, they are not very clear. Here you note that EU/EEA countries (like for example Germany) are except from proving English skills formally, but here Here you list Germany as requiring an English test [even though there is an asterisk, that I don't find explained anywhere]. I just interpret this as I do not have to prove that I speak English, and would like to point out that I did my Master studies in English

individual parts of my masters thesis are still quite fascinating to me. I think particle physics can benefit a lot from the automatisability and ingenuity of good machine learning (for a weird application, see an example use of my graph auto-encoder on feynman diagrams here). I believe that a good anomaly detection algorithm can allow you to solve much more general problems then supervised algorithms and that they are a sadly way to much neglected part of machine learning. And I also quite like the way graphs can change the way you think. That being said, I also always like learning new things.

Thank you for reading my motivation and for considering me for this position.

Sincerely,

Simon Klüttermann

For reference letters, please write a quick email to

- Prof. Dr. Michael Krämer: mkraemer@physik.rwth-aachen.de
- Dr. Alexander Mück: mueck@physik.rwth-aachen.de