

# Statement of Purpose

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I like challenges. After reading an article about genetic engineering I have chosen Biology as my major in the secondary school. With the biggest challenge I faced being memorization of some facts, I decided to change my major to Maths & Physics I always loved. I would have chosen Informatics if only I had any idea what that meant. Coming from a background where CS is associated with technicians repairing “broken” PCs, my idea of CS was very far from the romantic vision of young startup founders set out to change the world. Luckily, I have been exposed to Matrix and IRobot, both filled with autonomous intelligent machines ruling the world. Fascinated, I decided to find out if it is possible and how make it happen. Not that I wanted to destroy the world, no, but the sheer concept of creating a machine that could improve itself, or the technological singularity, name I didn’t know at the time, was enticing.

My journey began at the best tech university in the country, where I enrolled for the BSc in Robotics. I learned a lot about physics and mechanics, material science and manufacturing technologies; not until my first programming class, however, have I realized how a truly intelligent entity could be controlled. This, paired with my passion for vision and perception I’ve developed as a photojournalist, steered me towards my first computer vision course, where I learned about image processing and machine learning. I immediately knew that this was the area I wanted to focus on. It was not only challenging, since there weren’t any general purpose systems good enough for deployment in the real world, but it was also well aligned with my original passion for intelligent machines.

To learn from the best, I went for an internship to the Computer Vision Lab at Samsung R&D in Warsaw. My project was to design and implement a Bag of Words-based pipeline for object classification. Consequently, I learned about the state-of-the-art in keypoint detection and feature description, which later helped me to appreciate the importance of automatically learned low level features in convolutional neural networks (CNNs). I focused my research mainly on the visual codebook generation within Bag of Words. The final step was to optimize it and port to the Android platform. In my bachelor thesis I investigated how spatial information affect classification performance by implementing a similar system for Kinect-gathered point cloud classification. I continued my work at Samsung, where I worked on deep learning techniques for object classification and duplicate detection.

My observation was that deep learning, although superior to older approaches, required huge computational resources and datasets to be any good and therefore I decided to study computational science to be able to harness supercomputers. TUM seemed to be a great choice due to the computer vision teams operating there.

This summer I did an internship at Bloomberg in London, where I’ve been working on fraud detection in financial transactions. The problem can be cast as unsupervised anomaly detection with further verification in a supervised settings. I learned how difficult it can be to introduce an innovative approach in a corporate setting. This, together with my earlier

industrial experience, convinced me that I do want to pursue a PhD. I love solving scientific problems that do not have “the best” solution or reference specification and I vastly prefer it to chiseling icons in an user interface.

Currently, I am working with Caner Hazirbas and Rudolph Triebel of the Computer Vision group headed by Prof. Cremers. In our recent project we investigate the introspective capacity of neural networks. It is understood as the ability of a classifier to assess uncertainty of its prediction given the data [ref]. It is a paramount problem in mobile robotics or medicine where a wrong classification might lead to loss of life. While high classification accuracy is desired, it is impossible to assess whether a given prediction is accurate in the test setting, where no labels are available. It is, therefore, vital to assess uncertainty of predictions. Our intermediate results show that neural networks, augmented with additional layers and a novel cost function, can be jointly trained for classification and uncertainty estimation. The topic might expand into my master thesis.

In my doctoral research project I would like to focus on deep neural networks for reinforcement learning and recurrent neural networks. The former fascinates me since it is similar to how humans learn. Specifying a reward function or, as in the inverse problem, designating an expert is far easier than providing supervised training data. Recurrent neural networks, on the other hand, are well suited to sequential information processing. If beliefs about content could be introduced in a form of priors inferred from previous elements of the sequence, it might be possible to increase object classification accuracy in videos and to shrink the network size. It would reduce the amount of computation needed, possibly leading to an energy efficient system for portable devices. Another interesting problem is an end-to-end RNN for optical flow computation. The only end-to-end neural network, while efficient and accurate, does not use temporal information. It computes optical flow for any two possibly unrelated images [ref]. I would like to investigate RNN designs capable of computing optical flow while presented with a single image at a time. It might lead to better accuracy with fewer computations, thus better energy efficiency.

Passion for solving technical problems coupled with my demonstrated skills show that I am ready and extremely well motivated to carry out research as a PhD student at the University of Oxford. I am confident that I will be able to contribute significantly to and benefit immensely from my stay there. Thank you for considering my application.