1. Motivational letter

Figure 1. Input text: Meating with AI in Metaverse

Is it possible to model such biomolecules as proteins, one of the essentials in all known forms of life? The answer is as simple as - yes, it is. However, the major challenge of it is that the number of ways a protein could theoretically fold before settling into its final 3D structure of a molecule is astronomical. And this is where artificial intelligence comes into play, handling the issue. It demonstrates the feasibility to mathematically calculate favourable combinations via, for example, the latest version of AI system AlphaFold, recognised as a solution to the calculation challenge. So now the resulting opportunity to predict protein structures seems to be potentially helpful for scientists in developing vaccines and medicines for ailments much faster. There are, however, other fields for deep learning research, I would say, even more profound ones, as they address the eternal question of whether computers will be able to think like human beings, or, rather, produce art... OpenAI research company questioned themselves on that point too and finally came up with a new DALLE-2 system that is capable of producing diverse photorealistic images based on textual material. For this the process of NNs abstraction was vastly enhanced to accurately mimic brain neural connections. Figure 1 brilliantly illustrates such a technique at its full capacity, showcasing how underlying architecture is facilitated by the driving force of newly immersed diffusion method that comes from non equilibrium thermodynamics and stochastic analysis.

Not only do the breakthroughs mentioned spotlight the impact that AI can have on scientific discovery or its potential in some of the most fundamental fields that explain and shape our world. They also reflect my deepest interested in machine learning and artificial intelligence, my path to which has been meticulously, yet naturally, paved by successive blocks of knowledge gained during the study.

My research work began in the third year of the university when I encountered optimal transport theory and stochastic processes subjects. I studied connections between so-called Wasserstein gradient flows (the minimization process of some given functional on the space of probability measures) and stochastic differential equations. These topics intrigued me greatly due their vast utilisation in various applied fields, such as reinforcement learning and generative models training. They led me to my current diploma work revolving around the forward-backward diffusion dynamics and their mathematical interpretation. The idea for now is to generalize existing approaches while studying the abovementioned diffusions. And to say the

least of it, I must admit that the subject brought me closer to understanding the current state-of-the-art results, like those described for DALLE-2 system

All in all, having studied abstract mathematics for five years already and having achieved some degree of mathematical maturity by now, I have come to realise that a fair amount of concrete computing or engineering problems can be addressed via abstract mathematical framework, such as Topology, for example. The one being among my favourites during the course of study in Higher Schools of Economics, I now see how it is to be used in deep learning algorithms when viewed as a bridge between a range of input ideas and a sought outcome solution based on them. To illustrate, data encountered in robotics, geoscience or even in protein modelling can be at times characterized by varied complex geometries, and so the bunch of numerous features that need to be considered simultaneously is easier to handle in simplified alternative topological spaces that are more convenient for the tasks.

So in the light of a tight bond between abstract mathematics, reinforced learning and concrete tasks solutions becoming increasingly obvious, I believe that Machine Learning and Artificial Intelligence program is the best choice for mathematician students, such as I am, who are eager to embark on their route of this rapidly developing area and on their research that at this faculty can be done in such a great many of diverse fields. I am also convinced that fundamental mathematical knowledge I have in my arsenal is extremely beneficial as many theories that were once considered as purely abstract and inapplicable for solving real world problems became a unified tool for every engineer nowadays. I would also be honoured to enjoy the abundance of laboratories (I am particulary interested in Computational Intelligence and Computer Vision labs) and research groups your university has at its disposal, let along the renowned working climate that makes new ideas and discoveries easily possible.

Hoping to become a part of Scholtech globally recognised quality educational environment, I am looking forward to your positive response.

Yours sincerely,

Maxim Bobrin