

## Kratek opis usposabljanja mladega raziskovalca (*Short description of the Young Researcher's training*)

1. Raziskovalna organizacija (*Research organisation*):

Univerza v Ljubljani, Fakulteta za računalništvo in informatiko (University of Ljubljana, Faculty of Computer and Information Science)

2. Ime, priimek in elektronski naslov mentorja (*Mentor's name, surname and email*):

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3. Šifra in naziv raziskovalnega področja (*Research field*):

2.07.07 Računalništvo in informatika, Inteligentni sistemi (Computer Science, Intelligent Systems)

4. Kratek opis usposabljanja mladega raziskovalca (*Short description of the Young Researcher's training*):

Navedite tudi morebitne druge zahteve, vezane na usposabljanje mladega raziskovalca (npr. znanje tujih jezikov, izkušnje z laboratorijskim delom, potrebne licence za usposabljanje...).

*sl:* Globoko učenje je podpodročje strojnega učenja, temelječe na umetnih nevronskih mrežah, ki predstavlja kompleksne nelinearne matematične funkcije z uporabo arhitektur globokih nevronskih mrež. Globoko učenje se uporablja za modeliranje problemov realnega sveta in pogosto dosega najboljše rezultate v različnih problemih napovedovanja. Raziskovalno področje mladega raziskovalca bo strojno učenje, bolj specifično pa globoko učenje z uporabo različnih pristopov h globokim nevronskim mrežam. Konkretno podpodročje bodo generativne nasprotniške mreže (ang. Generative Adversarial Networks, GANs) in njihove variante, skupaj z (variacijskimi) samokodirniki (angl. autoencoders) ter superpozicije več modelov v enega. Osnovna naloga raziskovanja bo razvoj nove arhitekture globoke nevronske mreže, ki bo kombinirala ideje nenadzorovanega in delno nadzorovanega učenja v GAN in samokodirnikih z vključevanjem mehanizmov pozornosti ter idejo kompresije modelov s pomočjo superpozicije modelov z namenom izboljšanja delovanja. Razvite metode bodo testirane in primerjane z obstoječimi pristopi na različnih realnih problemih, večinoma iz področja analize medicinskih podatkov.

Mladi raziskovalec se bo vpisal v doktorski študij Fakultete za računalništvo in informatiko Univerze v Ljubljani in bo v času usposabljanja doktoriral iz opisanega raziskovalnega področja. Delal bo v Laboratoriju za kognitivno modeliranje, ki ima trenutno 15 aktivnih raziskovalcev s področja strojnega učenja in podatkovnega rudarjenja z več kot 20 let izkušenj in več kot deset tisoč citatov v znanstvenih publikacijah.

Kandidat za mladega raziskovalca mora imeti ustrezno predznanje iz računalništva in iz osnovnih metod strojnega učenja. Zahteva se dobro znanje programiranja in solidno dodiplomsko poznavanje matematike in statistike.

*eng:* Deep learning is a machine learning approach, based on artificial neural networks, which represents complex non-linear mathematical functions using various deep artificial neural

networks architectures. Deep learning is used to model real-world problems and often to achieve state-of-the-art results in various prediction problems. The research field of young researcher is going to be machine learning, more specifically deep learning using different approaches of deep neural networks. The particular subfield will be GANs (Generative Adversarial Networks) and its variants, together with (variational) autoencoders and superposition of many models into one. The basic task of research will be the development of a novel deep neural architecture that will combine the ideas of unsupervised and semi-supervised learning of GANs and autoencoders with the addition of attention mechanisms and the idea of model compression via superposition of many models into one in order to improve the performance. The developed methods will be tested and compared with existing approaches on several real world problems, mostly from the field of medical data analysis.

The young researcher will enroll into the PhD study program at the Faculty of Computer and Information Science, University of Ljubljana and will finish the PhD during the training period. (S)he will be working in the Laboratory for Cognitive Modeling which has 15 active researchers in the field of machine learning and data mining with more than 20 years of experience and more than ten thousand citations in the scientific literature.

The candidate for young researcher should have the appropriate background in computer science as well as in basic machine learning approaches. The required skills are in particular excellent programming skills and solid undergraduate knowledge of mathematics and statistics.