MEi:CogSci Projects for Specialisation

Projects at the "University"

Project	Description	Required Qualifications	Places | Level
Title of Project Responsible Person Department Link to website (If available)	Short description of project	Short descriptions of required qualifications	Number of places | Level: [IR II, S-I or MA]*
Grounding abstractness Igor Farkas, prof. Dept. of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	Abstract concepts lie at the core of human cognition, providing it with an immense potential for thinking. Yet, understanding abstractness remains an open challenge in cognitive science, despite an outburst of recent papers published on the topic. The goal of the project is to propose a conceptual framework for concrete and abstract concepts that could be implemented in a neural network and simulated in a smaller domain.	An ideal candidate would have solid knowledge in linguistics and experience with machine learning (neural networks) and/or programming. Purely theoretical project is also possible.	1 | S-I
Connectionist modeling in cognitive robotics Igor Farkas, prof. Dept. of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The goal will be to implement and test a neural network model of a chosen agent's component in a simulated or physical environment (NICO robot). The robot is supposed to learn a concrete task. Various foci are possible: intuitive physics, i.e. understanding causality in the physical world, intuitive psychology (theory of mind), i.e. understanding the other's goals, spatial cognition, etc. Concrete focus of the project will be negotiated.	At least basic programming skills (e.g. Python). Experience with artificial neural networks is an advantage.	1 | S-I
Towards humanizing human-robot interaction Igor Farkas, prof. Dept. of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The project can be for two students. Successful HRI in the future will be facilitated if certain expectations about interacting robots are met by the humans. The purpose of the theoretical part of the project is to investigate pros and cons of humanizing robots and analyze (some of) them on the level of design features (be referring to an existing literature). The computational part will be based on implementing and testing a selected aspect of humanized HRI.	The student doing the implementation part should have a programming experience (Python preferred) and experience with artificial neural networks is an advantage.	2 | S-I

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Social multi-agent simulation Martin Takac, assoc. prof. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The student will create a computational model of a social phenomenon of their choice (e.g. belief spreading, covid spreading in a population, etc.). The work includes reviewing the relevant theories in literature, designing and implementing a computational model (in Netlogo), running the simulations and interpreting the results.	Previous programming experience (in any language) on a moderate level required, so that the student is able to formalize the ideas into a code (Netlogo is easy to learn).	1 | S-I
Computational psychiatry Martin Takac, assoc. prof. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, CUB web	Project for two students: One student gathers the relevant neuroscientific literature about altered states of consciousness and proposes a formal theory/model of the functional changes in an altered mind (e.g. based on entropic brain theory of Carhart-Harris, 2014). The other student co-designs and implements the computational model, runs and analyses its simulations.	The student doing the implementation part should have a previous experience in programming (in any language).	2 | S-I
Mindfulness meditation, electroencephalography and brain stimulation Barbora Cimrová, PhD. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	Mindfulness meditation (MM) is a well-known practice with a positive impact on well-being, cognitive functions (attention, working memory, executive functions), immunity, and other aspects of practitioners' life. The effects of MM include structural and functional changes of the brain. The goal of the project is to make a theoretical overview of the state-of-the-art research on mindfulness meditation and potential combination of this method with brain electrical stimulation; to design and eventually perform an experiment regarding this topic.	Experience with an EEG is an advantage	1 | S-I
Human-robot interaction in virtual reality Kristína Malinovská, PhD. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	HRI becomes one of the most popular interdisciplnary topics highly related to cognitive science. The domain of cognitive robotics studies and offers natural ways of building humanlike robots in the way they will understand and align with their human users. However, such robotic platforms are not in abundance and often trained using their simulated counterparts. This project is an assignment spanning from dense literature review up to experimental design and/or programming of the HRI-VR experiments.	This project is a good opportunity for joint work. One student should have a background in psychology, or linguistics, and the other one experience with machine learning and/or programming.	1 | S-I

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Language games Kristína Malinovská, PhD. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The so called language games are a very powerful tool of studying emergence of communication and grounding of meaning. Stemming from the game theory, they can be used in a computer simulation with agents as well as for behavioral experiments with human subjects. This yet not well explored field in cognitive science requires further attention in many respects. This project is an assignment spanning from dense literature review up to experimental design and/or programming of experiments.	This project is a good opportunity for joint work. One student should have a background in psychology, or linguistics, and the other one experience with machine learning and/or programming.	1 | S-I
Biologically plausible learning in neural networks Kristína Malinovská, PhD. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The deep neural networks have become immensely popular in last 10 years. Despite their rapid development and super-human performance, they are still many research prospects to be studied in this area including the algorithms used for training the networks. Usually deep networks are trained using standard error backpropagation, a method developed in 1980's along with the multilayer perceptron. However powerful, the BP has been shown to be biologically implausible and new algorithms have been proposed and are still being developed. This project is an assignment spanning from dense literature review up to the experimental work with existing novel algorithms and/or being a part in proposing new ones.	Mathematics and programming skills required at least on a basic level. Experience with artificial neural networks is an advantage.	1-2 | S-I
Few-shot learning and prototype theory of categorization Kristína Malinovská, PhD. Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	The few-shot learning approach in artificial neural networks has recently become a popular way to address the problem of large labeled dataset requirements of traditional deep architectures. Simply said, in this paradigm we rather endow the network with some learning and generalization abilities than train it to generalize over a particular kind of data. The prototype theory of Eleanor Rosch and others have been proposed quite a long time ago, yet currently it can find a lot of use in so popular deep learning. This project is an assignment spanning from dense literature review up to the experimental work with existing models and/or being a part in proposing new ones.	Mathematics and programming skills required at least on a basic level. Experience with artificial neural networks is an advantage.	1 | S-I

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Cognitive and brain mechanisms of semantic memory retrieval Martin Marko, PhD. Centre for Experimental Medicine, Slovak Academy of Sciences web	A challenge in the research on human cognition is to understand the mechanisms enabling fluid retrieval of semantic knowledge that is suitable for current contexts and situational demands. This project is aimed to investigate these (domain-general and domain-specific) mechanisms and processes that underpin semantic memory retrieval in healthy participants, using experimental manipulation of relevant cognitive or neurobiological systems. Such manipulations may involve either various forms of cognitive load and interference or (optionally) non-invasive brain stimulation (tES), depending on the availability of the required device(s) and the currently ongoing experiments in our lab at that time. Note: this is an empirical assignment that includes duties associated with data collection. Thus, students taking this project will be expected to recruit participants, administer experimental sessions (on their own or in collaboration with each other), and analyze the empirical data (under the supervision).	The ability to manage and execute experimental sessions and assess the findings. For this, experience in empirical/experimental research and quantitative methodology is an advantage.	1-2 | S-I
Brain simulation, sensory gating and cognitive inhibition Igor Riečanský, PhD. Centre for Experimental Medicine, Slovak Academy of Sciences web	Cognitive inhibition is essential for goal-directed behavior. This project will investigate the possibilities of modulating brain inhibitory processes using non-invasive transcranial direct current brain stimulation. An experimental approach will be adopted using behavioral and electrophysiological methods (EEG, EMG).	Experience in experimental research and quantitative methodology is an advantage.	1-2 | S-I
Barriers of people's climate change beliefs and pro-environmental behaviors Jakub Šrol, PhD. Center of Social and Psychological Science, Slovak Academy of Sciences jakub.srol@savba.sk web	Despite the fact that people around the world voice their concern over negative consequences of climate change, their actual engagement in pro-environmental behavior is rather low. Researchers uncovered many barriers that people report as reasons for not engaging more with environmental issues, spanning from the lack of understanding of climate change, resulting from cognitive biases that increase psychological distance from the issue, or barriers driven by feelings of helplessness and guilt. The aim of the project is to gain further insight into barriers of people's climate change beliefs and pro-environmental behaviors, and to find ways to improve people's engagement with this issue.	Background in psychology is an advantage	1 | S-I

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Interventions to reduce people's susceptibility to fake news and conspiracy theories Jakub Šrol, PhD. Center of Social and Psychological Science, Slovak Academy of Sciences jakub.srol@savba.sk web	Media, politicians, and scientists voice their concern over large proportions of people being susceptible to fake news and conspiracy theories. Although some debiasing methods, such as inoculation by counterarguments, have already proved effective in this regard, they all have their limits – e.g. successful inoculation has to occur before the exposure to conspiracy theory content. The aim of the project is to create and test the effectiveness of various new interventions – such as increasing information and scientific literacy or priming critical thinking about social media content – in reducing the belief in various popular conspiracy theories and trust in fake news.	Background in psychology is an advantage	1 | S-I
Studying effects of virtual reality training on motor rehabilitation Roman Rosipal, PhD. Institute of Measurement Science, Slovak Academy of Sciences web, web1	Technological advancements based on virtual reality (VR) offer various research and medical treatment challenges. Being part of the ReHaB project, the study focuses on hemiparetic patients after stroke. We test the hypothesis of whether experience with training in VR (in combination with motor-imagery-based brain-computer interface) will enhance narrow-band scalp-recorded EEG oscillations. Projects will carry a vital practical and analytical component connected to real EEG data recorded during the VR-based experiments.	Systematic work, basic principles of statistical analysis and testing, programming in MATLAB is an advantage.	1–2 | S-I
AI biases Tomas Gal, PhD Dept of Applied Informatics, Faculty of Math, Physics and Informatics, Comenius Uni. web	Human cognitive biases are mostly considered as a burden from pre-civilized times. They help us, however, to solve everyday practice, routinely. The aim of this research projects focuses on two questions (1) whether the AI should by stripped from all human-like biases and (2) if not, what kind of biases should be mimicked. Practical output of this research will be a conceptual model of economically profitable ethical AI.	Background in psychology or philosophy is an advantage.	1–2 | S-I
Development of beliefs by artificially modulated states of mind Tomas Gal, PhD Faculty of Math, Physics and Informatics, Comenius Uni. web	Research into altered states of mind, done by various methods, like dance, meditation or controlled stress.	Background is psychology is an advantage	1 | S-I

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Human being and information technology Emil Visnovsky, prof. Faculty of Philosophy, Comenius University web	Project will focus on the analysis and functions of information technology and its varieties in human life from a philosophical point of view based on contemporary cognitive science and AI.		1-2 | S-I
Nature of human consciousness Silvia Tomaskova, prof. University of Constantine the Philosopher in Nitra, Department of Philosophy, Nitra web	Main objective of the project is to reconsider novel experimental and theoretical models, theories on the status and function of conscious experience. Research concentrates on the inquiry into the nature of conscious/unconscious distinction, reality of Self, impairments of consciousness, self-knowledge, explanation of subjective „inner life".	Background in philosophy of mind is an advantage.	1 | S-I

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