Faculty common course 2021

English course title: Application oriented deep learning

Swedish course title:

Extent (credits): 5

Language of instruction: english

Recommended prerequisites:
Basic knowledge of the Python programming language is a benefit but there is also room to improve your programming skills. You will need to use Python for all homework assignments. Everyone without Python experience is highly encouraged to work through an online course on Python with an emphasis of the numpy package. Many good online resources are available, google yourself or choose one of the following:

- https://docs.python.org/3/tutorial/
- https://www.w3schools.com/python/python_intro.asp
- https://www.tutorialspoint.com/python/
- https://www.datacamp.com/community/tutorials/python-numpy-tutorial
- https://www.machinelearningplus.com/python/numpy-tutorial-part1-array-python-examples/

Learning outcomes of the course:
After successful completion of this course, students will be able to:

1. summarize the concepts of deep learning
2. apply deep learning for typical problems in their field of research
3. design and optimize network architectures for different problems

Specify which learning outcomes of the doctoral degree that are address/covered (see appendix 1 of the call or the template of ISP). Describe how:
A large part of the work of many PhD students is data analysis. This course will empower the students to plan and use appropriate methods by equiping the students with state-of-the-art techniques in machine learning. Machine learning made tremendous progress over the last years. The advances in computing resources together with the development of algorithms to efficiently train deep neural networks (deep learning) results in an unpreceded performance, most notably in the advances in image recognition. Deep learning can be applied to a vast variety of problems in different areas and will often outperform existing techniques.
The students will learn this powerful research method. The course will focus on the practical skills of applying deep learning to their domain specific problems. The discussion of many research examples will help the students to undertake qualified tasks in predetermined time frames. Through the discussion of weekly exercises the students will learn to review and evaluate their work.

Course contents:Fundamentals of Deep Learning; Generalization, Regularization and Validation; Optimization and Hyperparameter Tuning; Convolutional Neutral Networks; Classification and Regression Tasks; Visualization & Advanced Computer Vision Methods; Autoencoders; Generative models, variational autoencoders, generative adversarial networks; Research examples from different fields

Instruction (course structure): The course will take place over the course of 10 weeks with 1.5 hours teaching and 1.5 hours exercise class per week. Due to the Covid-19 situation, this course will be given in a novel way. Instead of weekly lectures, the content will be split up into smaller 15-20min chunks and delivered via on-demand videos. Each of these teching units will be accompanied with a practical excercise (hand-in assignements) where the students apply the learning content to a typical problem. This direct application will enhance the learning outcome and will equip the students with the skills to apply deep learning to their own problems. Questions on the content or exercises, as well as their correct solutions, will be discussed in a weekly 1.5h meeting (either in-person or zoom).

Assessment (form of examination): Via hand-in assignements. A successful participation in the excercises is required to pass the course. Weekly excercises where the students will apply the lecture content to practical problems will be distributed. The excercises will typically involve implementing a network architecture, training of this architecture on data and iteratively improving the network.

Course examiner (name, e-mail): Christian Glaser, christian.glaser@physics.uu.se

Department with main responsibility: Physics and Astronomy

Contact person/s (course responsible teacher) (name, e-mail): Christian Glaser, christian.glaser@physics.uu.se

Course dates/period: Period 1/ Autumn (Sept - Oct)

Maximum number of participants: 40

Submit the application for admission to: christian.glaser@phyics.uu.se

Submit the application not later than: Likely end of August. TBD