Deep Learning for Forest Remote Sensing Applications with Examples in Python (3 ECTS)

Description

Due to the performance and learning efficiency, deep learning techniques are increasingly used in many forest remote sensing applications. Such techniques are highly versatile and can answer the needs of a broad spectrum of applications, from simple image classification to complex 3D point cloud segmentation tasks. As a result, deep learning models are rapidly finding their operational implementation and are currently being deployed on cloud solutions or IoT devices throughout the forest value chain. The practical implementation of such solutions requires a whole toolset of technical solutions that differ from traditional forest remote sensing tools. The course aims at providing part of such a toolset to accelerate the development of deep learning applications in forest remote sensing research.

The course aims to provide a practical and theoretical introduction to using deep learning to solve common forest remote sensing tasks, from classification to regression. Following an initial theoretical introduction, the course will focus on the implementation and practical use of deep learning, concentrating on two common data types in forest remote sensing: images and point clouds. During the course, the students will learn how to manage, annotate and prepare data, train models, log results and interpret them, validate the models, and finally how to, deploy a model for operational use.

Upon completing the course, participants will be able to navigate the panorama of available algorithms better and develop their own deep learning model from scratch. The course is intended for students and researchers in ecology, natural resources, forestry, data science, agriculture, and environmental sciences.

The course will include the pre-course self-study through an introduction to python and literature reading, and the post-course home exam.

- Pre-course assignment 10 hours
- Working in the class 35 hours
- Home exam after the course 30 hours

Expected number of participants in the course is 25 students.

The language is English.

Contents

- Background theory of deep learning methods
- Deep learning for image tasks (object detection, image segmentation, regression)
- Deep learning for point cloud tasks (object detection, image segmentation, regression)
- Hands-on lab (developing a deep learning object detector/segmentation for images)
- Deep-learning deployment: edge computing Vs server solutions

Time

May 22 – 26, 2023, 08.30 – 16.00 each day.

Learning outcome

Knowledge and understanding

1. Overview of the panorama of deep learning techniques to solve image and point cloud tasks;
2. Develop and structure a plan for the development of an operational implementation of deep learning application.

Skills and abilities

1. Using python for deep learning tasks.
2. Training and deployment of deep learning models.

Pedagogical approach

The course will mainly focus on lab work alternated with lectures. In the end of the course, students will be given the home exam tasks, which should be seen as a repetition of previously given material.

Evaluation elements

The grading for the course is *Pass / Fail*.

Credits

3 ECTS

Attendants

The course is primarily intended for PhD students, but post-doctoral researchers are also welcome to attend.

Location

NMBU, Ås, Norway

Literature

Kattenborn, T., Leitloff, J., Schiefer, F., & Hinz, S. (2021). Review on Convolutional Neural Networks (CNN) in vegetation remote sensing. *ISPRS Journal of Photogrammetry and Remote Sensing*, *173*, 24-49. (https://www.sciencedirect.com/science/article/pii/S0924271620303488)

Hamedianfar, A., Mohamedou, C., Kangas, A., Vauhkonen, J. (2022) Deep learning for forest inventory and planning: a critical review on the remote sensing approaches so far and prospects for further applications, *Forestry: An International Journal of Forest Research*, Volume 95, Issue 4, October 2022, 451–65, https://academic.oup.com/forestry/article/95/4/451/6518266

Lang, N. Schindler, K., Wegner, J.D. (2019) Country-wide high resolution vegetation height mapping with Sentinel-2. *Remote Sensing of Environment*, 233, 111347 (https://www.sciencedirect.com/science/article/pii/S0034425719303669)

Oehmcke, S., Li, L., Revenga, J., Nord-Larsen, T., Trepekli, K., Gieseke, F., Igel, C. (2021) Deep Learning Based 3D Point Cloud Regression for Estimating Forest Biomass. arXiv preprint arXiv:2112.11335 (https://arxiv.org/abs/2112.11335)

Software

The course will be based in Python and all of the exercises will be done using web-based platform Google Colaboratory (https://colab.research.google.com/) so no particular software is required to be installed prior to the course.

Computers

The computer exercises will be done in the lecture room using private laptop computers.

Prerequisites

Before the course begins, students are expected to spend time on self-study amounting to at least 10 hours. Much of the self-study time should be dedicated to familiarizing with python and colab.

It is recommended that participants have already knowledge in the use of remote sensing data and the tools to process and analyse them (e.g. R, Python).

Teachers

Stefano Puliti, Maciej Wielgosz, Rasmus Astrup (all Norwegian Institute of Bioeconomy Research (NIBIO))

Registration

The course is free for all NOVA-affiliated participants. Registration fee for non-NOVA-affiliated participants: 2500 NOK. All meals are included for all participants. To register for the course use the link: http://bit.ly/41FHSiO

Accommodation

It is possible to book accommodation at the students' dorms for 625 NOK pr. day/person, including bed linen, towels and cleaning on departure. See registration link.

Contact

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