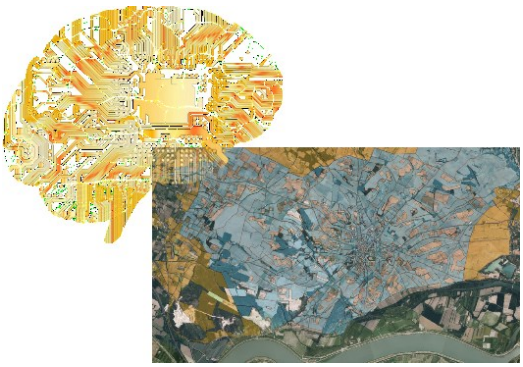
European Spatial Data Research

EduServ 18th
Distance e-Learning Courses
Spring 2020

Deep Learning for Remote Sensing



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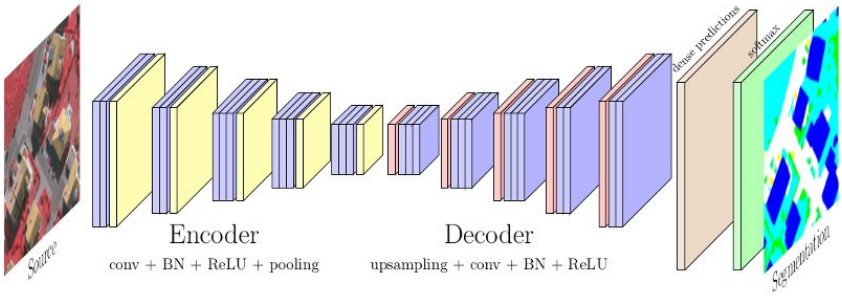
Target audience: Graduate university students in the fields related to geomatics and environmental studies; staff from survey and mapping agencies; public authorities and interested parties involved in remote sensing data processing.



Deep Convolutional Neural Network with encoder-decoder architecture for dense classification.

Introduction: Deep Learning has led to significant breakthroughs in various fields including natural language processing and computer vision. Remote sensing also benefits from such methodological advances and deep networks currently achieve state-of-the-art results in many automatic tasks, such as object detection, semantic segmentation (e.g. for land cover mapping), change detection, etc. The goal of this course is to introduce deep learning, review the main architectures relevant for cartography, photogrammetry and other EuroSDR related fields, as well as to train the participants with available software and codes. The audience will be offered to know about and practice with recent architectures proposed by the lecturers.

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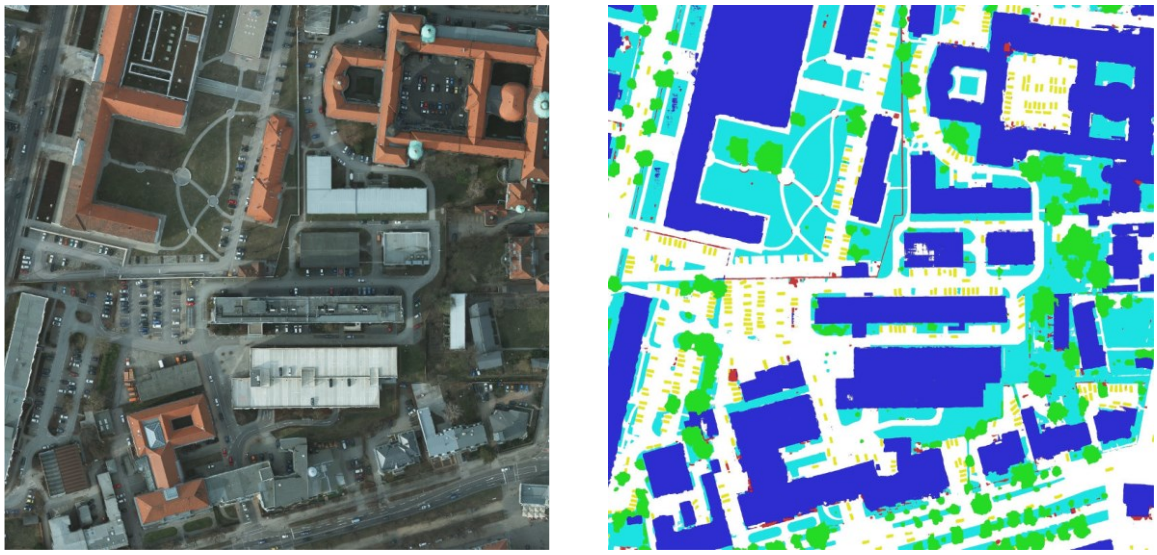
Course objective: After completing this course, the participants will be able to:

- use and deploy deep learning tools to solve remote sensing problems;
- get insight about the theoretical and mathematical concepts behind these deep neural networks;
- know how and when apply deep learning.

The audience will be welcome to come with their own data to discuss with the lecturers about the relevance of deep learning solutions in their context**.**

Course outline: The course provides the audience with an overview of deep learning techniques and tools used in the context of remote sensing. The pre-course seminar will introduce theoretical aspects: after explaining basic principles and best practices, it will cover 2D and 3D processing with deep learning. The e-learning part of the course will include more in-depth theoretical aspects and propose practical exercises and assignments. In particular, in Modules 2 & 3, for each network/task, the course will include some practical experiments with available software libraries.

Requirements: students are expected to be familiar with the Python programming language. A computer and a working gmail adress will be necessary to access the practical experiments.



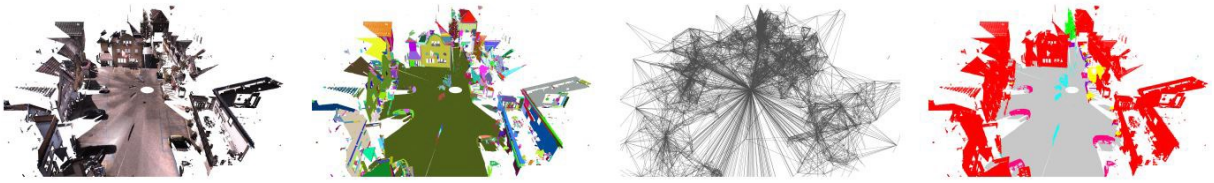
Urban mapping by semantic segmentation of VHR RGB imagery.

Module 1: Introduction to deep networks

The first module will aim to provide an introduction to deep networks. We will review the main principles, standard architectures such as multilayer perceptron and convolutional neural networks, and provide useful tips & tricks (data augmentation, dropout, fine-tuning, normalization, etc.).

Module 2: Deep learning on raster imagery

The second module will address raster imagery. We will present deep learning solutions for various problems, such as classification (patch-based approach, classification of deep features), semantic segmentation (FCN, SegNet, U-Net, etc), object detection (Faster-RCNN, YOLO, etc), instance segmentation (Mask R-CNN), multimodal fusion, change detection, hyperspectral processing. For each network/task, the module will include a description of the principles and some practical experiments.



(a) RGB point cloud (b) Geometric partition (c) Superpoint graph (d) Semantic segmentation

LiDAR point cloud semantic classification with SuperPoint Graph.

Module 3: Deep learning on points clouds

The third and last module will address 3D point clouds analysis. We will present an overview of the recent developments in deep learning architectures for performing semantic segmentation on 3D data. In particular, we will present image-based, voxel-based, convolution-based, and graph-based methods, with a special focus on the set-based method PointNet. We will also present different approaches for adapting these algorithms to the typical scale of remote sensing applications. Similarly to the previous ones, this module will include a description of the theoretical principles, and a practical experiment in which the students will follow a guided implementation of a classic algorithm (PointNet) to perform semantic segmentation on aerial LiDAR data.