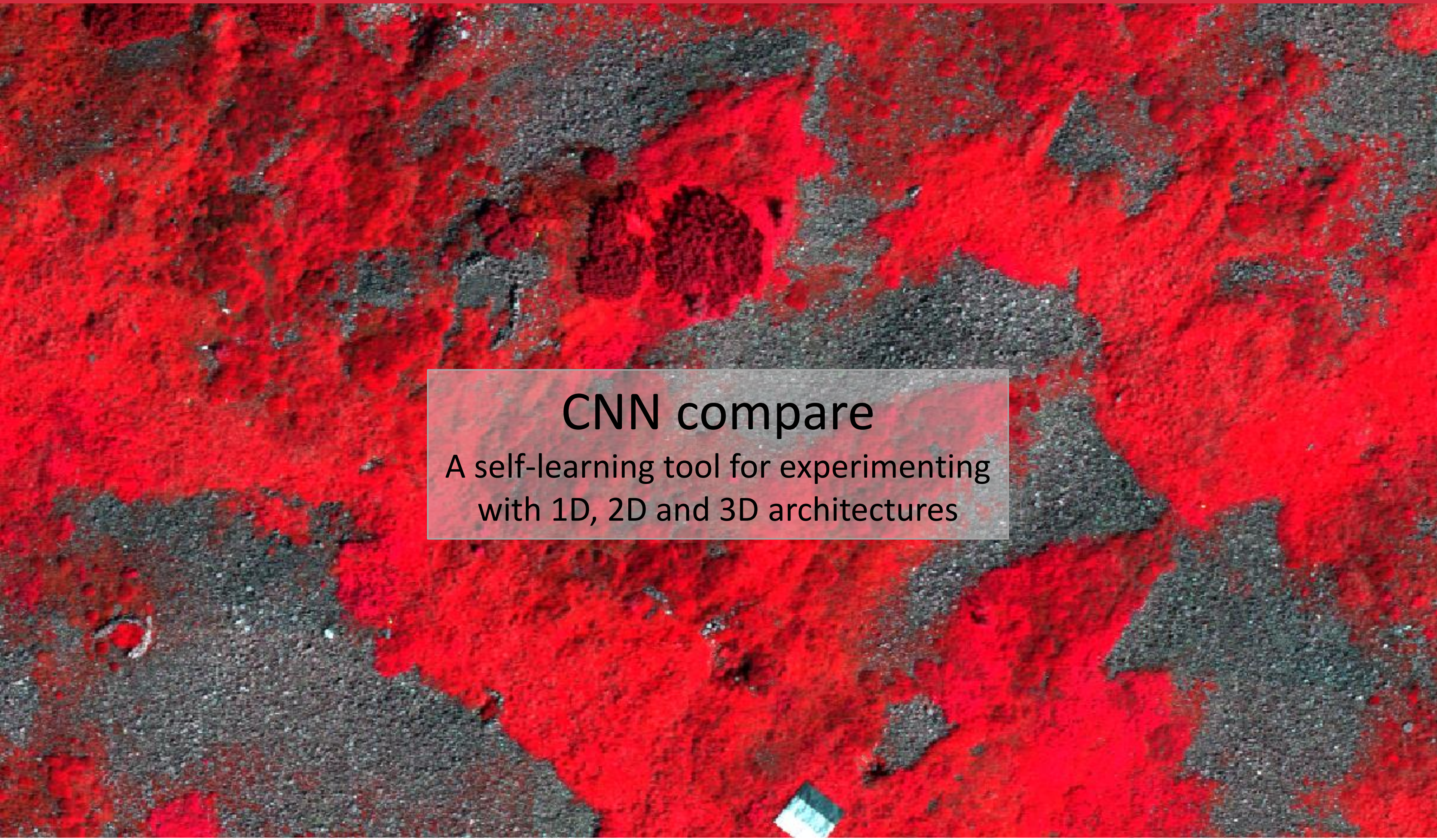

CNN compare

A self-learning tool for experimenting with 1D, 2D and 3D architectures

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CNN compare

Motivation

- Utilization of convolutional neural networks (CNN) in remote sensing (RS) has been growing rapidly in recent years
- Online learning materials and textbooks exist but there is a lack of „sandboxes“ suited for teaching classification of RS data using CNN

Goal

- To develop easy-to-use tools enabling practical experimenting with different designs of CNNs

Target audience

- MSc and PhD students, researchers and practitioners from public sector and industry in fields related to remote sensing and computer vision dealing with CNNs at a beginner level

A basic knowledge of CNN, Python and Jupyter notebooks required.

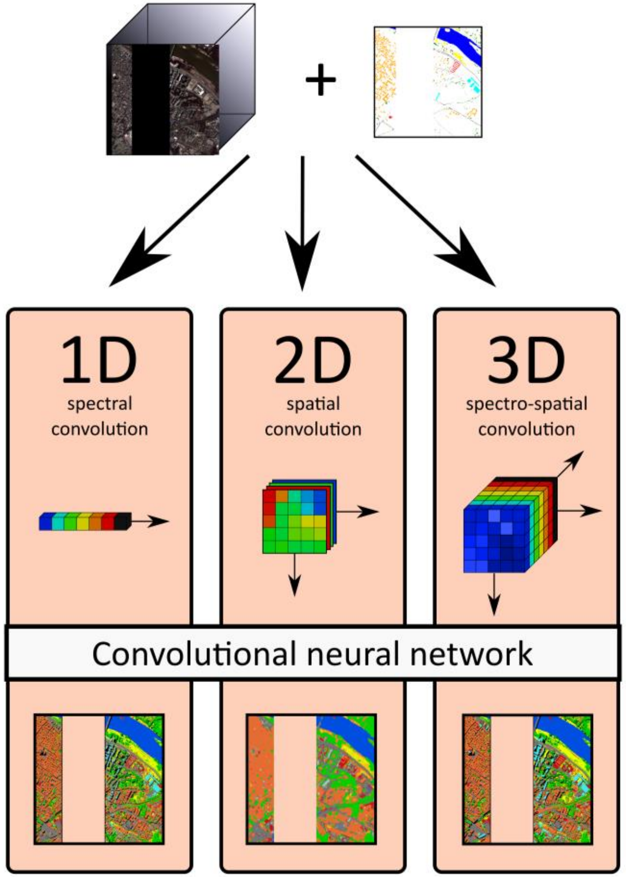
CNN compare

- Classifier Comparison tool to understand 1D (spectral), 2D (spatial) and 3D (spectro-spatial) CNN architectures for classification of hyper- or multispectral images

- Implemented in PyTorch

- A straightforward framework ready for building more complex networks

PyTorch



CNN compare – source code and data

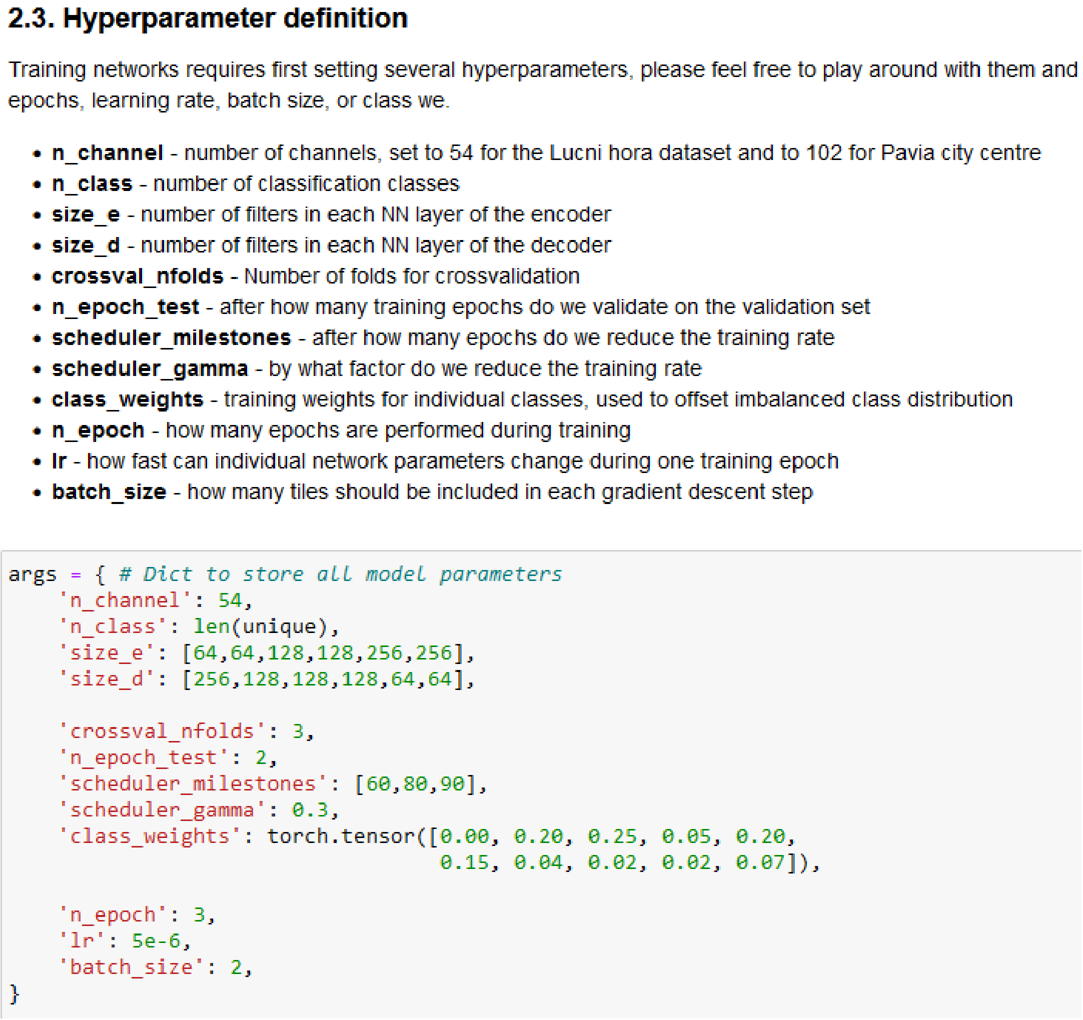
- The code is available from ~~github.com/YesPrimeMinister/ETRAINEE-ClassifierComparison~~

- Two datasets (or just use any GDAL-compatible rasters):

- Luční hora, Krkonoše, Czechia – 54 bands, 1847x1563 pixels
- 9 classes in Arctic-alpine tundra grassland
- Not open yet, available for experimentation during this session

- Pavia City centre – 1096x1096 pixels, 102 bands, 9 classes
- Used in the currently available version of our tool
- Available from www.ehu.eus/ccwintco/index.php/Hyperspectral_Remote_Sensing_Scenes#Pavia_Centre_and_University

Understand CNN parameters by experimenting

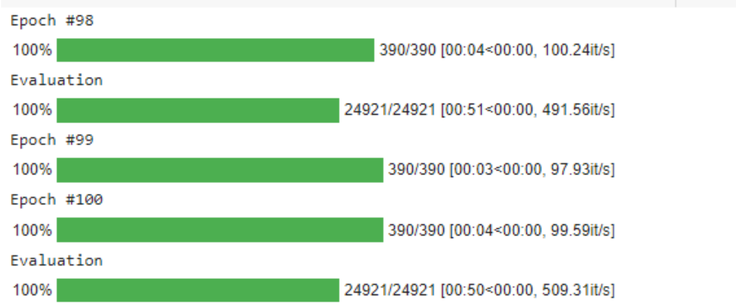


2.3. Hyperparameter definition

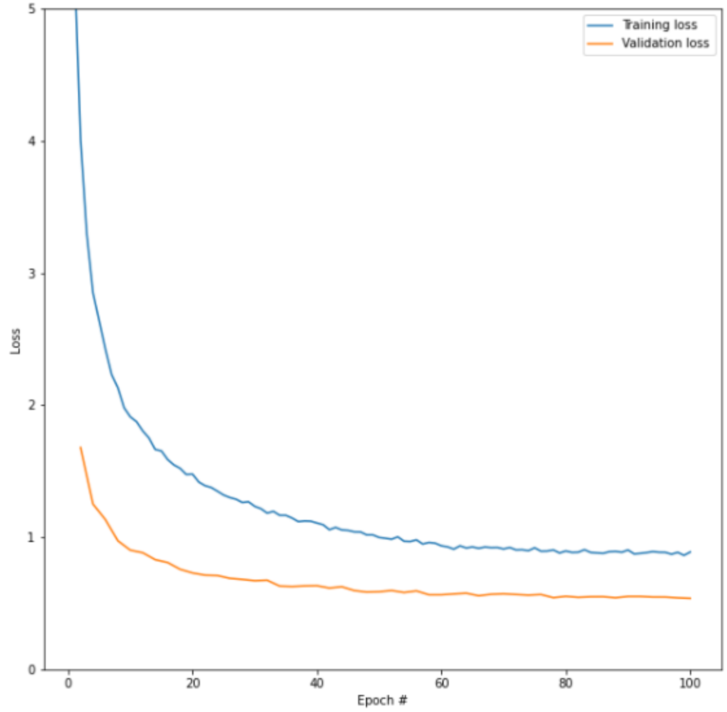
Training networks requires first setting several hyperparameters, please feel free to play around with them and epochs, learning rate, batch size, or class we.

- **n_channel** - number of channels, set to 54 for the Lucni hora dataset and to 102 for Pavia city centre
- **n_class** - number of classification classes
- **size_e** - number of filters in each NN layer of the encoder
- **size_d** - number of filters in each NN layer of the decoder
- **crossval_nfolds** - Number of folds for crossvalidation
- **n_epoch_test** - after how many training epochs do we validate on the validation set
- **scheduler_milestones** - after how many epochs do we reduce the training rate
- **scheduler_gamma** - by what factor do we reduce the training rate
- **class_weights** - training weights for individual classes, used to offset imbalanced class distribution
- **n_epoch** - how many epochs are performed during training
- **lr** - how fast can individual network parameters change during one training epoch
- **batch_size** - how many tiles should be included in each gradient descent step

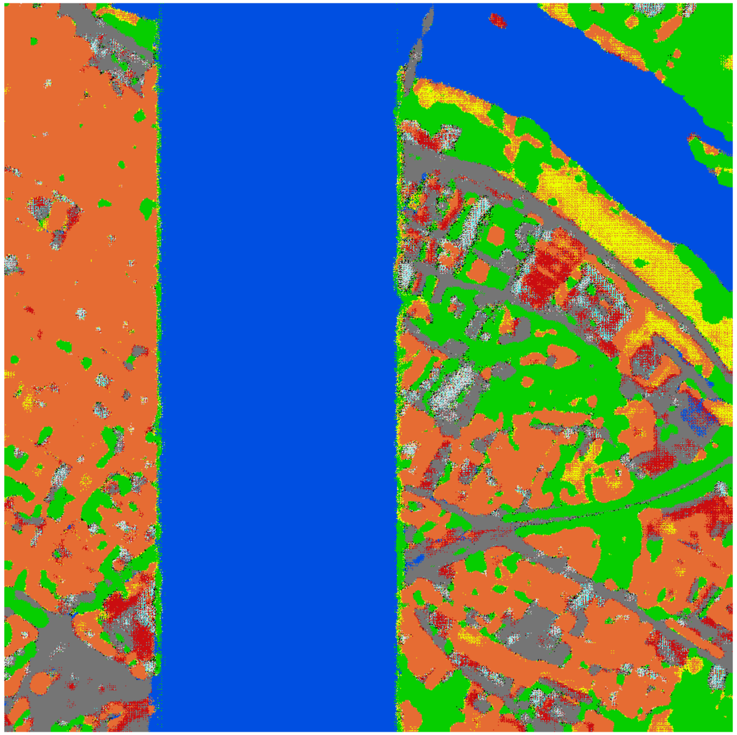
```
args = { # Dict to store all model parameters
    'n_channel': 54,
    'n_class': len(unique),
    'size_e': [64,64,128,128,256,256],
    'size_d': [256,128,128,128,64,64],

    'crossval_nfolds': 3,
    'n_epoch_test': 2,
    'scheduler_milestones': [60,80,90],
    'scheduler_gamma': 0.3,
    'class_weights': torch.tensor([0.00, 0.20, 0.25, 0.05, 0.20,
                                   0.15, 0.04, 0.02, 0.02, 0.07]),

    'n_epoch': 3,
    'lr': 5e-6,
    'batch_size': 2,
}
```

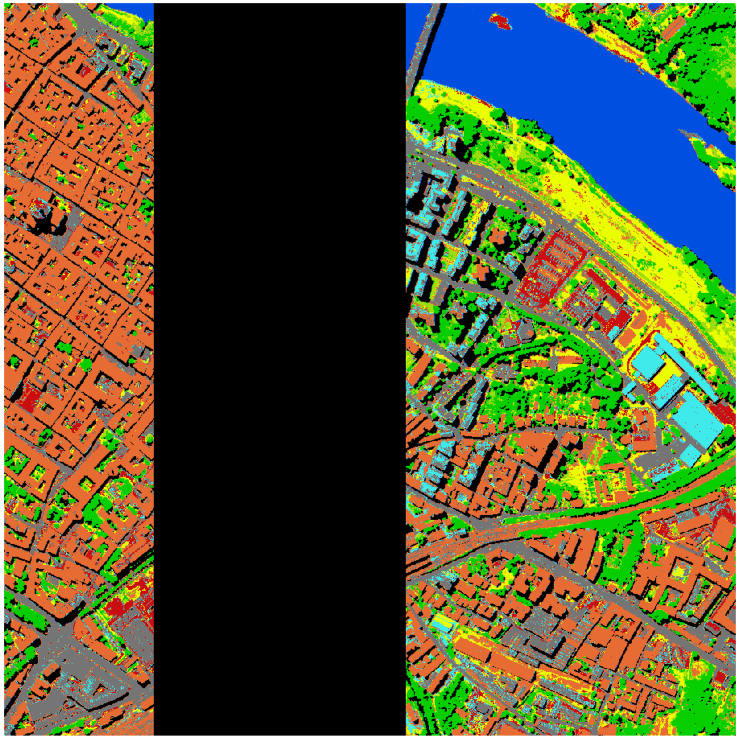


```
Epoch #98
100% 390/390 [00:04<00:00, 100.24it/s]
Evaluation
100% 24921/24921 [00:51<00:00, 491.56it/s]
Epoch #99
100% 390/390 [00:03<00:00, 97.93it/s]
Epoch #100
100% 390/390 [00:04<00:00, 99.59it/s]
Evaluation
100% 24921/24921 [00:50<00:00, 509.31it/s]
```



CNN compare – raster outputs





Thank you for your attention!

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https://web.natur.cuni.cz/gis/etrainee/

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