Konvoluutionaaliset neuroverkot maanpeiteluokittelussa ja puulajitunnistuksessa

Dosentti Ilkka Pölönen

Metsätieteen päivät / Taksaattoriklubi

26.11.2018

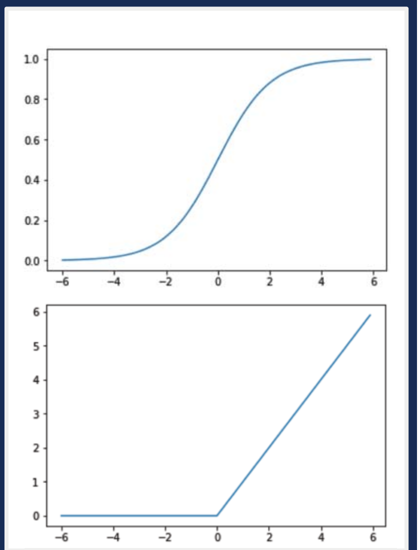
Neuroverkko

- Summaaja

$$f(x_k) = \sum_{j=1}^{m} w_{kj} x_j$$

- Aktivaatio

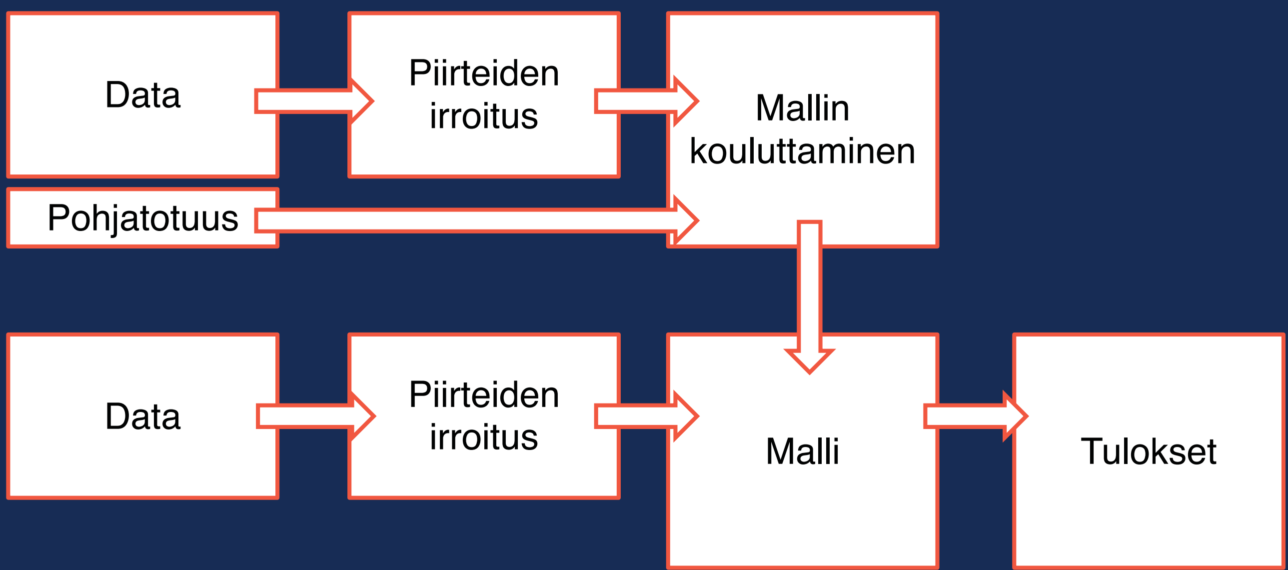
$$y_k = \phi(f(x_k) + b_k)$$



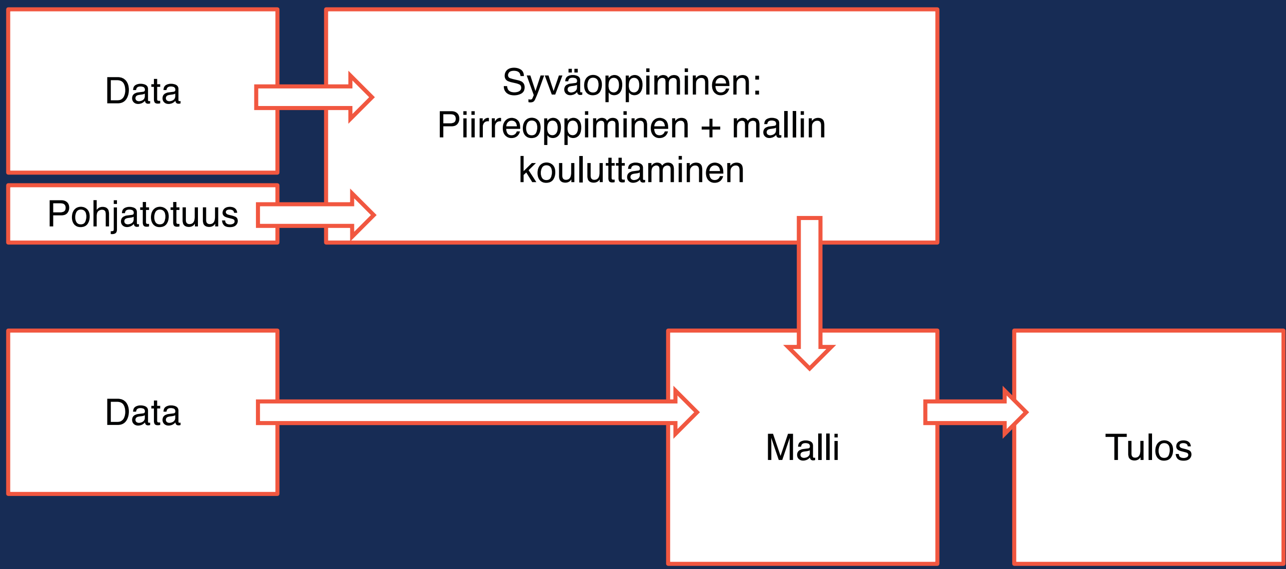
Monikerrosverkko

- $f(x_k) = \sum_{j=1}^{m} w_{kj} x_j$
- $g(x_k) = \sum_{j=1}^{m} w_{kj} x_j$
- $y_k = \phi(f(x_k) + b_k)$
- $\phi(g\left(\phi(f(x_k))\right) = y_k$

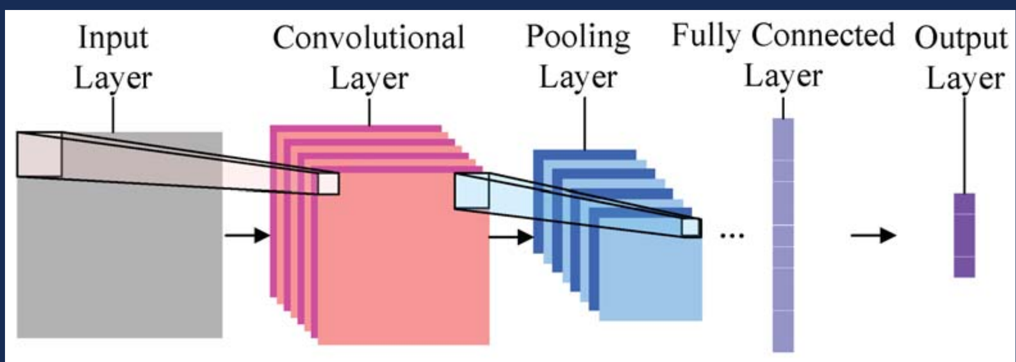
Ohjattu oppiminen



Syväoppiminen



Konvoluutionaalinen neuroverkko



?

$$\phi(g\left(\phi(f(x_k))\right)$$

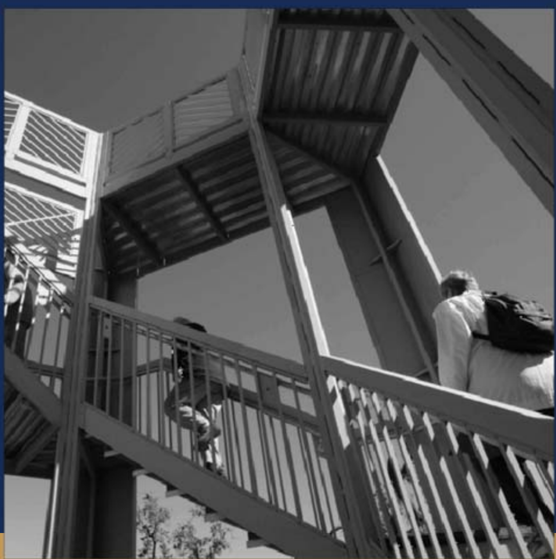
2D konvoluutio

- $K = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$
- F on kuva
- Konvoluutio:

$$[F * K](i,j) = \sum_{u,v} F(i-u, j-v)K(u,v)$$

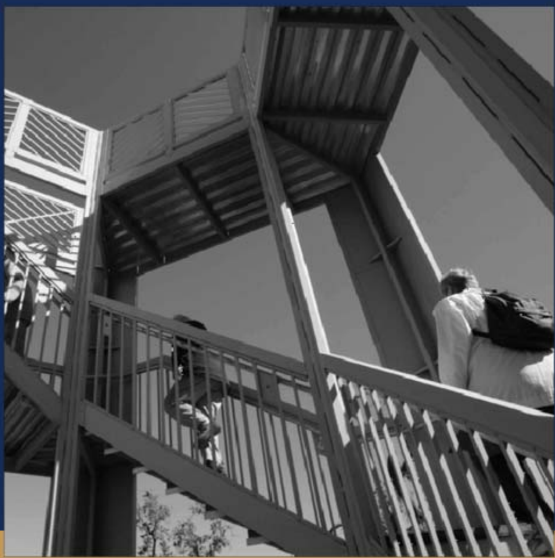
Konvoluutio

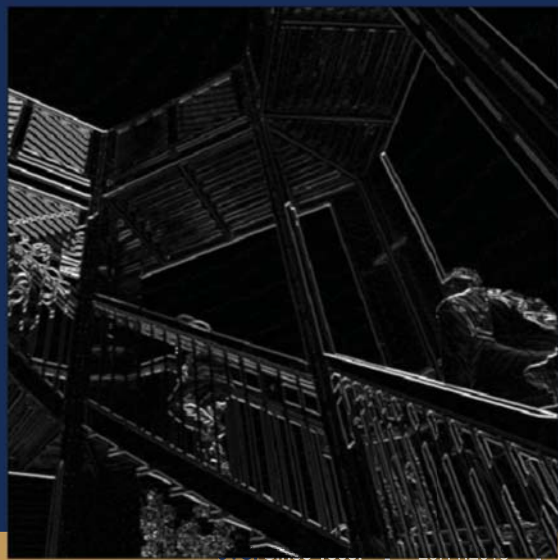
- $K = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$



Konvoluutio

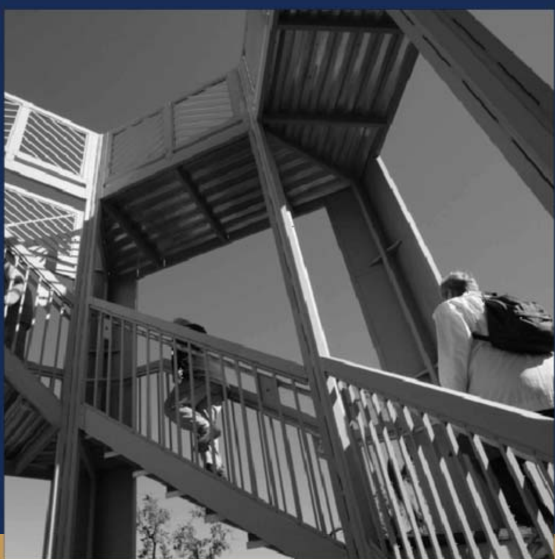
- $K = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$

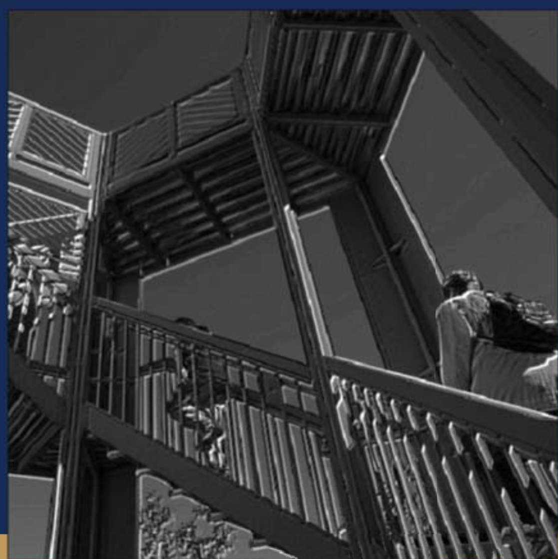




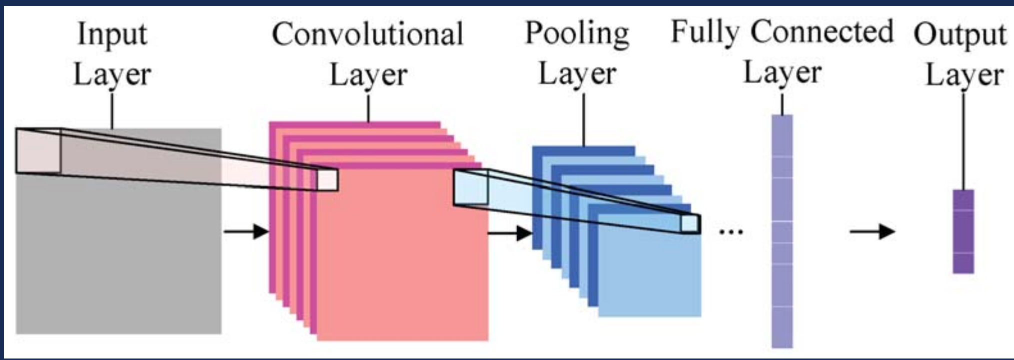
Konvoluutio

- $K = \begin{bmatrix} -1.2 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0.8 \end{bmatrix}$





Konvoluutionaalinen neuroverkko



K

$\phi(g\left(\phi(f(x_k))\right)$

Konvoluutionaalinen neuroverkko

Layer	Kernel / pool size or Activation	Output Shape	Parameters
Conv3D	(3,3,1) ReLU	(39, 39, 33, 64)	640
Conv3D	(3,3,3) ReLU	(37, 37, 31, 64)	110656
MaxPooling3D	(2,2,1)	(18, 18, 31, 64)	0
Conv3D	(3,3,3) ReLU	(16, 16, 29, 128)	221312
MaxPooling3D	(2,2,3)	(8, 8, 9, 128)	0
Conv3D	(3,3,3) ReLU	(6, 6, 7, 256)	884992
MaxPooling3D	(2,2,3)	(3, 3, 2, 256)	0
Flatten		(4608)	0
Dense	ReLU	(128)	589952
Dropout (0.25)		(128)	0
Dense	SoftMax	(3)	387
Total params:	1,807,939		
Trainable params:	1,807,939		
Non-trainable params:	0		

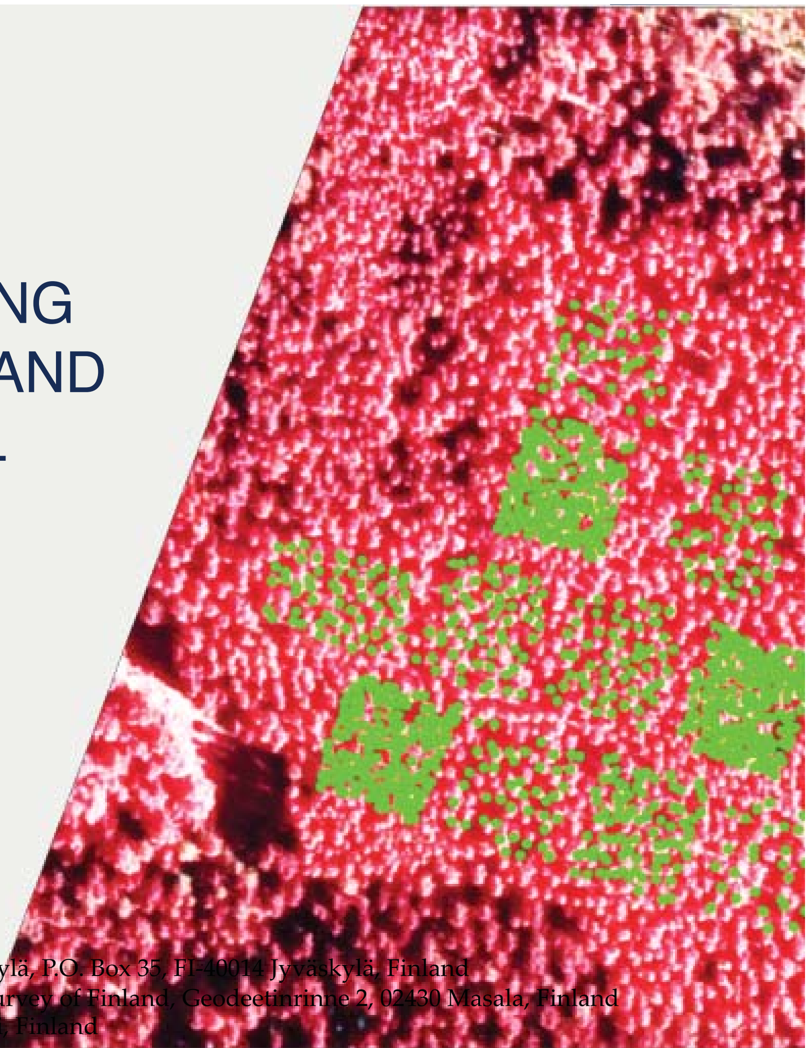
Table 1. Structure of our experimental CNN.

Konvoluutionaalinen neuroverkko

- Optimointi: Stochastic gradient decent
- Kustannusfunktio: Categorical cross entropy
  - Laskee ristiin entropiaa luokkien välillä

TREE SPECIES IDENTIFICATION USING 3D SPECTRAL DATA AND 3D CONVOLUTIONAL NEURAL NETWORK

Ilkka Pölönen[1], Leevi Annala[1], Samuli Rahkonen[1], Olli Nevalainen[2], Eija Honkavaara[2], Sakari Tuominen[3], Niko Viljanen[2], Teemu Hakala[2]



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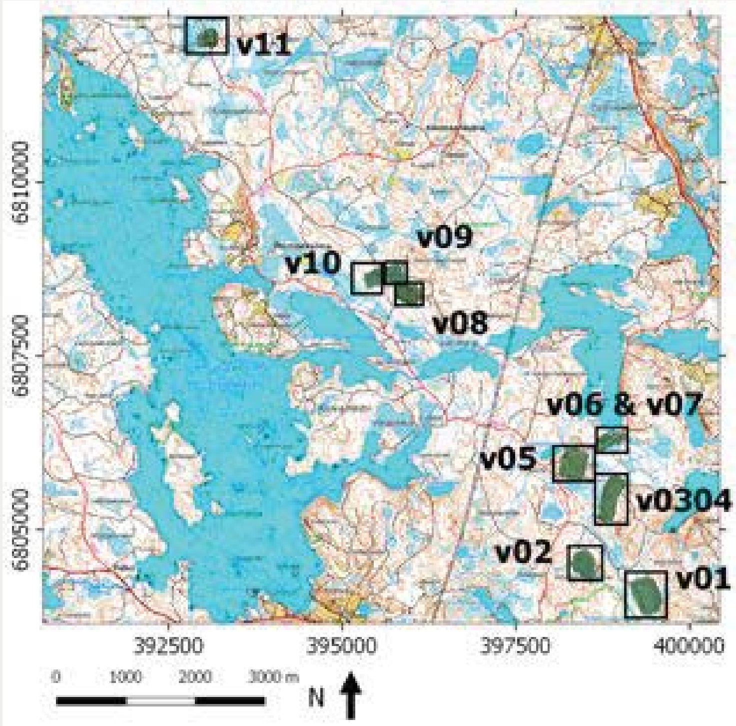
[2]Finnish Geospatial Research Insititute, National Land Survey of Finland, Geodeetinrinne 2, 02430 Masala, Finland
[3]Natural Resources Institute Finland, PL 2 00791 Helsinki, Finland

Data

- Collected from Vesijako, 2015
- VTT-Proto-2012-b hyperspectral imager
- RGB -camera



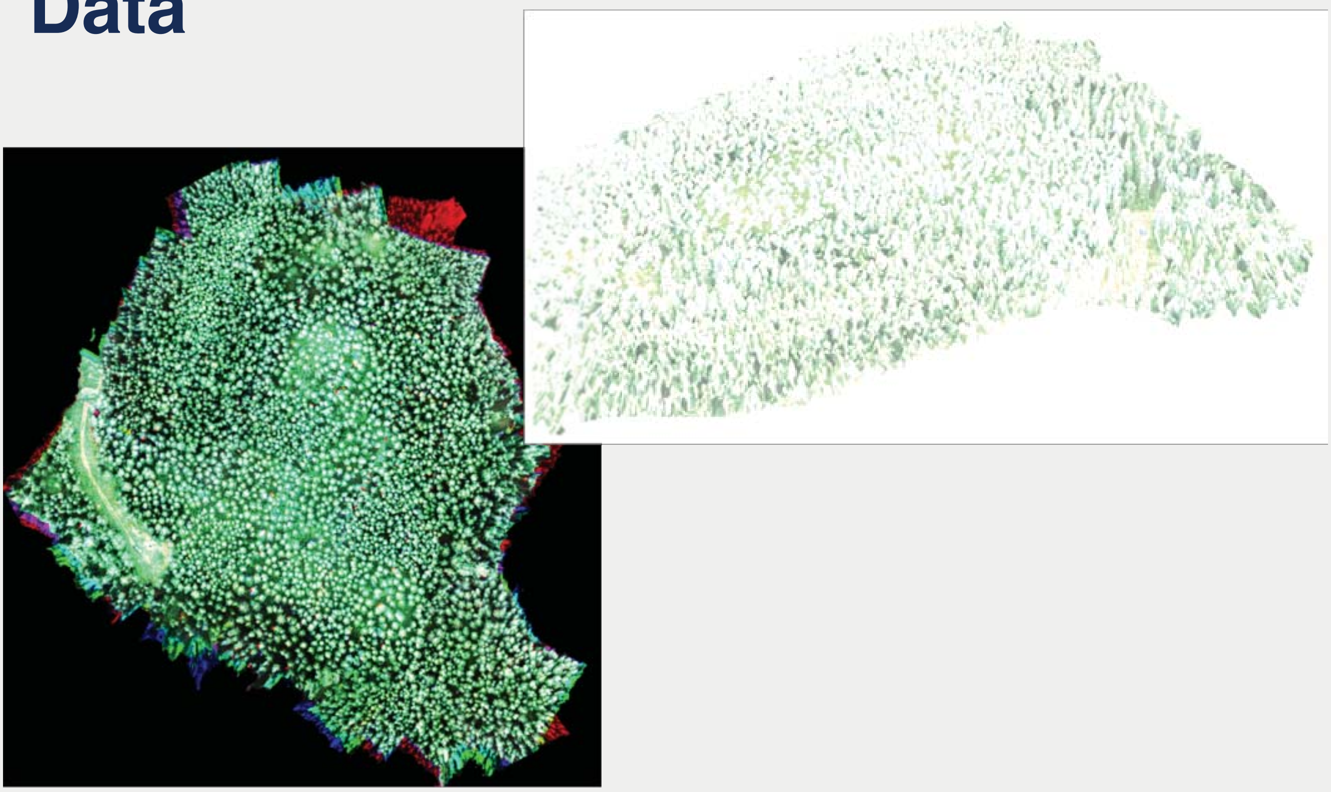
Data

- Collected from Vesijako, 2015
- VTT-Proto-2012-b hyperspectral imager
- RGB -camera

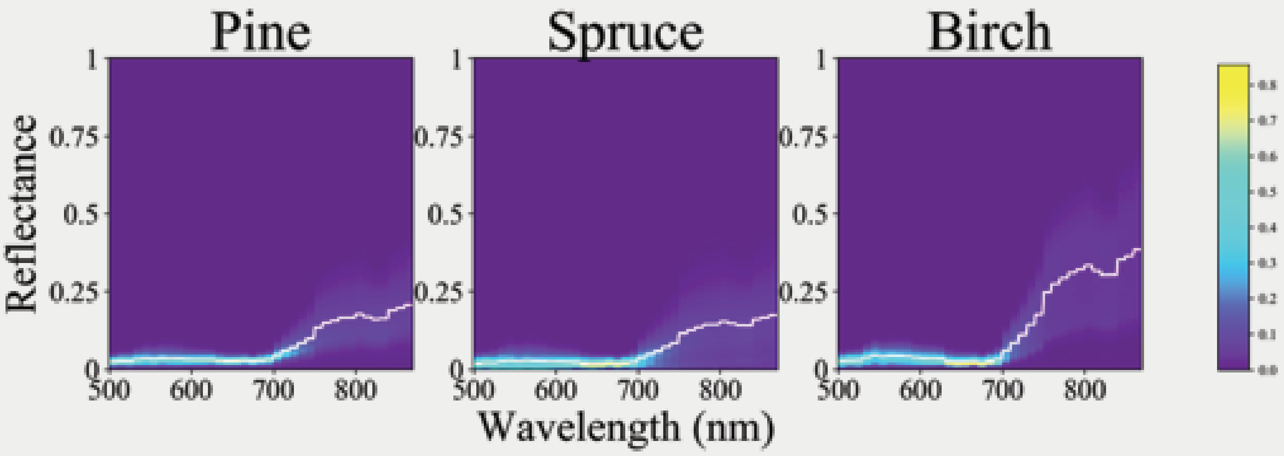
Training set

- 3D volume cube (41x41x34) pixels
  - One treetop model
  - 33 spectral channels
  - 4x4 meter
- Approx. 1000 trees/class
- After augmentation 16555
  - Simple rotation and flipping operations

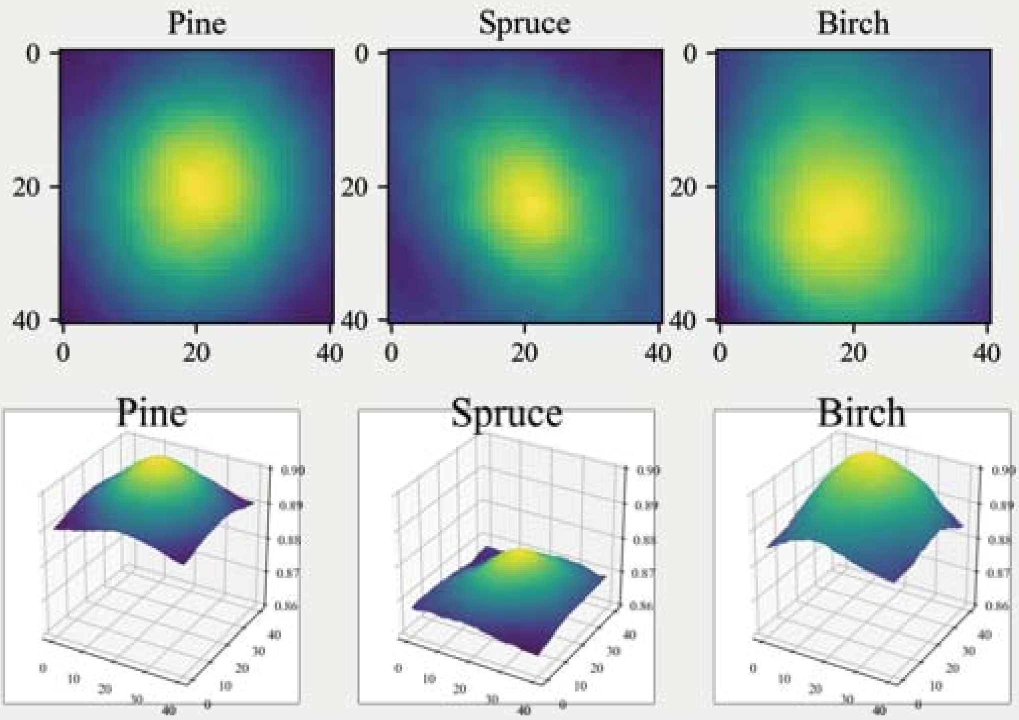
Data



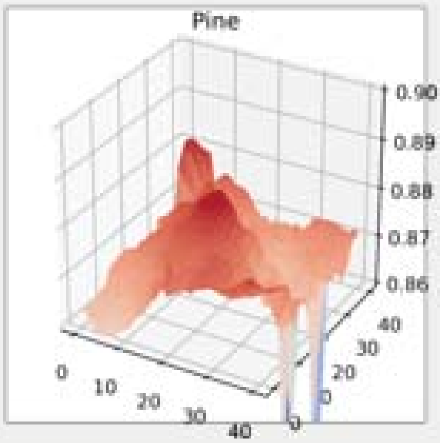
Spectral variance and mean between different tree species

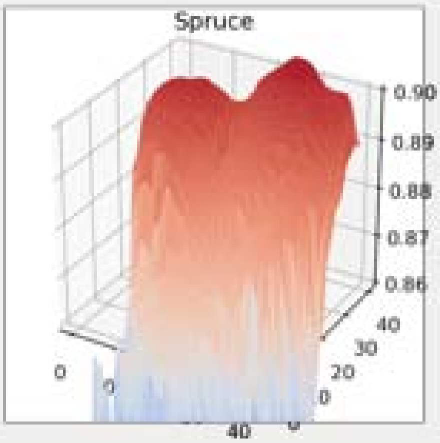


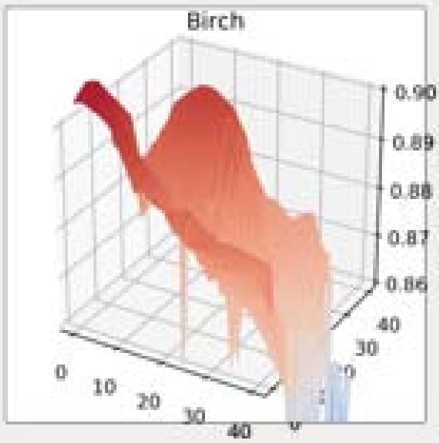
Average shapes of different treetops



Random treetops from test data

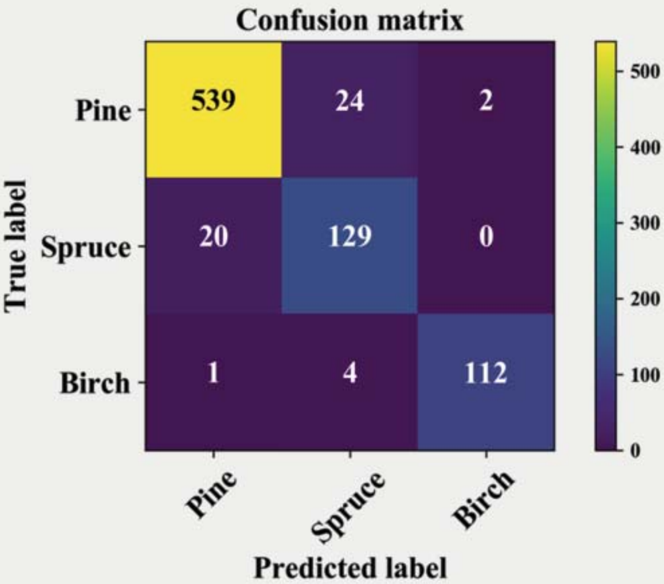


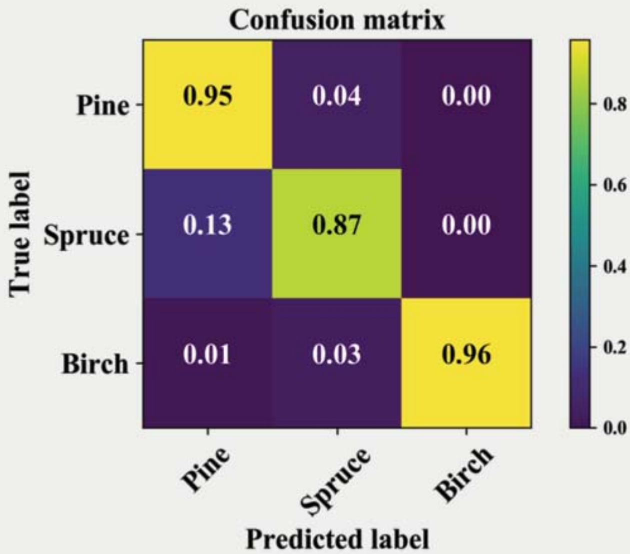


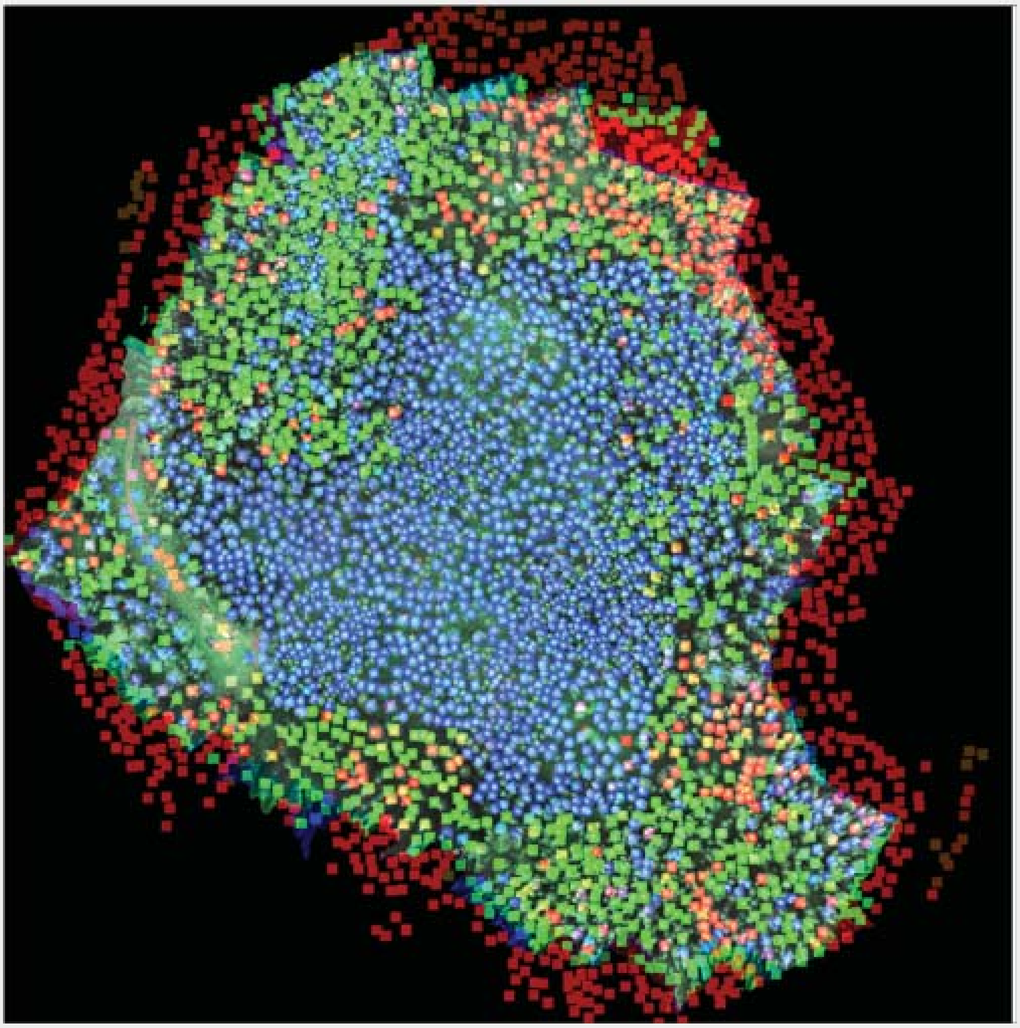


Results

- Test set 831 samples



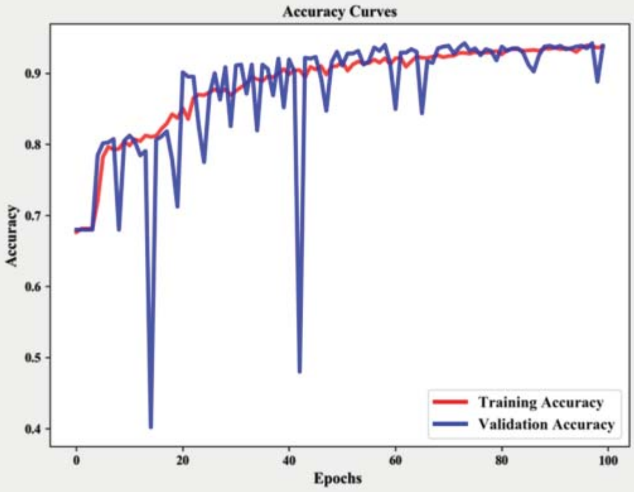


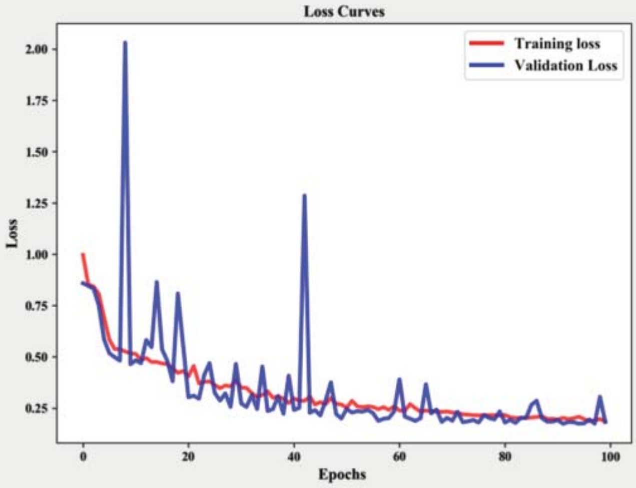


Riskit

- Ylisovittuminen
- Mustalaatikko

Accuracy and loss

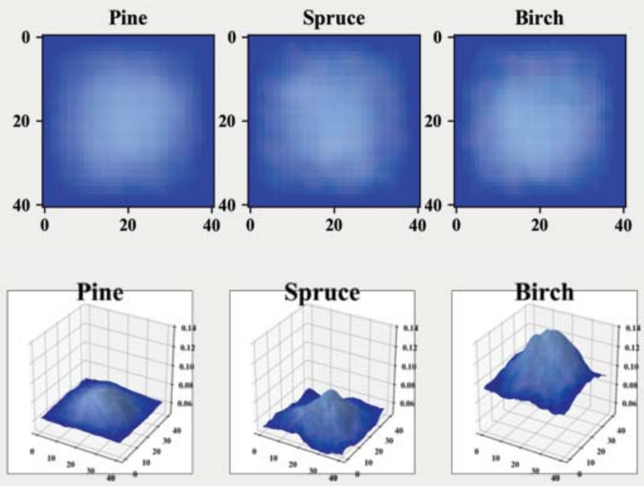


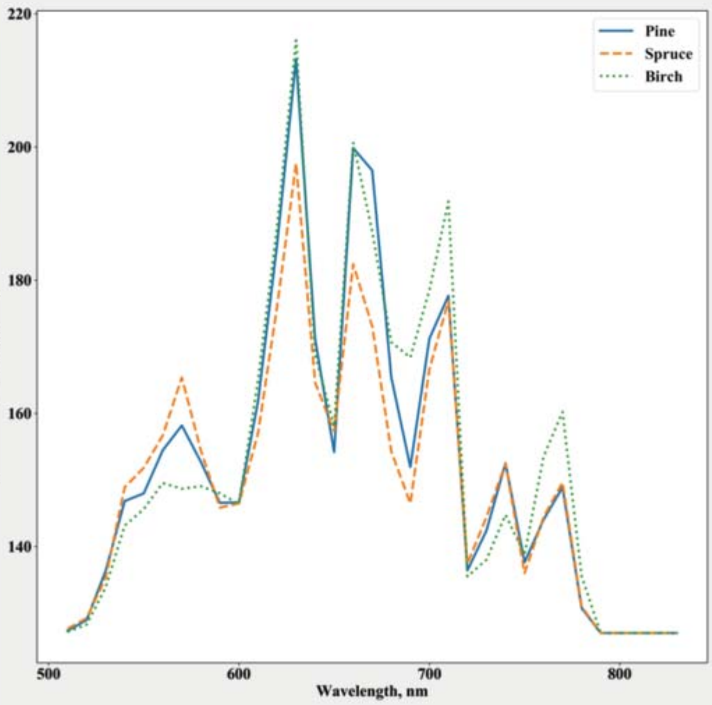


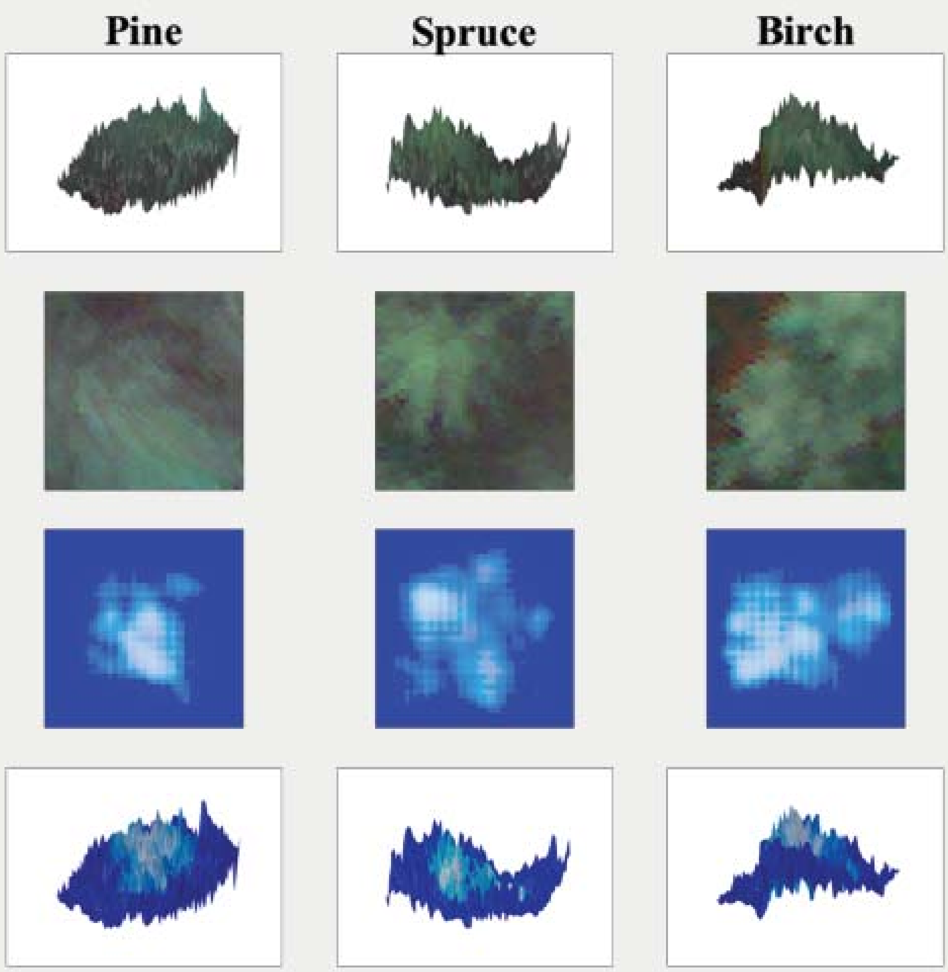
Saliency maps

- It is reasonable to ask, is the classification based on real feature of wanted object or something secondary such as ground type in tree species recognition.
- Calculate gradient over layers from output to input
- Higher values contributes most to classification results

Saliency maps







Land cover classification from multispectral data using convolutional autoencoder networks

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Pro Gradu

2018

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Pian saatavilla:

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U-NET

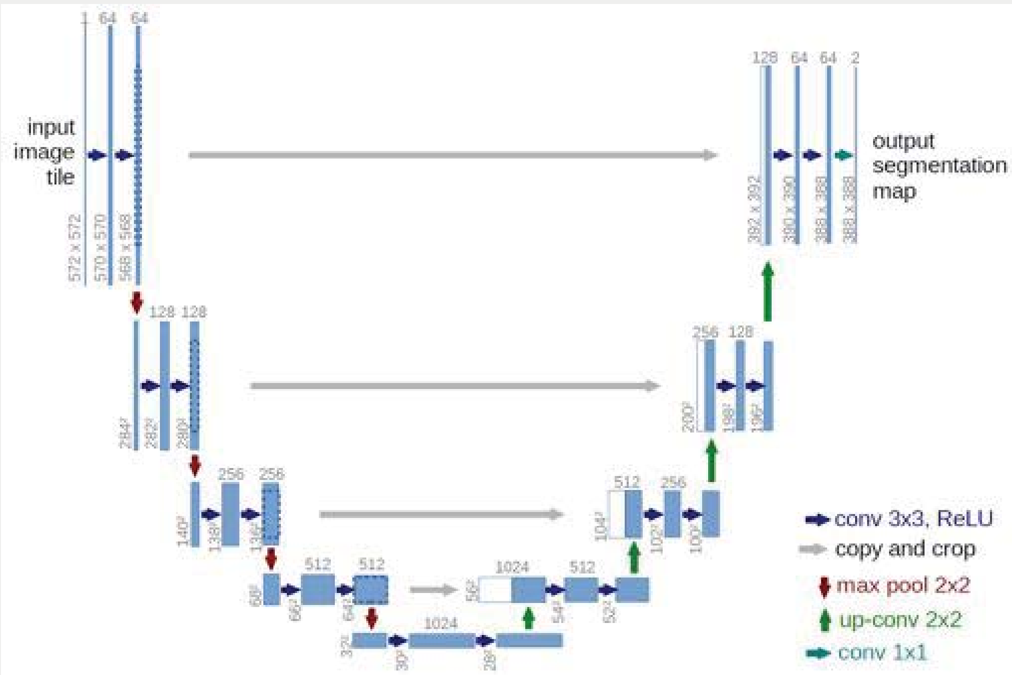

Figure 7. U-Net architecture (Ronneberger, Fischer, and Brox 2015)