

Neural Network Nearest-Neighbour Transformation for Segmentation of Retinal Blood Vessels

Bachelor's Thesis Introductory Talk

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Pattern Recognition Lab (CS 5)



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Outline

- Motivation
- Introduction
- Method
- Process



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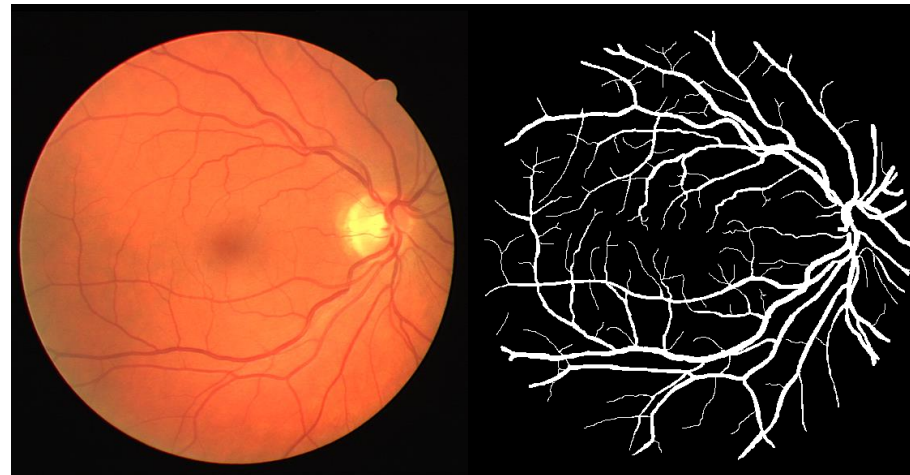
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Fundus Photography

- important modality for examining eye
- diagnosis of diseases (e.g. glaucoma, diabetic retinopathy)
- segmentation supports computer-aided diagnosis

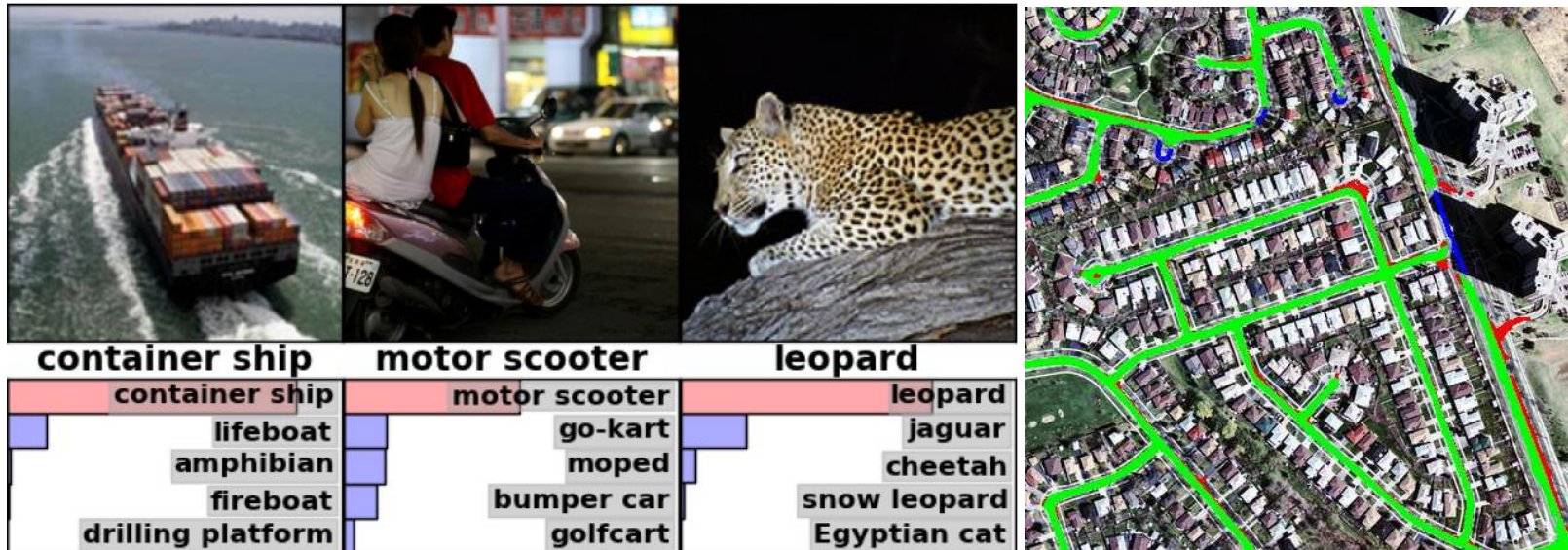


[DRIVE database]



Neural Networks

- good performance in computer vision tasks



[Krizhevsky et al., 2012]

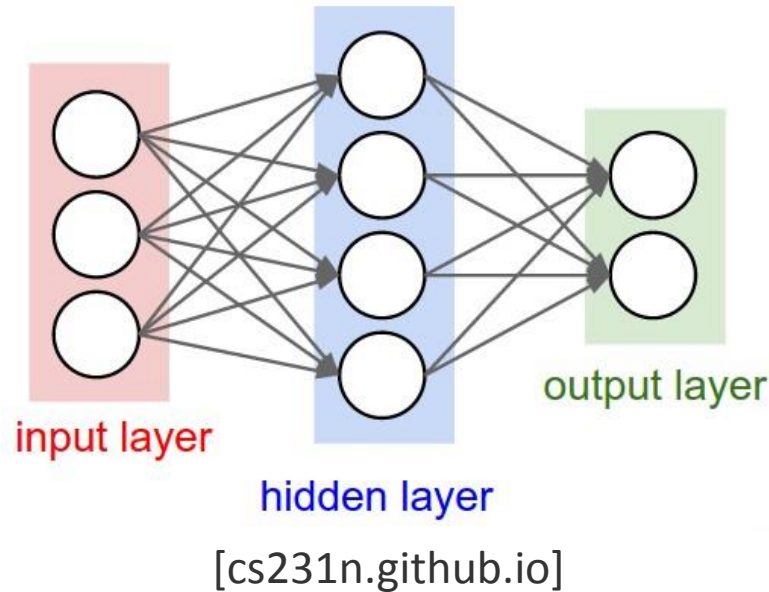
[Mnih & Hinton, 2010]

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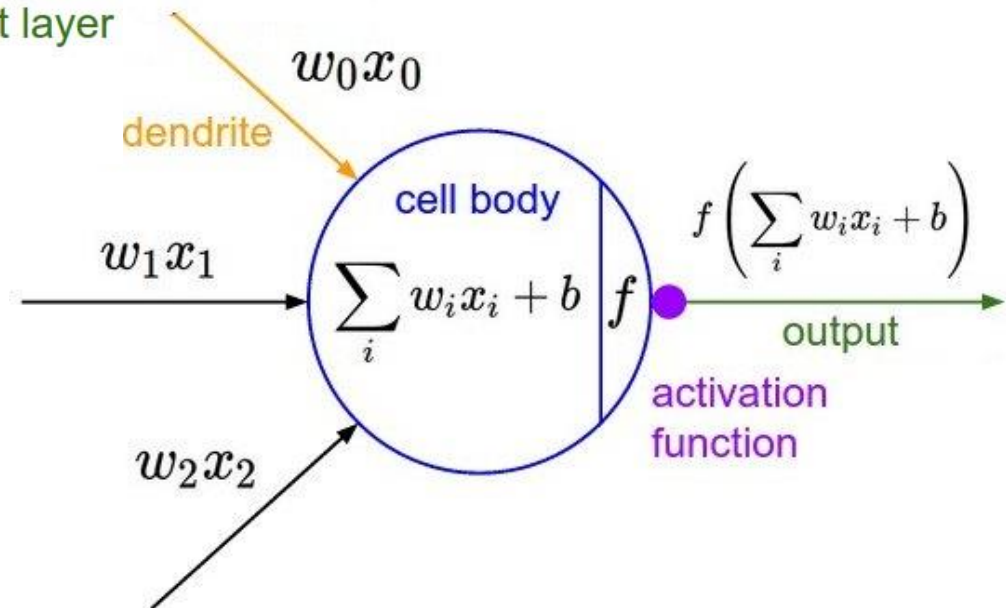
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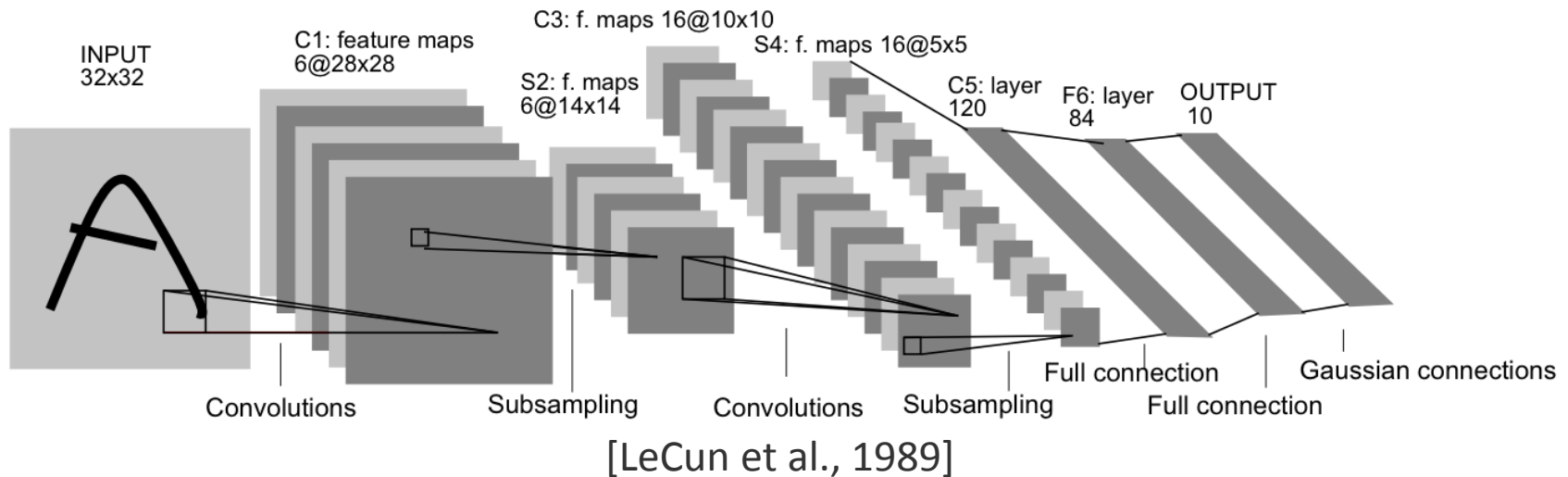
Neural Networks



- loosely based on biological neural networks
- learnable weights



Convolutional Neural Networks

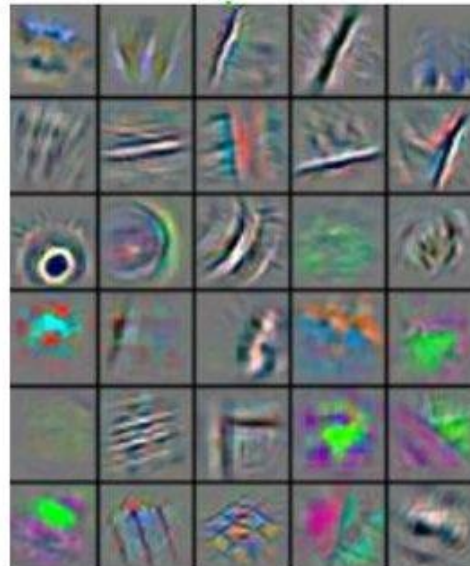


- inputs are images
- learnable filters
- parameter sharing → less parameters to train
- neurons not fully connected

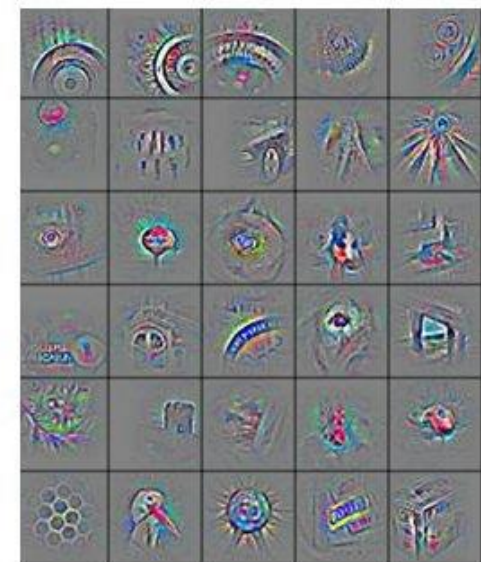
Convolutional Neural Networks



1st hidden layer



2nd hidden layer



3rd hidden layer

[Zeiler & Fergus, 2013]

- each following layer detects more abstract features



Neural Networks - Problems

- image transform too complex for network to learn explicitly
- underfitting effects
- overfitting effects
- complex/deep network hard to train (local minima)



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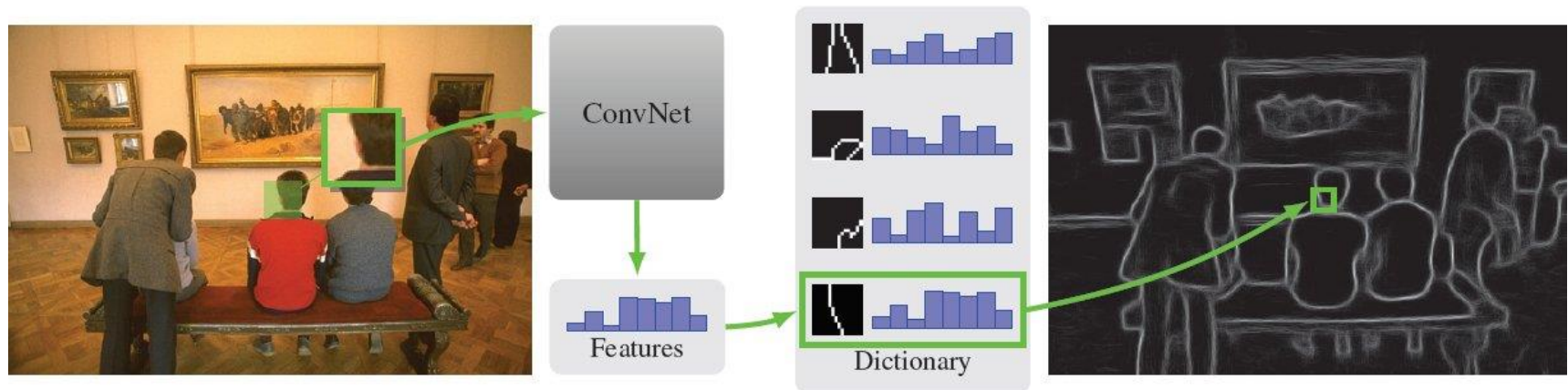
N⁴-Fields

***N*⁴-Fields: Neural Network Nearest Neighbor Fields for Image Transforms**

Yaroslav Ganin, Victor Lempitsky
Skolkovo Institute of Science and Technology (Skoltech)

- architecture for natural edge detection/thin object segmentation
- neural network and nearest-neighbour search applied sequentially
- process images patch-by-patch

N⁴-Fields



- run patch through convolutional neural network
→ receive neural code
- compare with dictionary entries through nearest-neighbour search
→ retrieve output patch
- average all output patches to segmented image

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Process

- train convolutional neural network (GPU)
- evaluate on **DRIVE** database
= digital retinal images for vessel extraction
- Play with it!
 - adjust hyperparameters (learning rate, regularization, ...)
 - try to improve performance

Thank you for your attention!





References

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- Zeiler, M.D., Fergus, R.: *Visualizing and Understanding Convolutional Networks*. (2012)
- Ganin, Y. and Lempitsky, V.S.: N^4 -Fields: neural network nearest neighbor fields for image transforms. In: *ACCV*. (2014) 536–551



References

- http://cs231n.github.io/assets/nn1/neural_net2.jpeg
- http://cs231n.github.io/assets/nn1/neuron_model.jpeg