

# Terrain Discrimination

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# Section 1

## Perceptron Classifier

# Perceptron – benchmark

Perceptron(max\_iter=100000)

Average training time [s]	69.76
Average score	0.542

Table: Average results from 10 iterations of the test.

## Conclusion

0.542 is benchmark we need to beat with more advanced methods to justify their use.

## Section 2

### Multy-Layer Perceptron (MLP) Classifier

# MLP L-BFGS

**Limited-memory BFGS** is optimization algorithm in the family of quasi-Newton methods. It should perform the best for small datasets like ours.

In the following tests we use this default values for MLP classifier (if some of them are changed, it is noted):

<b>Solver</b>	L-BFGS
<b>Alpha</b>	$10^{-5}$
<b>Hidden layer sizes</b>	1 layer, 15 neurons
<b>Random state</b>	fixed seed
<b>Activation function</b>	ReLU

# MLP L-BFGS – Activation functions

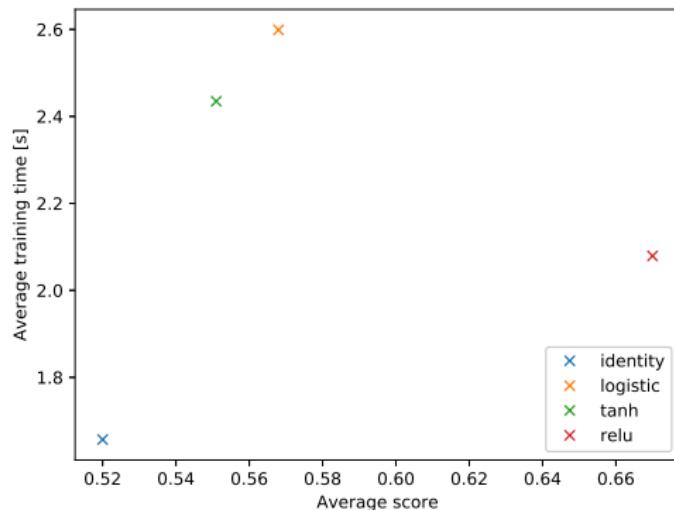


Figure: Average results from 20 iterations with different activation functions.

# MLP L-BFGS – Activation functions

## Conclusion

ReLU activation function gives the best results and is faster than most other functions for this problem.

# MLP L-BFGS – Number of neurons (1 hidden layer)

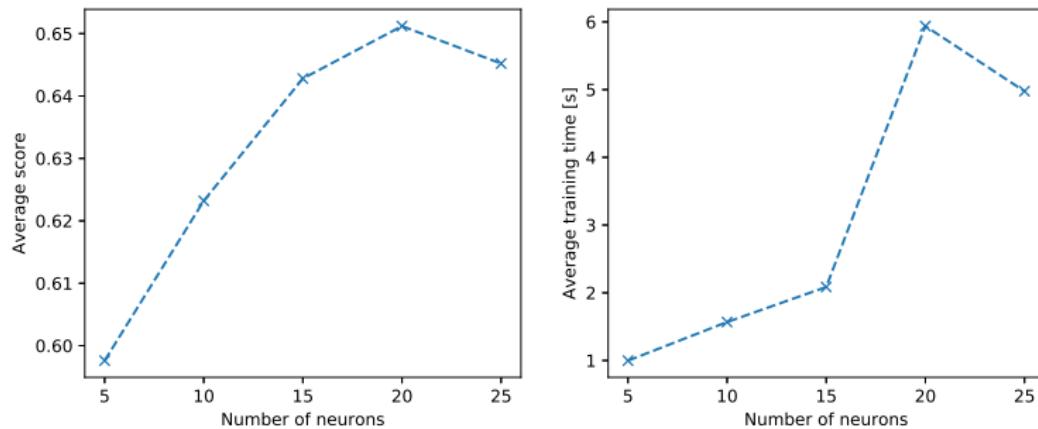


Figure: Average results from 50 iterations with different numbers of neurons in one hidden layer.

# MLP L-BFGS – Number of neurons (1 hidden layer)

## Conclusion

Optimal number of neurons with one hidden layer from perspective accuracy is around 20 for this problem. However, it also has the longest training time. Higher numbers of neurons probably result in over-fitting.

# MLP L-BFGS – Number of neurons (2 hidden layers)

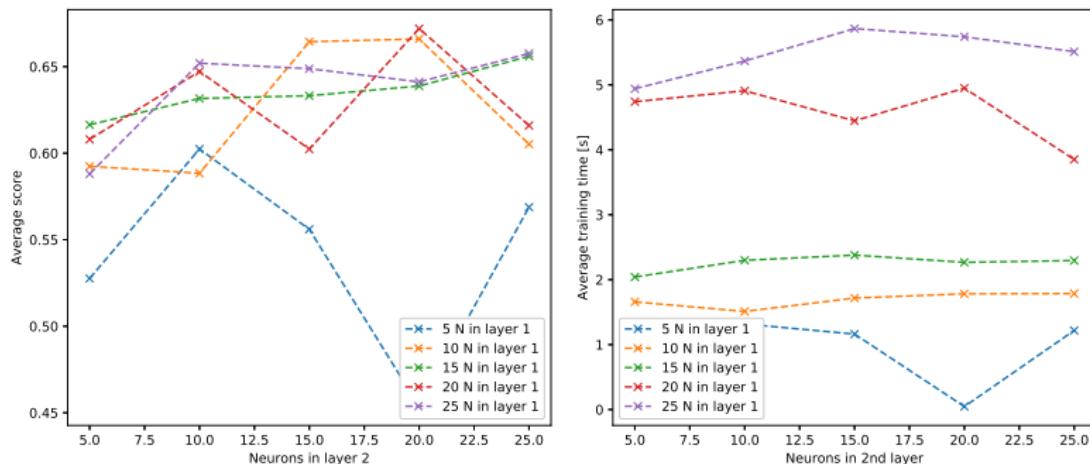


Figure: Average results from 50 iterations with different numbers of neurons in one hidden layer.

# MLP SGD

**Stochastic gradient descent** is optimization algorithm for optimizing differentiable or subdifferentiable functions.

In the following tests we use this default values for MLP classifier (if some of them are changed, it is noted):

<b>Solver</b>	SGD
<b>Alpha</b>	$10^{-5}$
<b>Hidden layer sizes</b>	1 layer, 15 neurons
<b>Random state</b>	fixed seed
<b>Activation function</b>	ReLU
<b>Batch size</b>	200
<b>Initial learning rate</b>	0.001

# MLP SGD – Initial learning rate

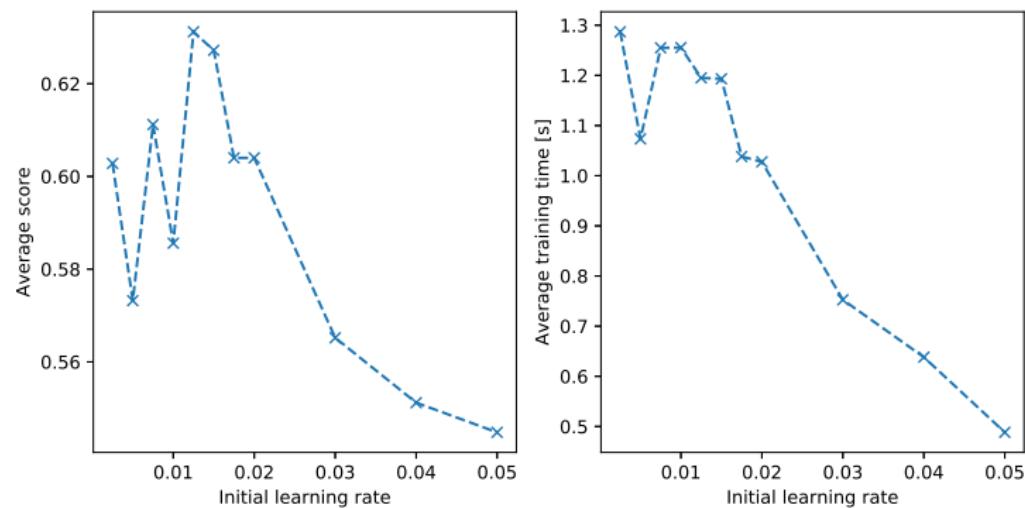


Figure: Average results from 50 iterations with different initial learning rates.

# MLP SGD – Batch size

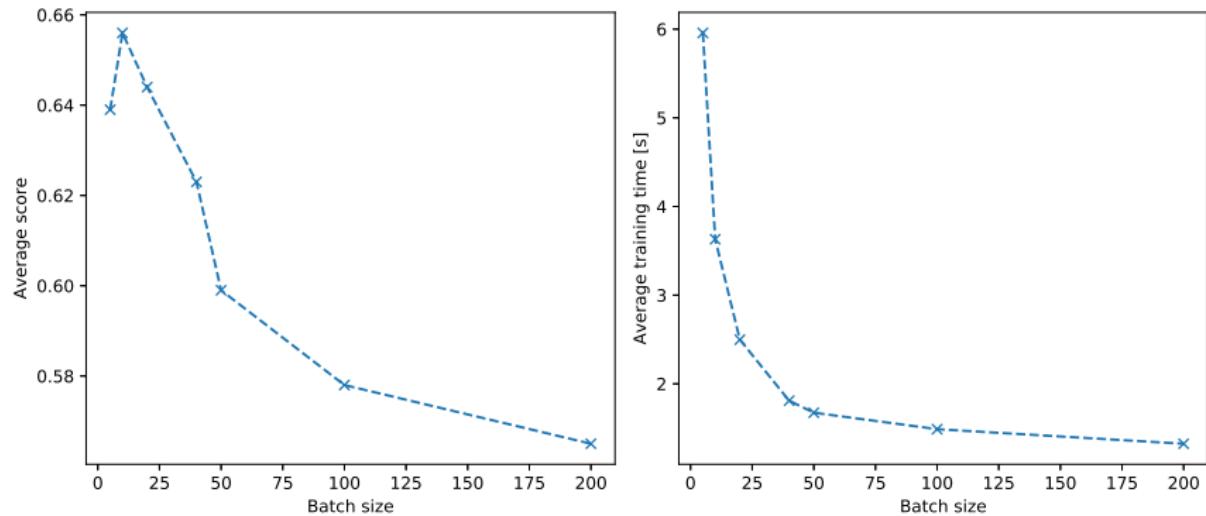


Figure: Average results from 20 iterations with different batch sizes.

