

Deep Learning

Exercise Sheet 4

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Submission until May 22nd, 12:00 (PM) via Learnweb (id: 3110)

Question 1: Optimization - Theory - 6 Points

- a) Explain Local Minimum, Global Minimum and Saddle points for a function. [3 Points]
- b) Explain the differences among, Stochastic Gradient Descent, Nesterov Momentum and Adam optimizers.[3 Points]

Question 2: Optimization - Math 9 Points

Given a set of weights $\theta = \{0.2, 0.1, 0.4, 2, 1.3, 1.5\}$ and a transformation array $T = \{0.3, 0.5, 1.2, -2.4, 0.8, 0.01\}$. Assume we get the gradients G of the cost function with respect to weights by the Hadamard product (elementwise product) of θ and T ($G = \theta \circ T$). Use SGD, Nesterov Momentum and Adam optimizers to update the weights for two iterations. Hyperparameters are as follows:

Adam: $\rho_1 = 0.9, \rho_2 = 0.999, \epsilon = 0.001, \delta = 10^{-8}$

Nesterov Momentum: $\alpha = 0.5, v = 0, \epsilon = 0.001$

SGD: $\epsilon = 0.1$

Question 3: Adam Optimizer - Programming 5 Points

Implement python code to Adam Optimizer and Nesterov Momentum for the XOR problem given in last exercise to train the network (Please do not use tensorflow or keras or any other machine learning modules). Use the hyper-parameters given in above problem. Print the code, convergence and results in Pdf.

WARNING!

Plagiarism is a serious offense in academia. If we detect plagiarism in your answer sheets, you will be taken to the examination board which may lead to ex-matriculation.

Group submissions: If you work in group, indicate it on the answer sheet and also mention your group members. Group submissions receive 0 points, but solutions will be corrected.

Submission guidelines: Submit your answers as pdf only with the name of the file following the format: DL_group_"Group_no"_Ex_"Assignment_no"_Your matriculation number".pdf . Late submissions are not accepted. Please submit only through Learnweb. Email submissions are not accepted.

Bonus points: You have an opportunity to receive upto 4 bonus points (10% of the maximum marks in the exam) through the assignments as shown below.

Range of Marks	# Bonus points
21% – 40%	1
41% – 60%	2
61% – 80%	3
81% – 100%	4