Deep Learning for Visual Computing
Assignment 1, 2020S

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Image classification

Image classification refers to a process in computer vision that can classify an image according to its visual content. For example, in the CIFAR-10 dataset there are different animals and different means of transport to be classified.

Training, validation, and test sets

In Machine learning in general, the data is usually split into training, validation and test set.

- **Training set:** This part of the dataset is usually the biggest and is used to train the model. However, to evaluate the model its not useable as this would highly favor overfitted models.
- **Validation set:** This part of the data is used to compare the performances of different models to identify the best one. For the reason just mentioned, it is important to not use this data for training.
- **Test set:** This data is used to estimate the final performance of the chosen ML-model. This is needed especially if we compare a lot of models as some model will be overfitted to the validation set simply by chance.

Linear classifiers

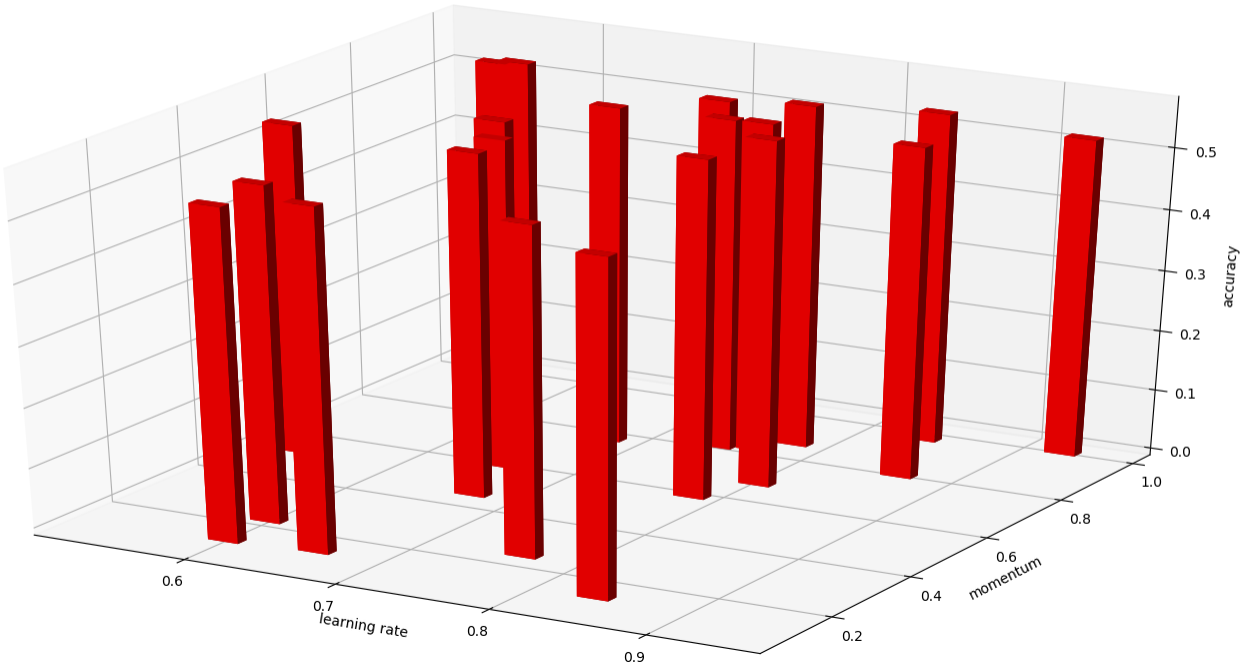
Visually speaking, a linear classifier divides the feature space with a hyperplane which is the decision-boundary between two differen classes.
Formally,

$$w = f(x, \theta) = Wx + b \text{ with } \theta = (W, b)$$

where $W \in \mathbb{R}^{TxD}$ is the weight matrix and $b \in \mathbb{R}^T$ is the bias vector.

Results

We decided to implement a random grid search variant, the learning rate is varied from 0.5 to 1 and the momentum is varied from 0 to 0.999, randomly, twenty times. Shuffling and nesterov momentum are turned on. The batch-size was set to 32. We did not notice any significant difference in the accuracy distribution for the different momentum and learning rates, here is a plot:



Limiting the learning rate variation from 0-1 to 0.9-1 did not effect the results, the same applies to limiting the range of the momentum from 0.5-0.99. The accuracy on the test-set is 0.571, the best accuracy on the validation set was 0.575, for the parameters learning-rate = 0.8225 and momentum = 0.411 (also used for test-set). The results are not great, probably because there is no bias vector used. Also, it would help to have more measures than just the accuracy to make judgements (like recall, precision, f1-score...). Since the final test accuracy and the validation accuracy are not that far apart, there does not seem to be an issue with over- or underfitting.