

CS4361/5361 Machine Learning

Fall 2019

Lab 5 - The Keras library

Due Monday, November 4, 2019. Submit a paper copy by 5:00 p.m.

Email report to olacfuentes@gmail.com, include UTEP-ML2019 in the subject line.

In this lab you will become familiar with the `Keras` library, one of the most commonly used tools in deep learning research. Your task is to obtain the best results you can (on the test set, of course) using the fully-connected (dense) neural networks on the Gamma ray and solar x-ray datasets and convolutional neural networks on MNIST and CIFAR-10. Extra credit will be given to the best results for every dataset and for obtaining results at least as good as those of the baseline with the smallest number of parameters.

While the combination of architectures and parameters you can use is almost infinite, I suggest you read the documentation at keras.io and focus on the following:

- Regularizers - L1, L2, dropout
- Normalization - Does batch normalization help?
- Optimizer used and initial parameters: learning rate, momentum
- Dense layers - number and size
- Convolutional layers - number of filters, size of convolutional filters, stride
- Pooling layers - maximum vs. average
- Activation functions - relu, elu, sigmoid, etc.
- Initializers - Glorot and He seem to be the best, but you can try others.
- Batch size
- Data augmentation
- Epochs - important parameter in general, for this lab you can use either 10 or 20 epochs for each experiment; early stopping (when test error is minimal) is not allowed.

Write a report including (at least) the following items:

1. For each dataset, show the results obtained by the baseline implementation provided in the class web page. Then write a narrative describing the changes you attempted in order to improve performance. Include what succeeded and what did not and try to explain why. Summarize your results in a table.
2. Discussion of results. What techniques seem to improve performance? Which ones do not? What are the performance/time trade-offs?
3. Conclusions.
4. Appendix: Source code