MC886/MO444 Machine Learning and Pattern Recognition

Assignment #2 — 2017s2 — Prof. Sandra Avila

Objective

Explore classification techniques and come up with the best possible model to the problem, avoiding overfitting. In particular, build an object recognition system to accurately classify images using the CIFAR-10 dataset (`https://www.cs.toronto.edu/~kriz/cifar.html`).

Activities

1. Perform Logistic Regression as the baseline (first solution) to learn the 10 classes in the dataset. Use one-vs-all strategy to build a classification model.
2. Perform Multinomial Logistic Regression (i.e., Softmax regression). It is a generalization of Logistic Regression to the case where we want to handle multiple classes.
3. Move on to Neural Networks, using one hidden layer. You should numerically check your gradient calculations.
4. Extend your Neural Network to two hidden layers. Try different activation functions. Does the performance improve?
5. Pick your best model and plot the confusion matrix in the test set. What are the conclusions?
6. Prepare a 4-page (max.) report with all your findings. It is UP TO YOU to convince the reader that you are proficient on Logistic Regression and Neural Network, and the choices it entails.

Dataset

The CIFAR-10 dataset consists of 60,000 32×32 color images in 10 classes, with 6,000 images per class.

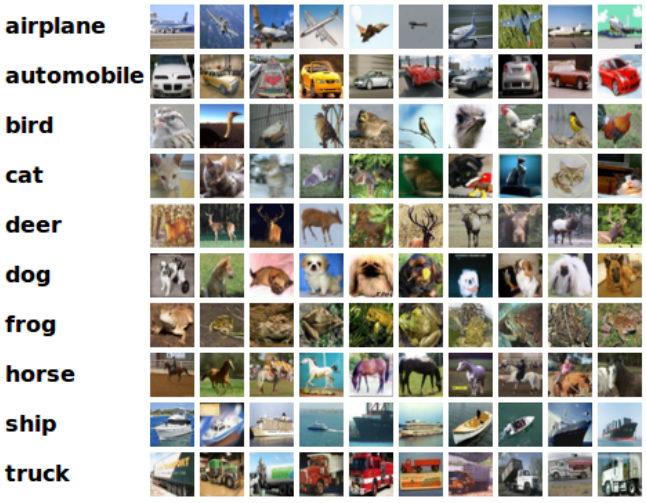

Figure 1: Classes in the dataset, as well as 10 random images from each. Figure reproduced from `https://www.cs.toronto.edu/~kriz/cifar.html`.

Dataset Information:

- You should respect the following traininig/test split: $50,000$ training examples, and $10,000$ test examples. Avoid overfitting.
- The classes are completely mutually exclusive. There is no overlap between automobiles and trucks. "Automobile" includes sedans, SUVs, things of that sort. "Truck" includes only big trucks. Neither includes pickup trucks.

- The data is available at: `https://www.dropbox.com/s/vtqjzk9vfc4fzvh/cifar-10.tar.bz2`:
  'train' folder (50,000 images, labels.txt) + 'test' folder (10,000 images, labels.txt),
  labels: 0 airplane, 1 automobile, 2 bird, 3 cat, 4 deer, 5 dog, 6 frog, 7 horse, 8 ship, 9 truck.

Deadline

Friday, **October 10**, in the beginning of the class, 7pm.
Penalty policy for late submission: You are not encouraged to submit your assignment after due date. However, in case you did, your grade will be penalized as follows:

- October 11 7pm : grade * 0.75
- October 12 7pm : grade * 0.5
- October 13 7pm : grade * 0.25

Submission

On the deadline day, bring your 4-page printed report. The template for report is available at `https://www.dropbox.com/s/nc6d89otr8ekvjd/report-model.zip`. Please, print on both sides of the page. The report should be written in Portuguese or English.
Submit a zip file, with the code and the report (PDF file), via Moodle.
This activity is **NOT** individual, it must be done in pairs (two-person group).