COMS W4995-2: Deep Learning   Jan 25, 2018

Assignment 1. Due on Thu, Feb 8, 11:59pm

Instructor: *Iddo Drori*,   Assignment CAs: *Abhinav Sharma, Animesh Sharma*

In this assignment, you are required to create a fully-connected deep neural network in Python from scratch. Your network will be trained on the CIFAR10 dataset and will learn to classify images into 10 categories: airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck.

The following files are provided:

- **HW1-uni.ipynb**: Skeleton code with some utility functions. Each function contains details in comments.

- **homework1.tar**: Find this on the Courseworks files tab in the Datasets folder. This contains folders for train and test images. There are $50,000$ labeled train images and $10,000$ unlabeled test images.

1   Part 1 (60%)

- Implement the following operations: forward propagation, cost function, backward propagation, parameter updates, train, and predict, affine_forward, affine_backward, activation_forward and activation_backward.

- Split train data into train and validation sets (10% of the data).

- Train your network, and make predictions on the test set. Use the *save_predictions*() function to save *y_pred* to file "ans1-uni.npy". The numpy array should contain the unnormalized scores from the network, so the shape should be (num_classes, test_size)

- Your network needs to have a validation accuracy of 50%.

2   Part 2 (40%)

- Improve the ability of your network to generalize by implementing the following:

  1. Regularizers: L1 regularization, L2 regularization, Dropout, Data Augmentation.
  2. Optimizers: SGD with momentum, rmsprop, adam.

- Retrain the network using all combinations of the methods above and save your best predictions on test set to file "ans2-uni.npy" similar to Part 1.

3   Submission and grading

For Part 1, you should receive full credit for a working implementation (that should easily get to 50% accuracy on your validation set). For Part 2, scores will be based on test set accuracy (should be more than part 1). Please leave output cells in your notebook intact so that we can also see your validation accuracies. Also mention your final accuracies and methods you used that led to the best results for part 2 in the notebook.

The assignment can be done in groups of at most 2 students. Each student must submit individually on Courseworks. Submit **HW1-uni.zip** file only that contain the following files named in the specified way:

- HW1-uni.ipynb

- ans1-uni.npy

- ans2-uni.npy

4   Notes

- For submission, please follow naming conventions and file structure given above since grading will be done using a script.

- Ensure that only the provided functions are being used to load data and save predictions to file. These will preserve the order of samples for test set.

- Don't import any other libraries.

- Preserve the output cells in your IPython notebooks, don't clear them before submission.

- Mention the methods and validation accuracies you achieved for part 2 in separate cell in the notebook.