

Homework 1

Due: Sunday, 11th February 2018, 11:55 PM

Instructor: Iddo Drori

Homework TA: Vikram Sunil Bajaj

In this homework, 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.
- **HW1-data.tar:** This contains folders for train and test images. There are 50,000 labeled train images and 10,000 unlabeled test images.

1 Part 1 (70%)

- Implement the following operations: forward propagation, cost function, backward propagation, parameter updates, train, 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 un-normalized 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 (30%)

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, and save your 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.
- Please leave output cells in your notebook intact so that we can also see your validation accuracies.
- The homework can be done in pairs. However, each student must submit individually on NYU Classes.
- Submit HW1-uni.zip file only that contains the following files named in the specified way:

- HW1-uni.ipynb
- ans1-uni.npy
- ans2-uni.npy

3.1 Important Notes

- For submission, please follow naming conventions and file structure given above since grading will be done using a script.
- “uni” in the file names is a placeholder for your NYU NetID.
- 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 Jupyter (IPython) notebooks, don’t clear them before submission.