EE239AS, Winter 2019 **Homework #5**
Neural Networks & Deep Learning Prof. J.C. Kao
UCLA ECE TAs: W. Chuang, M. Kleinman, K. Liang & A. Wickstrom

Due Monday, 25 Feb 2019, by 11:59pm to Gradescope.
100 points total.

You should complete the notebooks in order, i.e., CNN-Layers, followed by CNN-BatchNorm, followed by CNN. This is due to potential dependencies. Note however, that CNN can be completed without CNN-Layers, since we provide the fast implementation of the CNN layers to be used in question 3.

1. (40 points) **Implement convolutional neural network layers.** Complete the CNN-Layers.ipynb Jupyter notebook. You will have to copy over your solutions for `layers.py` and `optim.py` from HW #4 into `nndl/`. Print out the entire workbook and relevant code and submit it as a pdf to gradescope. Download the CIFAR-10 dataset, as you did in earlier homework.

2. (20 points) **Implement spatial normalization for CNNs.** Complete the CNN-BatchNorm.ipynb Jupyter notebook. Print out the entire workbook and relevant code and submit it as a pdf to gradescope.

3. (40 points) **Optimize your CNN for CIFAR-10.** Complete the CNN.ipynb Jupyter notebook. Print out the entire workbook and relevant code and submit it as a pdf to gradescope.