CS231n Convolutional Neural Networks for Visual Recognition

These notes accompany the Stanford CS class CS231n: Convolutional Neural Networks for Visual Recognition.
For questions/concerns/bug reports contact Justin Johnson regarding the assignments, or contact Andrej Karpathy regarding the course notes. You can also submit a pull request directly to our git repo.
We encourage the use of the hypothes.is extension to annote comments and discuss these notes inline.

Spring 2017 Assignments

Assignment #1: Image Classification, kNN, SVM, Softmax, Neural Network

Assignment #2: Fully-Connected Nets, Batch Normalization, Dropout, Convolutional Nets

Assignment #3: Image Captioning with Vanilla RNNs, Image Captioning with LSTMs, Network Visualization, Style Transfer, Generative Adversarial Networks

Module 0: Preparation

Python / Numpy Tutorial

IPython Notebook Tutorial

Google Cloud Tutorial

Google Cloud with GPUs Tutorial (for assignment 2 onwards)

AWS Tutorial

Module 1: Neural Networks

Image Classification: Data-driven Approach, k-Nearest Neighbor, train/val/test splits
L1/L2 distances, hyperparameter search, cross-validation

Linear classification: Support Vector Machine, Softmax
parameteric approach, bias trick, hinge loss, cross-entropy loss, L2 regularization, web demo

Optimization: Stochastic Gradient Descent
optimization landscapes, local search, learning rate, analytic/numerical gradient

Backpropagation, Intuitions

chain rule interpretation, real-valued circuits, patterns in gradient flow

Neural Networks Part 1: Setting up the Architecture

model of a biological neuron, activation functions, neural net architecture, representational power

Neural Networks Part 2: Setting up the Data and the Loss

preprocessing, weight initialization, batch normalization, regularization (L2/dropout), loss functions

Neural Networks Part 3: Learning and Evaluation

gradient checks, sanity checks, babysitting the learning process, momentum (+nesterov), second-order methods, Adagrad/RMSprop, hyperparameter optimization, model ensembles

Putting it together: Minimal Neural Network Case Study

minimal 2D toy data example

Module 2: Convolutional Neural Networks

Convolutional Neural Networks: Architectures, Convolution / Pooling Layers

layers, spatial arrangement, layer patterns, layer sizing patterns, AlexNet/ZFNet/VGGNet case studies, computational considerations

Understanding and Visualizing Convolutional Neural Networks

tSNE embeddings, deconvnets, data gradients, fooling ConvNets, human comparisons

Transfer Learning and Fine-tuning Convolutional Neural Networks

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