CS231n Convolutional Neural Networks for Visual Recognition

Course Website

These notes accompany the Stanford CS class CS231n: Convolutional Neural Networks for Visual Recognition. For questions/concerns/bug reports, please submit a pull request directly to our git repo.

Spring 2024 Assignments

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

Assignment #2: Fully Connected and Convolutional Nets, Batch Normalization, Dropout, Pytorch & Network Visualization

Assignment #3: Network Visualization, Image Captioning with RNNs and Transformers, Generative Adversarial Networks, Self-Supervised Contrastive Learning

Module 0: Preparation

Software Setup

Python / Numpy Tutorial (with Jupyter and Colab)

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

Student-Contributed Posts

Taking a Course Project to Publication

Recurrent Neural Networks