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CS231n: Convolutional Neural Networks for Visual Recognition

[\(index.html\)](#)

Schedule and Syllabus

Unless otherwise specified the course lectures and meeting times are Tuesday and Thursday 12pm to 1:20pm in the NVIDIA Auditorium in the Huang Engineering Center. (map (<https://campus-map.stanford.edu/?id=04-080&lat=37.42787956&lng=-122.17429865&zoom=17&srch=nvidia%20auditorium>))

This is the syllabus for the **Spring 2017** iteration of the course. The syllabus for the Winter 2016 (<http://cs231n.stanford.edu/2016/syllabus>) and Winter 2015 (<http://cs231n.stanford.edu/2015/syllabus>) iterations of this course are still available.

| Event Type | Date | Description | Course Materials |
|------------|----------------------|---|---|
| Lecture 1 | Tuesday April 4 | Course Introduction Computer vision overview Historical context Course logistics | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture1.pdf) [video] (https://www.youtube.com/watch?v=vT1JzLTH4G4&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Lecture 2 | Thursday April 6 | Image Classification The data-driven approach K-nearest neighbor Linear classification I | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture2.pdf) [video] (https://www.youtube.com/watch?v=OoUX-nOEjG0&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) [python/numpy tutorial] (http://cs231n.github.io/python-numpy-tutorial) [image classification notes] (http://cs231n.github.io/classification) [linear classification notes] (http://cs231n.github.io/linear-classify) |
| Lecture 3 | Tuesday April 11 | Loss Functions and Optimization Linear classification II Higher-level representations, image features Optimization, stochastic gradient descent | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture3.pdf) [video] (https://www.youtube.com/watch?v=h7iBpEHGVNc&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) [linear classification notes] (http://cs231n.github.io/linear-classify) [optimization notes] (http://cs231n.github.io/optimization-1) |
| Lecture 4 | Thursday April 13 | Introduction to Neural Networks Backpropagation Multi-layer Perceptrons The neural viewpoint | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture4.pdf) [video] (https://www.youtube.com/watch?v=d14TUNcbn1k&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) [backprop notes] (http://cs231n.github.io/optimization-2) [linear backprop example] (handouts/linear-backprop.pdf) [derivatives notes] (handouts/derivatives.pdf) (optional) [Efficient BackProp] (http://yann.lecun.com/exdb/publis/pdf/lecun-98b.pdf) (optional) related: [1] (http://colah.github.io/posts/2015-08-Backprop/), [2] (http://neuralnetworksanddeeplearning.com/chap2.html), [3] (https://www.youtube.com/watch?v=qQpm3BrIUfo) (optional) |
| Lecture 5 | Tuesday April 18 | Convolutional Neural Networks History Convolution and pooling ConvNets outside vision | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture5.pdf) [video] (https://www.youtube.com/watch?v=bNb2fEVKeEo&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) ConvNet notes (http://cs231n.github.io/convolutional-networks/) |

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| Lecture 6 | Thursday April 20 | Training Neural Networks, part I Activation functions, initialization, dropout, batch normalization | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture6.pdf) [video] (https://www.youtube.com/watch?v=wEoyxE0GP2M&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) Neural Nets notes 1 (http://cs231n.github.io/neural-networks-1/) Neural Nets notes 2 (http://cs231n.github.io/neural-networks-2/) Neural Nets notes 3 (http://cs231n.github.io/neural-networks-3/) tips/tricks: [1] (http://research.microsoft.com/pubs/192769/tricks-2012.pdf), [2] (http://yann.lecun.com/exdb/publis/pdf/lecun-98b.pdf), [3] (http://arxiv.org/pdf/1206.5533v2.pdf) (optional) Deep Learning [Nature] (http://www.nature.com/nature/journal/v521/n7553/full/nature14539.html) (optional) |
| A1 Due | Thursday April 20 | Assignment #1 due kNN, SVM, SoftMax, two-layer network | [Assignment #1] (http://cs231n.github.io/assignments2017/assignment1/) |
| Lecture 7 | Tuesday April 25 | Training Neural Networks, part II Update rules, ensembles, data augmentation, transfer learning | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture7.pdf) [video] (https://www.youtube.com/watch?v=_JB0AO7QxSA&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) Neural Nets notes 3 (http://cs231n.github.io/neural-networks-3/) |
| Proposal due | Tuesday April 25 | Couse Project Proposal due | [proposal description] (http://cs231n.stanford.edu/project.html) |
| Lecture 8 | Thursday April 27 | Deep Learning Software Caffe, Torch, Theano, TensorFlow, Keras, PyTorch, etc | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture8.pdf) [video] (https://www.youtube.com/watch?v=6SlgtELqQWc&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Lecture 9 | Tuesday May 2 | CNN Architectures AlexNet, VGG, GoogLeNet, ResNet, etc | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture9.pdf) [video] (https://www.youtube.com/watch?v=DAOcjcFr1Y&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) AlexNet (https://papers.nips.cc/paper/4824-imagenet-classification-with-deep-convolutional-neural-networks.pdf), VGGNet (https://arxiv.org/abs/1409.1556), GoogLeNet (https://arxiv.org/abs/1409.4842), ResNet (https://arxiv.org/abs/1512.03385) |
| Lecture 10 | Thursday May 4 | Recurrent Neural Networks RNN, LSTM, GRU Language modeling Image captioning, visual question answering Soft attention | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture10.pdf) [video] (https://www.youtube.com/watch?v=6niqTuYFZLQ&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) DL book RNN chapter (http://www.deeplearningbook.org/contents/rnn.html) (optional) min-char-rnn (https://gist.github.com/karpathy/d4dee566867f8291f086), char-rnn (https://github.com/karpathy/char-rnn), neuraltalk2 (https://github.com/karpathy/neuraltalk2) |
| A2 Due | Thursday May 4 | Assignment #2 due Neural networks, ConvNets | [Assignment #2] (http://cs231n.github.io/assignments2017/assignment2/) |
| Midterm | Tuesday May 9 | In-class midterm Location: Various (https://piazza.com/class/j0vi72697xc49k?cid=1272) (not our usual classroom) | |
| Lecture 11 | Thursday May 11 | Detection and Segmentation Semantic segmentation Object detection Instance segmentation | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture11.pdf) [video] (https://www.youtube.com/watch?v=nDPWYwWRIRo&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Lecture 12 | Tuesday May 16 | Visualizing and Understanding Feature visualization and inversion Adversarial examples DeepDream and style transfer | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture12.pdf) [video] (https://www.youtube.com/watch?v=6wcs6szJWMY&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) DeepDream (https://github.com/google/deepdream) neural-style (https://github.com/jcjohnson/neural-style) fast-neural-style (https://github.com/jcjohnson/fast-neural-style) |

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| Milestone | Tuesday May 16 | Course Project Milestone due | |
| Lecture 13 | Thursday May 18 | Generative Models PixelRNN/CNN Variational Autoencoders Generative Adversarial Networks | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture13.pdf) [video] (https://www.youtube.com/watch?v=5WoltGTWV54&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Lecture 14 | Tuesday May 23 | Deep Reinforcement Learning Policy gradients, hard attention Q-Learning, Actor-Critic | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture14.pdf) [video] (https://www.youtube.com/watch?v=lvoHnicueoE&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Guest Lecture | Thursday May 25 | Invited Talk: Song Han (https://stanford.edu/~songhan/) Efficient Methods and Hardware for Deep Learning | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture15.pdf) [video] (https://www.youtube.com/watch?v=eZdOkDtYMoo&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| A3 Due | Friday May 26 | Assignment #3 due | [Assignment #3] (http://cs231n.github.io/assignments2017/assignment3/) |
| Guest Lecture | Tuesday May 30 | Invited Talk: Ian Goodfellow (http://www.iangoodfellow.com/) Adversarial Examples and Adversarial Training | [slides] (http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture16.pdf) [video] (https://www.youtube.com/watch?v=ClfsB_EYsVI&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) |
| Lecture 16 | Thursday June 1 | Student spotlight talks, conclusions | [slides] |
| Poster Due | Monday June 5 | Poster PDF due | [poster description] (http://cs231n.stanford.edu/project.html) |
| Poster Presentation | Tuesday June 6 | | |
| Final Project Due | Monday June 12 | Final course project due date | [reports] (reports.html) |