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=0oUX-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=q0pm3BrIUFo) (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/)

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=6SlgtELqOWc&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=DAOcjicFr1Y&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)

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=5WoItGTWV54&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=CIfsB_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)