<http://cs229.stanford.edu/materials.html>

|  |  |
| --- | --- |
| [Stnf](http://www.stanford.edu/class/cs229/) | CS 229 Machine Learning Course Materials |

|  |
| --- |
| **Handouts and Problem Sets** |

* Handout #1: [Course Information](http://cs229.stanford.edu/info.html)
* Handout #2: [Course Schedule](http://cs229.stanford.edu/schedule.html)
* Homework #0: [Problem Set 0](http://cs229.stanford.edu/materials/ps0.pdf) | [Solutions](http://cs229.stanford.edu/materials/ps0_key.pdf)
* Homework #1: [Problem Set 1](http://cs229.stanford.edu/materials/ps1.pdf) | [Solutions](http://cs229.stanford.edu/materials/ps1_key.pdf)
* Homework #2: [Problem Set 2](http://cs229.stanford.edu/materials/ps2.pdf) | [Solutions](http://cs229.stanford.edu/materials/ps2_key.pdf)
* Practice Midterms: [Practice Midterm 1](http://cs229.stanford.edu/materials/midterm2014.pdf) | [Practice Midterm 2](http://cs229.stanford.edu/materials/midterm2015.pdf) | [Practice Midterm 1 Solutions](http://cs229.stanford.edu/materials/practicemidterm1sol.pdf) | [Practice Midterm 2 Solutions](http://cs229.stanford.edu/materials/practicemidterm2sol.pdf)
* Homework #3: [Problem Set 3](http://cs229.stanford.edu/materials/ps3.pdf) | [Solutions](http://cs229.stanford.edu/materials/ps3_key.pdf)
* Homework #4: [Problem Set 4](http://cs229.stanford.edu/materials/ps4.pdf) | [mix.dat](http://cs229.stanford.edu/materials/ps4/mix.dat)| [bellsej.m](http://cs229.stanford.edu/materials/ps4/bellsej.m)| [q6.zip](http://cs229.stanford.edu/oldPs/ps4/q6.zip)| [Solutions](http://cs229.stanford.edu/materials/ps4_key.pdf)

|  |
| --- |
| **Lecture Notes** |

* [Lecture notes 1 (ps)](http://cs229.stanford.edu/notes/cs229-notes1.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes1.pdf)  Supervised Learning, Discriminative Algorithms
* [Lecture notes 2 (ps)](http://cs229.stanford.edu/notes/cs229-notes2.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes2.pdf)  Generative Algorithms
* [Lecture notes 3 (ps)](http://cs229.stanford.edu/notes/cs229-notes3.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes3.pdf)  Support Vector Machines
* [Lecture notes 4 (ps)](http://cs229.stanford.edu/notes/cs229-notes4.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes4.pdf)  Learning Theory
* [Lecture notes 5 (ps)](http://cs229.stanford.edu/notes/cs229-notes5.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes5.pdf)  Regularization and Model Selection
* [Lecture notes 6 (ps)](http://cs229.stanford.edu/notes/cs229-notes6.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes6.pdf)  Online Learning and the Perceptron Algorithm. (optional reading)
* [Lecture notes 7a (ps)](http://cs229.stanford.edu/notes/cs229-notes7a.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes7a.pdf)  Unsupervised Learning, k-means clustering.
* [Lecture notes 7b (ps)](http://cs229.stanford.edu/notes/cs229-notes7b.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes7b.pdf)  Mixture of Gaussians
* [Lecture notes 8 (ps)](http://cs229.stanford.edu/notes/cs229-notes8.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes8.pdf)  The EM Algorithm
* [Lecture notes 9 (ps)](http://cs229.stanford.edu/notes/cs229-notes9.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes9.pdf)  Factor Analysis
* [Lecture notes 10 (ps)](http://cs229.stanford.edu/notes/cs229-notes10.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes10.pdf)  Principal Components Analysis
* [Lecture notes 11 (ps)](http://cs229.stanford.edu/notes/cs229-notes11.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes11.pdf)  Independent Components Analysis
* [Lecture notes 12 (ps)](http://cs229.stanford.edu/notes/cs229-notes12.ps) [(pdf)](http://cs229.stanford.edu/notes/cs229-notes12.pdf)  Reinforcement Learning and Control

|  |
| --- |
| **Supplemental Notes** |

* [Supplemental notes 1 (pdf)](http://cs229.stanford.edu/extra-notes/loss-functions.pdf)   Binary classification with +/-1 labels.
* [Supplemental notes 2 (pdf)](http://cs229.stanford.edu/extra-notes/boosting.pdf)   Boosting algorithms and weak learning.
  + [Matlab code to generate plots (.m)](http://cs229.stanford.edu/extra-notes/boosting_example.m)   Functional after implementing stump\_booster.m in PS2.
* [Supplemental notes 3 (pdf)](http://cs229.stanford.edu/extra-notes/representer-function.pdf)   The representer theorem.
* [Supplemental notes 4 (pdf)](http://cs229.stanford.edu/extra-notes/hoeffding.pdf)   Hoeffding's inequality.

|  |
| --- |
| **Section Notes** |

* [Section notes 1 (pdf)](http://cs229.stanford.edu/section/cs229-linalg.pdf)   Linear Algebra Review and Reference
* [Section notes 2 (pdf)](http://cs229.stanford.edu/section/cs229-prob.pdf)   Probability Theory Review
* [Section notes 3 (pdf)](http://cs229.stanford.edu/materials/MATLAB_Session.pdf) Files for the Matlab tutorial: [sigmoid.m](http://cs229.stanford.edu/section/matlab/sigmoid.m), [logistic\_grad\_ascent.m](http://cs229.stanford.edu/section/matlab/logistic_grad_ascent.m), [matlab\_session.m](http://cs229.stanford.edu/materials/matlab_session.m)
* [Section notes 4 (ps)](http://cs229.stanford.edu/section/cs229-cvxopt.ps) [(pdf)](http://cs229.stanford.edu/section/cs229-cvxopt.pdf)  Convex Optimization Overview, Part I
* [Section notes 5 (ps)](http://cs229.stanford.edu/section/cs229-cvxopt2.ps) [(pdf)](http://cs229.stanford.edu/section/cs229-cvxopt2.pdf)  Convex Optimization Overview, Part II
* [Section notes 6 (ps)](http://cs229.stanford.edu/section/cs229-hmm.ps) [(pdf)](http://cs229.stanford.edu/section/cs229-hmm.pdf)  Hidden Markov Models
* [Section notes 7 (pdf)](http://cs229.stanford.edu/section/gaussians.pdf)   The Multivariate Gaussian Distribution
* [Section notes 8 (pdf)](http://cs229.stanford.edu/section/more_on_gaussians.pdf)   More on Gaussian Distribution
* [Section notes 9 (pdf)](http://cs229.stanford.edu/section/cs229-gaussian_processes.pdf)   Gaussian Processes

|  |
| --- |
| **Other resources** |

**Advice on applying machine learning:**Slides from Andrew's lecture on getting machine learning algorithms to work in practice can be found [here](http://cs229.stanford.edu/materials/ML-advice.pdf).

**Previous projects:**A list of last year's final projects can be found [here](http://cs229.stanford.edu/projects2015.html).

**Matlab resources:**Here are a couple of Matlab tutorials that you might find helpful: <http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html> and <http://www.math.mtu.edu/~msgocken/intro/node1.html>. For emacs users only: If you plan to run Matlab in emacs, here are [matlab.el](http://cs229.stanford.edu/materials/matlab.el), and a helpful [.emac's file](http://cs229.stanford.edu/materials/emacs).

**Octave resources:**For a free alternative to Matlab, check out [GNU Octave](http://www.gnu.org/software/octave/). The official documentation is available [here](http://www.gnu.org/software/octave/doc/interpreter/). Some useful tutorials on Octave include <http://en.wikibooks.org/wiki/Octave_Programming_Tutorial> and <http://www-mdp.eng.cam.ac.uk/web/CD/engapps/octave/octavetut.pdf> .

**Data:**Here is the [UCI Machine learning repository](http://www.ics.uci.edu/~mlearn/MLRepository.html), which contains a large collection of standard datasets for testing learning algorithms. If you want to see examples of recent work in machine learning, start by taking a look at the conferences [NIPS](http://www.nips.cc/) (all old NIPS papers are online) and ICML. Some other related conferences include UAI, AAAI, IJCAI.

**Viewing PostScript and PDF files:** Depending on the computer you are using, you may be able to download a [PostScript viewer](http://www.cs.wisc.edu/~ghost/) or [PDF viewer](http://www.adobe.com/products/acrobat/readstep2_allversions.html) for it if you don't already have one.

|  |  |
| --- | --- |
| Comments to [cs229-qa@cs.stanford.edu](mailto:cs229-qa@cs.stanford.edu) | [Home Page](http://www.stanford.edu/class/cs229/) |