



Copyright © 2012 Hal Daumé III

http://ciml.info

This book is for the use of anyone anywhere at no cost and with almost no restrictions whatsoever. You may copy it or re-use it under the terms of the CIML License online at ciml.info/LICENSE. You may not redistribute it yourself, but are encouraged to provide a link to the CIML web page for others to download for free. You may not charge a fee for printed versions, though you can print it for your own use.

version 0.8, August 2012

Code and Datasets

Rating	Easy?	AI?	Sys?	Thy?	Morning?
+2	y	y	n	y	n
+2	y	y	n	y	n
+2	n	y	n	n	n
+2	n	n	n	y	n
+2	n	y	y	n	У
+1	y	y	n	n	n
+1	y	y	n	y	n
+1	n	y	n	y	n
О	n	n	n	n	У
О	y	n	n	y	y
O	n	y	n	y	n
0	у	y	y	y	y
-1	y	y	y	n	y
-1	n	n	y	y	n
-1	n	n	y	n	У
-1	y	n	y	n	У
-2	n	n	y	y	n
-2	n	y	y	n	У
-2	y	n	y	n	n
-2	y	n	y	n	у



Bibliography

Frank Rosenblatt. The perceptron: A probabilistic model for information storage and organization in the brain. *Psychological Review*, 65:386–408, 1958. Reprinted in *Neurocomputing* (MIT Press, 1998).

Index

K-nearest neighbors, 54	clustering quality, 163	exponential loss, 87, 154	
ϵ -ball, 35	collective classification, 81		
<i>p</i> -norms, 89	complexity, 29	feasible region, 97	
0/1 loss, 85	concave, 86	feature combinations, 49	
	concavity, 175	feature mapping, 49	
absolute loss, 14	concept, 141	feature normalization, 55	
activation function, 114 confidence intervals, 64		feature scale, 28	
activations, 37	constrained optimization problem, 96	feature space, 25	
active learning, 177			
AdaBoost, 151	convergence rate, 92	feature vector, 24, 26	
algorithm, 84	convex, 84, 86	features, 11, 24	
all pairs, 74	cross validation, 60, 64	forward-propagation, 121	
all versus all, 74	cubic feature map, 128	fractional assignments, 172	
architecture selection, 123	curvature, 92	furthest-first heuristic, 165	
area under the curve, 60, 79			
AUC, 60, 77, 79	data covariance matrix, 169	Gaussian distribution, 106	
AVA, 74	data generating distribution, 15	Gaussian kernel, 131	
averaged perceptron, 47	decision boundary, 29	Gaussian Mixture Models, 173	
	decision stump, 153	generalize, 9, 16	
back-propagation, 118, 121	decision tree, 8, 10	generative story, 108	
bag of words, 52	decision trees, 53	geometric view, 24	
bagging, 150	development data, 22	global minimum, 90	
base learner, 149	dimensionality reduction, 163	GMM, 173	
batch, 158	discrete distribution, 106	gradient, 90	
batch learning, 180	distance, 26	gradient ascent, 90	
Bayes error rate, 102, 147	dominates, 59	gradient descent, 90	
Bayes optimal classifier, 101, 147	dot product, 41	graph, 81	
Bayes optimal error rate, 102	dual problem, 135	81,	
Bernouilli distribution, 106	dual variables, 135	hard-margin SVM, 97	
bias, 38	,	hash kernel, 162	
binary features, 25	early stopping, 49, 117	held-out data, 22	
bipartite ranking problems, 77	embedding, 163	hidden units, 113	
boosting, 139, 149	ensemble, 149	hidden variables, 171	
bootstrap resampling, 150	error driven, 39	hinge loss, 87	
bootstrapping, 63, 65	error rate, 85	histogram, 12	
	Euclidean distance, 26	hyperbolic tangent, 114	
categorical features, 25	evidence, 112	hypercube, 33	
chain rule, 105	example normalization, 55, 56	hyperparameter, 21, 40, 86	
chord, 87	examples, 9	hyperplane, 37	
circuit complexity, 122	expectation maximization, 171	hyperspheres, 33	
clustering, 30, 163	expected loss, 15	hypothesis, 141	

hypothesis class, 144 hypothesis testing, 63	margin, 44, 96 margin of a data set, 44	primal variables, 135 principle components analysis, 169	
	marginal likelihood, 112	prior, 112	
i.i.d. assumption, 103	maximum a posteriori, 111	probabilistic modeling, 101	
imbalanced data, 68	maximum depth, 21	Probably Approximately Correct, 140	
importance weight, 69	maximum likelihood estimation, 103	projected gradient, 135	
independently, 102	Mercer's condition, 130	psd, 130	
independently and identically dis-	model, 84		
tributed, 103	modeling, 21	radial basis function, 123	
indicator function, 85	multi-layer network, 113	random forests, 154	
induce, 15		RBF kernel, 131	
induced distribution, 70	naive Bayes assumption, 105	RBF network, 123	
induction, 9	nearest neighbor, 24, 26	recall, 58	
inductive bias, 17, 26, 28, 88, 106	neural network, 154	receiver operating characteristic, 60	
iteration, 30	neural networks, 50, 113	reconstruction error, 169	
•	neurons, 37	reductions, 70	
jack-knifing, 65	noise, 17	redundant features, 52	
Jensen's inequality, 175	non-convex, 119	regularized objective, 85	
joint, 109	non-linear, 113	regularizer, 85, 88	
joint, 109	Normal distribution, 106	representer theorem, 127, 129	
V magnat majahhara ar	normalize, 42, 55	ROC curve, 60	
K-nearest neighbors, 27	null hypothesis, 63	Roc curve, oo	
Karush-Kuhn-Tucker conditions, 136	num nypoutesis, sy		
kernel, 125, 129	chicative function 0=	sample complexity, 141–143	
kernel trick, 130	objective function, 85	semi-supervised learning, 177	
kernels, 50	one versus all, 72	sensitivity, 60	
KKT conditions, 136	one versus rest, 72	separating hyperplane, 84	
	online, 38	SGD, 158	
label, 11	online learning, 180	shallow decision tree, 17, 153	
Lagrange multipliers, 104	optimization problem, 85	shape representation, 52	
Lagrange variable, 104	output unit, 113	sigmoid, 114	
Lagrangian, 104	OVA, 72	sigmoid function, 110	
layer-wise, 123	overfitting, 20	sigmoid network, 123	
leave-one-out cross validation, 61	oversample, 71	sign, 114	
level-set, 89		single-layer network, 113	
license, 2	p-value, 63	slack, 132	
likelihood, 112	PAC, 140, 151	slack parameters, 97	
linear classifier, 154	paired t-test, 63	smoothed analysis, 165	
linear classifiers, 154	parametric test, 63	soft assignments, 172	
linear decision boundary, 37	parity function, 122	soft-margin SVM, 97	
linear regression, 94	patch representation, 52	span, 127	
linearly separable, 43	PCA, 169	sparse, 89	
link function, 114	perceptron, 37, 38, 54	specificity, 60	
log likelihood, 103	perpendicular, 41	squared loss, 14, 87	
log posterior, 112	pixel representation, 51	stacking, 82	
log probability, 103	polynomial kernels, 130	StackTest, 82	
log-likelihood ratio, 107	positive semi-definite, 130	statistical inference, 101	
logarithmic transformation, 57	posterior, 112	statistically significant, 63	
logistic loss, 87	precision, 58	stochastic gradient descent, 158	
logistic regression, 111	precision/recall curves, 58	stochastic optimization, 157	
LOO cross validation, 61	predict, 9	strong learner, 151	
loss function, 14	preference function, 76	strong learning algorithm, 151	

strongly convex, 92	text categorization, 52	Vapnik-Chernovenkis dimension, 146
structural risk minimization, 84	the curse of dimensionality, 32	variance, 150
sub-sampling, 70	threshold, 38	VC dimension, 146
subderivative, 93	Tikhonov regularization, 84	vector, 25
subgradient, 93	training data, 9, 15, 20	visualize, 163
subgradient descent, 94	training error, 16	vote, 27
support vector machine, 96	trucated gradients, 160	voted perceptron, 47
support vectors, 137	two-layer network, 113	voting, 47
surrogate loss, 87		-
symmetric modes, 119	unbiased, 43 underfitting, 20	weak learner, 151 weak learning algorithm, 151
t-test, 63	unit hypercube, 34	weighted nearest neighbors, 35
test data, 20	unsupervised learning, 30	weights, 37
test error, 20	-	-
test set, 9	validation data, 22	zero/one loss, 14