

Index

- Adversarial augmentation learning, 259
- Adversarial autoencoder, 156
- Adversarial learning, 148
- Adversarial manifold learning, 256
- Autoencoding variational Bayes, 145

- Bayesian learning, **33**, 140
- Bayesian speaker recognition, 35
- Bottleneck features, 169

- Center loss, 236
- Conditional independence, 26, 31
- Conjugate prior, 22
- Contrastive divergence, 119
- Cross-entropy error function, 149, 153, 157

- Data augmentation, 249
- Deep belief network, 128
- Deep Boltzmann machine, 133
- Deep learning, 115
- Deep neural network, 15, **120**
 - Error backpropagation algorithm, 124, 151
 - Feedforward neural network, 123
 - Multilayer perceptron, 123
 - Rectified linear unit, 123
 - Training strategy, 130
- Deep transfer learning, **158**
 - Covariate shift, 161
 - Distribution matching, 163
 - Domain adaptation, 161
 - Feature-based domain adaptation, 162
 - Instance-based domain adaptation, 161
 - Maximum mean discrepancy, 163
 - Multi-task learning, 160, 165
 - Neural transfer learning, 165
 - Transfer learning, 159
- Denosing autoencoder, 135
- Dimension reduction, 249
- Domain adaptation, 217
 - Dataset-invariant covariance normalization, 219
 - Inter-dataset variability compensation, 218
 - Within-class covariance correction, 220
- Domain adversarial training
 - Adversarial I-vector transformer, 247
 - Domain adversarial neural network (DANN), 271
 - Variational domain adversarial neural network (VDANN), 271
- Domain-invariant autoencoder, 232

- EM algorithm, **17**, 22
- End-to-end, 269
- Evidence lower bound, 15, 25
- Expectation-maximization algorithm, 16

- Factor analysis, 62
 - Data likelihood, 65
 - E-step, 66
 - EM algorithm, 67
 - EM formulation, 65
 - Generative model, 64
 - M-step, 65
 - Posterior density of latent factors, 66
 - Relationship with NAP, 68
 - Relationship with PCA, 67
- Factorized posterior distribution, 26
- Factorized variational inference, 26
- Feature learning, 266
 - Variational representation of utterances, 242
- Feature-domain adaptation, 218

- Gaussian mixture models, 36
 - Auxiliary function, 39
 - EM algorithm, 37
 - EM steps, 40
 - Gaussian density function, 36, 251, 253
 - Incomplete data, 38
 - Log-likelihood, 36
 - Mixture posteriors, 38
 - Universal background model, 40
- Generative adversarial network, 146, 156
 - Auxiliary classifier GAN, 254
- Generative model, 147
- Gibbs sampling, 32, 119
- GMM–SVM, 45
 - GMM–SVM scoring, 57
 - GMM-supervector, 55
 - Nuisance attribute projection, 58

- GMM–SVM (Cont)
 - Objective function, 60
 - Relation with WCCN, 61
- GMM–UBM
 - GMM–UBM scoring, 44
 - MAP adaptation, 41
- Gradient vanishing, 153
- Greedy training, 130, 137
- Heavy-tailed PLDA, 76
 - Compared with GPLDA, 83
 - Generative model, 76
 - Model parameter estimation, 79
 - Posterior calculations, 77
 - Scoring, 81
- I-vector whitening, 227
- I-vectors, 83
 - Cosine-Distance Scoring, 96
 - Generative model, 84
 - I-vector extraction, 87
 - I-vector extractor, 87
 - PLDA scoring, 96
 - Relation with MAP, 89
 - Senone I-vectors, 102
 - Session variability suppression, 91
 - Total factor, 85
- Importance reweighting, 161
- Importance sampling, 30
- Importance weight, 31
- Important sampling, 161
- Incomplete data, 17
- Isotropic Gaussian distribution, 136, 145
- Jensen’s inequality, 16
- Jensen-Shannon divergence, 150, 258
- JFA
 - Generative model, 103
 - JFA scoring, 109
 - Latent posterior, 104
 - likelihood ratio score, 110
 - Linear scoring, 110
 - Parameter estimation, 106
 - Point estimate, 109
- JFA:Estimating eigenchannel matrix, 107
- JFA:Estimating eigenvoice matrix, 107
- JFA:Estimating speaker loading matrix, 108
- Joint Factor Analysis, 103
- Kullback–Leibler divergence, 18, 251
- Linear discriminant analysis, 91
- Local gradient, 125
- Logistic sigmoid function, 123
- Markov chain, 147
- Markov chain Monte Carlo, 31
- Markov switching, 132
- Markov-chain Monte Carlo sampling, 119
- Maximum *a posteriori*, 21
- Maximum likelihood, 16, 147
- Mean-field inference, 134, 140
- Minimax optimization, 149, 256
- Mixture of PLDA, 190
 - DNN-driven mixture of PLDA, 202
 - SNR-dependent mixture of PLDA, 197
 - SNR-independent mixture of PLDA, 190
- Mode collapse, 153
- Model regularization, 34, 259
- Monte Carlo estimate, 144
- Multi-task DNN, 203, 214
- Multiobjective learning, 256
- Nonparametric discriminant analysis, 93
- Nuisance-attribute autoencoder, 233
- Partition function, 117
- PLDA
 - EM algorithm, 70
 - Enhancement of PLDA, 75
 - Generative model, 69
 - PLDA Scoring, 72
- PLDA adaptation, 227
- Probabilistic linear discriminant analysis, 69
- Probabilistic model, 13
- Proposal distribution, 30
- Regression DNN, 211
- Reparameterization trick, 144
- Restricted Boltzmann machine, 115, 128
 - Bernoulli-Bernoulli RBM, 116
 - Gaussian-Bernoulli RBM, 117
- Robust PLDA, 175
 - Duration-invariant PLDA, 176
 - SNR- and duration-invariant PLDA, 185
 - SNR-invariant PLDA, 175
- Saddle point, 153
- Sampling method, 29
- Score calibration, 203, 206
- Score matching, 137
- Semi-supervised learning, 130, 158, 167
- Softmax function, 123
- Source-normalized LDA, 222
- Speaker embedding, 172, 269
 - Meta-embedding, 173
 - x-vectors, 172
- Stack-wise training procedure, 129
- Stacking autoencoder, 135
- Stochastic backpropagation, 142
- Stochastic gradient descent, 120, 124, 136, 152
- Stochastic gradient variational Bayes, 144
- Stochastic neural network, 140

Student's t -distribution, 251	Uncertainty modeling, 140
Sum-of-squares error function, 124	Uncertainty propagation, 97
Supervised manifold learning, 253	
Support vector discriminant analysis, 96	Variational autoencoder, 140, 156
Support vector machines, 45	VAE for domain adaptation, 240
dual problem, 47	VAE scoring, 237
primal problem, 47	Variational Bayesian learning, 29, 140, 250
slack variables, 48	Variational lower bound, 25, 141
Wolfe dual, 49	Variational manifold learning, 252
Total-factor prior, 223	VB-EM algorithm, 24, 28, 134
Triplet loss, 236	
Two-player game, 149	Within-class covariance analysis, 91