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## Deep Learning: A Bayesian Perspective

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### Abstract:

Deep learning is a form of machine learning for nonlinear high dimensional pattern matching and prediction. By taking a Bayesian probabilistic perspective, we provide a number of advantages, with more efficient algorithms for optimisation and hyper-parameter tuning, and an explanation of predictive performance. A framework for constructing good Bayesian predictors in high dimensions is provided. Traditional high-dimensional data reduction techniques; principal component analysis (PCA), partial least squares (PLS), reduced rank regression (RRR), projection pursuit regression (PPR) are shown to be shallow learners. Their deep learning counterparts exploit multiple layers of data reduction which leads to performance gains. Stochastic gradient descent (SGD) training, and optimisation and Dropout (DO) provide model and variable selection. Bayesian regularization is central to finding networks and optimizing the bias-variance trade-off, to achieve good out-of sample performance.

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