

Foundations of Machine Learning

AI2000 and AI5000

FoML-18

Classification with the Basis Functions

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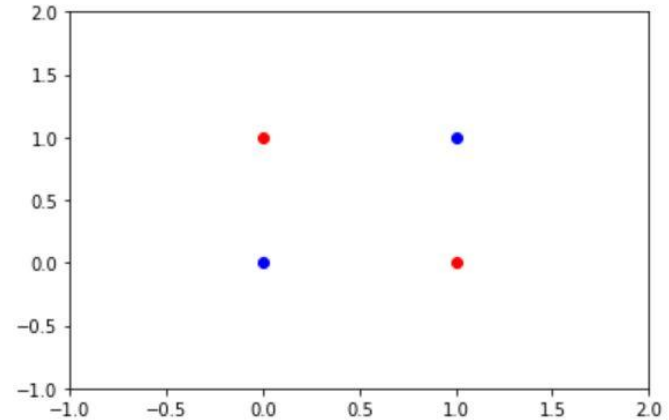
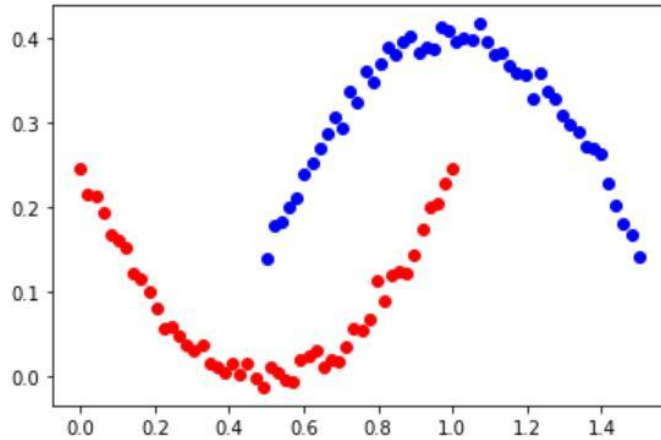
So far in FoML

- Intro to ML and Probability refresher
- MLE, MAP, and fully Bayesian treatment
- Supervised learning
 - a. Linear Regression with basis functions (regularization, model selection)
 - b. Bias-Variance Decomposition (Bayesian Regression)
 - c. Decision Theory - three broad classification strategies
 - Probabilistic Generative Models - Continuous & discrete data
 - (Linear) Discriminant Functions - least squares solution, Perceptron

Classification with Basis functions

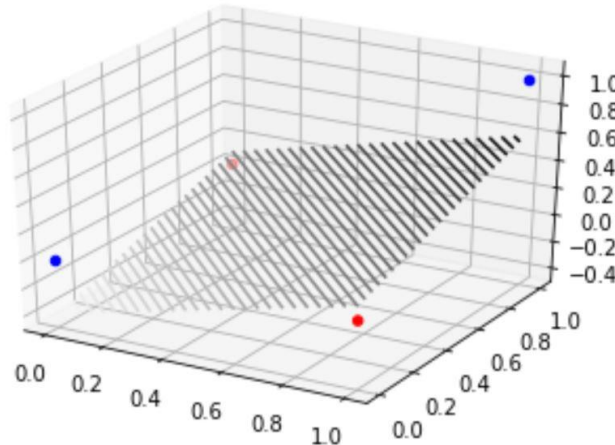


When the data is not linearly separable



Sometimes preprocessing (feature design) helps

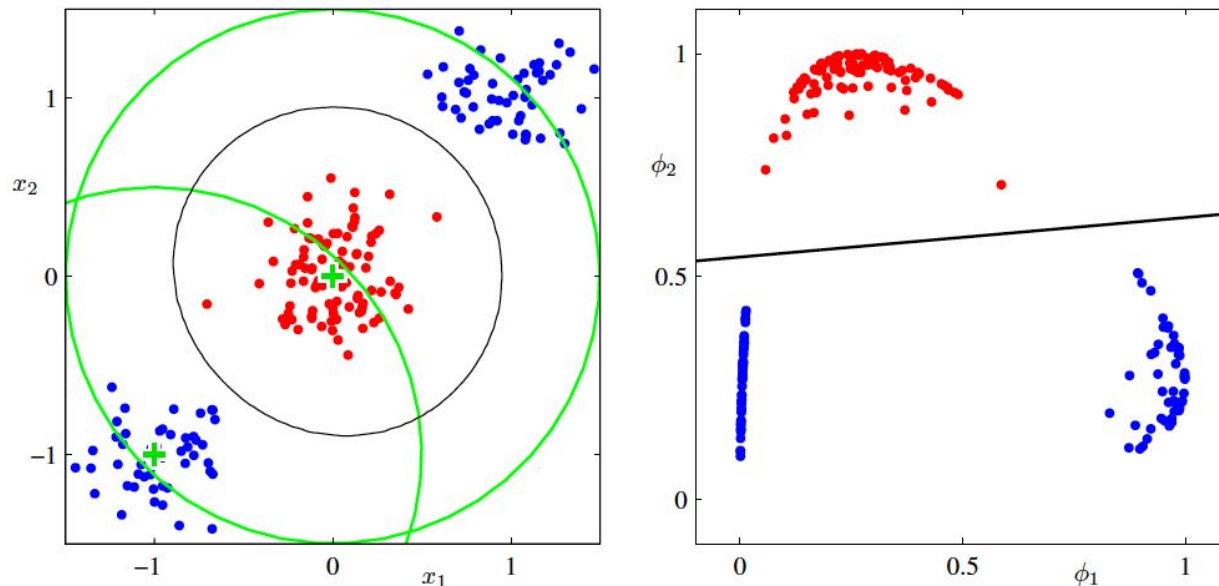
- Consider the XOR function with $\phi(\mathbf{x}) = (x_1, x_2, x_1x_2)^T$
- Perceptron in the new space will classify the data



$$y(\mathbf{x}) = f(\mathbf{w}^T \phi(\mathbf{x}))$$



Use of Basis functions



Left: data in the original input space
Right: space of two Gaussian basis functions



Basis functions - advantages

- Enable to learn nonlinear mapping functions from i/p to target
- Leads to closed form solution for LS problem and leads to tractable Bayesian treatment

Basis Functions - Limitations

- Basis functions are fixed (not learned)
- Hard to visualize high-dim data to design the basis functions
- In higher dimensions we need more basis functions (curse of dimensionality)

Next

Probabilistic Discriminative models

- Logistic Regression

