IE 529 Fall 2016 Final Project

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I. PCA

Algorithm 1 PCA in Feature Spaces

procedure PCA(X)
  given n data: $\vec{x}^1, \vec{x}^2, \cdots, \vec{x}^n$ to form the n by m input matrix: $X = \left[\vec{x}^1; \vec{x}^2; \cdots; \vec{x}^n\right]^T$
  de-mean (or standardize) the input matrix: X
  calculate covariance matrix: $Cov = \frac{1}{n} X^T X$
  singular value decomposition (SVD) on covariance matrix: $U, S, V = svd(Cov)$
  choose the first k eigenvectors to from the m by k matrix: $E = \left[\vec{u}^1; \vec{u}^2; \cdots; \vec{u}^k\right]$
  calculate the projection of any test data $\vec{x}$ on eigenvectors: $\vec{p} = E^T \vec{x}$
output

II. Kernel PCA

Algorithm 2 Kernel PCA

procedure K-PCA(X)
  given n data: $\vec{x}^1, \vec{x}^2, \cdots, \vec{x}^n$ to form the n by m input matrix: $X = \left[\vec{x}^1; \vec{x}^2; \cdots; \vec{x}^n\right]^T$
  calculate the n by n Kernel matrix K : $K_{ij} = k(\vec{x}^i, \vec{x}^j)$
  centralize K to get K' : $K' = K - I_n K/n - K I_n/n + I_n K I_n/n^2$
  solve equation: $n\lambda\vec{\alpha} = K'\vec{\alpha}$ to get the eigenvectors: $\vec{\alpha}^1, \vec{\alpha}^2, \cdots, \vec{\alpha}^p$ and normalize them
  compute the projection of any test data $\vec{x}$: $\vec{p}_j = \sum_{i=1}^{n} \vec{\alpha}_i^j k(\vec{x}^i, \vec{x})$
output