1. Experimenting with AdaBoost.
   - Use `generate_data_1.m` with \( n = 1000 \) to create a synthetic training and testing set.
   - Implement Discrete AdaBoost using a weak learner of your choice, and demonstrate it on the above synthetic data using 60 boosting iterations.
   - As a function of the number of iterations, plot the training error, the testing error, and the upper bound on the empirical error.

2. Suppose you and your homework partner obtain a dataset \( x^i \in \mathbb{R}^d, i = 1, \ldots, n \), from which you assemble a data matrix \( X = [x^1, \ldots, x^n] \in \mathbb{R}^{d \times n} \) and compute the inner product matrix \( Q = X^\top X \in \mathbb{R}^{n \times n} \). After you compute \( Q \), you realize you wanted to center the data before computing the inner products, i.e., to use \( x^i - \mu \) in place of \( x^i \), where \( \mu = \frac{1}{n} \sum_{i=1}^{n} x^i \).
   Unfortunately, you deleted the dataset.
   Show your partner that hope is not lost, since \( Q' \), the inner product matrix for the centered data, can be obtained from \( Q \) via the expression \( Q' = HQH \) with \( H = I - \frac{1}{n} 1_n 1_n^\top \), where \( 1_n \) denotes a column vector of \( n \) ones.

3. Kernel PCA Experiment on Toy Data.
   (a) Implement Kernel PCA using a Gaussian kernel.
   (b) Reproduce the result in Fig. 4 of Schölkopf et al. (1999).