Math 590 — Computer Assignment 1 — due Wednesday, Sept. 10, 2014

1. Compare the four different versions of `DistanceMatrix` given in the class slides for memory and speed efficiency. Can you find a faster and/or more memory efficient version? MATLAB's profiler might be useful for this problem.

2. Perform a series of distance matrix interpolation experiments similar to those reported in the tables on pp. 56–57 of the slides for Chapter 1, Part 2. However, now use $N = 2^k$ Sobol$'$ points in $[0,1]^d$ for $k = 1, \dots, 12$ and $d = 1, 2, 3$ (you can use the appropriate option in `CreatePoints` which depends on `sobolset` from `Statistics Toolbox`). This means that your table should contain three columns with 12 rows each.

   (a) Produce tables of RMS-errors equivalent to those is the slides, evaluating your errors at 1000, 1600 and 1000 evenly spaced points for $d = 1, 2, 3$, respectively.

   (b) Produce plots of absolute errors and describe the distribution of the errors.

   (c) What is the apparent rate of convergence

   $$\text{rate}_k = \frac{\ln(e_{k-1}/e_k)}{\ln 2}, \qquad k = 2, 3, \dots,$$

   for different values of d? Here e_k corresponds to the error at level k of the sequence of experiments.

3. Modify `RBFInterpolation2D.m` so that you can repeat the previous exercise with Gaussians instead of the simple norm basis functions from Problem 2.

   (a) Can you find values of the shape parameter ε such that the Gaussian experiments are more accurate than those for distance matrix interpolation?

   (b) For your "optimal" choices of ε, what can you say about the apparent rate of convergence of Gaussian RBF interpolation?