CSC 335
Homework Set 6
Due 5:00 p.m., November 22, 2011

Problems from Burden and Faires:

Section 6.1: #3(a) #7(c)

Section 6.2: #9(a), #11(a), #13(a), #17(a)

Section 6.3: #8

Section 6.4: #1, #3

Section 6.5: #1(a), #3(a), #5(a)

Section 6.6: #1, #3(d), #5(d)

Problems from Dr. Pounds:

1. **Determinants of Hilbert Matrices**

   Write a program in a high level computer language (JAVA, C/C++, Python, or Fortran) to find the determinant of a Hilbert matrix. Hilbert matrices have elements defined as follows.

   $$H_{i,j} = \frac{1}{i+j-1}$$

   To help you check your code, the determinant of a 2x2 Hilbert matrix is 1/12 and the determinant of a 3x3 Hilbert matrix is 1/2160. I want you to determine the order of the largest Hilbert matrix of which you can compute the determinant on *cobra* using double precision arithmetic. By this I mean you don't produce NAN's in your output! Turn in a copy of your code and also submit it to me via e-mail.

2. **Complex Matrices, Inversion, Multiplication, and Machine Limits**

   In this problem you will construct two complex matrices and multiply them by one another to produce a product matrix. The matrix elements for ($\hat{M}$) will be defined as follows.

   $$m_{j,k} = \alpha\left[\cos\left(\frac{j^2 k\pi}{N^3}\right) + i\sin\left(\frac{2j^2 k\pi}{N^3}\right)\right]$$

   $$\alpha = \left[\left(\cos\left(\frac{j^2 k\pi}{N^3}\right)\right)^2 + \left(\sin\left(\frac{2j^2 k\pi}{N^3}\right)\right)^2\right]^{-1/2}$$

   where N is the dimension of the matrix. Matrix $\hat{M}^{-1}$ will be the inverse of $\hat{M}$. Using any computer language you want, write a program to construct $\hat{M}$ and $\hat{M}^{-1}$ and then carry out the matrix multiplication

   $$\hat{M}\hat{M}^{-1} = \hat{P}$$

   Have your program then compute the sum of the diagonal elements of $\hat{P}$. By definition the matrix $\hat{P}$ should be equal to the identity matrix, $\hat{I}$, and therefore the sum of the diagonal elements should equal the dimension of the matrix. Using the highest floating point precision available in your language of choice, prepare a chart of N and the sum of the diagonal elements of $\hat{P}$. Also determine the largest value of N (matrix dimension) for which you can calculate the matrix product above on cobra.