**Project 3, due on 04/12.**

**Problem. Implementing Arnoldi algorithm.**

Step 1: Generate a $50 \times 50$ strictly diagonally dominant matrix. Do this by modifying the code my_io.c at:

/afs/crc.nd.edu/user/z/zxu2/Public/ACMS40212-S12/col_decomp_mat_vec_multi/data_gen

The current my_io.c code generates a matrix with randomly filled entries.

Step 2: Implement your stable Arnoldi algorithm. You can simply use unit vector $\boldsymbol{e}_1$ as $\boldsymbol{v}_1$.

Let the dimension $k$ of the Krylov subspace be much less than the dimension of the matrix. For instance, let $k = 20$.

**Hand-In.**

**1.** The hardcopy of your source code (Also send the source code to me by email. Please use the email title: Project 3: your name).

**2.** A report which contains validation of results and a description of your algorithm using the pseudo code language.

**3.** Validation. Since now you have the orthonormal basis $Q$ of the Krylov subspace $span\{\boldsymbol{r}^{(0)}, A\boldsymbol{r}^{(0)}, A^2\boldsymbol{r}^{(0)}, \dots, A^{k-1}\boldsymbol{r}^{(0)}\}$, generate a vector $\boldsymbol{b}$ in this subspace by doing a linear combination of $\boldsymbol{r}^{(0)}, A\boldsymbol{r}^{(0)}, A^2\boldsymbol{r}^{(0)}, \dots, A^{k-1}\boldsymbol{r}^{(0)}$, then solve $Q\boldsymbol{x} = \boldsymbol{b}$ for $\boldsymbol{x}$ by $\boldsymbol{x} = Q^T\boldsymbol{b}$ to see if $\boldsymbol{x}$ agrees with coefficients of the linear combination to generate $\boldsymbol{b}$.

Remark: for parallel implementation of GMRES method, see

(a) H.F. Walker. Implementation of the GMRES method using Householder transformations, SIAM Journal on Scientific and Statistical Computing, 1988

(b) J. Erhel. A parallel GMRES version for general sparse matrices, Electronic Transactions on Numerical Analysis, 1995