Due: February 22nd, 2012

1. In the `linalg` folder you will find programs:

```
 Cholesky.m        luNopiv.m       tridiag.m     luPiv.m
GEPivShow.m      luNopivVec.m     tridiags.m       GEshow.m
```

   (a) Read Cholesky.m and luNopiv.m and correct (if needed) the algorithm presented in class.
   (b) Describe the algorithm involved in luNopiv.m.
   (c) In each of the above create a matrix A (using tridiag or otherwise) and vector b of dimension at least 3 and illustrate the use of each program.

2. Write a `Bisection(a)` function which takes in a real number a and finds an approximation to $\sqrt[3]{a}$ to within 10^{-4} using the bisection algorithm. What is the result for $a = 25$, and $a = 8$?

3. Write a `parabola(x,y)` function to automatically set up and solve the system of equationsfor a parabola defined by $y = c_1x^2 + c_2x + c_3$. The function definition should be
   `function c = parabola(x,y)`

   The function should take two input vectors x and y, each of length three, that define three points through which the parabola passes. The function should return

   (a) a vector c of the three coefficients.
   (b) a plot of the parabola with the input points shown on the graph.

   Test your answer with the following points:

   (a) (-2,-1), (0,1), (2,2)
   (b) (-2,-2), (-1,-2), (-1,2)

4. Write a function `Newtonsp` that will approximate to within 10^{-4}, the value of x_0 which is the point on the graph of $y = x^2$ that is closest to $(1, 0)$.

Midterm Instructions:

1. Time: 10:00 am -12:30 pm
2. The Exam will be closed book. No notes.
3. Please show your work in the exam, write in complete sentences, and Indicate your answers clearly.

Preparing for the Midterm:

1. The syllabus will be everything covered in class upto (and including) February 16th, 2012.

   Below is intended as a check-list and it is **not** meant to be exhaustive. If I miss something out then please send me an email, I will added it onto the web-based copy.

   (a) You should know the definition/meaning of the following terms/notions:

      i. Floating Point number, Round-off error, overflow, Truncation error.

      ii. Bracketing, Bisection method, Secant Method, Newton's Method, Regula Falsi, Hybrid methods, Convegence criteria.

      iii. inner product, matrix operations, norms, rank, nullspace, columnspace, linear independence, consistency

      iv. Permutation matrix, Gaussian Elimination, Pivoting, Back and forward substitution, LU decomposition, Cholesky Decomposition,flops.

   (b) You should know the following OCTAVE commands/terms/operations:

      i. function, script files.

      ii. array indexing, vectorisation, Global, local variables.

      iii. Built in functions discussed in class and the method of execution.

      iv. Extracting columns or rows from matrices

   (c) You will need to know how to accomplish the following tasks:

      i. Give a definition and one example of cancellation error.

      ii. Identify (at least) two important differences between symbolic and numeric computations.

      iii. Use an infinite series to give an example of truncation error, with Big O notation.

      iv. Be able to distinguish the effects of roundoff and truncation errors in a computed result, for example, by viewing a plot such as Figure (5.4) in G.E. Recktenwald.

      v. Writing m-files , analysing the pros and cons of, and specifying convergence criteria: Bracketing, Bisection method, Secant Method, Newton's Method, Hybrid methods.

      vi. Writing m-files, stating conditions required for a successful LU factorization of A and Cholesky factorization of A. Further, given a deomposition how to solve the linear system.

      vii. Given L, U, and permutation matrix P from an LU factorization of A, apply these to solve $Ax = b$. Specifically, use the P appropriately.

      viii. Order of flop estimates for Gaussian elimination with back substitution, LU factorization, and Cholesky factorization.