**Test 1 - MATH 472**

Name: ______________________________

Directions:

Choose THREE of the following FOUR problems to submit for solution. Each problem is worth $33\frac{1}{3}$ points.

1. In Problem 7.5.12, you are asked to do the following:

   "Use the condition number estimator to produce a plot of $\kappa^*$ versus n for each of the following matrix families (you may want to consider a semilog or log-log scale for some of the plots):

   (a) Tn, $4 \leq n \leq 20$;
   (b) Kn, $4 \leq n \leq 20$;
   (c) Hn, $4 \leq n \leq 20$;
   (d) An, $4 \leq n \leq 20$.

   Compare your estimates with the exact values from *cond* and the estimates from *rcond*."

   We define a new family of matrices $S_n$, with entries:

   $s_{ij} = 1/(i+j-1)$ if either i=j or $|i-j| = 1$; and $s_{ij} = 0$ otherwise.

   That is, the matrix is tridiagonal. Include, in your existing analyses for problem 7.5.12, the same treatment for the $S_n$ family of matrices (sizes 4 to 20). Comment on how your results for $S_n$ compare to the condition numbers/estimates of the other families of matrices.

2. Repeat Problem 7.2.11, but for $S_{10}$ (defined above) and

   $b = (1, 1, 1, 1, 1, 1, 1, 1, 1, 1)^T$.

   Make sure to print your solution vector $x$ to the console.

   Recall, in Problem 7.2.11, you are asked to do the following: "Write a code to do Gaussian elimination with partial pivoting, and apply it to the system $A_5x = b$, where $b = (-4, -7, -6, -5, 16)^T$ and the solution is $x = (0, 1, 2, 3, 4)^T$."

3. Repeat problem 7.4.10, but for the system $Ax = b$, where $A = K_{10}T_{10}$ (matrix product of $K_{10}$ and $T_{10}$) and $b = (-4, -1, 0, 0, 0, 0, 0, 0, 10, 40)^T$. Make sure to write to the console the solution $x$ to the system, as well as the factors $L$, $U$ (and $P$ if you have created a permutation version of the factorization algorithm). Verify $A = (P)LU$, and print this verification to the console.

   Recall Problem 7.4.10: "Write an $LU$ factorization code with partial pivoting, and apply it to the system $A_5x = b$, where $b = (-4, -7, -6, -5, 16)^T$ and the solution is $x = (0, 1, 2, 3, 4)^T$."

4. Repeat Problem 3.9.8, for the expression $-3x + 2e^{-x^2} = 0$ on the interval [0,3].

   Recall Problem 3.9.8: "Use fixed-point iteration to find a value of $x$ in [1,2] such that $2\sin(\pi x) + x = 0$."