Name: _____

Date: _____

Section: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	Total
Points:	25	25	10	60
Score:				

Instructor/grader comments:

1. The matrix factorization

$$A = L\,U$$

can be used to compute the determinant of A. We have

$$\det(A) = \det(L)\det(U).$$

Since L is a (lower) triangular matrix with ones on the main diagonal,

$$\det(L) = 1.$$

Since U is an (upper) triangular matrix,

$$\det(U) = u_{11}\,u_{22}\cdots u_{nn}.$$

Therefore

$$\det(A) = u_{11}\,u_{22}\cdots u_{nn}.$$

Hint: in Matlab, the product $u_{11}\,u_{22}\cdots u_{nn}$ can be computed using the expression `prod(diag(U))`.

   (a) (10 points) Use `lufact` function that we develop in class and write a matlab function `hw03p1det` that computes the determinant of A. Your function should not use the built-in `det` function. Provide a help string for your function.

   (b) (10 points) Write a matlab script (call it **hw03p1.m**) that (a) initializes matlab random number generator with the seed 222, and generates two random matrices of size 20 and 40, (b) prints help for your function `hw03p1det`, (c) tests your function by comparing the determinants of the two matrices it computes with the determinants obtained by the built-in function `det`. Place the command `clear` at the top of your script.

   (c) (5 points) describe your results (2-3 sentences) in the README.md file.

2. Students of linear algebra learn that the solution to the system of linear equations

$$A\,x = b$$

can be written

$$x = A^{-1}b,$$

where A^{-1} is the inverse of matrix A;

$$A\,A^{-1} = I,$$

where I is the identity matrix.

Here is one of many methods how to compute A^{-1}: the inverse of a matrix A can be defined as the matrix X whose columns x_j solve the equations

$$Ax_j = e_j,$$

where e_j is the jth column of the identity matrix.

Note: in the vast majority of practical computational problems, it is unnecessary and inadvisable to actually compute A^{-1}.

(a) (15 points) Using the LU factorization code that we develop in class, write a matlab function `hw03p2inverse(A)` that uses the algorithm above to compute the inverse of A. Your function is not supposed use the matlab backslash operator or `inv` function. Your function is supposed to have a help text for use with matlab help system.

Hints: you can use matlab function `eye(n)` to generate $n \times n$ identity matrix; in matlab `A(:,j)` extracts the jth column of matrix `A`.

(b) (10 points) Write a matlab script (call it e.g. **hw03p2.m**) that tests your function by comparing the inverses it computes with the inverses obtained from the matlab `inv(A)` function using two random matrices of size $n = 8$. Include the command `help hw02p3inverse` in your script. Place the command `clear` at the top of your script.

Hint: one way to compare two matrices, say A and B, is to use matlab command `norm(A - B)`.

Gitlab

3. (10 points) Create a gitlab project called **hw03** (name it exactly as shown). Upload **all** matlab files that are required to run your code. Share the project with the instructor and the TAs and grant them **Reporter** privileges.