corrected Assignment #3

Due Wednesday, 22 September, 2021 at the start of class.

Submit on paper or by email: `elbueler@alaska.edu`

Exercise 2.2.2. (*A Matlab/Octave question, of course.*)

Exercise 2.2.3. (*A Matlab/Octave question, again.*)

Exercise 2.2.7.

Exercise 2.2.8.

Exercise 2.3.2. (*Do parts* (b) *and* (c) *only.*) ⟵ *CORRECTED!*

Exercise 2.3.4. (*To verify the solution is correct, please compute and report* `norm(U*x-b)`.)

Exercise 2.4.1. (*Do* not *do the "Write out the L matrix . . . " part. Instead, use Matlab/Octave to verify that* $LU = A$ *to good accuracy.*)

P3. *Function 2.3.1 in section 2.3 is the forward substitution algorithm, Function 2.3.2 is the back substitution algorithm, and Function 2.4.1 in section 2.4 is the LU factorization algorithm. This exercise combines these parts to create a solver for linear systems. This is an initial version of the solver, but in section 2.6 we will add an important refinement.*

(a) By downloading them or typing them in, check that you have correct versions of `forwardsub()`, `backsub()`, and `lufact()` from the textbook. In particular, demonstrate these functions on reasonable 3×3 matrices, that is, test them in cases where you know the exact answer and you can check correctness. (*There is no need to show the functions themselves in your solution, but show how you test them.*)

(b) On page 57 there is a 3-step standard method for solving linear systems $Ax = b$:

1. Factor $LU = A$ using Gaussian elimination.
2. Solve $Lz = b$ using forward substitution.
3. Solve $Ux = z$ using back substitution.

Implement this standard method by writing this Matlab/Octave function:

```
function x = linearsolve0(A,b)
```

This function will call `forwardsub()`, `backsub()`, and `lufact()` to do the three steps above. It will not do any detailed calculation itself; it *only* calls the pieces.

(c) Set up convenient 3×3 and 4×4 linear system examples $Ax = b$ for which you know the exact solution x. Check that `linearsolve0()` works correctly by showing it solves these systems accurately, i.e. so that the error is of size $O(10^{-15})$ or so.