nmi | spring 2024

homework 03 | gauss elimination, PA=LU factorization

q1. gauss elimination

a) (15 pts) code gauss elimination algorithm as a callable function in python.

b) (5 pts) call your function to solve the following system of equations,

$$\begin{aligned} x + 2y - z &= 3 \\ 2x + y - 2z &= 3 \\ -3x + y + z &= -6. \end{aligned}$$

c) **MATH 685 ONLY**. (5 pts) discuss the cost of solving this system of equations using gauss elimination.

algorithm

```
# forward elimination

for j = 1 : n-1
  # check for zero on diagonal
  if abs(a(j,j))<eps; error('zero pivot encountered'); end

  # eliminate column j
  for i = j+1 : n

    # calc factor between rows
    mult = a(i,j)/a(j,j);

    # eliminate element i,j
    for k = j+1:n
      a(i,k) = a(i,k) - mult*a(j,k);
    end
```

```
    b(i) = b(i) - mult*b(j);
  end
end

# back substitution

for i = n : -1 : 1
  for j = i+1 : n
    b(i) = b(i) - a(i,j)*x(j);
  end
  x(i) = b(i)/a(i,i);
end
```

code

[ ] ↳ *3 cells hidden*

q2. **MATH 385 ONLY**. (5 pts) LU factorization vs PA=LU factorization

what is naive gauss elimination? in relation, what are LU factorization and PA=LU factorization?

q3. PA=LU factorization

a) **MATH 385 ONLY**. (10 pts) solve the following system of equations using PA=LU factorization. show your work.

$$\begin{bmatrix} 3 & 1 & 2 \\ 6 & 3 & 4 \\ 3 & 1 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 3 \end{bmatrix}$$

a) **MATH 685 ONLY**. (20 pts) code the PA=LU algorithm as function in python and use it to solve the same system of equations.