Assignment 2

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def forward\_substitution(L, b):

    n = len(b)

    x = [[0.0] \* n for i in range(n)]

    for i in range(n):

        if L[i][i] == 0.0:

            return None

        sum = 0

        for j in range(i):

            sum += L[i][j] \* x[j]

        x[i] = (b[i] - sum) / L[i][i]

    return x

def backward\_substitution(U, b):

    n = len(b)

    x = [[0.0] \* n for i in range(n)]

    for i in range(n - 1, -1, -1):

        if U[i][i] == 0.0:

            return None

        sum = 0.0

        for j in range(i + 1, n):

            sum += U[i][j] \* x[j]

        x[i] = (b[i] - sum) / U[i][i]

    return x

def upper\_triangular\_matrix\_U(k, n, L, U):

    # Get the upper triangular matrix U

    for j in range(k, n):

        sum = 0.0

        for p in range(k):

            sum += L[k][p] \* U[p][j]

        U[k][j] = A[k][j] - sum

    print(f"upper triangular matrix step {k+1}: {U}")

def lower\_triangular\_matrix\_L(k, n, L, U, A):

    # Get the lower triangular matrix L

    for i in range(k + 1, n):

        sum = 0.0

        for p in range(k):

            sum += L[i][p] \* U[p][k]

        L[i][k] = (A[i][k] - sum) / U[k][k]

    print(f"Lower triangular matrix step {k+1}: {L}\n")

def LU\_decomposition(A):

    n = len(A)

    L = [[0.0] \* n for i in range(n)]

    U = [[0.0] \* n for i in range(n)]

    for k in range(n):

        if A[k][k] == 0:

            return None

        L[k][k] = 1

        upper\_triangular\_matrix\_U(k, n, L, U)

        lower\_triangular\_matrix\_L(k, n, L, U, A)

    return L, U

if \_\_name\_\_ == '\_\_main\_\_':

 # gauss\_elimination

 print("================= gauss\_elimination =================================")

  A = [[1, 2, 1, -1], [3, 2, 4, 4], [4, 4, 3, 4], [2, 0, 1, 5]]

  b = [5, 16, 22, 15]

  res = gauss\_elimination(A, b)

  print(f"A = {A}")

  print(f"b = {b}")

  print(f"Guass Elimination Solution = {res}")

OUTPUT

upper triangular matrix step 1:

[[1.0, 2.0, 1.0, -1.0],

[0.0, 0.0, 0.0, 0.0],

[0.0, 0.0, 0.0, 0.0],

[0.0, 0.0, 0.0, 0.0]]

upper triangular matrix step 2:

[[1.0, 2.0, 1.0, -1.0],

[0.0, -4.0, 1.0, 7.0],

[0.0, 0.0, 0.0, 0.0],

[0.0, 0.0, 0.0, 0.0]]

upper triangular matrix step 3:

[[1.0, 2.0, 1.0, -1.0],

[0.0, -4.0, 1.0, 7.0],

[0.0, 0.0, -2.0, 1.0],

[0.0, 0.0, 0.0, 0.0]]

upper triangular matrix step 4:

[[1.0, 2.0, 1.0, -1.0],

[0.0, -4.0, 1.0, 7.0],

[0.0, 0.0, -2.0, 1.0],

[0.0, 0.0, 0.0, -1.0]]

Lower triangular matrix step 1:

[[1, 0.0, 0.0, 0.0],

[3.0, 0.0, 0.0, 0.0],

[4.0, 0.0, 0.0, 0.0],

[2.0, 0.0, 0.0, 0.0]]

Lower triangular matrix step 2:

[[1, 0.0, 0.0, 0.0],

[3.0, 1, 0.0, 0.0],

[4.0, 1.0, 0.0, 0.0],

[2.0, 1.0, 0.0, 0.0]]

Lower triangular matrix step 3:

[[1, 0.0, 0.0, 0.0],

[3.0, 1, 0.0, 0.0],

[4.0, 1.0, 1, 0.0],

[2.0, 1.0, 1.0, 0.0]]

Lower triangular matrix step 4:

[[1, 0.0, 0.0, 0.0],

[3.0, 1, 0.0, 0.0],

[4.0, 1.0, 1, 0.0],

[2.0, 1.0, 1.0, 1]]

A = [[1, 2, 1, -1], [3, 2, 4, 4], [4, 4, 3, 4], [2, 0, 1, 5]]

b = [5, 16, 22, 15]

Guass Elimination Solution = [16.0, -6.0, -2.0, -3.0]T