实验五 矩阵三角分解与线性方程组计算

# 实验目的

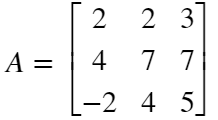
1. 掌握矩阵三角分节法
2. 通过练习熟悉用矩阵三角分解法求解线性方程组

# 实验环境

1. 计算机
2. MATLAB集成环境

# 实验内容与代码

## 使用杜立特尔分解法对下列矩阵进行LU分解，并用矩阵形式输出结果



clc;clear;

A = [2 2 3; 4 7 7; -2 4 5]

A = 3×3

2 2 3

4 7 7

-2 4 5

b = [0; 0; 0]

b = 3×1

0

0

0

[L, U, y, res] = doolittle(A, b)

L = 3×3

1 0 0

2 1 0

-1 2 1

U = 3×3

2 2 3

0 3 1

0 0 6

y = 3×1

0

0

0

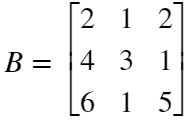
res = 3×1

0

0

0

## 使用克洛特分解法对下列矩阵进行LU分解，并用矩阵形式输出结果



clc;clear;

B = [2 1 2; 4 3 1; 6 1 5]

B = 3×3

2 1 2

4 3 1

6 1 5

b = [0;0;0]

b = 3×1

0

0

0

[L, U, y, res] = crout(B, b)

L = 3×3

2 0 0

4 1 0

6 -2 -7

U = 3×3

1.0000 0.5000 1.0000

0 1.0000 -3.0000

0 0 1.0000

y = 3×1

0

0

0

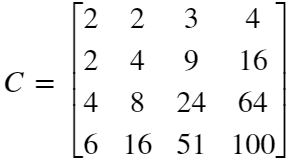
res = 3×1

0

0

0

## 使用任意分解法对下列矩阵进行LU分解，并用矩阵形式输出结果



clc;clear;

C=[2 2 3 4; 2 4 9 16; 4 8 24 64; 6 16 51 100]

C = 4×4

2 2 3 4

2 4 9 16

4 8 24 64

6 16 51 100

b = [0;0;0;0]

b = 4×1

0

0

0

0

[L, U, y, res] = doolittle(C, b)

L = 4×4

1 0 0 0

1 1 0 0

2 2 1 0

3 5 2 1

U = 4×4

2 2 3 4

0 2 6 12

0 0 6 32

0 0 0 -36

y = 4×1

0

0

0

0

res = 4×1

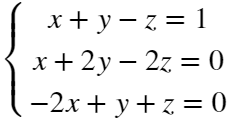
0

0

0

0

## 用LU分解求解下列方程组：



clear; clc;

A = [1 1 -1; 1 2 -2; -2 1 1]

A = 3×3

1 1 -1

1 2 -2

-2 1 1

b = [1;0;0]

b = 3×1

1

0

0

[L, U, y, res] = doolittle(A, b)

L = 3×3

1 0 0

1 1 0

-2 3 1

U = 3×3

1 1 -1

0 1 -1

0 0 2

y = 3×1

1

-1

5

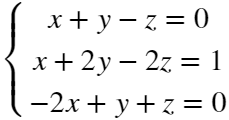
res = 3×1

2.0000

1.5000

2.5000

## 用LU分解求解下列方程组：



clear; clc;

A = [1 1 -1; 1 2 -2; -2 1 1]

A = 3×3

1 1 -1

1 2 -2

-2 1 1

b = [0;1;0]

b = 3×1

0

1

0

[L, U, y, res] = doolittle(A, b)

L = 3×3

1 0 0

1 1 0

-2 3 1

U = 3×3

1 1 -1

0 1 -1

0 0 2

y = 3×1

0

1

-3

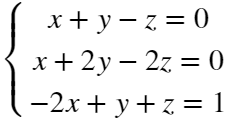
res = 3×1

-1.0000

-0.5000

-1.5000

## 用LU分解求解下列方程组：



clear; clc;

A = [1 1 -1; 1 2 -2; -2 1 1]

A = 3×3

1 1 -1

1 2 -2

-2 1 1

b = [0;0;1]

b = 3×1

0

0

1

[L, U, y, res] = doolittle(A, b)

L = 3×3

1 0 0

1 1 0

-2 3 1

U = 3×3

1 1 -1

0 1 -1

0 0 2

y = 3×1

0

0

1

res = 3×1

0

0.5000

0.5000

## 此实时脚本中使用的函数：

function [L, U, y, x] = doolittle(A, b)

[row\_a, col\_a] = size(A);

for j = 1:col\_a

U(1,j) = A(1,j);

end

L(1,1) = 1;

for i = 2:row\_a

L(i,1) = A(i,1)/A(1,1);

end

for i = 2:row\_a

for j = i:col\_a

temp\_sum = 0;

for k = 1:i-1

temp\_sum = temp\_sum + L(i,k)\*U(k,j);

end

U(i,j) = A(i,j) - temp\_sum;

temp\_sum\_1 = 0;

for p = 1:i-1

temp\_sum\_1 = temp\_sum\_1 + L(j,p)\*U(p,i);

end

L(j,i) = (A(j,i) - temp\_sum\_1)/U(i,i);

end

end

x = zeros(row\_a,1);

y(1,1) = b(1,1);

for i = 2:row\_a

temp\_sum\_2 = 0;

for j = 1:i-1

temp\_sum\_2 = temp\_sum\_2 + L(i,j)\*y(j,1);

end

y(i,1) = b(i) - temp\_sum\_2;

end

x(row\_a,1) = y(row\_a,1) / U(row\_a,col\_a);

for i = row\_a-1: -1: 1

temp\_sum\_3 = 0;

for j = i+1: row\_a

temp\_sum\_3 = temp\_sum\_3 + U(i,j)\*x(j,1);

end

x(i,1) = (y(i,1) - temp\_sum\_3) / U(i,i);

end

end

function [L, U, y, x] = crout(A, b)

N = size(A);

n = N(1);

L = zeros(n, n);

U = eye(n, n);

L(1:n, 1) = A(1:n, 1);

U(1, 1:n) = A(1, 1:n) / L(1, 1);

for k = 2:n

for i = k:n

L(i, k) = A(i, k) - L(i, 1:(k-1)) \* U(1:(k-1), k);

end

for j = (k+1):n

U(k, j) = (A(k, j) - L(k, 1:(k-1)) \* U(1:(k-1), j)) / (L(k, k));

end

end

N = size(L);

n = N(1);

for i = 1:n

if i>n

s = L(i, 1:(i-1)) \* y(1:(i-1), 1);

else

s = 0;

end

y(i, 1) = (b(i) - s) / L(i, i);

end

N = size(U);

n = N(1);

for i = n:-1:1

if (i<n)

s = U(i, (i+1):n) \* x((i+1):n, 1);

else

s = 0;

end

x(i, 1) = (y(i) - s) / U(i, i);

end

end

# 实验小结

通过此次实验，掌握了矩阵三角分解法，并通过练习熟悉了用矩阵三角分解法求解线性方程组。发现，LU分解求解方程组仅多了 解Ly=b和Ux=y的过程，故直接在LU分解的函数中添加，则分解步骤中添加空常数集即可完成实验内容。