

LUsol manual

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LUsol is a light-weight software for solving a sparse linear system, which is usually generated from scientific or engineering problems. This software is developed mainly for education in a course about the finite element method and the finite volume method, where partial differential equations are converted to their discrete algebraic counterparts taking the general form

$$\boxed{\mathbf{Ax} = \mathbf{b}}$$

where A is a sparse matrix.

To apply **LUsol** to find the unknown x, users need to generate two input files:

a.in (Coefficient Matrix A),

b.in (Right-hand-side Vector b).

The solution will be stored in the output file:

x.out.

Each entry in the coefficient matrix is stored as a line in the triplet form as

row indice, column indice, value

Each entry in the RHS vector is stored as a line in the following format

row indice, value

Example:

$$\mathbf{A} = \begin{bmatrix} 2 & 0 & 0 & 0 & 1 & 0 \\ 1 & 2 & 0 & 0 & 0 & 1 \\ 0 & 1 & -10 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 & 0 \end{bmatrix}, \mathbf{b} = \begin{bmatrix} 7 \\ 11 \\ -24 \\ 4 \\ 1 \\ 8 \end{bmatrix}$$

In the **a.in** file:

```

1 1 1 2.0
2 1 5 1.0
3 2 1 1.0
4 2 2 2.0
5 2 6 1.0
6 3 2 1.0
7 3 3 -10.0
8 3 4 1.0
9 4 4 1.0
10 5 1 1.0
11 6 2 4.0

```

There are 11 lines corresponding to the 11 entries in the coefficient matrix A.

In the **b.in** file:

```

1 1 7.0
2 2 11.0
3 3 -24.0
4 4 4.0
5 5 1.0
6 6 8.0

```

There are 6 lines corresponding to the 6 entries in the RHS vector b.

The solution is found and saved in the **x.out** file.

```

1 0.10000000000000000E+001
2 0.20000000000000000E+001
3 0.30000000000000000E+001
4 0.40000000000000000E+001
5 0.50000000000000000E+001
6 0.60000000000000000E+001

```