# Mid-term project report

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## Purpose:

Develop a linear calculation system to simulate and solve simple circuit (DC source, steady state, common electronic component).

## Design Proposal:

Develop environment:

Windows OS, Matlab IDE, Atom editor.

Algorithm:

A circuit is exactly a graph in mathematical perspective.

Based on Ohm's law

$$I = \frac{V}{R} \quad \text{or} \quad V = IR \quad \text{or} \quad R = \frac{V}{I}.$$

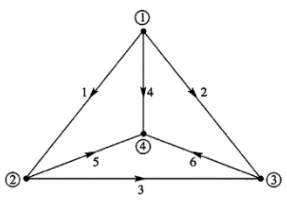
and Kirchhoff's current law,

$$\sum_{k=1}^{n} I_k = 0$$

We can derive a simplest mathematical model:

$$A^T \begin{bmatrix} C1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & Cn \end{bmatrix} A * \begin{matrix} v1 \\ \vdots \\ vn \end{matrix} = \begin{matrix} i1 \\ \vdots \\ in \end{matrix}$$

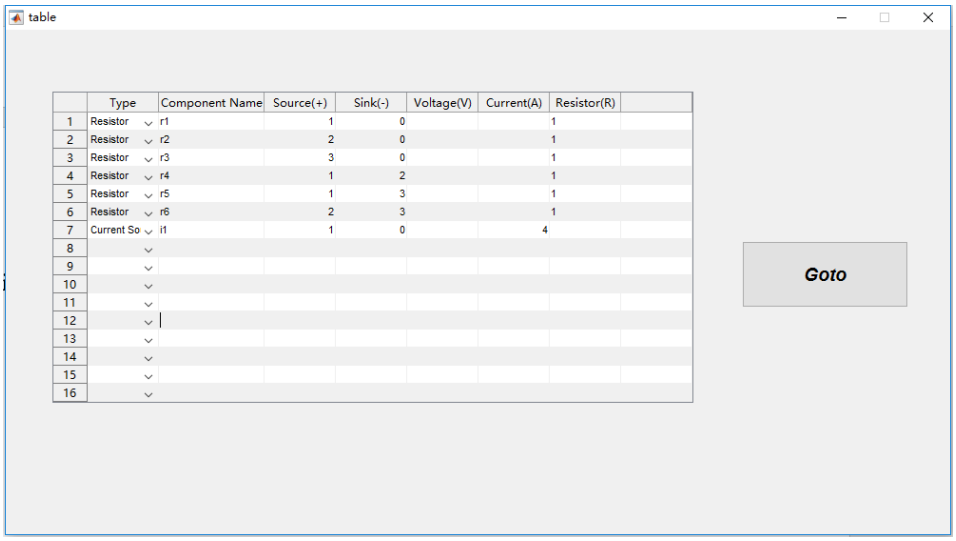
The A here is incidence matrix, C is conductance in each edge, v is voltage of corresponding node relative to ground, i is external current flow in corresponding node.

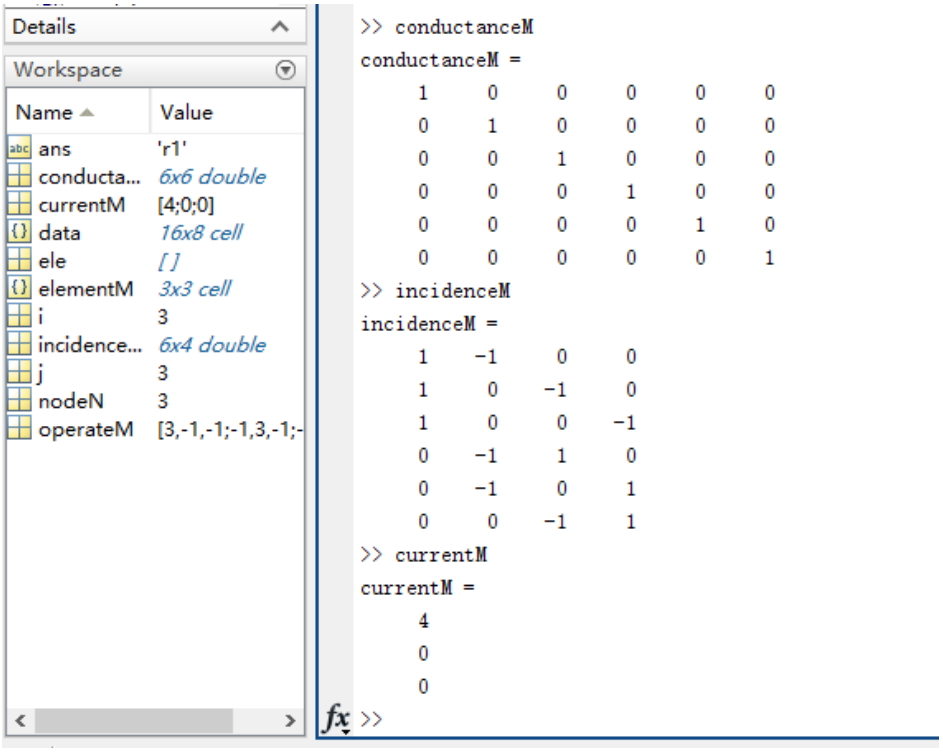



$$A = \begin{matrix} \text{node} \\ ①\ ②\ ③\ ④ \end{matrix} \begin{bmatrix} -1 & 1 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 \\ -1 & 0 & 0 & 1 \\ 0 & -1 & 0 & 1 \\ 0 & 0 & -1 & 1 \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{matrix} \text{ edge}$$

Since it's a linear system, we can solve all state of elements if we get enough information. So the core part of program is handle different request from input, design a **efficient, structured and relative user-friendly** calculation system. Further more, add more common electric components to system.

Semi-finished program:




I have finished framing the overall structure(object oriented program), determine standard input format, here I'd like to list some features.

Support resistor, independent voltage and current source only at present.

Calculate from enough information to solve any other information you want.

Some exciting bugs are to be found.

Some trouble in designing GUI callback functions may effect calculation efficiency.

Hope any of your advise.