# SPICE simulation

Resources used : I have referred to the following website to get clarity on how to construct the matrix "https://cheever.domains.swarthmore.edu/Ref/mna/MNA3.html" - It describes *modified nodal analysis*.

I have worked with my classmate Roshini Priya. We exchanged ideas related to node mapping and matrix construction.

## Algorithm

### Parsing of Elements

- First I have opened file and readlines. And I splitted at `#` to separate comments. I again splitted the obtained list at spaces and stored them in `ckt_final`.
- I have used the list to read only between `.circuit` and `.end` and ignored the rest. This part is the required netlist of the circuit.
- I have created 3 different dictionaries to store all V, I, R components seperately. I ran `for` loop through each line of the list and stored the elements as node1, node2, and value of the component. I also have track of no. of various elements in the circuit.

### Node Mapping

- I have defined global variable `node_map`. I defined a function `getNodes`.
- I called this function to iterate through all the dictionaries and mapped them to the redefined nodes respectively. I stored the nodes in the same dictionary and used them in the further program.
- Now that we have sysytematically stored nodes, it will be easy to consrcut the matrices.

### Matrix Construction

- Defined the size of matrices - generally no. of nodes(excluding `GND`) + no. of voltage sources
  - A is a square matrix of the same dimension
  - b is a column matrix of the same dimension
  - used np.zeroes
- *For the passive elements i.e `R`:*
  - It constitutes the matrix of size - no. of nodes * no. of nodes (excluding `GND`).
  - There values are inverted and added according to KCL equations.
- *For Voltage sources:*
  - According to terminals, 1(positive node) or -1(negative node) is written in matrix A an their respective value in matrix b.
  - Their numbering - no .of nodes (exculding `GND`) + count of respective voltage source - 1 (accounting to that array numbering starts from 0)

- *For Currents sources:*
  - According to the direction, i.e exit(negative) or entry(positive) of current into the node signs are assigned.
  - And their values are entered in matrix b in respective node rows.
- *For current through voltage sources:*
  - This ensures that matrix is not singular.
  - Entry of current is positive and exit of current is negative.(written in matrix A)
  - This is convention is opposite to what sir has discussed in class.

**Solving Matrices**

- I have imported numpy and used `np.linalg.solve` for Gaussian elimination purpose.

**Reporting the Values**

- The first values - as many as no. of nodes are node voltages(`Vout`) and the rest values are current through voltage sources(`Iout`).
- I used `for` loops and `node_map` to assign the voltage values to the respective nodes.

And in the last made sure that fle is closed.

Every time the tests run global variable `node_map` is re-intialised so as to clear any information from before test.

## Raising Errors

I made sure that all the Errors mentioned in `test_evalSpice.py` are raised.