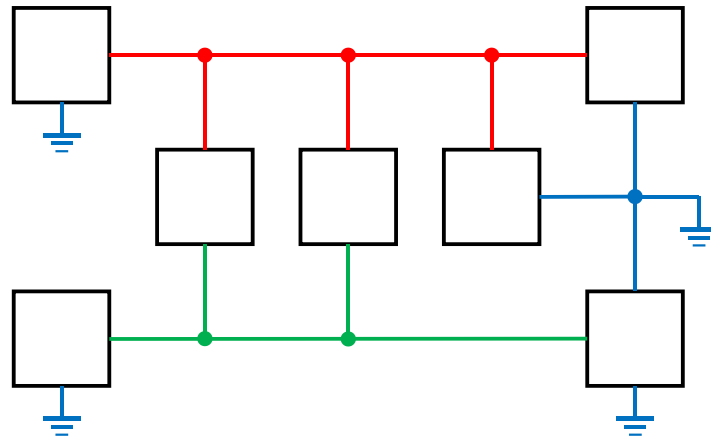


The Nodal Analysis Method

A node is any point representing a connection between two or more circuit components, *plus* all other points in the circuit that can be reached by traversing ideal wire (or earth) without crossing through any circuit component. Earth ground is considered a node.

For example, the following circuit has three nodes identified by the colors red, blue and green.



Formulation of the equations:

1. Identify all of the nodes, select one as the reference, and label the others.
2. If there are voltage sources, either independent or controlled, for each one:
 - a. Write down the voltage constraint equation.
 - b. Draw an enclosure around the source and the two nodes it is connected to. This enclosure is called a supernode.
3. If two supernodes share a node, merge them into a single larger supernode. Merge as many pairs as appropriate.
4. Write a KCL equation for each supernode enclosure, and for each of the remaining original nodes, **except** for the reference node or any supernode involving the reference node. Express the resistor currents terms of the node voltages and the resistance values.
5. If there are controlled sources, define each control variable in terms of the node voltages.
6. Write the equations in matrix form.

If N is the number of nodes in the circuit, and M is the number of *unique* dependent source control variables not initially defined in terms of node voltages, the total number of equations will be $N-1+M$.

--- At this point, no substitutions should yet have been made ---

Solution of the equations:

7. Now, use any method of your choice to solve the equations.