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**Quick reference guide to the linear-algebraic nodal analysis algorithm**  
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INPUT:

Suppose we are given a complete description of an electric circuit containing only resistors, dc voltage sources, and dc current sources. The LANA algorithm proceeds with the steps provided below.

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ALGORITHM:

1. Identify and label the entire set of nodes in our circuit.
  2. Model the circuit as a directed graph.
  3. Create the entire incidence matrix.
  4. Create all circuit vectors.
  5. State the entire set of circuit equations.
  6. Determine all ordinary and generalized nodes in the circuit.
  7. Ground the circuit.
  8. State the grounded circuit equations.
  9. Identify the essential nodes, nonessential nodes, and supernodes.
  10. Eliminate the node dependencies that arise due to the voltage sources.
  11. State the maximally deflated circuit equations.
  12. Solve the linear-algebraic nodal analysis equation.
  13. Completely describe the electrical behavior of the circuit.
  14. Verify by measuring the node voltage potentials on the real circuit.
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OUTPUT:

This algorithm outputs the modeled values for all independent node voltage potentials. We can then use these node potential to solve for any circuit variable we desire.

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WHY IS THIS USEFUL?

This modeling activity is quite powerful for any learner who is curious to know how linear algebra is applied in the real-world. Specifically, the LANA algorithm empowers us to model the electric behavior of a subclass of real circuits using a nonsingular linear-systems problem in the form

$$A_r^T G A_r \mathbf{u} = A_r^T G \mathbf{b} - \mathbf{f}.$$

The matrix  $K = A_r^T G A_r$  is positive definite in this modeling context. This matrix structure is very popular in STEM modeling contexts and has received much attention over decades of research and development in numerical linear algebra.

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