LANA Example 1 : Physical Prototype and Measurements
Explore The Linear-Algebraic Nodal Analysis (LANA) Algorithm
on a Circuit with 7 Resistors, 3 Voltage Sources, 3 Current Sources

LANA Example 1: Ideal schematic diagram

Figure 1 provides an ideal circuit diagram for an electric circuit that includes seven 1kΩ resistors, three dc voltage sources, and three dc current sources. In this diagram, we label and enumerate each ideal circuit element and assign associated values.
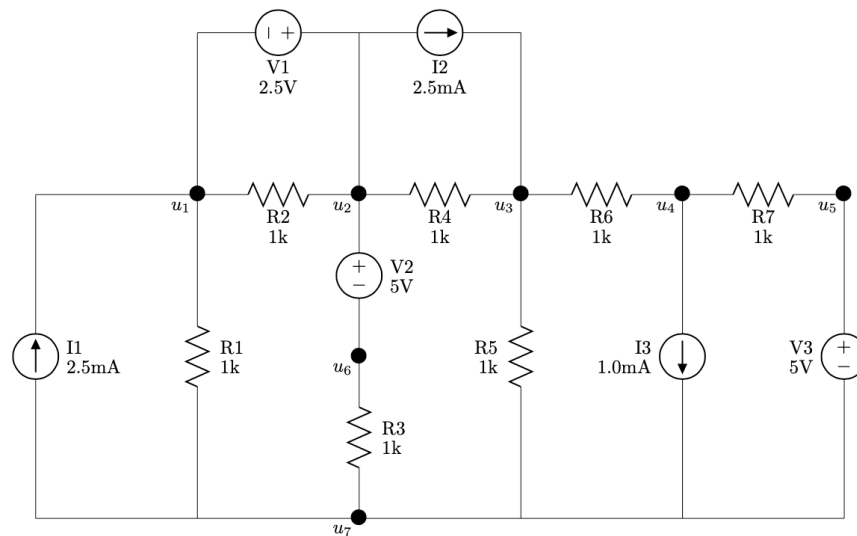

Figure 1: An ideal schematic diagram of a circuit containing seven resistors, three dc voltage sources, and three dc current sources.

Example 1: Parts needed for this circuit

To build this circuit, we need the following parts:

☐ One half-size 2.2"x 3.4"solderless breadboard

☐ Two yellow 0.43" jumper wire

☐ Seven 1k resistors (brn-brn-blk-blk-brn)

☐ Two 5V dc voltage sources (red and black wires out of the bottom of the source)

☐ One 2.5V dc voltage source (white and black wires out of the bottom of the source)

☐ Two 2.5mA dc current sources (red and black wires out of the side of the source)

☐ One 1.0mA dc current source (white and black wires out of the side of the source)

☐ Six fully-charged 9V batteries

Example 1: Get started with a picture of the physical circuit

In Figure 2, we see a photograph of the circuit we build in this example. For detailed instructions on how to built this circuit, see the bottom of this page under the "Example 2: Build this circuit" section.
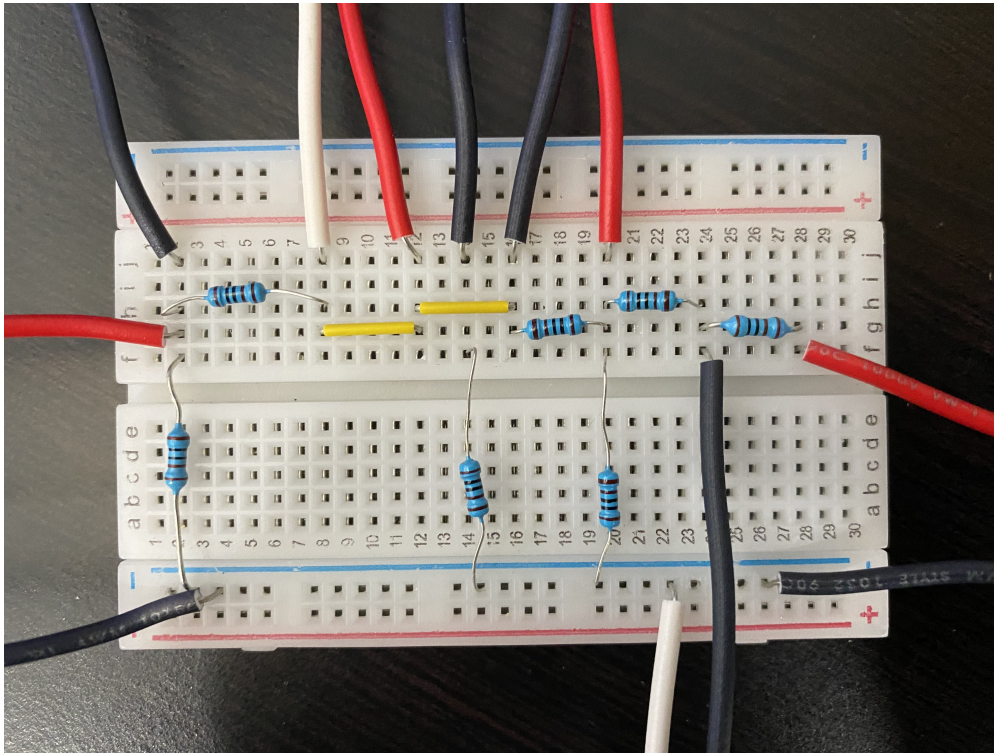

Figure 2: Photograph of the prototype for this LANA Example 1 circuit.

Example 1: Build this circuit

To build the circuit, please grab all the necessary parts described in the "Example 1: Parts needed for this circuit" section on the first page of this document. Then, follow the instructions below:

1. ☐ Disconnect batteries from dc sources

2. ☐ Insert yellow 0.4" jumper across g8 and g12

3. ☐ Insert yellow 0.4" jumper across g12 and g16

4. ☐ Insert resistor r_1 across f2 and LN2

5. ☐ Insert resistor r_2 across h2 and h8

6. ☐ Insert resistor r_3 across f14 and LN12

7. ☐ Insert resistor r_4 across g16 and g20

8. ☐ Insert resistor r_5 across f20 and LN16

9. ☐ Insert resistor r_6 across h20 and h24

10. ☐ Insert resistor r_7 across g24 and g28

11. ☐ Insert white lead of v_{v_1} in j8 and blk lead in j2

12. ☐ Insert red lead of v_{v_2} in j12 and blk lead in j14

13. ☐ Insert red lead of v_{v_3} in f28 and blk lead in LN22

14. ☐ Insert red lead of i_{i_1} in g2 and blk lead in LN3

15. ☐ Insert red lead of i_{i_2} in j20 and blk lead in j16

16. ☐ Insert white lead of i_{i_3} in LN19 and blk lead in f24

Example 1: Measure Circuit Variables

In the table below, please write all the measurements you took for the fundamental circuit variables associated with the LANA Example 3 circuit. Notice that for each circuit element, we have two physical measurements.

LANA Example 1, Table I: Observed Circuit Variable Values

Circuit Element	Voltage Variable	Measured voltage (V)	Current Variable	Measured current (mA)
R1	v_{r_1}		i_{r_1}	
R2	v_{r_2}		i_{r_2}	
R3	v_{r_3}		i_{r_3}	
R4	v_{r_4}		i_{r_4}	
R5	v_{r_5}		i_{r_5}	
R6	v_{r_6}		i_{r_6}	
R7	v_{r_7}		i_{r_7}	
V1	v_{v_1}		i_{v_1}	
V2	v_{v_2}		i_{v_2}	
V3	v_{v_3}		i_{v_3}	
I1	v_{i_1}		i_{i_1}	
I2	v_{i_2}		i_{i_2}	
I3	v_{i_3}		i_{i_3}	

Example 1: Measure the node voltage potentials

Using the digital multimeter, please measure the voltage potential at each node of our LANA Example 3 circuit. We begin by connecting the negative lead of our multimeter to your chosen ground node. For the sake of this exploration, let's attach ground to node seven, since this is suggested in the ideal circuit diagram in Figure 1. Then, we connect the positive lead of the multimeter to each of the nodes, one by one, to capture the voltage measurement. In figure 3, we enumerate the node locations on for this circuit.
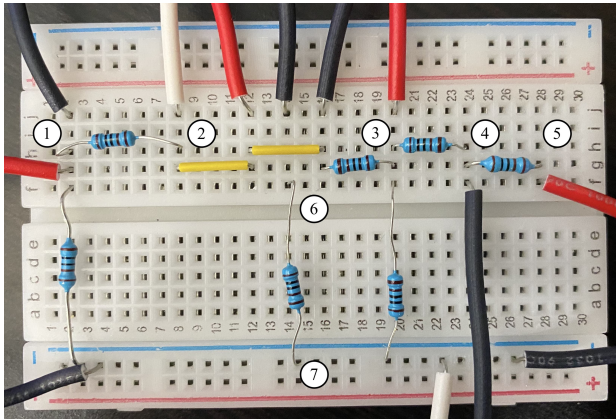

Figure 3: Nodes on Physical Circuit

Table 2:Node potential measurements

Node	Node Variable	Measured value (V)
1	u_1	
2	u_2	
3	u_3	
4	u_4	
5	u_5	
6	u_6	
7	u_7	