LANA Example 2 : Physical Prototype and Measurements
Explore The Linear-Algebraic Nodal Analysis (LANA) Algorithm
on a Circuit with 8 Resistors, 2 Voltage Sources, 2 Current Sources

LANA Example 2: Ideal schematic diagram

Figure 1 provides an ideal circuit diagram for an electric circuit that includes eight 1kΩ resistors, two 5V dc voltage sources, and two 2.5mA dc current sources. In this diagram, we label and enumerate each ideal circuit element and assign associated values.

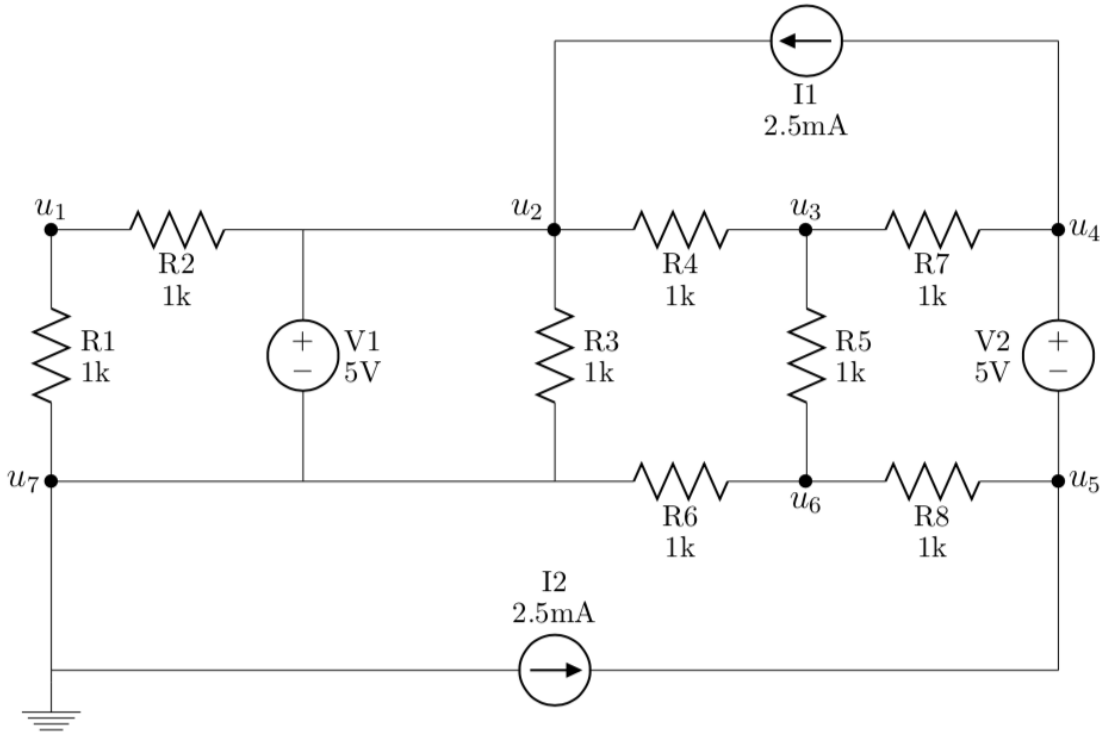

Figure 1: An ideal schematic diagram of a circuit containing eight resistors, two dc voltage sources, and two dc current sources.

Example 2: 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 orange 0.3" jumper wires
- ☐ One green 0.5" jumper wire
- ☐ Eight 1k resistors (brn-brn-blk-blk-brn)
- ☐ Two 5V dc voltage sources (red 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)
- ☐ Four fully-charged 9V batteries

Example 2: 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.

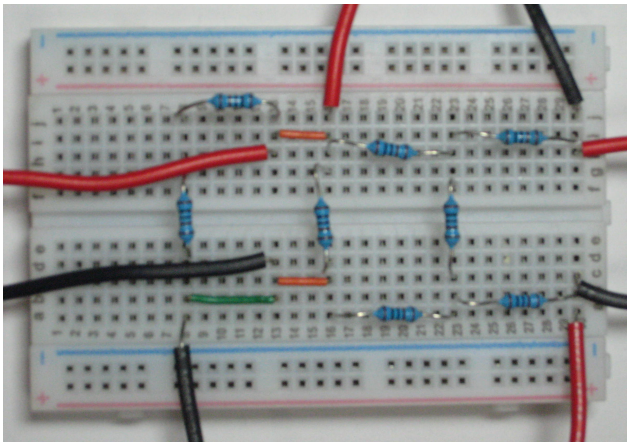

Figure 2: Photograph of the prototype for this LANA Example 2 circuit.

Example 2: Build this circuit

To build the circuit, please grab all the necessary parts described in the "Example 2: 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 orange 0.3" jumper across i13 and i16
3. ☐ Insert orange 0.3" jumper across c13 and c16
4. ☐ Insert green 0.5" jumper across b8 and b13
5. ☐ Insert resistor r_1 across e8 and g8
6. ☐ Insert resistor r_2 across j8 and j13
7. ☐ Insert resistor r_3 across d16 and g16
8. ☐ Insert resistor r_4 across h16 and h23
9. ☐ Insert resistor r_5 across c23 and f23
10. ☐ Insert resistor r_6 across a16 and a23
11. ☐ Insert resistor r_7 across i23 and i30
12. ☐ Insert resistor r_8 across b23 and b30
13. ☐ Insert red lead of v_{v_1} in h13 and blk lead in d13
14. ☐ Insert red lead of v_{v_2} in h30 and blk lead in c30
15. ☐ Insert red lead of i_{i_1} in j16 and blk lead in j30
16. ☐ Insert red lead of i_{i_2} in a30 and blk lead in a8

Example 2: Measure Circuit Variables

In the table below, please write all the measurements you took for the fundamental circuit variables associated with the LANA Example 2 circuit. Notice that for each circuit element, we have two physical measurements.

LANA Example 2, 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}	
R8	v_{r_8}		i_{r_8}	
V1	v_{v_1}		i_{v_1}	
V2	v_{v_2}		i_{v_2}	
I1	v_{i_1}		i_{i_1}	
I2	v_{i_2}		i_{i_2}	

Example 2: Measure the node voltage potentials

Using the digital multimeter, please measure the voltage potential at each node of our LANA Example 2 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.

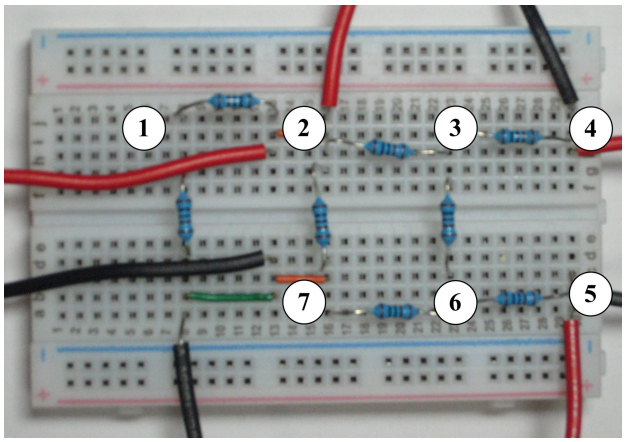

Figure 3: Nodes on Physical Circuit

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	