Example 2: Linear Algebraic Nodal Analysis Algorithm
Circuit with 8 Resistors, 2 Voltage Sources, 2 Current Sources
(Revised version of Example 4.2.1 p. 122 of Artice Davis's Textbook)

Example 2: Ideal schematic diagram

In this example, we build an electric circuit that includes eight 1kΩ resistors, two 5V dc voltage sources, and two 2.5mA dc current sources. Figure 1 is an ideal circuit diagram that provides a complete description of this circuit. Notice that in this diagram, we label and enumerate each ideal circuit element and assign associated values.
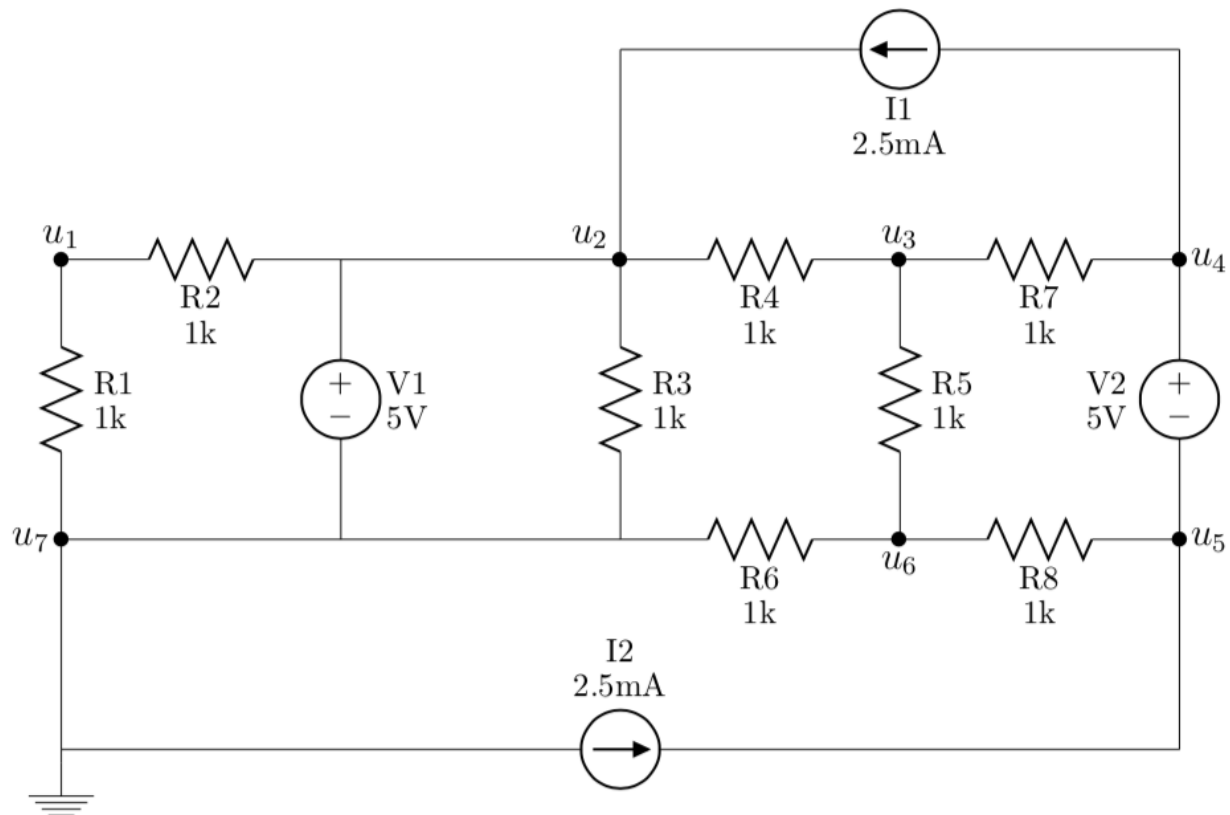

Figure 1: Ideal circuit schematic diagram

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 red 0.2" jumper wires

☐ One blue 0.6" jumper wire

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

☐ Two 5V dc voltage sources

☐ Two 2.5mA dc current sources

☐ Four fully-charged 9V batteries

Example 2: Get started with a picture of the physical circuit

In Figure 2, we see a wiring diagram for the circuit we build in this example. The reader can find detailed instructions on how to prototype this circuit at the bottom of this page under the "Example 2: Build this circuit" section.
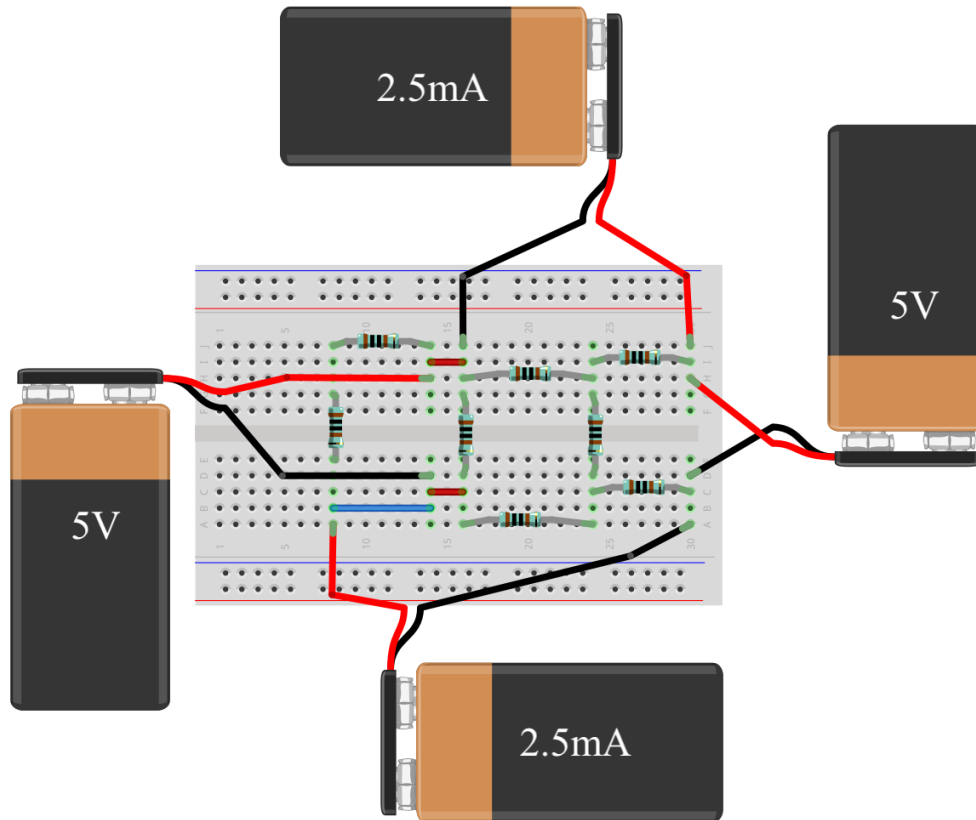

Figure 2: Digital Wiring Diagram for the Real Circuit.

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 red 0.2" jumper across i14 and i16

3. ☐ Insert red 0.2" jumper across c14 and c16

4. ☐ Insert blue 0.6" jumper across b8 and b14

5. ☐ Insert resistor r_1 across d8 and g8

6. ☐ Insert resistor r_2 across j8 and j14

7. ☐ Insert resistor r_3 across d16 and g16

8. ☐ Insert resistor r_4 across h16 and h24

9. ☐ Insert resistor r_5 across d24 and g24

10. ☐ Insert resistor r_6 across a16 and a24

11. ☐ Insert resistor r_7 across i24 and i30

12. ☐ Insert resistor r_8 across b24 and b30

13. ☐ Insert red lead of v_{s_1} in i14 and blk lead in d14

14. ☐ Insert red lead of v_{s_2} in h30 and blk lead in c30

15. ☐ Insert red lead of i_{s_1} in j30 and blk lead in j16

16. ☐ Insert red lead of i_{s_2} in a8 and blk lead in a30

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 the nine nodes of our LANA Example 2 circuit. We begin by connecting the negative lead of our multimeter to node seven. Then, we connect the positive lead of the multimeter to each of the nine nodes, one by one, to capture the voltage meter. In figure 3, we enumerate the node locations on the wiring diagram for this circuit.
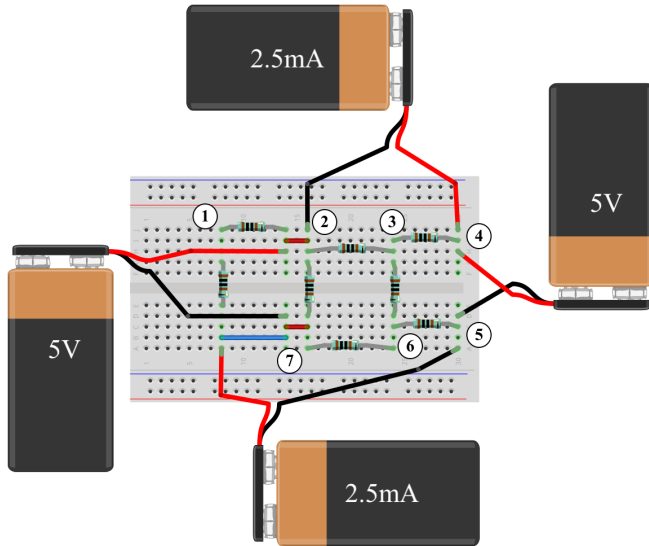

Figure 3: Nodes on Physical Circuit

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	