Ethics Conversations

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What is the responsibility of an engineer?

Can/should an engineer design ethically?

PROOF OF CONCEPTS

Generating Excellent "Everyday" Technical Documents

Omega Labs Documentation
Peterson Method

Project Plan

Proof of Concepts

Exploration Map

Metacognition and Reflection Journal

A L P H A | O M E G A

Electric Circuits
ECSE-2010

Alpha-Omega Design Lab Continuum

Students choose between:

a traditional, procedural lab
(Alpha Experiments)

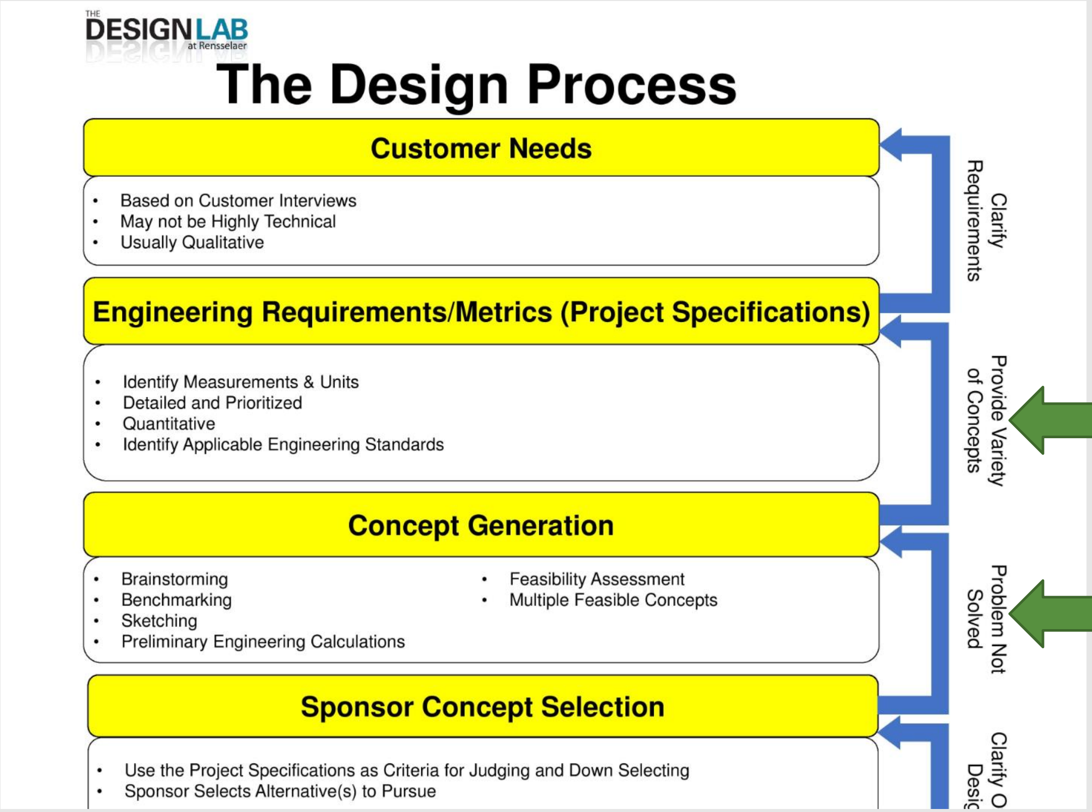
a design based, open ended lab
(Omega IExplorations)

Common documentation for both Alpha and Omega Labs:
Proof of Concepts

The Design Process
Connecting to IED and Senior Capstone

Benefits of excellent "everyday" technical writing:

1. Ownership of your own growth and progress
2. Low-risk practice and iteration
3. Teammates and technical experts can better assist you (getting you further in the design process much earlier)
4. Final reports are significantly easier to compile
5. Consistent and permanent documentation for your technical portfolio (interviews, resumes, future presentations)
6. Same skill(s) will be used in your real life and in your career!



Proof of Concepts-

"Everyday" technical documentation

Templates and Links

Connecting to IED and Senior Capstone

Proof of Concept Document Template

Design Process Review:

Concept Generation

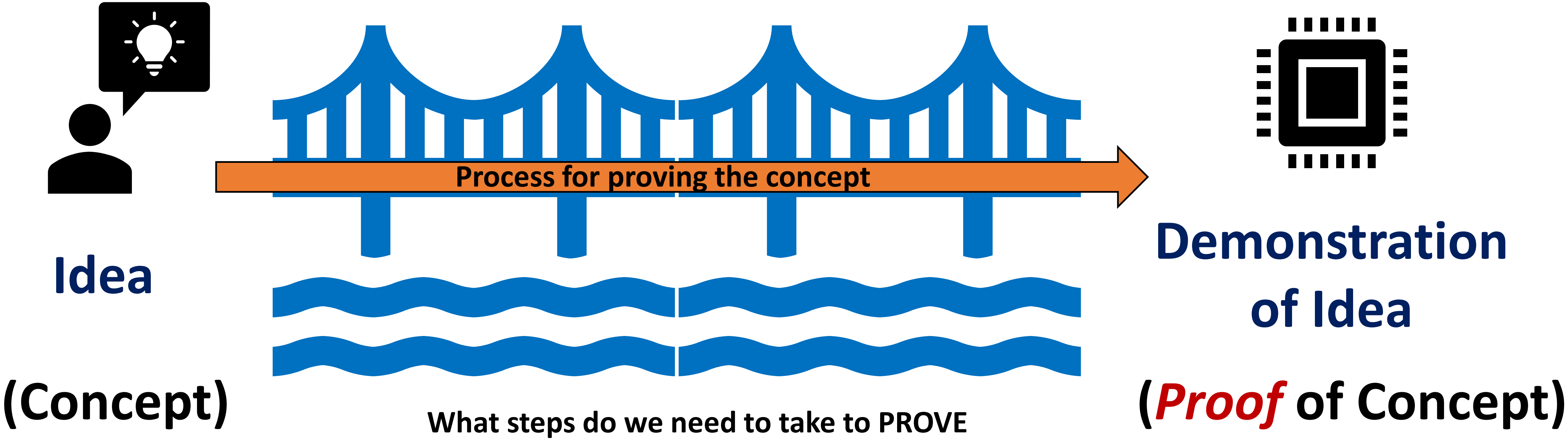
Design Process Review:

Product Specification

Design Process Review:

Technical Writing

Proof of Concepts Process Flow (Simplified Design Process)



What steps do we need to take to PROVE that we have implemented our idea AND that it's correct?

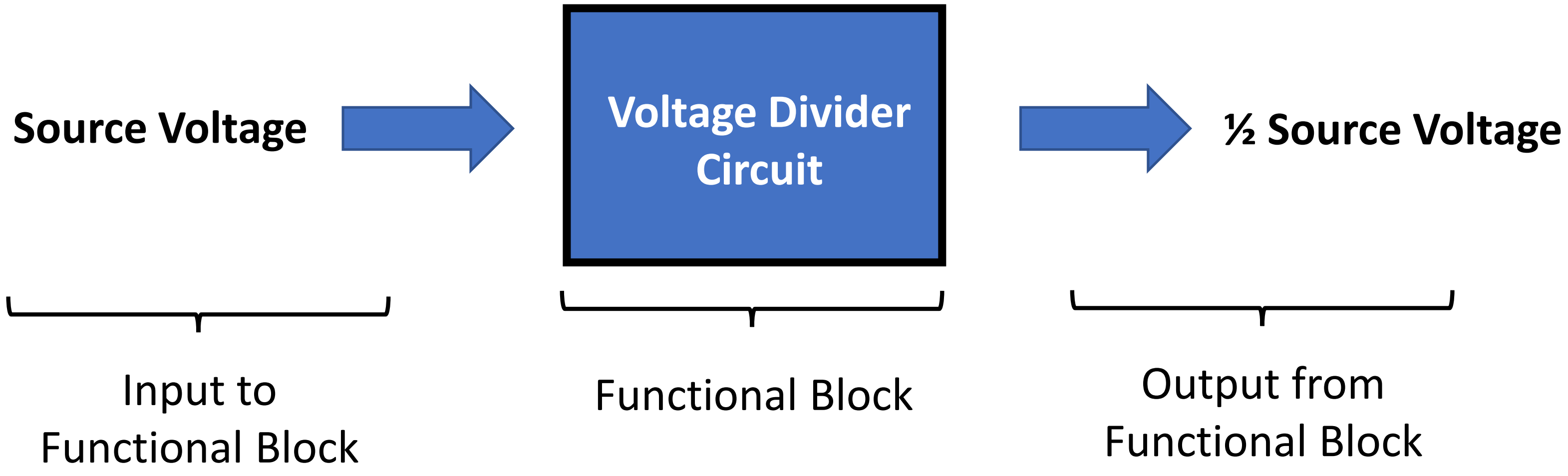
Proof of Concepts Process Flow
Step 0: Block Diagram

- How do we get from an **idea** for how a system will function to a **technical representation** of the system?

Block Diagram: process flow with main functional blocks, inputs and outputs

Example: I want to create a circuit, that outputs a voltage that is ½ of the input voltage

- Based on known inputs and outputs (from your concept), figure out which system components you need *conceptually* (no need to worry about math yet…)

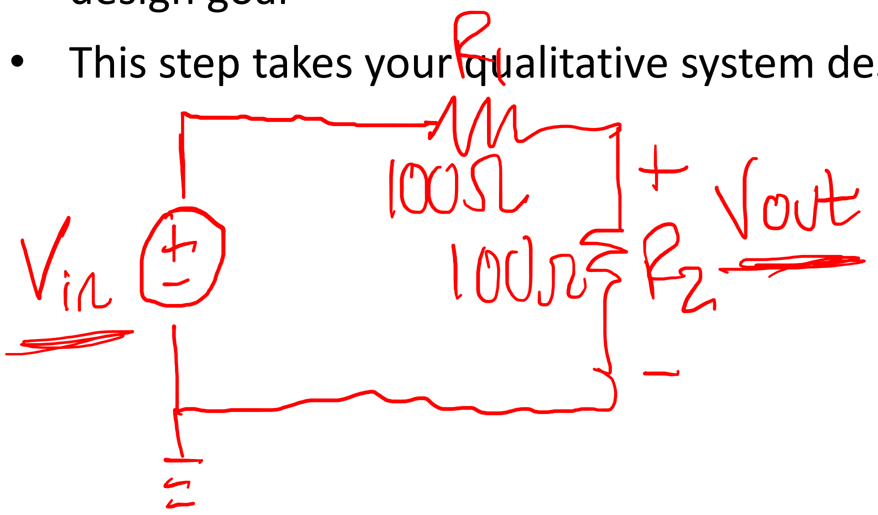


Well-labeled = all functional blocks, inputs, and outputs are labeled

- Note: block diagrams are *required* for Omega Explorations, but are not required for most Alpha labs

Proof of Concepts Process Flow
Step 1: Mathematical Analysis

- Replace each functional block and necessary inputs/outputs with its circuit equivalent
- Using circuit theory, determine what the values of components in the circuit need to be to achieve your design goal
- This step takes your qualitative system design and attaches numbers to it (first technical step)



Voltage divider equation

$$V_{out} = \frac{R_2}{R_1 + R_2} V_{in}$$

for $V_{out} = \frac{1}{2} V_{in}$

$R_1 = R_2$

Choose $R_1 = R_2 = 100\Omega$

$V_{in} = 1V$

Well-labeled = all components (resistors and voltage sources here) labeled with values, all relevant measurement points labeled (Vout, Vin)

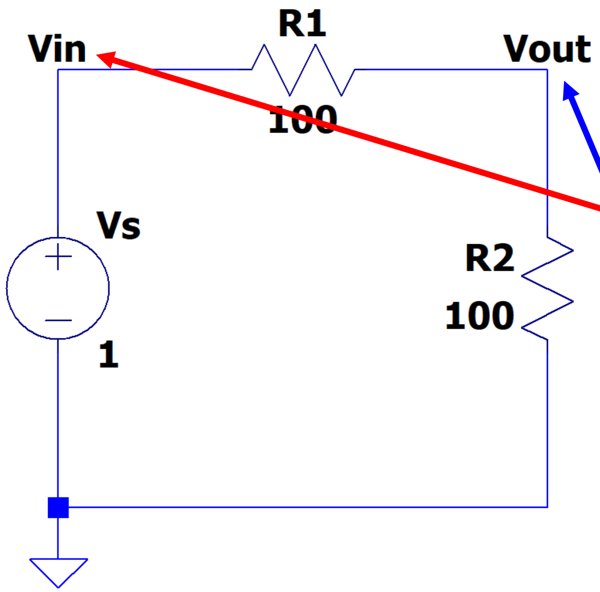
$V_{out} = \frac{100\Omega}{100\Omega + 100\Omega} 1V$

$= \frac{1}{2} V = 0.5V$

$V_{out} = \frac{1}{2} V_{in}$ ✓

Proof of Concepts Process Flow
Step 2: System Simulation

- Create your system in a simulation program (Ltspice for circuits) with the exact same components as in Step 1
- Run a simulation to verify that your mathematical analysis is correct/it does what you intend your system



LTSpice Circuit Schematic

--- Operating Point ---

V(vin):	1	voltage
V(vout):	0.5	voltage
I(R2):	-0.005	device_current
I(R1):	-0.005	device_current
I(Vs):	-0.005	device_current

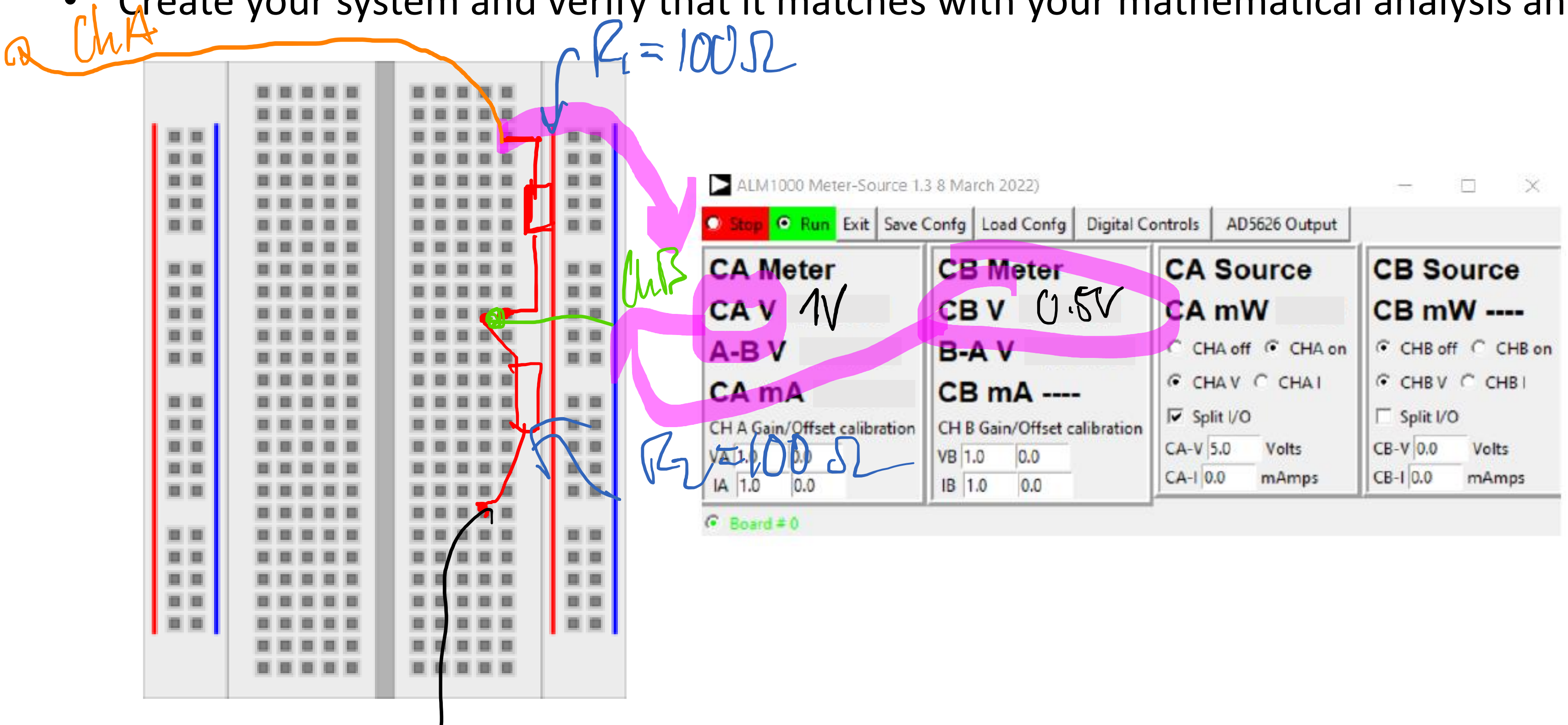
Well-labeled = all relevant measurement points labeled (Vout, Vin)

LTSpice DC Operating Point Simulation Results

- Do the simulation results match the mathematical analysis? If **yes**, move on to physical experimentation. If **no**, **check your simulation and/or your mathematical analysis**.

Proof of Concepts Process Flow
Step 3: Physical Experiment

- Physically create your system (if applicable) and measure expected outputs
- Create your system and verify that it matches with your mathematical analysis and simulations



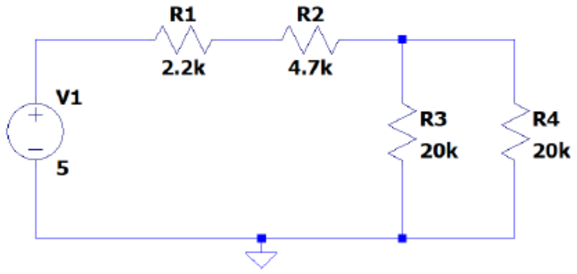
Well-labeled = all relevant measurement points labeled on circuit (Vout, Vin) and all measurement values labeled with their corresponding names (Vout, Vin)

- Do the measurements match the circuit simulation? If **yes**, **you have proven your concept**! If **no**, **check your physical system setup, your simulation and/or your mathematical analysis**.

Example from Lab01: Mathematical Analysis

1) Prove the Ohm's, KCL, and KVL laws in a circuit

Building Block:



The circuit used is described by this schematic. A source of 5 volts was used for all calculations. Resistors R1 and R2 are in series, and R3 and R4 are in parallel.

Analysis:

Ohm's Law
used to find currents
$V = IR$
$5V = I(16.9k\Omega)$
$I = .296mA$

$I_1 = .296mA$ ✓
$I_2 = .296mA$ ✓

$V_3 = I_3 R_3$
$2.959V = I_3(20k\Omega)$
$I_3 = .148mA$ ✓
$I_4 = .148mA$ ✓

Kirchoff's Current law
$I_2 = I_3 + I_4$
(currents at node sum to zero)
$.296mA = .148mA + .148mA$ ✓

Kirchoff's Voltage Law
Voltages sum to zero (in series)
$5V = V_1 + V_2 + V_{34}$
$5V = .651V + 1.390V + 2.959V$
$5V = 5V$ ✓

Note*: Solving for the voltages is **not included for Concept 1 - solving for voltage across each resistor is demonstrated below in Concept 2.*

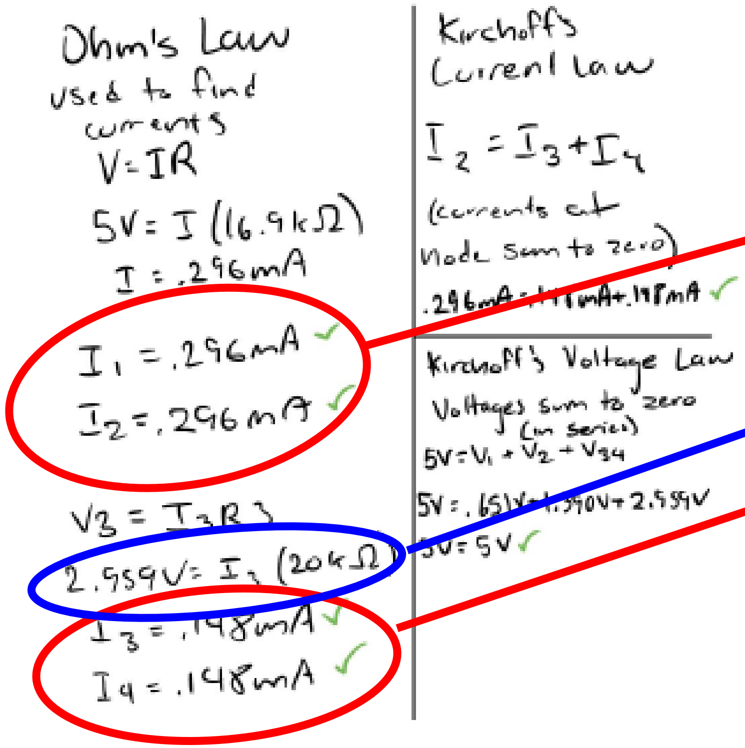
Ohm's Law: Using Ohm's law, we solve for current based on voltage and resistance, and receive the expected value.

Kirchoff's Current Law: Based on the calculated currents, we can plug them into the expected equation based on KCL. The currents entering and exiting the node do indeed sum to zero.

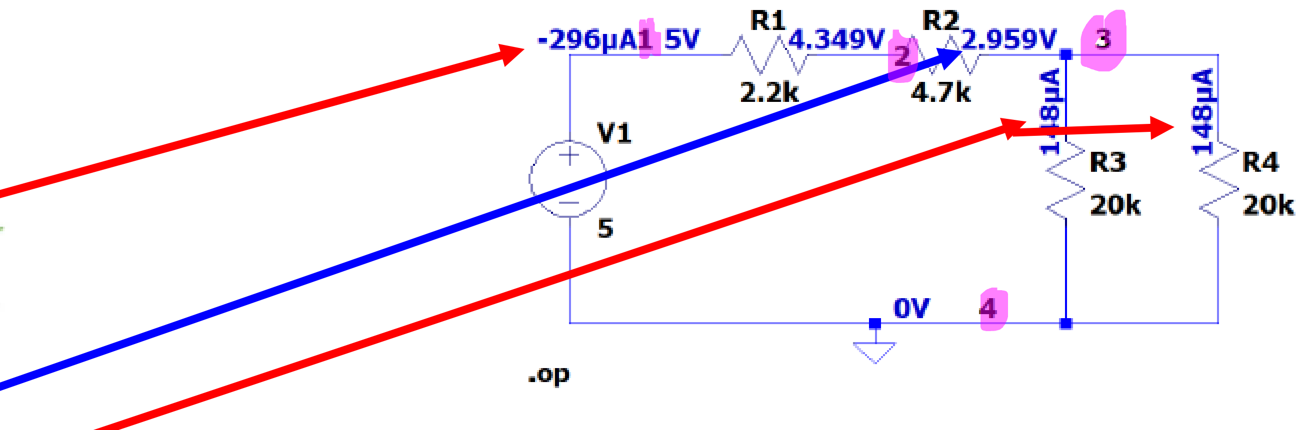
Kirchhoff's Voltage Law: The voltage drop across each resistor sums to the total amount of voltage provided to the source, as stated by KVL.

Example from Lab01: Circuit Simulation

Analysis:



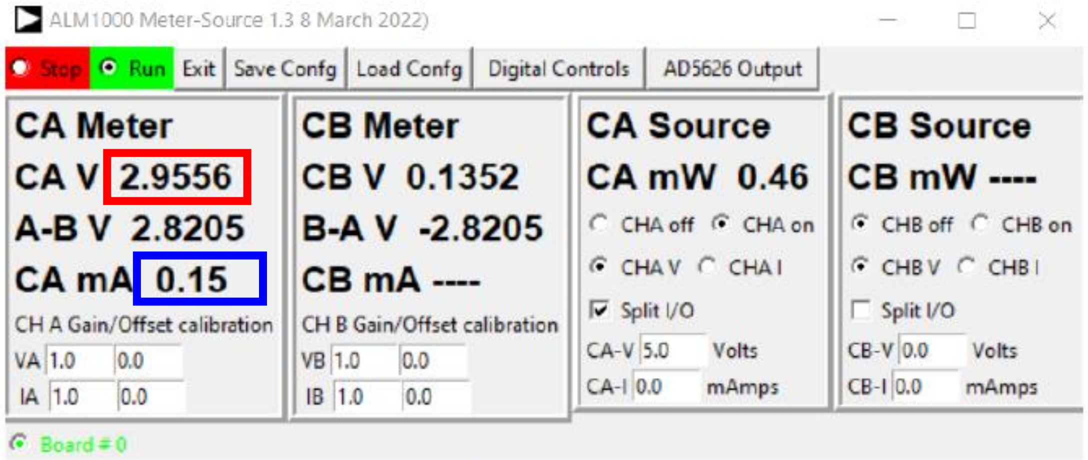
Simulation:



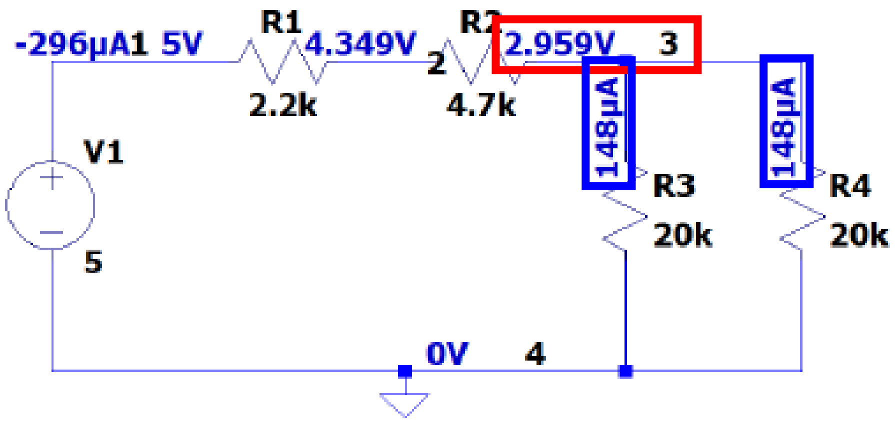
The simulation confirms that our current values were accurate, as we calculated using Ohm's Law. It also supports Kirchoff's Current and Voltage Laws by providing the same values for voltage and current that we used in the calculation. Thus, the simulation supports all three laws.

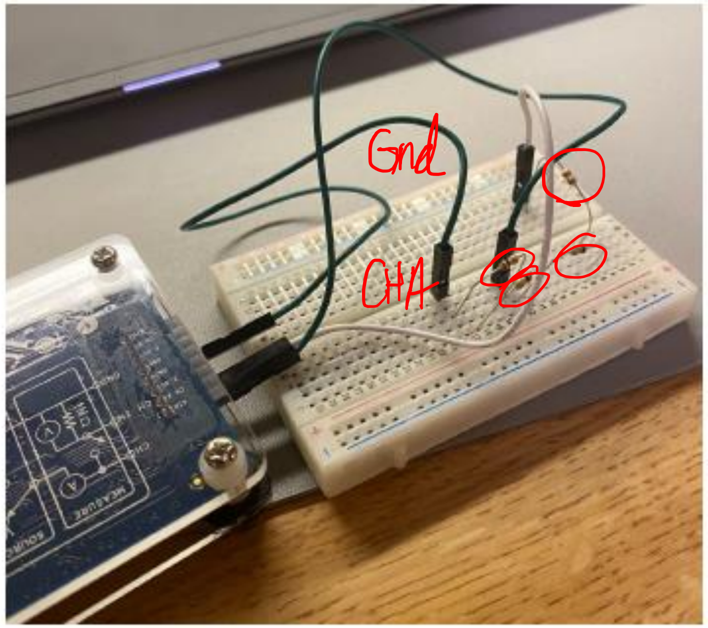
Example from Lab01: Physical Experiment

Measurement:



Meter-Source readings with A-IN connected to node 3.





The voltage received at Node 3 (as labeled in the LTspice simulation) is at 2.957 volts, which is close to the expected 2.959V. All voltages are very close to the simulated and calculated value. The current received is .15 mA, very close to the expected .148mA.

Possible Improvements Here: 1) Label the picture with the nodes from the LTSpice schematic; 2) Label the wires in the picture; 3) Be more specific about which current was being measured.

Ethics Discussions

- https://sites.ecse.rpi.edu//courses/S23/ECSE-1010/in_class_activities/Class_3_Ethics_Discussion_Activity.pdf

- Groups of 4 or 6
- Open a Google Doc
- Pick ONLY ONE topic to discuss
- Choose a side for 15 minutes
- Choose the OPPOSITE side for another 15 minutes
- Write main points in your Google Doc
- Get ready for your groups representative to say your most salient point out loud to the entire class!

What to do…

Work on your skills in partners or small groups…

If you have a question ask! Raise your hand…if there is a picture you can post it in the chat too!

Help someone else…

Post your work to Gradescope

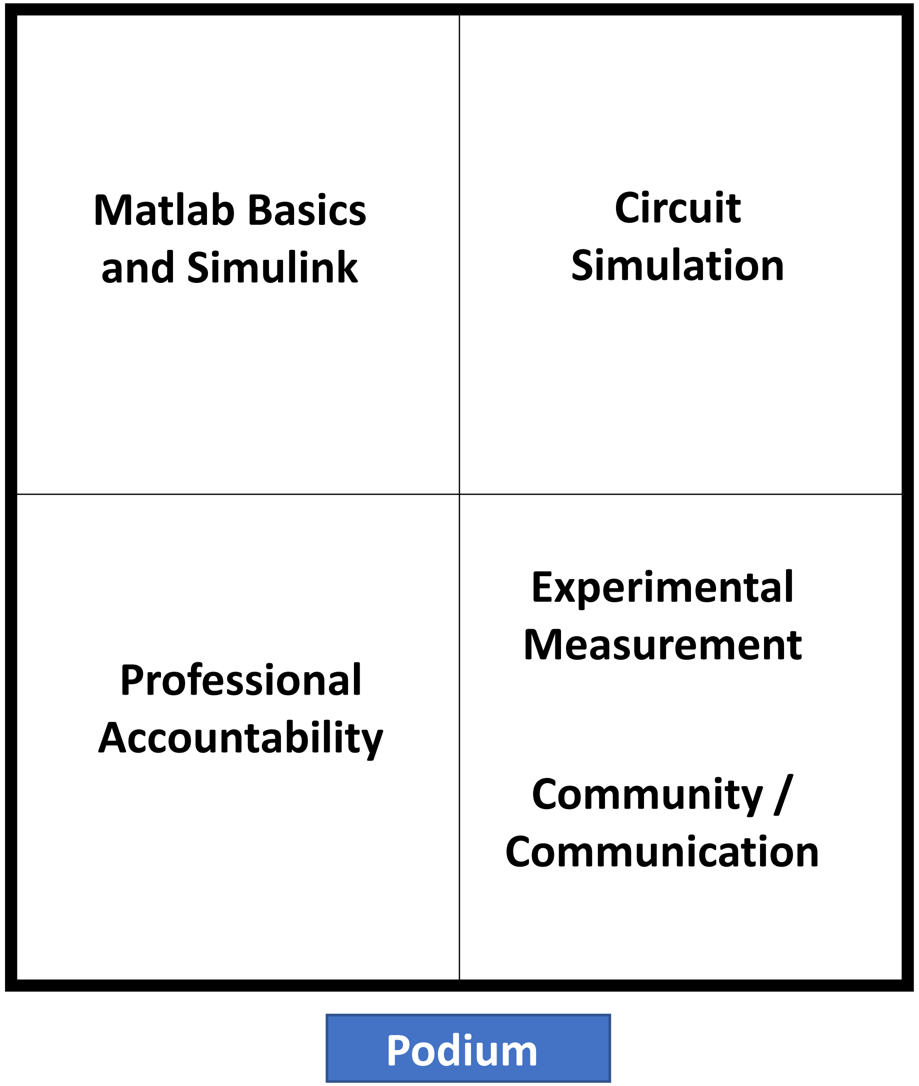
Try to ensure EVERYONE on your team has the most things submitted

If you are done…guess what….you sign up for the next day of Proof of Skills and start the minimum!

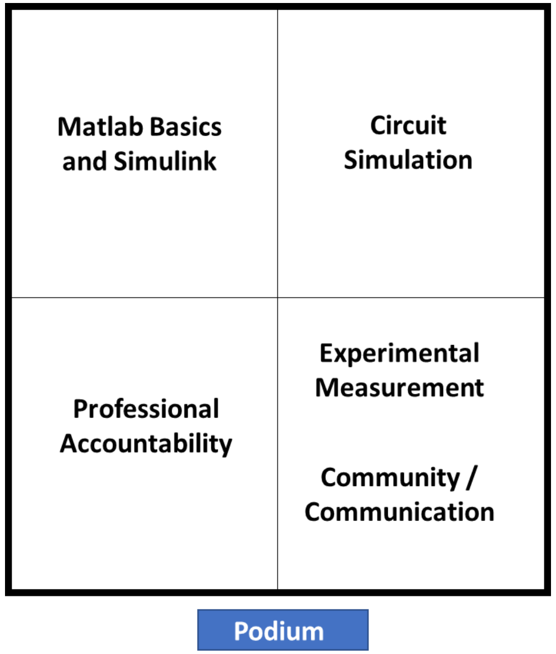
Your TA and SA Team (ask for help!)

Name	Email	Hours
Chenyi Kuang	kuangc2@rpi.edu	20
Nazifa Rumman	rumman@rpi.edu	10
Noah Kader	kadern@rpi.edu	UNDERGRAD 4

Where do I go to join the team working on my skill for the day?



Proof of Skills Day 2



Name	Professional Accountability	Circuit Simulation	Experimental Measurement and Personal Instrumentation	MATLAB Basics and Simulink	Community, Communication and Asking for Help
YOUR Skill to lead	**Prof. Patterson**	**Chenyi Kuang / Noah Kader**	**Nazifa Rumman**	**Chenyi Kuang**	**Prof. Patterson / Nazifa Rumman**

Due on Friday, 1/20

- Document with main points of ethics debate
- Day 2 Proof of Skills on Gradescope
- Sign up for Day 3 of Proof of Skills
- Metacognition journal entry on today’s ethics discussions