Applied Linear Algebra

Electrify the Linear-Systems Problem

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Foothill College
December 7, 2019

Getting to Know You

Please work on front of survey

Make the Eigenvalue Problem Resonate with our Students — Saturday 12/9/2017: 2:30pm – 3:30pm

PART I: PARTICIPANT INFORMATION

Participant's Name: _____
First *Last*

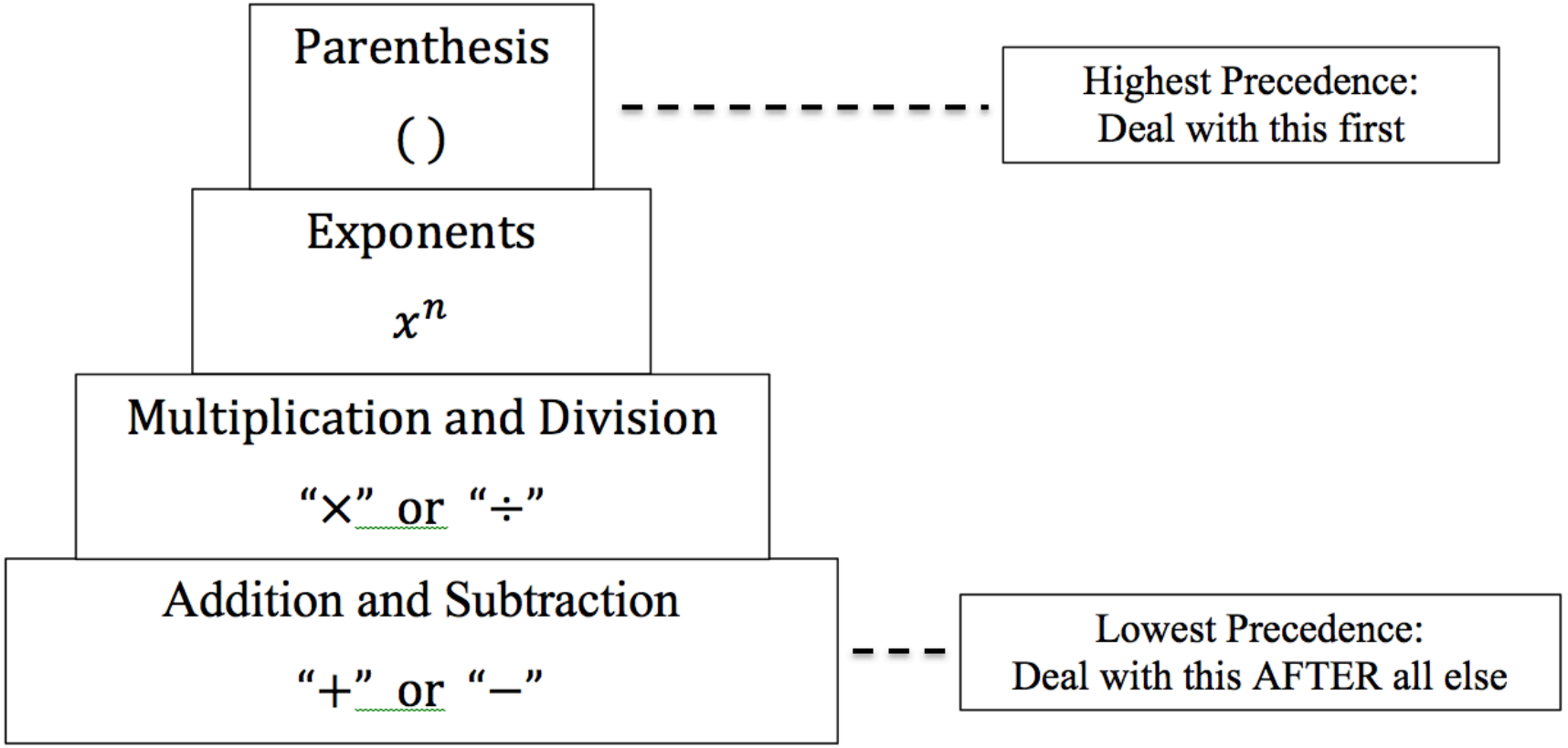
College: _____ City (where College is): _____

1. What is the title of the linear algebra course at your institution?
(For example, at Foothill College our Linear Algebra course is titled Math 2B: Linear Algebra)

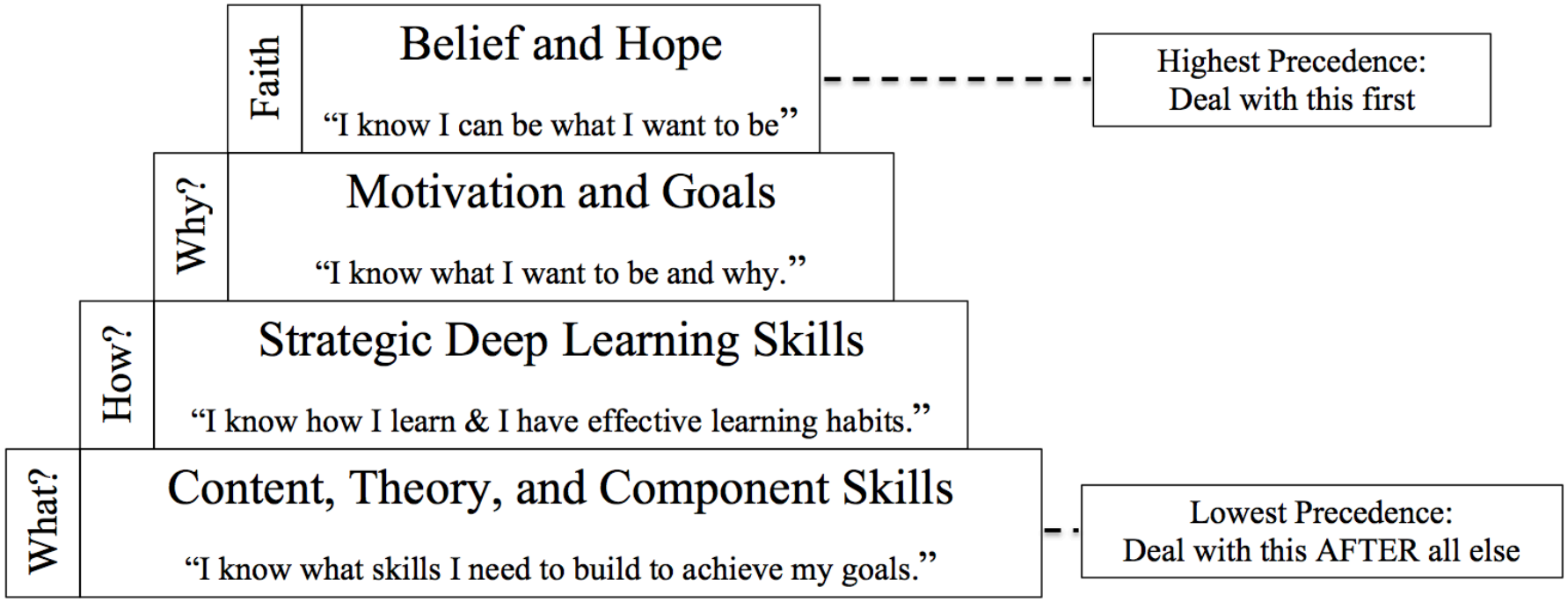
2. How many sections of this course are offered at your institution per year?

(For example, Foothill college offers 3 sections in fall quarter, 2 sections in winter quarter and 2 sections in spring quarter for a total of 7 sections of Math 2B per year. If you don't know how many sections, just write IDK).

Operator Hierarchy



Learning Needs Hierarchy



Linear Algebra Serves Client Disciplines

DECLARED STEM MAJOR	#
BioChemistry or Chemistry	3
Cognitive Science	1
Computer Science	78
M.S. in Data Science	3
Engineering (Total)	48
Aerospace	1
Bio or BioMedical	2
Chemical	2
Civil	6
Computer	3
Electrical	10
Environmental	2
Material Science	1
Mechanical	18
Unspecified	4
Math	16
Math (Applied)	7
Physics	7
Statistics	10
STEM	174
TOTAL STUDENTS	188

DECLARED NONSTEM MAJOR	#
Business	2
Cognitive Science	1
Economics	5
English Literature	1
Psychology	1
Public Policy	1
Undeclared	3
NONSTEM	14
TOTAL STUDENTS	188

Linear Algebra Serves Client Disciplines

DECLARED STEM MAJOR	#
BioChemistry or Chemistry	
Cognitive Science	
Computer Science	
M.S. in Data Science	
Engineering (Total)	
Aerospace	
Bio or BioMedical	
Chemical	
Civil	6
Computer	
Electrical	10
Environmental	
Material Science	
Mechanical	18
Unspecified	
Math	
Math (Applied)	7
Physics	7
Statistics	
STEM	48
TOTAL STUDENTS	188

Applied Mathematical Modeling Process

Real-world problem

Mathematization

Ideal mathematical model

(Prohibitive obstacle)

Plan

Iterate

Reflect

Act

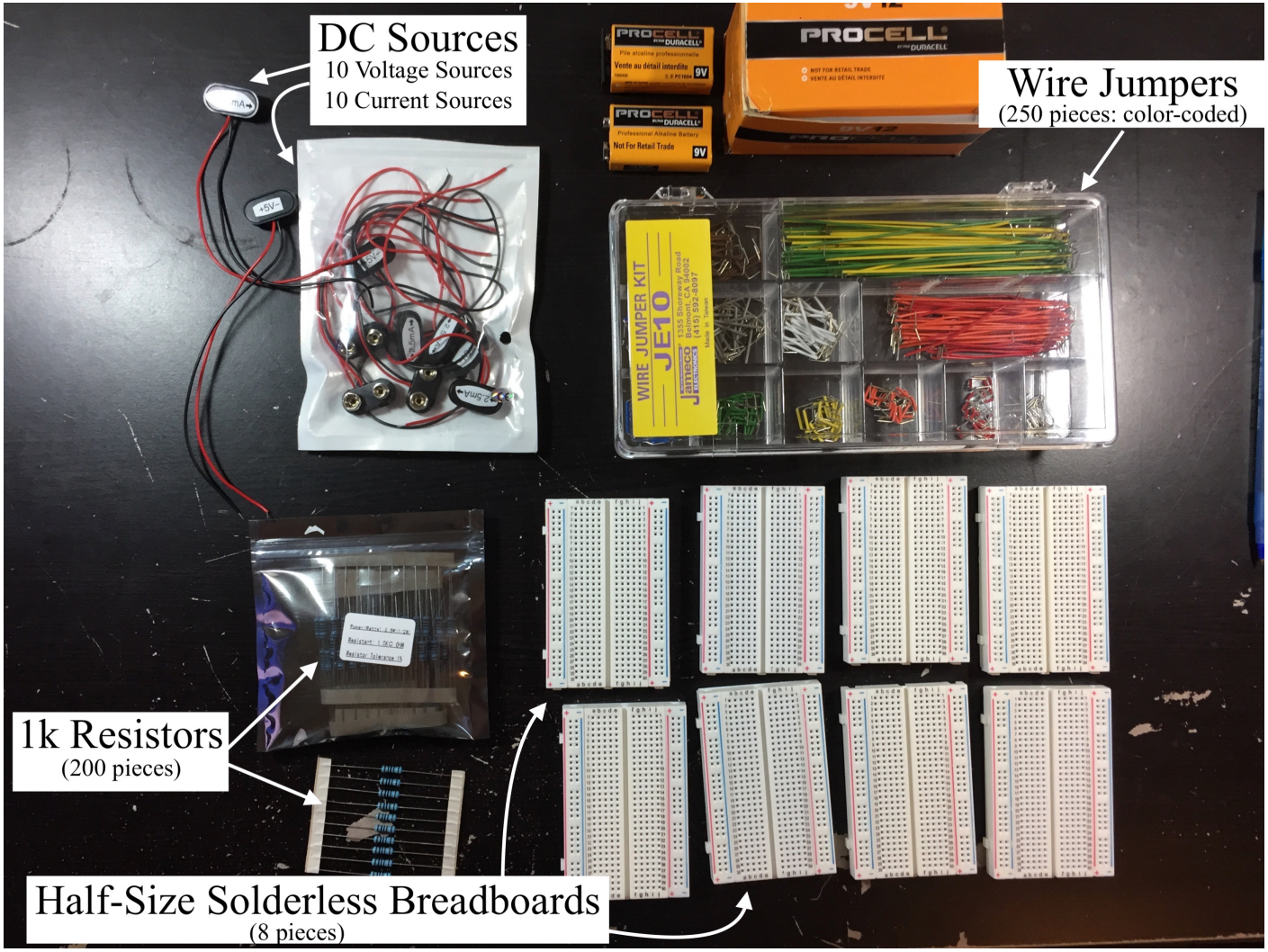
Mathematical analysis

Meaningful solution

Critical thinking

Ideal solution

Electronics Lab Kit



Electronics Lab Kit

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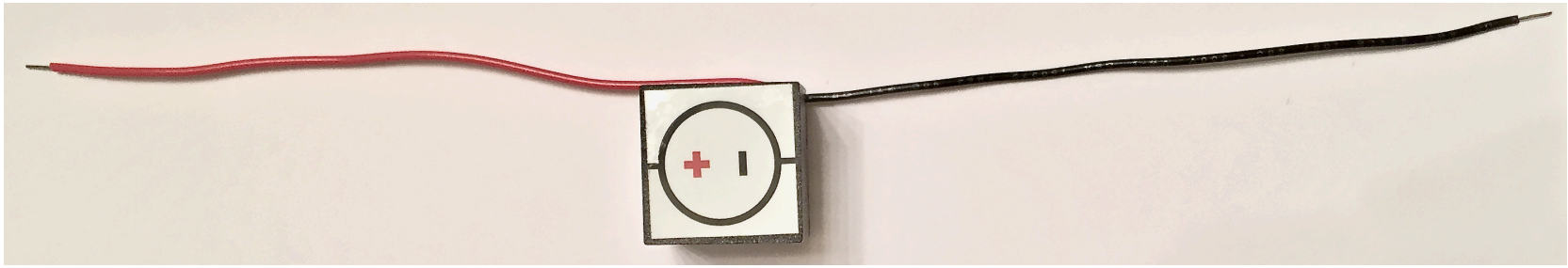
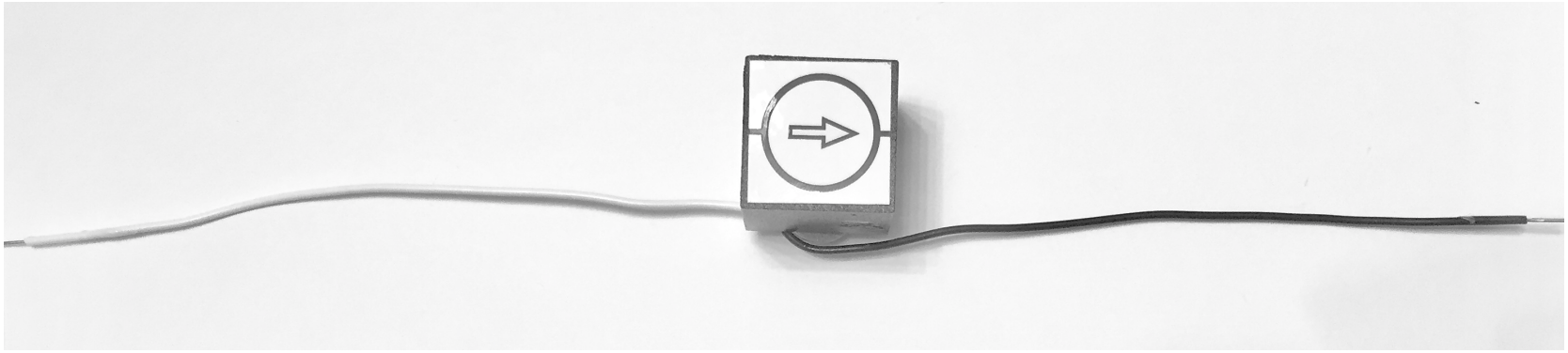
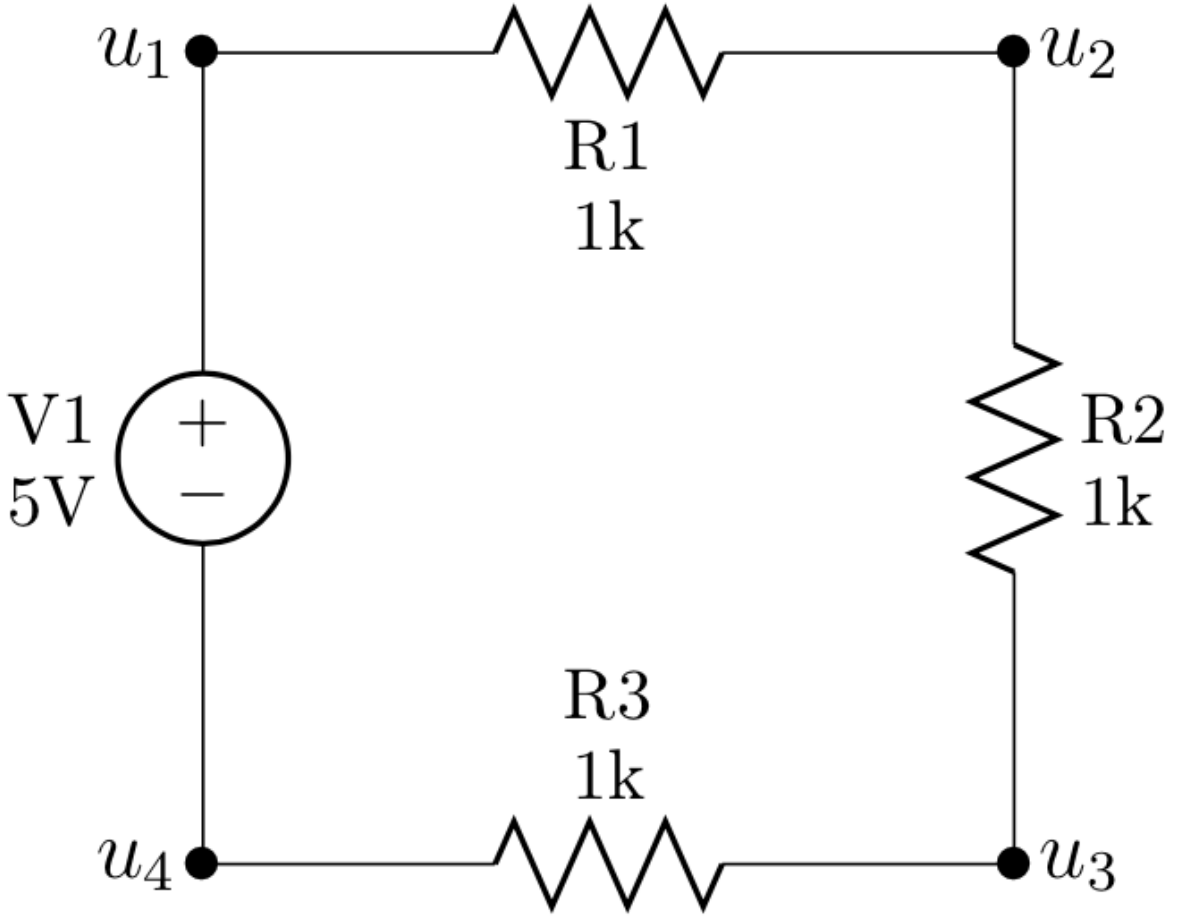
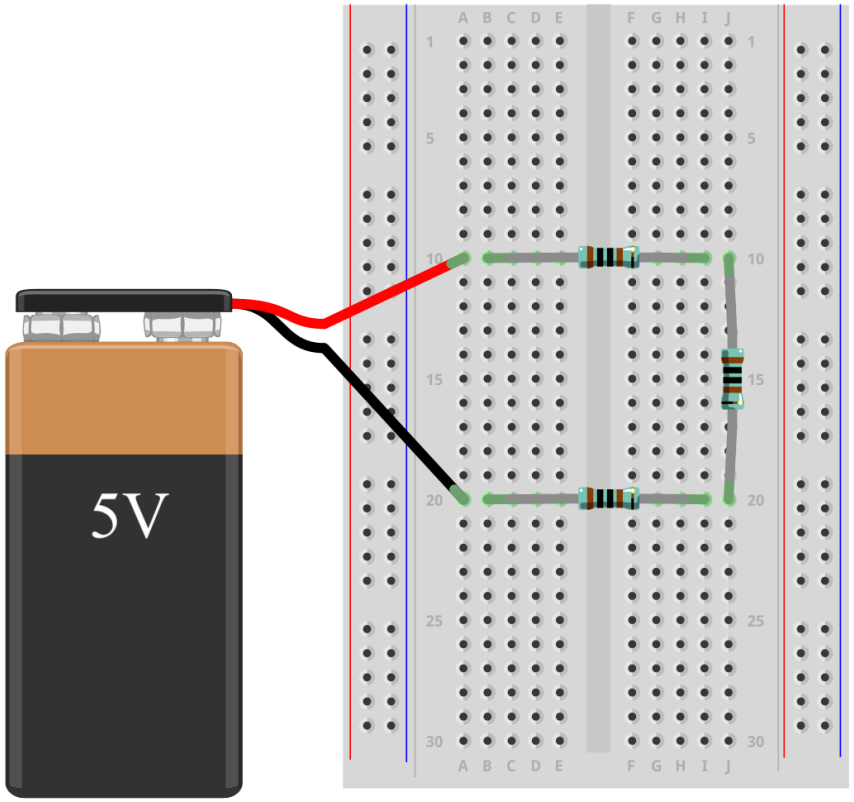




CMC^3 Example 1: Introductory Circuit



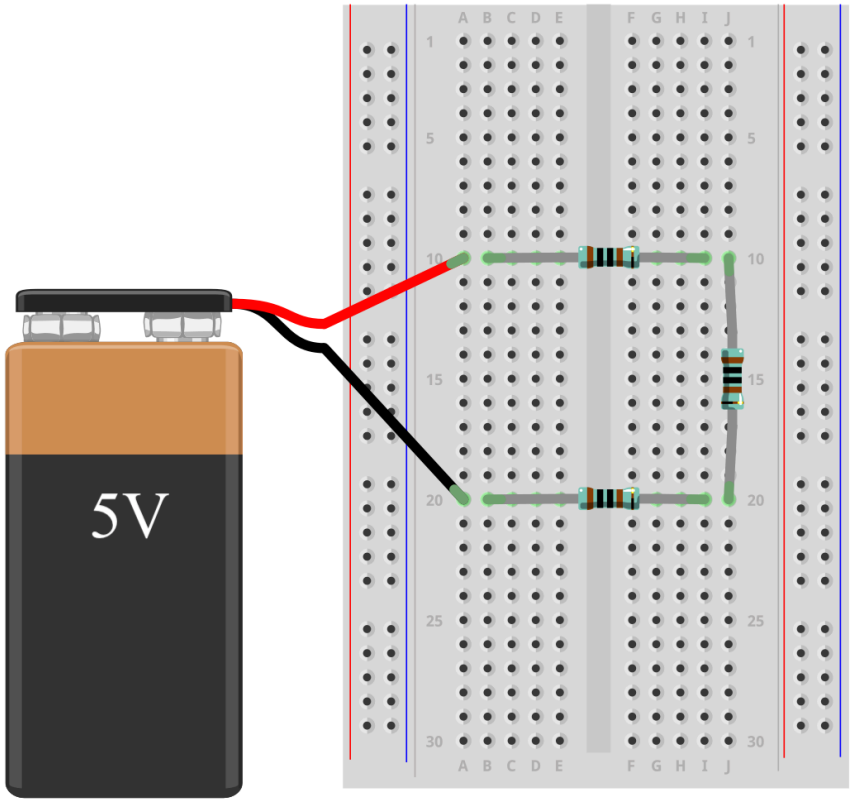
CMC³ Example 1: Introductory Circuit



CMC^3 Example 1: Introductory Circuit

Let's build together

CMC³ Example 1: Introductory Circuit



CMC^3 Example 1: Introductory Circuit

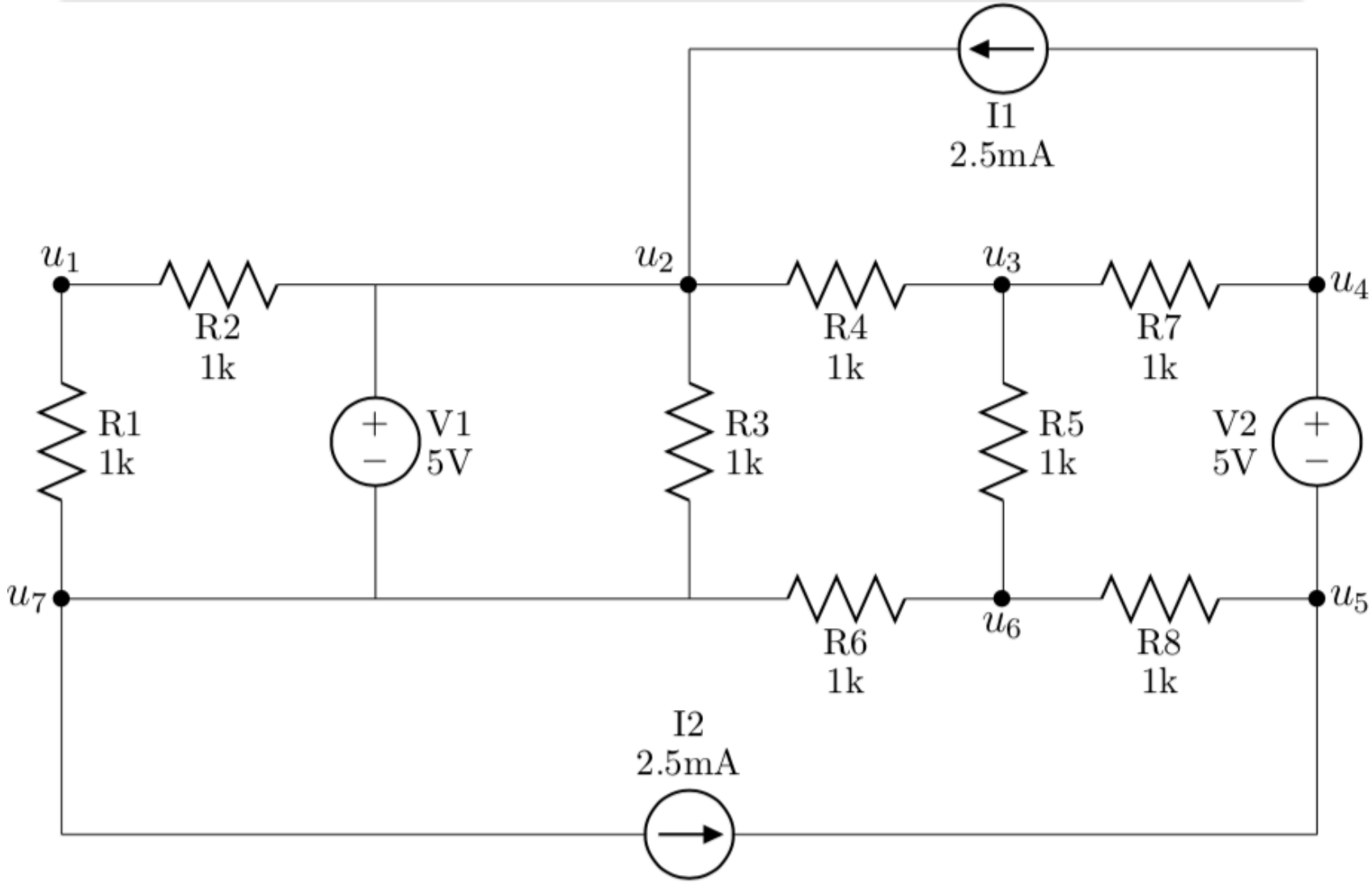
$$\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} 5.0 \\ 0 \end{bmatrix}$$

CMC^3 Example 1: Introductory Circuit

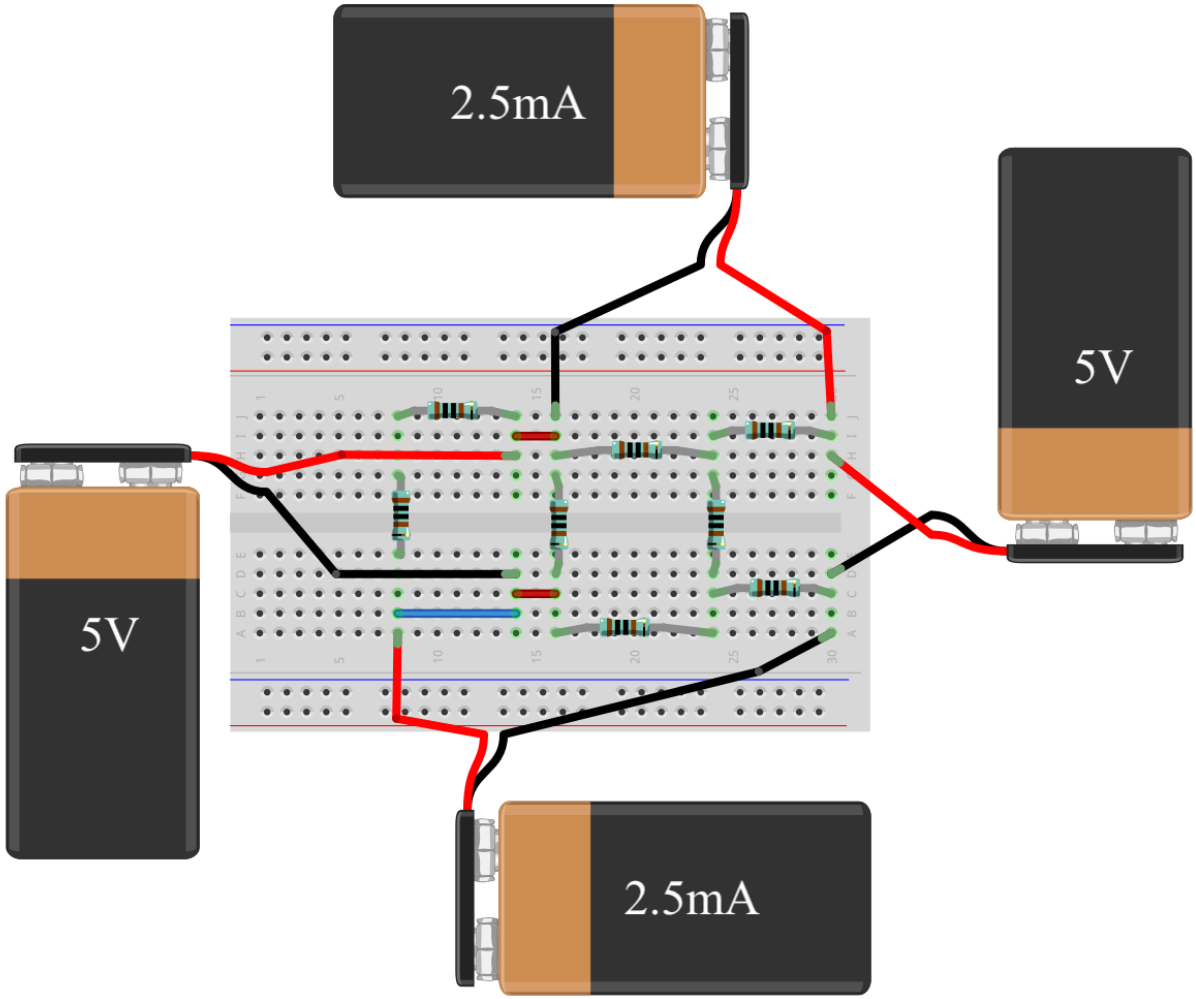
Node Variable	Measured value (V)	Modeled value (V)
u_1	4.94	5.00
u_2	3.30	3.33
u_3	1.65	1.67
u_4	0.00	0.00

Table III: Model verification

LANA Example 2: Advanced Circuit



LANA Example 2: Advanced Circuit



CMC^3 Example 2: Advanced Circuit

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & -1 & -1 \\ 0 & -1 & 2 & -1 \\ 0 & -1 & -1 & 3 \end{bmatrix} \begin{bmatrix} u_1 \\ u_3 \\ u_4 \\ u_6 \end{bmatrix} = \begin{bmatrix} 5 \\ 5 \\ 5 \\ -5 \end{bmatrix}$$

LANA Example 2: Advanced Circuit

Node Variable	Measured value (V)	Modeled value (V)
u_1	2.497	2.50
u_2	4.98	5.00
u_3	3.728	3.75
u_4	4.95	5.00
u_5	0.003	0.00
u_6	1.241	1.25
u_7	0.000	0.00

Table III: Model verification

Six Major Problems

	CALCULUS	LINEAR ALGEBRA
1.	$F(X) \in C^{(1)}(\mathbb{R})$	$A \in \mathbb{R}^{m \times n}$
2.	$\frac{d}{dx}\left[F(x) \right] = f(x)$	$A\,\mathbf{x} = \mathbf{b}$
3.	$\frac{d}{dx}\left[F(x) \right] = f(x)$	$A\,\mathbf{x} = \mathbf{b}$
4.	$\nabla\left[F(\mathbf{x}) \right] = \mathbf{f}(\mathbf{x})$	$\min_{\mathbf{x} \in \mathbb{R}^n} \|A\,\mathbf{x} - \mathbf{b}\|_2$
5.	$\nabla\left[F(\mathbf{x}) \right] = \mathbf{f}(\mathbf{x})$	$A\,\mathbf{x} = \lambda\,\mathbf{x}$
6.	$F(x) = \sum_{n=0}^{\infty} c_n\,(x-a)^n$	$A = U\,\Sigma\,V^*$

Your Feedback

Please work on back of survey

PART II: CURRENT WORK LOAD

8. How interested are you in trying this eigenvalue modeling activity in your classroom?

☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
Not at all interested					Very interested

9. What resources do you think you would need to implement this activity in your classroom?

10. What was your favorite part of this presentation?

Questions

Find or Contact me

Webpage:

appliedlinearalgebra.com

YouTube Channel:

AppliedLinearAlgebra.com