



AI First Engineering

FUNDAMENTALS OF AI-AUGMENTED ENGINEERING: A Conversational Approach

CHAPTER 8

LAB-8:

Group Report Template

From Matrix Predictions to Physical Evidence

One report per group. Fill it in during the lab, finish the analysis together, and submit it with your MATLAB script(s), the Stage C photo and every member's pre-lab.

Course / section	
Station number	
Lab date	
Submitted by (one member)	
Due	As announced by your instructor

PREDICT › BUILD › MEASURE › MODEL › COMPARE › INVESTIGATE
THINK › PSEUDOCODE › AI › CODE

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Team and Contribution Record

REVIEW NOTE How to use this template

- Grey italic text is guidance; replace or delete it when you write your answer.
- Record measurements during the lab with **every digit the meter shows** and the unit.
- Sections 1–6 are filled in **during** the session. Sections 7–10 are completed as a group afterwards.
- Use V, k Ω , mS and mA throughout. Keep 4 significant figures in computed values.
- Never edit a prediction after the matching measurement. If a prediction was wrong, say so and explain why.

List every member. Record the role each person held in each stage (Student Manual, Section 3). Every member initials the agreement statement below. A member who did not take part in the lab does not sign and is not listed as a contributor.

Member name	Stage A role	Stage B role	Stage C role	Evidence role
1.				
2.				
3.				
4.				

Member	Main contributions to the report (sections written, analysis, code, figures)	Initials
1.		
2.		
3.		
4.		

SIGN Agreement statement

We agree that the record above is accurate, that every member contributed meaningfully, and that the data in this report were measured by our group during our own lab session and were not changed to improve agreement. Initials of every member:

1. Committed Predictions (from the pre-lab)

Copy each member's pre-lab Q1 and Q2 answers BEFORE the lab begins. Disagreement inside the group is useful evidence — keep it.

Member	Q1: Stage A $\rightarrow$ B, V1 will ... because ...	Q2: Stage B $\rightarrow$ C, which of V1, V2 changes more? because ...
1.		
2.		
3.		
4.		

NOMINAL PREDICTIONS (VS = 5.00 V, NOMINAL RESISTANCES) — FROM THE CHOSEN GROUP SCRIPT

Stage	V1 (V)	V2 (V)	V3 (V)
A		—	—
B			—
C			

Which member's script did the group use, and did it pass the P3 self-test (both lecture circuits, r_{num} at round-off)?

Optional independent check: did the group also reduce the two lecture matrices in the Gauss-Jordan Stepper (lab.aifirstengineering.org/numerical-methods/gauss-jordan, Fractions mode) and obtain 2, 1 V and 25/13, 10/13, 5/13 V exactly? ☐ yes ☐ no ☐ not used

2. Station Checks (Stage 0)

Check	Result	Notes
Kit complete (Student Manual, Section 4)	☐ yes ☐ no	
Module seated at column 1; jumper on 5 V	☐ yes ☐ no	
LED lit in the Stage 0 check	☐ yes ☐ no	
Vs (Stage 0), meter reading	_____ V	
Polarity correct (reading positive)	☐ yes ☐ no	

3. Measured Inputs

Every resistor measured OUT of the board with the power OFF, before it was installed. The 1 % band is nominal $\times 0.99$ to nominal $\times 1.01$.

Resistor	Nominal (k Ω)	Measured (k Ω)	Within ± 1 % of nominal?	Measured by
R1	1.0		☐ yes ☐ no	
R2	10		☐ yes ☐ no	
R3	1.0		☐ yes ☐ no	
R4	2.2		☐ yes ☐ no	
R5	3.3		☐ yes ☐ no	
R6	4.7		☐ yes ☐ no	

Supply voltage	Vs (A)	Vs (B)	Vs (C)
Measured (V)			

Meter used for all readings (model and any note on settings, e.g. auto-ranging behaviour you observed):

4. Stage A — Voltage Divider

Quantity	Value	Unit
Predicted $V_1 = V_s(A) \cdot R_2 / (R_1 + R_2)$, measured inputs (recorded BEFORE measuring)		V
Measured V_1		V
$dV = V_{\text{meas}} - V_{\text{pred}}$		mV

Is the Stage A build trustworthy enough to continue? What evidence did you use?

5. Stage B — Two Unknown Nodes

5.1 MODEL

KCL equations at V_1 and V_2 (currents leaving each node sum to zero), in terms of $G_1 \dots G_4$ and V_s :

NUMERIC A AND B (MEASURED R_1 – R_4 , V_s (B))

	A: col 1	A: col 2	b (mA)
row 1			
row 2			

Entries of A in mS , b in mA . Use your MEASURED values; at least 4 significant figures.

5.2 RESULTS

Node	V_pred (V)	V_meas (V)	$dV = V_{\text{meas}} - V_{\text{pred}}$ (mV)	r_num (mA)	r_meas (mA)
V1					
V2					

Compare with your pre-lab Q1. Did V1 move from Stage A to Stage B as predicted? Explain physically, using where the new current through $R3$ and $R4$ comes from.

6. Stage C — Three Unknown Nodes

6.1 MODEL

KCL equations at V1, V2 and V3, in terms of G1...G6 and Vs:

NUMERIC A AND B (MEASURED R1–R6, VS (C))

	A: col 1	A: col 2	A: col 3	b (mA)
row 1				
row 2				
row 3				

Entries of A in mS, b in mA. Use your MEASURED values; at least 4 significant figures.

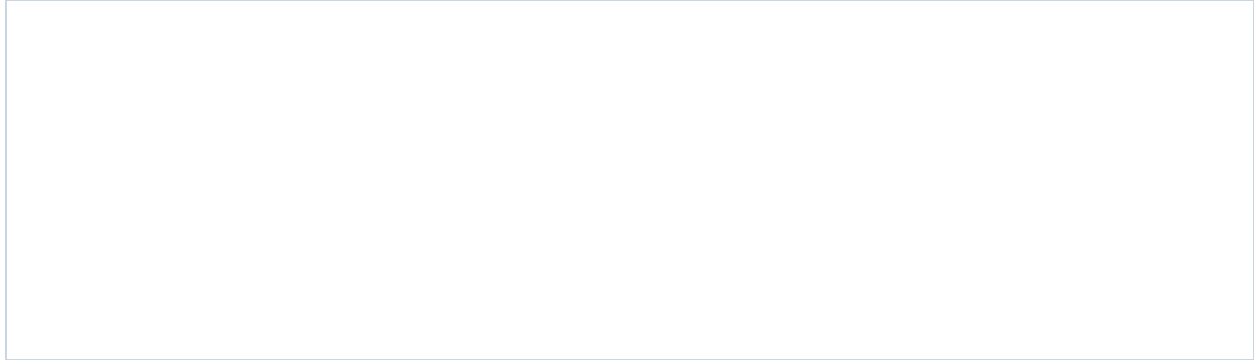
Why are entries (1,3) and (3,1) of A zero, even though V3 depends on V1?

6.2 RESULTS

Node	V_pred (V)	V_meas (V)	dV (mV)	r_num (mA)	r_meas (mA)
V1					
V2					
V3					

Optional independent check (not graded): enter your numeric Stage C A and b in the Gauss-Jordan Stepper (Decimals mode). Does its V agree with V_{pred} from A1b? ☐ yes, to _____ decimals ☐ no — which entry differs? _____ ☐ not used

Stage C photo: insert below, with the V s, $V1$, $V2$ and $V3$ strips labelled.



7. Coupling: Stage A → B → C

Measured node voltage (V)	Stage A	Stage B	Stage C	Change B → C (mV)
V1				
V2	—			
V3	—	—		—

Each stage has its own measured Vs. If Vs changed between stages, say how much of each change you think came from Vs and how much from the added resistors.

Was your group's Stage C prediction (which of V1, V2 changes more) correct? Explain with the circuit.

8. Evidence and Discrepancy

8.1 WHAT THE TWO RESIDUALS TELL YOU

Show algebraically that $r_{\text{meas}} = r_{\text{num}} + A \cdot dV$, so that $r_{\text{meas}} \approx A \cdot dV$. Then explain in your own words why a nonzero r_{meas} is not a failure of Kirchhoff's Current Law.

8.2 SENSITIVITY PROBE (STAGE C MODEL)

Increase ONE input by 1 % (Vs: by one step of its last displayed digit), re-solve, record the change in each predicted voltage, restore. Values in mV.

Input changed	$\Delta V1$ (mV)	$\Delta V2$ (mV)	$\Delta V3$ (mV)
R1 + 1 %			
R2 + 1 %			
R3 + 1 %			
R4 + 1 %			
R5 + 1 %			
R6 + 1 %			
Vs + one display digit			
Your measured dV (Stage C)			

Which input does each node depend on most? Compared with this sensitivity scale and with the meter's last digit, are your measured differences small, or clearly larger? Which path (agreement or discrepancy) does your evidence support?

8.3 INVESTIGATION (COMPLETE THE PATH YOUR EVIDENCE SUPPORTS)

PATH 1 Path 1 — Agreement

State the evidence for agreement, which input limits your confidence most, and what you would need in order to detect a smaller error. Do not invent a discrepancy.

PATH 2 Path 2 — Discrepancy

List the hypotheses you considered (your own and the AI's), the ONE discriminating measurement you made, and what it showed.

#	Hypothesis	Source (us / AI)	Discriminating measurement	Result: supported / ruled out
1				
2				
3				

9. AI Use and Verification Record

Required even if your use was small. If you did not use AI for some task, write "not used".

Task	Tool used	What you asked (short summary or prompt)	What you accepted / changed / rejected
Writing or debugging the MATLAB script			
Troubleshooting a discrepancy (Path 2 only)			
Other			

AI TEAMMATE Verified AI claim (required)

Quote or summarise ONE substantive claim an AI made (about your code, the circuit or a cause of discrepancy). State how you checked it independently — a hand calculation, the self-test, a measurement or a source — and whether it was correct.

10. Conclusion: Verification, Validation, Improvement

What did r_num establish, and what did it NOT establish?

What do your measurements establish about this model of THIS circuit, and within what limits?

One specific improvement to the experiment or the model, and the evidence that motivates it.

11. Attachments Checklist

Item	Attached?
MATLAB script(s) (.m) that reproduce Sections 5, 6 and 8.2	☐
Stage C photo with strips labelled (Section 6)	☐
Every member's pre-lab (P1–P4), including the AI-use note	☐
TA sign-off recorded	☐

12. Grading Rubric (35 points)

Criterion	Full credit looks like	Pts
Pre-lab and committed predictions	Every member's pre-lab attached; Q1/Q2 recorded before the lab; nominal predictions correct	4
Measured inputs and station checks	All six R measured out of circuit, every digit and unit; band check; Vs per stage	4
Stage data and procedure integrity	Predictions recorded before measurements in A, B, C; tables complete; photo	6
Model derivation	Correct KCL with the leaving convention; A and b correct in units; symmetry and zero entries explained	6
MATLAB	A\b (no inverse); r_num and r_meas computed; script runs and reproduces the tables; self-test passed	4
Evidence and investigation	$r_{\text{meas}} \approx A \cdot dV$ shown; sensitivity table used to judge differences; path chosen from evidence and carried out honestly	6
AI use and verification	Record complete; one substantive AI claim checked independently	3
Conclusion	Clear distinction between verification and validation; concrete, evidence-based improvement	2
Total		35

Differences between prediction and measurement are not penalised. Honest, well-reasoned evidence is graded; data that appear adjusted to agree are not accepted.

INSTRUCTOR / TA USE

Points awarded	Grader	Comments

13. Human Review and Approval

Before submitting, one member other than the main writer reads the full report and checks units, significant figures, that every table is filled, and that the script reproduces the numbers.

Reviewed by	Date	Issues found and fixed