ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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GitHub Repository as Handbook, Jupyter Notebook as Report

A Format Redesign for the Electrical Engineering II Lab

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Host Sponsor UNC Charlotte

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A Format Redesign for the Electrical Engineering II Lab

EE II Lab Background: Laplace transform, Frequency domain, Bode, First and Second order system response, ...

Key Overview: We are changing the delivery format of the lab, not the core experimental content

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Motivation I: The Cons of PDF Handbooks

Wall of Text

- Linear PDF formats lack structural hierarchy, in limited scaffolding for multi-hour labs (relying only on bookmarks)
- Hard to quickly rewind and cross-reference previous labs during an active experiment.

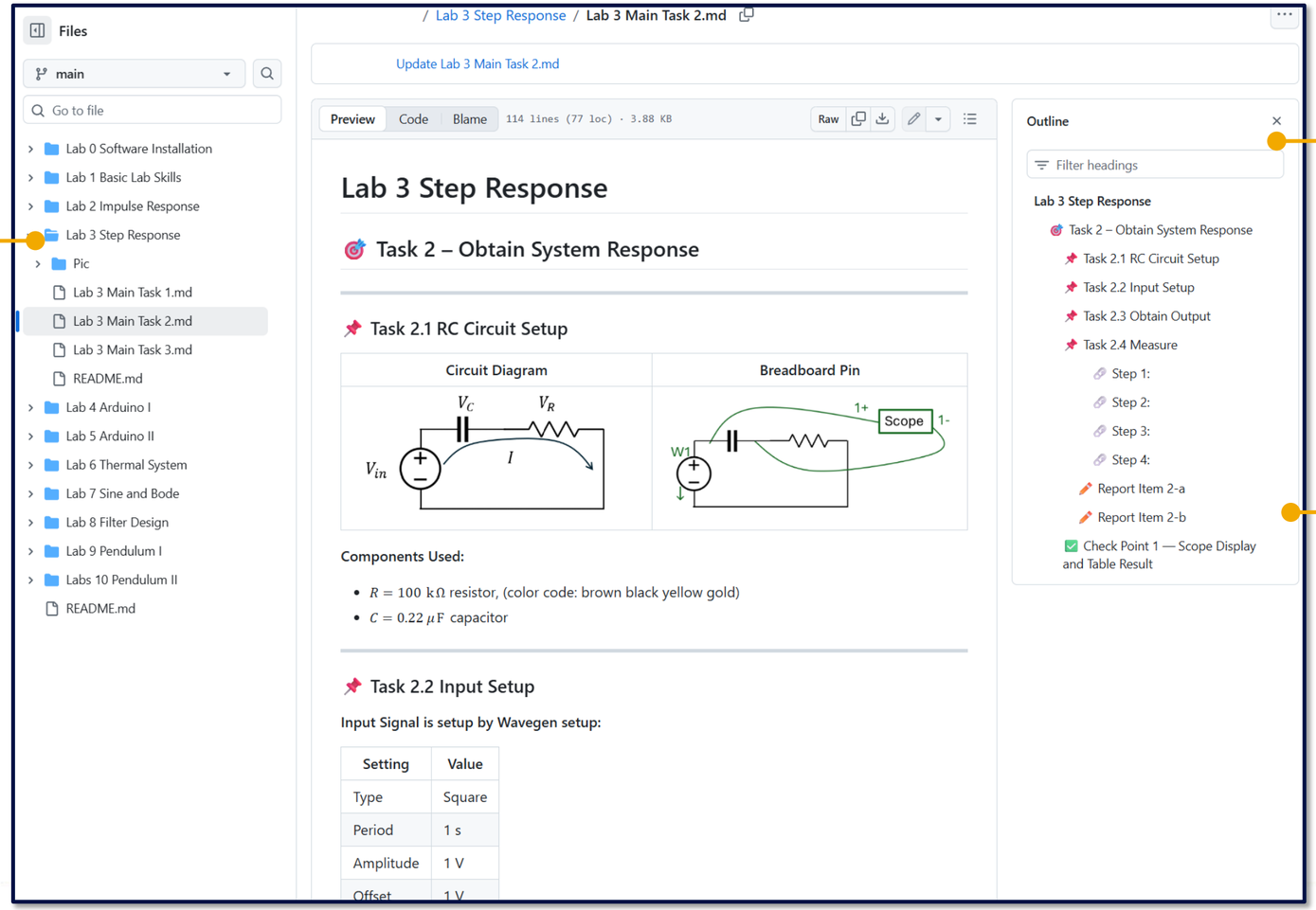
Broken Code

- Copying Arduino/Python code from a PDF often results in broken indentation, broken line wrapping.
- Difficult to setup code syntax highlighting in PDF.

Change I: Shift from PDF Handbooks to GitHub Repo

Weekly Modularity

Distinct weekly folders (e.g., Lab 3 Step Response) replace the PDF.



Hierarchical Navigation

Task outlines offers clear overview.

Explicit Deliverables

Tags like 'Report Item 2-a' explicitly indictate what must be shown in the report.

Features of GitHub Markdown for Lab Handbook

Copiable Code Block

```
Serial.print(millis());         // Print time in milliseconds
Serial.print(", ");
Serial.println(your_voltage, 3);
// your_voltage is a variable name
// Print voltage with 3 decimal places
```

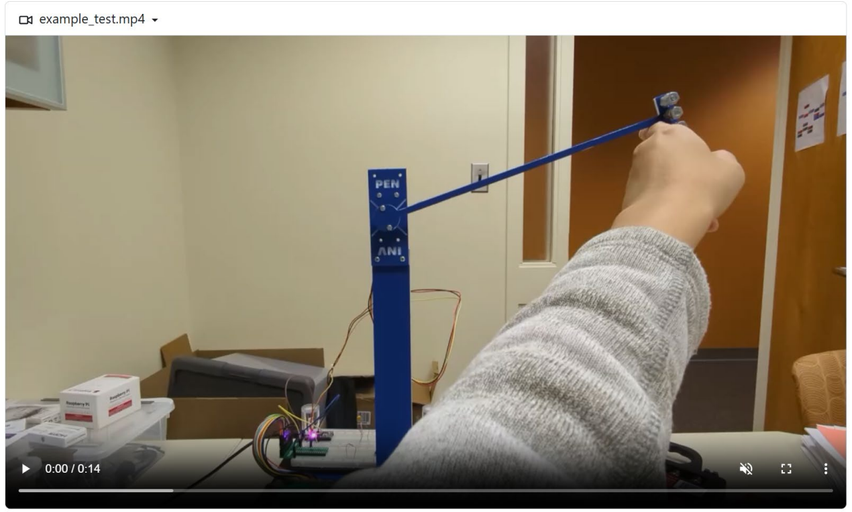
```python
import pandas as pd

file_path = '???.txt'
lab9_data = pd.read_csv(file_path, names=['Time', 'Voltage'])
print (lab9_data)
```

Markdown supports embedding syntax-highlighted code blocks.

Example: Arduino (top); Python (bottom)

Embedded Short Video



Short video clips embedded directly in handbook to demonstrate important hardware operations.

Features of GitHub Markdown for Lab Handbook

Latex Math Support

Compare the denominator of pendulum system model:

$$\frac{...}{s^2+\frac{b}{m\cdot l^2}s+\frac{g}{l}}$$

Versus the standard 2nd order transfer function:

$$\frac{...}{s^2+2\zeta\omega_n s+\omega_n^2}$$

```
26  Compare the denominator of pendulum system model:
27
28  $$\frac{...}{s^2+\frac{b}{m\cdot l^2}s+\frac{g}{l}}$$
29
30  Versus the standard 2nd order transfer function:
31
32  $$\frac{...}{s^2+2\zeta\omega_n s+\omega_n^2}$$
33
```

Top: math rendered in GitHub repo;

Bottom: actual typing in handbook.

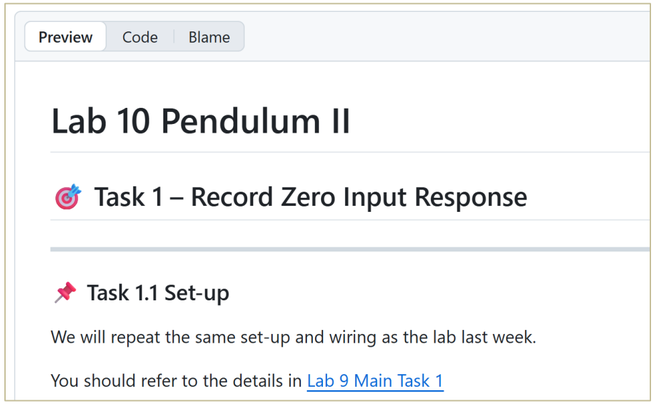
Color Highlight Blocks

> **Tip**
>
> Regarding to power term typing in Python
>
> 5×10^{3} can be typed as `5E3` in Python. 5×10^{-3} can be typed as `5E-3` in Python.

> **Note**
>
> Always record experiment data in 3 or more significant digits (figures)!

> **Caution**
>
> Never reverse the TMP 36 sensor's Vin and Gound connections.

Internal Links for Revisit



Students can jump back to Lab 9 handbook using the blue internal link.

Motivation II: The Cons of Traditional Reports

Calculator Dependency

- Relying on physical calculators for transfer-function analysis.
- Delays student exposure to modern scientific computing tools in Python.

Disjointed Data

- Experimental data files are isolated from reports.
- Students lack exposure to structured data analysis workflows.

Change II: Use Jupyter Notebooks as Reports

Markdown Documentation

- Students use Markdown format to write lab reports, including code, pictures, data, and other written details.

Python Scientific Computation

- Commonly used Python numpy library.
- Advanced Python scipy.signal library (specific for EE II), such as signal.lti, signal.impulse, signal.step, signal.bode, ...

Integrated Data Workflow

- Python Pandas library.
- Python MatPlotlib library.

Example Lab Report in Jupyter Notebook

Report Item 1-a

	Scope measurement
Period	1.995 ms
Amplitude	1.304 V

Report Item 1-b

```
[3]: import numpy as np

T = 1.995E-3
A = 1.304
omega = 2 * np.pi / T
print("Angular frequency =", omega, "rad/s")
```

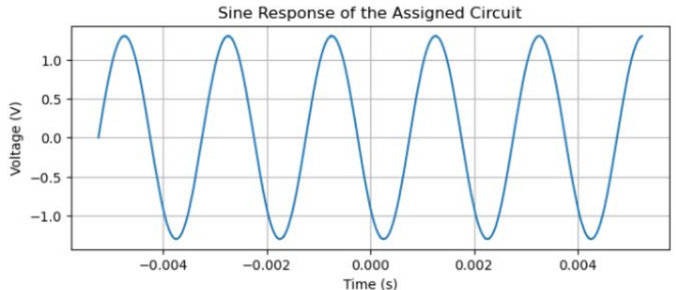
```
Angular frequency = 3149.466319388264 rad/s
```

Report Item 1-c

```
[4]: import pandas as pd
import matplotlib.pyplot as plt

file_path = 'default.csv'
lab_signal_data = pd.read_csv(file_path, sep=',', comment='#', skip_blank_lines=True)

# Plot data
plt.figure(figsize=(8, 3))
plt.plot(lab_signal_data['Time (s)'], lab_signal_data['Channel 1 (V)'])
plt.xlabel('Time (s)')
plt.ylabel('Voltage (V)')
plt.title('Sine Response of the Assigned Circuit')
plt.grid(True)
```



Change II: Use Jupyter Notebooks as Reports

The Experiment Data Workflow with Jupyter Notebook

1. Hardware Source

Analog Discovery or Arduino

2. Data Acquisition

Data	Image	
	Time (s)	Channel 1 (V)
1	-0.00512	0.00190734863281
2	-0.00511875	0.0154113769531
3	-0.0051175	0.0320434570313
4	-0.00511625	0.0468444824219
5	-0.005115	0.0619506835938
6	-0.00511375	0.0790405273438

Typically stored as CSV

3. Data Import

asee_demo.ipynb

Code

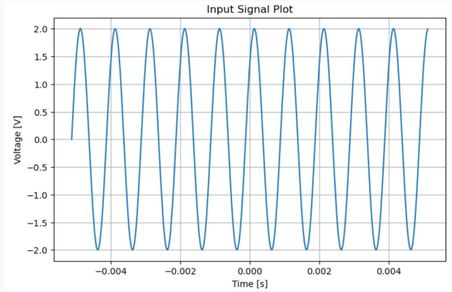
[7]:

	Time (s)	Channel 1 (V)
0	-0.005120	0.001907
1	-0.005119	0.015411
...	...	...
8190	0.005117	1.994476
8191	0.005119	1.996613

8192 rows × 2 columns

With Python Pandas

4. Data Analysis and Viz



With Python MatPlotlib

Assessment: Student Preference

Survey Results (Fall 2025 Data | N=41 responses from 64 enrolled students | 5-point scale)

Feel confident using scientific Python tools (NumPy, Pandas, SciPy) in an EE context.

Rate the GitHub manual as better than traditional PDF/paper manuals.

Recommend continuing the structured checkpoint workflow in future semesters.

Implementation Challenges

LMS Integration Gaps

- GitHub lacks integration with university Learning Management Systems (e.g., Blackboard).

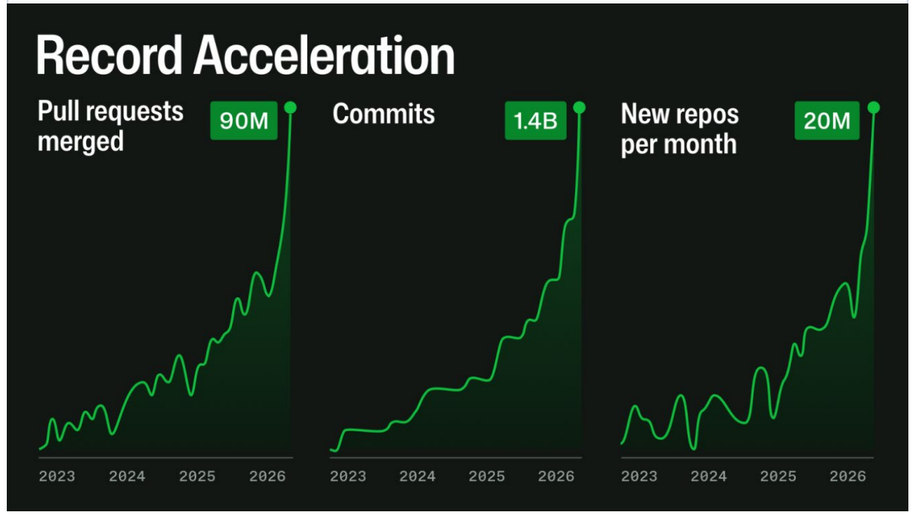
Report

> **Important**
>
> Submit individually as a PDF file.

To do so, export Jupyter Notebook as .html. Then convert .html to .pdf.

Platform Instability

- GitHub server under heavy load, especially since 2026 due to agentic AI



https://github.blog/news-insights/company-news/an-update-on-github-availability/

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Thanks!

The Lab Materials are available online:

https://github.com/BotYue/ELE-292-Lab-SU

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