

# COLA lab Report\*

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## Abstract

Abstract goes here. This is a placeholder text for the abstract section of the technical report. The abstract should provide a concise summary of the report's content, including the main objectives, methods, results, and conclusions. It should be written in a clear and accessible manner, allowing readers to quickly grasp the essence of the report without needing to read the entire document.

**Keywords:** technical report, LaTeX, template

**Project Repo:** [https://github.com/COLA-Laboratory/colalab\\_template](https://github.com/COLA-Laboratory/colalab_template)

## 1 Introduction

This template is intentionally minimal in formatting and focuses on structure. For LaTeX usage and conventions, see standard references such as [2, 1].

### 1.1 Problem Statement

### 1.2 Contributions

- Contribution 1.
- Contribution 2.
- Contribution 3.

### 1.3 System Overview (Example Figure)

As a placeholder example, Fig. 1 shows a simple “input-method-output” diagram. Replace it with a figure that matches your system or workflow.



**Figure 1:** Example overview diagram. Replace with a figure that matches your report.

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**Table 1:** Example notation table.

Symbol	Meaning
$n$	Number of samples
$d$	Feature dimension
$x_i \in \mathbb{R}^d$	Input feature vector
$y_i$	Target / label
$\theta$	Model parameters

## 1.4 Organization

The rest of this report is organized as follows. Section 2 covers background and definitions. Section 3 describes the methodology and core algorithm. Section 4 documents the experimental setup. Section 5 presents the results. Section 6 discusses limitations and implications. Section 7 concludes the report. Additional details can be placed in Appendix A.

## 2 Background and Preliminaries

### 2.1 Notation (Example Table)

Table 1 shows an example notation table. Replace the symbols and descriptions with those relevant to your report.

### 2.2 Definitions and Theorems (Examples)

**Definition 1** (Example Definition). *A technical report is a document that describes a technical problem, the adopted approach, and supporting evidence (e.g., experiments, proofs, or analyses) in a reproducible way.*

We will refer back to Definition 1 to illustrate cross-referencing in the template.

**Theorem 1** (Example Theorem). *For any real numbers  $a$  and  $b$ , we have  $a^2 + b^2 \geq 2ab$ .*

*Proof.* The claim follows from the fact that  $(a - b)^2 \geq 0$ , which expands to  $a^2 + b^2 - 2ab \geq 0$ . ■

### 2.3 Example Equation

Use numbered equations for results that you will reference. For example, a standard regularized least-squares objective is:

$$\min_{\theta} \quad \mathcal{L}(\theta) = \frac{1}{n} \sum_{i=1}^n \|f_{\theta}(x_i) - y_i\|_2^2 + \lambda \|\theta\|_2^2, \quad (1)$$

where  $\lambda \geq 0$  controls the amount of regularization.

### 2.4 Related Work (Placeholder)

## 3 Methods

### 3.1 Approach Overview

At a high level, the method takes input data  $D$ , applies a sequence of processing steps, and produces an output artifact (e.g., a model, a set of results, or a system). Refer back to Fig. 1 for the placeholder overview diagram.

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**Algorithm 1:** Example training loop.

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**Input:** Dataset  $D = \{(x_i, y_i)\}_{i=1}^n$ , hyperparameters  $\eta$   
**Output:** Trained parameters  $\theta$

- 1 Initialize  $\theta$  (e.g., randomly)
- 2 **for**  $t \leftarrow 1$  **to**  $T$  **do**
- 3    Sample a minibatch  $B \subseteq D$
- 4    Compute gradient  $g \leftarrow \nabla_{\theta}\mathcal{J}(\theta; B)$
- 5    Update  $\theta \leftarrow \theta - \eta g$
- 6 **return**  $\theta$

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### 3.2 Core Objective (Example Equation)

If your method can be described as an optimization problem, write the objective explicitly and reference it later. For example:

$$\min_{\theta} \quad \mathcal{J}(\theta) = \mathcal{L}(\theta) + \alpha\mathcal{R}(\theta), \quad (2)$$

where  $\mathcal{L}$  is a data-fit term,  $\mathcal{R}$  is a regularizer, and  $\alpha \geq 0$  balances the two.

### 3.3 Algorithm (Example Pseudocode)

Algorithm 1 shows a minimal example using `algorithm2e`. Replace it with your actual algorithm.

### 3.4 Complexity and Resources (Placeholder)

## 4 Experiments

### 4.1 Setup

- Hardware.
- Software.
- Randomness.

### 4.2 Datasets / Benchmarks (Example Table)

**Table 2:** Example dataset table (replace with your own).

Dataset	#Samples	#Features	Notes
Dataset-A	10,000	128	
Dataset-B	50,000	256	

### 4.3 Metrics (Example Definition)

For example, if you report mean squared error (MSE), define it explicitly:

$$\text{MSE} = \frac{1}{n} \sum_{i=1}^n (\hat{y}_i - y_i)^2. \quad (3)$$

### 4.4 Baselines and Ablations

- Baseline 1.
- Baseline 2.
- Ablation A.

## 4.5 Implementation Details

# 5 Results

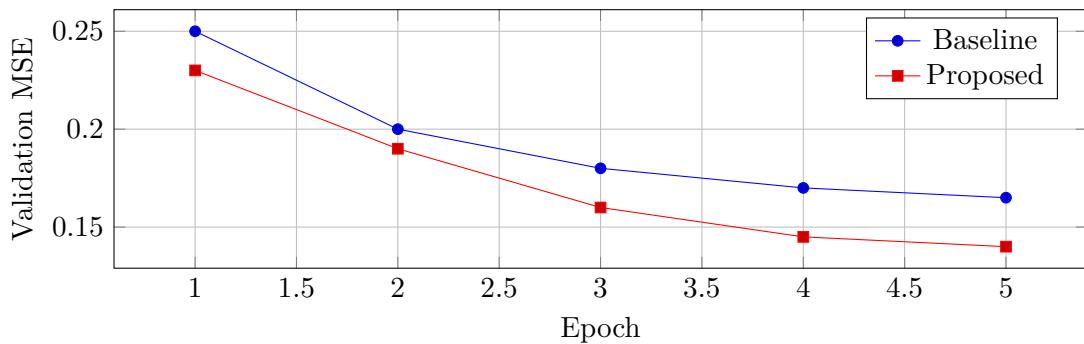
### 5.1 Main Results (Example Table)

**Table 3:** Example results table. Replace metrics and values with your own.

Method	MSE ↓	Runtime (s) ↓
Baseline	0.123	12.4
Proposed	0.101	13.1

### 5.2 Trend Visualization (Example Plot)

Fig. 2 is an example plot generated with `pgfplots`. Replace it with your actual figures.



**Figure 2:** Example learning curves. Replace with your plot or a figure via `\includegraphics`.

### 5.3 Key Takeaways

- Finding 1.
- Finding 2.
- Finding 3.

# 6 Discussion

### 6.1 Interpretation

### 6.2 Limitations

- Limitation 1.
- Limitation 2.
- Limitation 3.

### 6.3 Threats to Validity

### 6.4 Future Work

- Future work item 1.
- Future work item 2.

## 7 Conclusion

In this template, we demonstrated a typical technical-report structure with examples of cross-references (Section 2), equations (equation (1)), algorithms (Algorithm 1), tables (Table 3), and figures (Fig. 2).

## Acknowledgment

[Optional.] Acknowledge funding, collaborators, reviewers, and other support.

## References

- [1] Donald E. Knuth. *The TeXbook*. Addison-Wesley, 1984.
- [2] Leslie Lamport. *LaTeX: A Document Preparation System*. Addison-Wesley, 2 edition, 1994.

**Table 4:** Example appendix table.

Setting	Metric-1	Metric-2
Variant A	0.42	1.7
Variant B	0.39	1.9

## A Additional Details

### A.1 Extended Results (Example Table)

### A.2 Extra Notes