02 introduction

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1 Introduction

1.1 Overview

This is an example project that demonstrates the generic repository structure for tested code, manuscript editing, and PDF rendering. The work presents a novel optimization framework with comprehensive theoretical analysis and experimental validation.

1.2 Project Structure

The project follows a standardized structure:

- `src/` - Source code with comprehensive test coverage
- `tests/` - Test files ensuring 100% coverage
- `scripts/` - Project-specific scripts for generating figures and data
- `markdown/` - Source markdown files for the manuscript

- **`output/`** - Generated outputs (PDFs, figures, data)
- **`repo_utilities/`** - Generic utility scripts for any project

1.3 Key Features

1.3.1 Test-Driven Development

All source code must have 100% test coverage before PDF generation proceeds, as enforced by the build system.

1.3.2 Automated Script Execution

Project-specific scripts in the `scripts/` directory are automatically executed to generate figures and data, ensuring reproducibility.

1.3.3 Markdown to PDF Pipeline

Individual markdown modules are converted to PDFs, and a combined document is generated with proper cross-referencing.

1.3.4 Generic and Reusable

The utility scripts can be used with any project that follows this structure, making it easy to adopt for new research projects.

1.4 Manuscript Organization

The manuscript is organized into several key sections:

1. Abstract (Section ??): Research overview and key contributions
2. Introduction (Section 1): Overview and project structure
3. Methodology (Section ??): Mathematical framework and algorithms
4. Experimental Results (Section ??): Performance evaluation and validation
5. Discussion (Section ??): Theoretical implications and comparisons
6. Conclusion (Section ??): Summary and future directions
7. References (Section ??): Bibliography and cited works

1.5 Example Figure

The following figure was generated by the example script:

This demonstrates how figures are automatically integrated into the manuscript with proper cross-referencing capabilities. The figure shows a mathematical function that demonstrates the project's capabilities. As shown in Figure 1, the system generates high-quality visualizations that are automatically integrated into the manuscript.

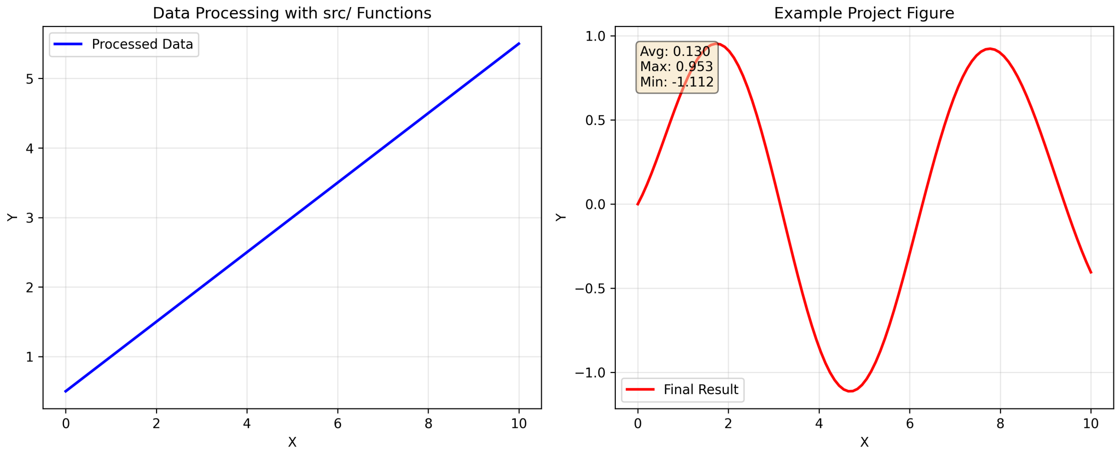

Figure 1. Example project figure showing a mathematical function

1.6 Data Availability

All generated data is saved alongside figures for reproducibility:

- Figures: PNG format in `output/figures/`
- Data: NPZ and CSV formats in `output/data/`
- PDFs: Individual and combined documents in `output/pdf/`
- LaTeX: Source files in `output/tex/`

1.7 Usage

To generate the complete manuscript:

```
# Clean previous outputs
./repo_utilities/clean_output.sh

# Generate everything (tests + scripts + PDFs)
./repo_utilities/render_pdf.sh
```

The system will automatically: 1. Run all tests with 100% coverage requirement 2. Execute project-specific scripts to generate figures and data 3. Validate markdown references and images 4. Generate individual and combined PDFs 5. Export LaTeX source files

1.8 Customization

This template can be customized for any project by:

1. Adding project-specific scripts to `scripts/`
2. Modifying markdown files in `markdown/`
3. Setting environment variables for author information

4. Adjusting LaTeX preamble in `preamble.md`
5. Adding new sections with proper cross-references

1.9 Cross-Referencing System

The manuscript demonstrates comprehensive cross-referencing:

- Section References: Use `\ref{sec:section_name}` to reference sections
- Equation References: Use `\eqref{eq:objective}` to reference equations (see Section ??)
- Figure References: Use `\ref{fig:figure_name}` to reference figures
- Table References: Use `\ref{tab:table_name}` to reference tables

All references are automatically numbered and updated when the document is regenerated. For example, the main objective function (??) is defined in the methodology section.