# Project Report

## Introduction

The digital logic simulator project aims to create a user-friendly, interactive environment for building and testing digital circuits. The primary goal is to address usability issues encountered in existing simulators, like Logisim, and incorporate successful features such as a grid layout, panning, and zooming.

## Background

Logisim, a key reference for this project, offers valuable lessons in user experience and functionality. However, its wiring system presented significant usability challenges, prompting the development of this simulator. By improving the user interface and streamlining the wiring process, this project seeks to enhance the digital circuit design experience.

## Methodology

The project adopted an agile development methodology, with iterative testing and refinement. Java Swing was used for the graphical user interface, ensuring cross-platform compatibility and ease of use. A focus on modularity allowed for flexible addition or alteration of components during the development process.

## Implementation Details

The simulator is being implemented in phases, starting with a large-scale skeleton overview of the project. Each item is being added in incremental steps. For example, the grid is first being created statically without zooming and panning, and will be expanded to include these features.

# Testing and Evaluation

Testing was conducted informally through debugging sessions.

# Results and Discussion

The first week took a lot of trial and error learning about Java Swing, brainstorming the architecture of the project, and working with ChatGPT effectively.

# Conclusion

Now that a larger framework has become clearer in the design process, the next weeks of adding additional features should be easier.

# References and Appendices


- Logisim software
- Java Swing documentation

# User Manual

## Setup

Launch the Application by running the App.java file `/src/main/java/logicsim/App.java`.

## Functionality

Current functionality is limited. Hover over items in the Logic Component Pallete on the left-hand side to select a Logic Gate. Clicking within the Rectangle will show a message within the Console Standard Output of the program.

## Future Functionality

### Adding Components

Clicking a component or clicking and dragging a component will allow you to add the Logic Gate to the Grid on the right-hand side. Each logic gate will be able to be rotated, as well as have its inputs or outputs negated.

### Wiring

Click and drag from the input-end or output-end of any component to connect wires between components.

# Design Manual

## Architecture Overview

The application is structured around the main `App` class, which extends `JFrame`. It orchestrates the overall layout and interactions between the `PalettePanel`, `GridPanel`, and `TopMenuBarPanel`.

- `App`: Serves as the main entry point and container for the application. It initializes and arranges the primary panels.
- `TopMenuBarPanel`: Extends `JPanel` and includes menu items for actions like saving, loading, undoing changes, adjusting settings, and accessing information about the application.
- `PalettePanel`: Extends `JPanel`, contains a collection of `PaletteComponents`, and handles mouse events for interactions with these components.
- `GridPanel`: Also extends `JPanel` and is responsible for displaying the grid, logic gates, and wires. It manages mouse interactions and holds references to `GridLogicHandler`.
- `GridLogicHandler`: Handles the logic related to the grid, including interactions with logic gates and wires.
- `PaletteComponent`: Represents a draggable component in the `PalettePanel` with properties such as `logicGate` and `bounds`. It includes a `draw()` method for rendering.
- `LogicGate`: An abstract class extended by specific gate types like `ANDGate`. It provides essential methods like `draw()`, `contains()`, and `output()` to handle logic gate functionalities.

Each of these components works together to provide a comprehensive digital logic simulation environment.

# Design Patterns

## Flyweight

The `LogicGate` instances are shared among `PaletteComponents` to minimize memory usage. Only the position and orientation are unique to each `PaletteComponent`.

## State

The `GridLogicHandler` will potentially implement the State pattern to step through the circuit states, much like a debugger stepping through code.

# Component Descriptions

## App

At the top of the architectural hierarchy is the App class. This launches and initializes the application and creates a layout for the TopMenuBarPanel, PalettePanel, and GridPanel.

## TopMenuBarPanel

The TopMenuBarPanel will contain commands for saving and loading circuits.

## PalettePanel

The PalettePanel displays PaletteComponents which each house a LogicGate component.

## GridPanel

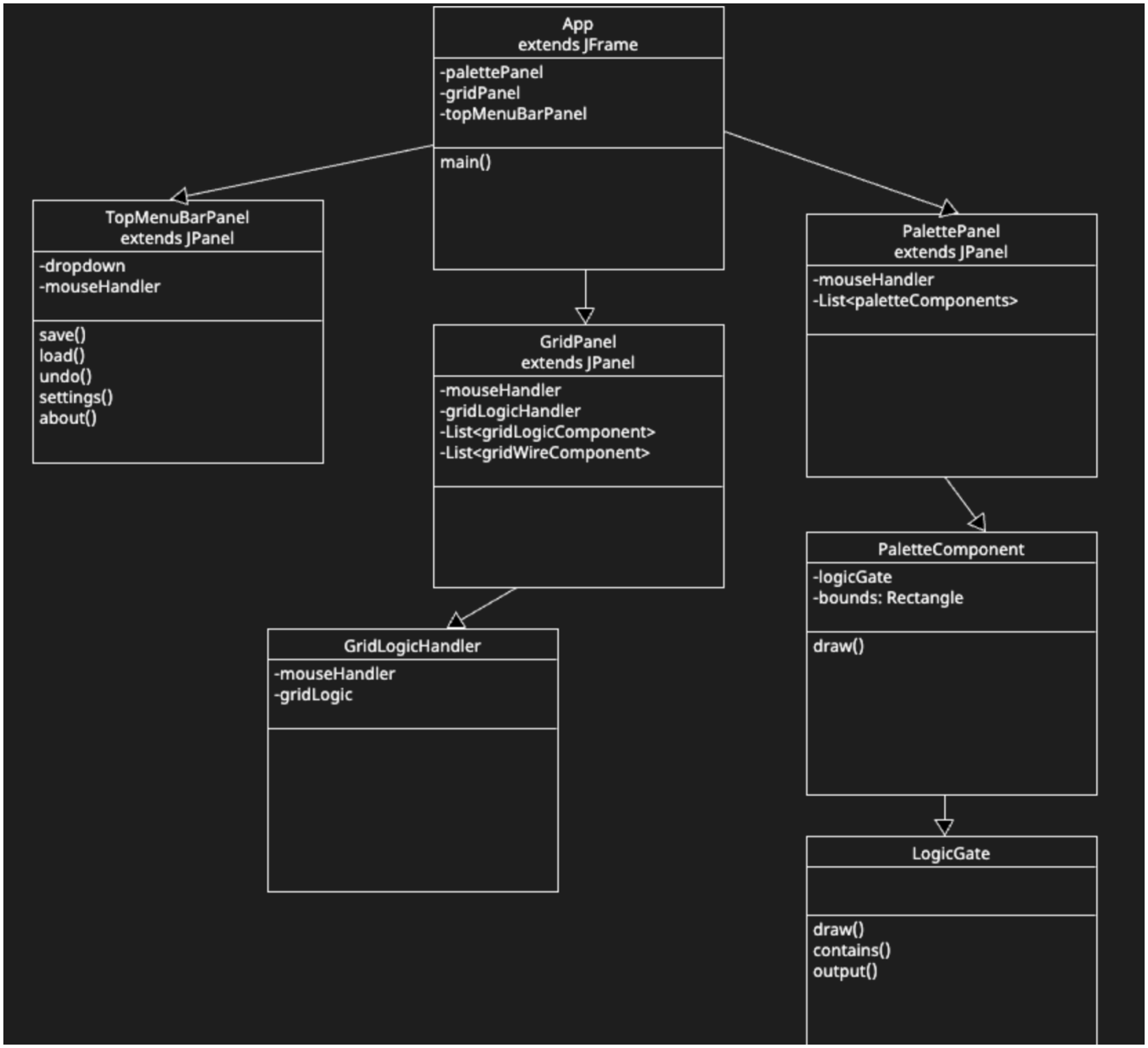
The GridPanel displays a grid and the current view of the logic gates and wires. In future updates, a CircuitLogic class will be added that calculates outcomes based on the circuit on the grid.

## LogicGate

Logic Gates are currently implemented as an abstract class which is extended by each gate

such as ANDGate.

# Diagrams




# Standards and Conventions

The project adheres to Java's camelCase naming convention, with classes beginning with uppercase letters, methods as verbs, and objects as nouns.