System Documentation

Name: Strimbeanu Mihai Alexandru

Class: CEN4.S2A

1. Introduction

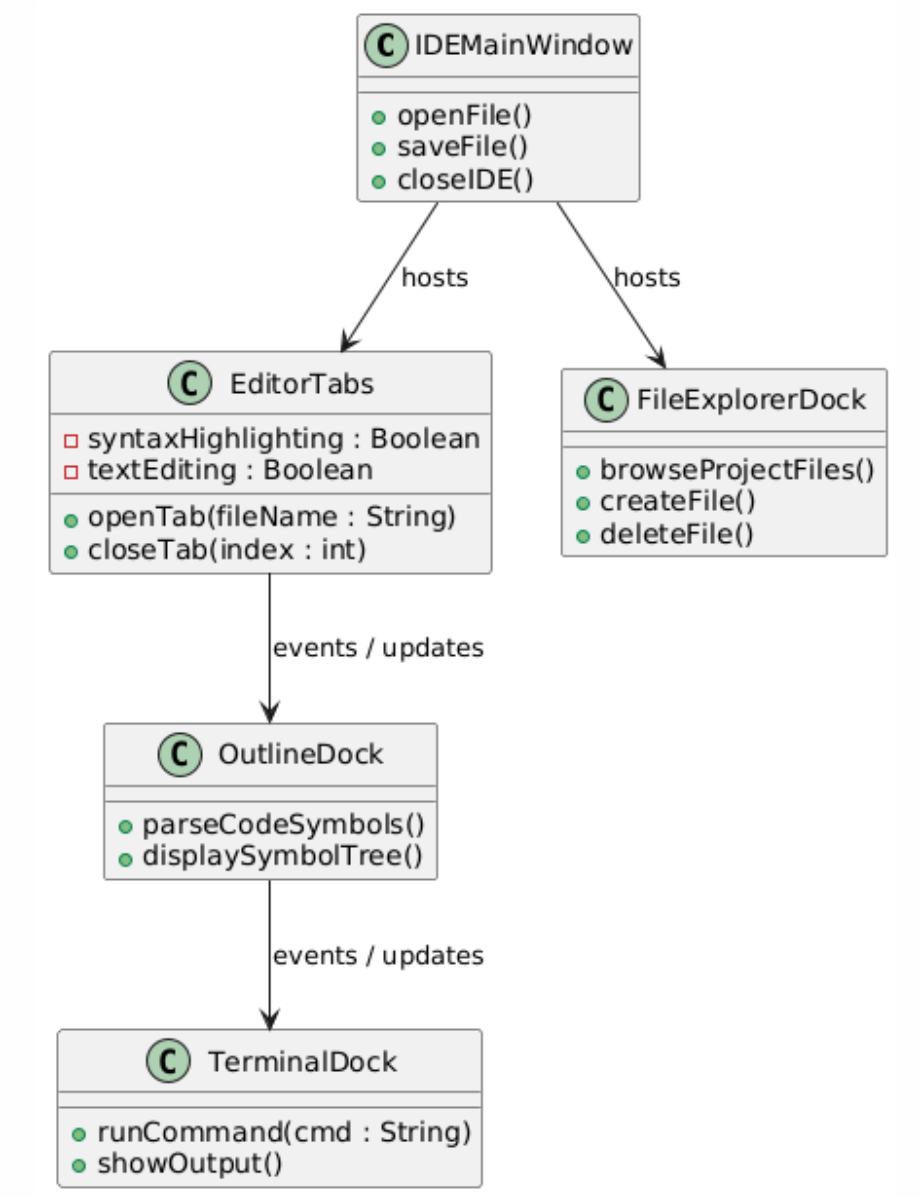
This document provides a comprehensive overview of the custom IDE-like application developed by *Strimbeanu Mihai Alexandru (CEN4.S2A)*.

The system offers:

- A **PySide6-based** GUI layout
- A **File Explorer** panel supporting basic file operations (create, rename, delete)
- A **Tabbed Code Editor** with syntax highlighting for Python and C
- An **Outline** panel that displays code symbols (functions, classes, etc.)
- An **Integrated Terminal** to run commands and view output
- A **Menu Bar** with essential file, edit, view, and run features

This documentation details the application's architecture, features, and implementation details.

2. High-Level Architecture



Major Components

1. **Main Window (`IDEMainWindow`)**

2. The top-level controller managing layout, docks, and the menu bar.

    Hosts references to the editor tabs, file explorer, outline, and terminal docks.

3. **File Explorer (`FileExplorerDock`)**
    - Dock on the left, allowing directory navigation and file actions (open, rename, etc.).
    - Sends open-file events to the editor.
4. **Tabbed Code Editor (`EditorTabs`)**
    - Manages multiple open files in tabs.
    - Invokes Python/C syntax highlighting based on file extension.
    - Allows saving, closing, and pinning tabs.
5. **Outline Panel (`OutlineDock`)**
    - Displays hierarchical symbols (classes, functions) extracted from the active file.
    - Clicking a symbol navigates the editor to its line.
6. **Terminal (`TerminalDock`)**
    - Dock at the bottom with a text output view and command input line.
    - Runs commands (e.g., Python scripts, GCC builds) via `QProcess`.
    - Outputs merged stdout/stderr.
7. **Syntax Highlighting**
    - **Python**: `tokenize`-based approach with optional second pass for advanced features.
    - **C**: Regex-based highlighting for keywords, function calls, comments, numbers, etc.

3. Key Features

1. **File Explorer**
    - Navigate directories
    - Right-click context menu to create, rename, or delete files/folders
    - Double-click to open files in the editor
2. **Tabbed Editor**
    - Multiple files open at once
    - Syntax highlighting (Python `.py` and C `.c`)
    - Basic editing commands (cut, copy, paste, undo, redo)
    - Pin tabs to prevent accidental closure
3. **Outline**
    - Parses Python or C files to find top-level symbols (classes, functions, preprocessor directives, etc.)
    - Refreshes on tab switch or file save
    - Clicking a symbol jumps the editor's cursor to that line

4. **Terminal**
    - Embedded command line using `QProcess`
    - Allows running arbitrary shell commands (like `python`, `gcc`, `git`)
    - Displays merged stdout and stderr output
    - "Refresh Terminal" feature clears and re-initializes the terminal
5. **Menu Bar**
    - **File**: Open Folder, Save, Exit
    - **Edit**: Cut, Copy, Paste, Undo, Redo
    - **Run**: Execute current Python or C file
    - **View**: Toggle visibility of File Explorer, Outline, Terminal
    - **Settings**: Placeholder (e.g., for preferences)

4. System Flows (Use Cases)

1. **Open a Folder**
    - User selects a directory from "File > Open Folder."
    - `FileExplorerDock` updates its root path to the chosen directory.
    - The directory tree is displayed in the explorer.
2. **Open a File**
    - User double-clicks a file in the file explorer.
    - `EditorTabs.open_file()` loads the file, applies syntax highlighting based on the extension.
3. **Edit and Save Files**
    - User edits in the `QPlainTextEdit`.
    - Pressing Ctrl+S (or "File > Save") writes changes to disk.
    - Outline can be refreshed if the file structure changed.
4. **Outline Navigation**
    - When the active tab changes, `OutlineDock.refresh_outline()` re-parses the file.
    - Clicking on a symbol in the outline sets the editor's cursor to that line.
5. **Run Code**
    - If active file is a `.py` file, the IDE runs `python file.py` in the terminal.
    - If active file is a `.c` file, it runs `gcc file.c -o file.exe && .\file.exe` (Windows) or similar.
    - The terminal displays command output interactively.
6. **Terminal Commands**
    - User can manually enter commands (e.g., `git status`, `dir`, etc.) and see outputs.

5. Implementation Details

5.1 Technologies

- **Python 3**
- **PySide6** (Qt for Python)
- **Syntax Highlighters**:
  - Python: Built-in `tokenize`
  - C: Regex-based with naive multiline comment handling
- **File Explorer**: `QFileSystemModel` or custom logic
- **Terminal**: `QProcess` capturing merged stdout/stderr

5.2 Project Structure

IDE_Project/

main.py	# Entry point
mainwindow.py	# IDEMainWindow: sets up docks, menu, layout
editor.py	# EditorTabs + syntax highlighter classes
fileexplorer.py	# FileExplorerDock
outline.py	# OutlineDock: parses Python/C for symbols
terminal.py	# TerminalDock: handles QProcess commands

5.3 Editor Behavior

- Every open file is a `QPlainTextEdit` in `EditorTabs`.
- `_apply_highlighting(editor, file_path)` picks Python or C highlighter.
- Tab key can be set to insert spaces or keep `\t`; `setTabStopDistance()` sets visual width.

5.4 Outline Logic

- **Python**: Uses `ast` or `tokenize` to find `def` and `class` plus line numbers.
- **C**: Uses custom regex or partial parser for function definitions, macros, preprocessor lines.
- Clicking an item moves the editor's cursor using `QTextCursor` to that line.

5.5 Terminal Logic

- A `QLineEdit` for command input, `QPlainTextEdit` for output.
- On Enter or programmatic `execute_command(cmd)`, the system starts a `QProcess`.
- Output is appended to the text area, and a new prompt appears upon completion.

6. Deployment and Setup

1. **Install Python 3.9+**
2. **Install PySide6 and denepdencies**
3. **Run**

7. Known Limitations

- **Python** highlighting is limited by `tokenize`; advanced function/argument coloring requires an extra pass or a more robust parser.
- **C** highlighting uses naive regex; multiline macros, advanced pointer syntax, or complex definitions may break.
- **No real-time Outline**: Outline updates primarily on tab switch or manual refresh.
- **No debugging**: Currently no integrated stepping or breakpoints.

8. Future Enhancements

1. **More Advanced Parsing**
    - Use a *concrete syntax tree* library (e.g., LibCST) for Python, or more advanced solutions for C.
2. **Autocomplete / IntelliSense**
    - Integrate with a Language Server Protocol for code completion and error checking.
3. **Debugging Interface**
    - Add breakpoints, stepping, variable watch windows.
4. **Real-Time Outline**
    - Continuously re-parse as the user types, possibly with a slight delay to avoid performance issues.
5. **Version Control**
    - Integrate Git commands in the IDE with a dedicated panel or tab.

9. Conclusion

This IDE project demonstrates a functional yet extensible code editor with:

- **Multi-file editing**
- **File system navigation**
- **Symbol-based outline**
- **Terminal command execution**

While not as feature-complete as large commercial IDEs, it provides a solid foundation for advanced extensions in parsing, debugging, and project management.