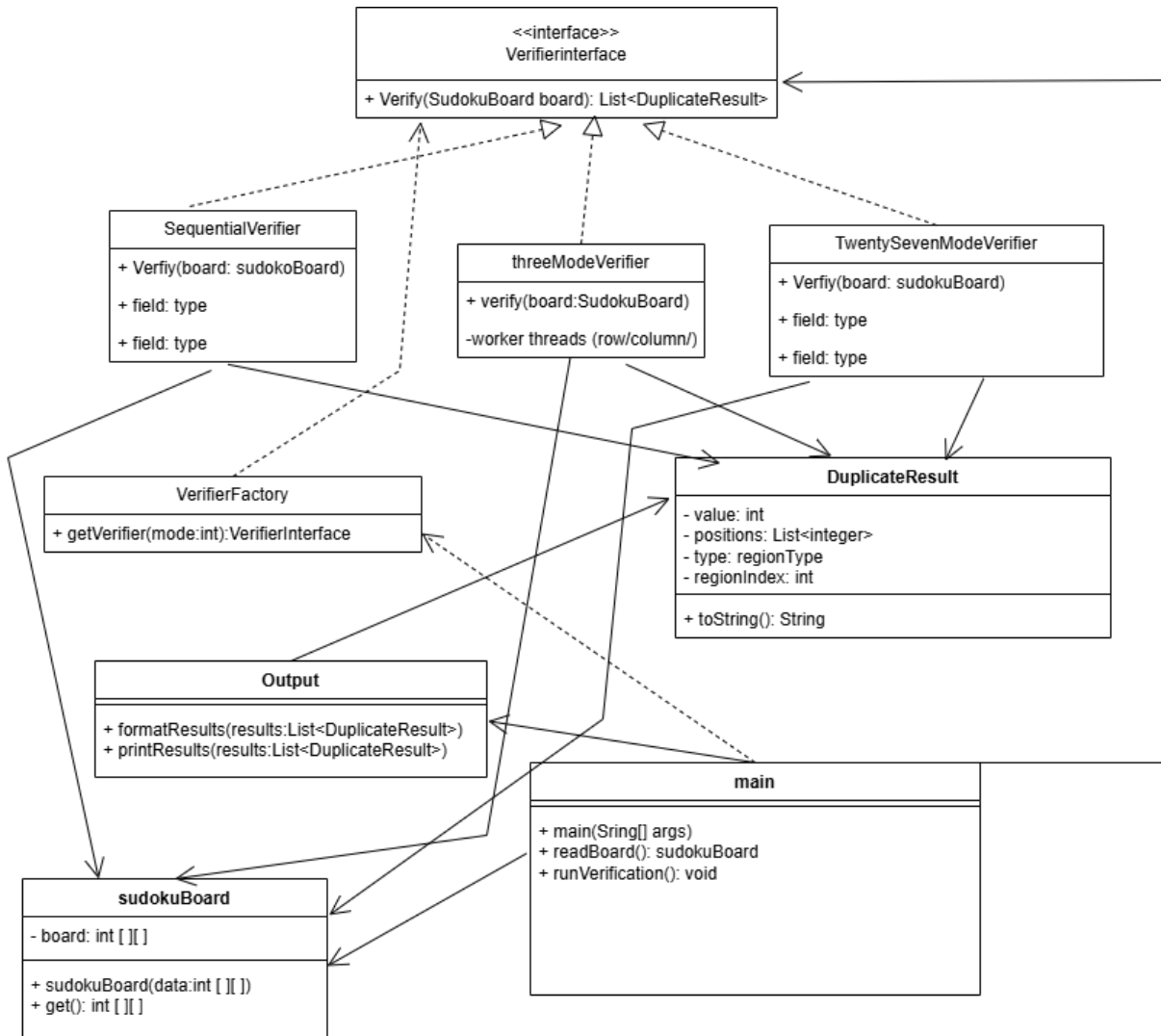# 1. Class Diagram

2. Sequence Diagram

Participants: User, Main, SudokuBoard, FileSystem, CSVParser, VerifierFactory, SequentialVerifier, ThreeModeVerifier, TwentySevenModeVerifier, ThreadPool, DuplicateResult, Output

Program Start

- User → Main: Start application
- Main → User: Request CSV file path + mode
- User → Main: Provide path, mode

Board Loading

- Main → SudokuBoard: fromCSV(path)
- SudokuBoard → FileSystem: readAllLines(path)
- FileSystem → SudokuBoard: List<String> lines
- SudokuBoard → CSVParser: parse lines (split, trim, validate)
- CSVParser → SudokuBoard: 9x9 int[][] grid
- SudokuBoard: validate 1..9, validate row count, validate col count
- SudokuBoard → Main: SudokuBoard instance

Verifier Selection

- Main → VerifierFactory: getVerifier(mode)
- **alt [mode == 0]**
  - VerifierFactory → SequentialVerifier: new SequentialVerifier()
- **alt [mode == 3]**
  - VerifierFactory → ThreeModeVerifier: new ThreeModeVerifier()
- **alt [mode == 27]**
  - VerifierFactory → TwentySevenModeVerifier: new TwentySevenModeVerifier()

Verification Phase

- Main: select correct verifier based on mode
- **alt [Sequential Mode (0)]**
  - Main → SequentialVerifier: verify(board)
  - SequentialVerifier: scan rows
  - SequentialVerifier: scan columns
  - SequentialVerifier: scan boxes
  - SequentialVerifier → DuplicateResult: create objects for duplicates
  - DuplicateResult → SequentialVerifier: instances
  - SequentialVerifier → Main: List<DuplicateResult>
- **alt [Three-Thread Mode (3)]**
  - Main → ThreeModeVerifier: verify(board)
  - ThreeModeVerifier → ThreadPool: newFixedThreadPool(3)
  - ThreeModeVerifier → ThreadPool: submit(rowTask)
  - ThreeModeVerifier → ThreadPool: submit(columnTask)
  - ThreeModeVerifier → ThreadPool: submit(boxTask)
  - **par [Row thread]**
    - DuplicateResult*
  - **par [Column thread]**
    - DuplicateResult*
  - **par [Box thread]**
    - DuplicateResult*
  - ThreadPool: shutdown() awaitTermination()
  - ThreeModeVerifier → Main: List<DuplicateResult>
- **alt [Twenty-Seven-Thread Mode (27)]**
  - Main → TwentySevenModeVerifier: verify(board)
  - TwentySevenModeVerifier → ThreadPool: newFixedThreadPool(27)
  - **loop [submit 9 row tasks]**
    - submit(rowTask[i])
  - **loop [submit 9 column tasks]**
    - submit(colTask[i])
  - **loop [submit 9 box tasks]**
    - submit(boxTask[i])
  - **par [all 27 tasks return]**
    - DuplicateResult*
  - ThreadPool: shutdown() awaitTermination()
  - TwentySevenModeVerifier → Main: List<DuplicateResult>

Output Formatting

- Main → Output: formatResults(results)
- Output: group rows, cols, boxes sort by index + value
- Output → Main: formatted text
- Main → User: print formatted output