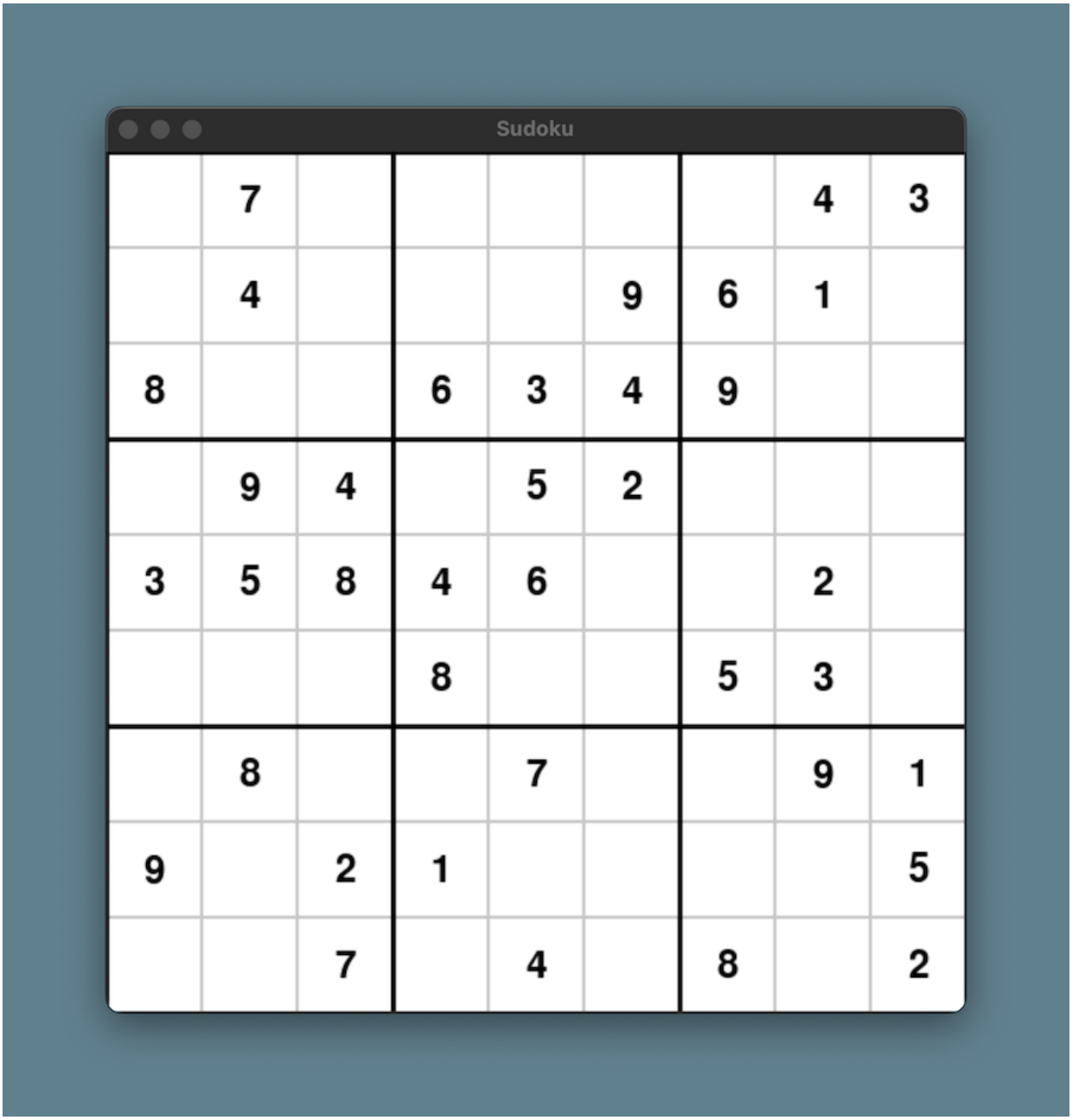
CS131 A4 Sudoku Solver

Bix von Goeler This project implements a Sudoku solver by turning the puzzle into a constraint satisfaction problem (CSP). The project includes a GUI for visualizing the solving process.



Requirements

- Tested using `Python 3.11`
- Install: `pygame` for GUI and visualization
- Install: `numpy` for numerical operations and sudoku grid representation
- Or run: `pip install -r requirements.txt` inside project directory

Running The Project

1. Run the project using `python main.py` and optionally the following args:
   - `-s SPEED`: Millisecond Delay Between Solve Steps (default 15)
   - `-p PUZZLE`: Puzzle to solve: [easy | evil | rand] (default evil)
   - `-h`| `--help`: Show and explain these options again
2. The GUI will open, displaying the grid and the current puzzle.
3. Use the following keys to control the simulation:
   - `spacebar`: Start the solver
4. When finished exit the program by closing the window or with `^C` in the terminal.

Structure and Assumptions

This implementation uses several constraint satisfaction principles:

Domain Initialization:

Each empty cell starts with a domain of possible values (1-9) that don't conflict with existing numbers.

Variable Selection Heuristics:

Minimum Remaining Values (MRV): Selects cells with the fewest possible values first. Degree Heuristic: When there's a tie, selects the cell that constrains the most other cells.

Forward Checking:

After each assignment, we update the domains of related cells and check for cells with empty domains. Backtracking: If an assignment leads to a dead end, it undoes the assignment and tries the next value.

Random Dataset:

The rand puzzle option chooses a random puzzle from a large dataset of puzzles. The easy and evil options complete the puzzles required by assignment spec.

Real-time Visualization:

The solver works step-by-step, integrated into the game loop. The current cell being considered is highlighted in yellow. Filled-in values are shown in blue to distinguish from the original puzzle.