BLG 458E - Functional Programming
Homework 2 Report

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May 2025

Problem Definition

This homework implements the Schelling Segregation Model, a classic agent-based model of social dynamics introduced by Thomas Schelling in 1971. It shows how agents with minimal preference for similar neighbors can collectively produce large-scale segregation. The world is represented as a 200×200 grid where agents relocate until they are satisfied with their neighborhood composition.

Implementation Motivation

The main objective is to explore how simple individual preferences lead to emergent macro-level behavior. Implementing this in Haskell allows the use of pure functional paradigms to handle simulation logic, while Julia is utilized for grid generation and result visualization. This two-language hybrid also demonstrates how Haskell can be integrated into practical data-driven tasks.

Implementation Explanation

The simulation is carried out through two files:

- `schelling_withhaskell.jl`: Generates a randomized grid, saves it to a file, calls Haskell, and visualizes the results.
- `haskell_schelling.hs`: Executes the simulation logic. Each agent checks its happiness and relocates if necessary until no more unhappy agents remain.

Key Haskell Functions

- `isHappy`: Determines whether an agent is satisfied with its current neighbors.
- `runSchellingStep`: Moves all unhappy agents to suitable empty positions.
- `simulateUntilHappy`: Recursively performs simulation steps until convergence.
- `placeAll`: Assigns agents to new positions and clears their original cell.

Parameters Used

- Grid size: 200×200
- Agent types: Admirers (blue = 1), Haters (red = 2)
- Empty cell ratio: 20%
- Happiness threshold: 40%

Results

The simulation begins with a randomized initial configuration. After executing the simulation in Haskell, agents cluster into homogeneous regions. Happiness checks and movements converge quickly to a stable final grid where all agents are satisfied.

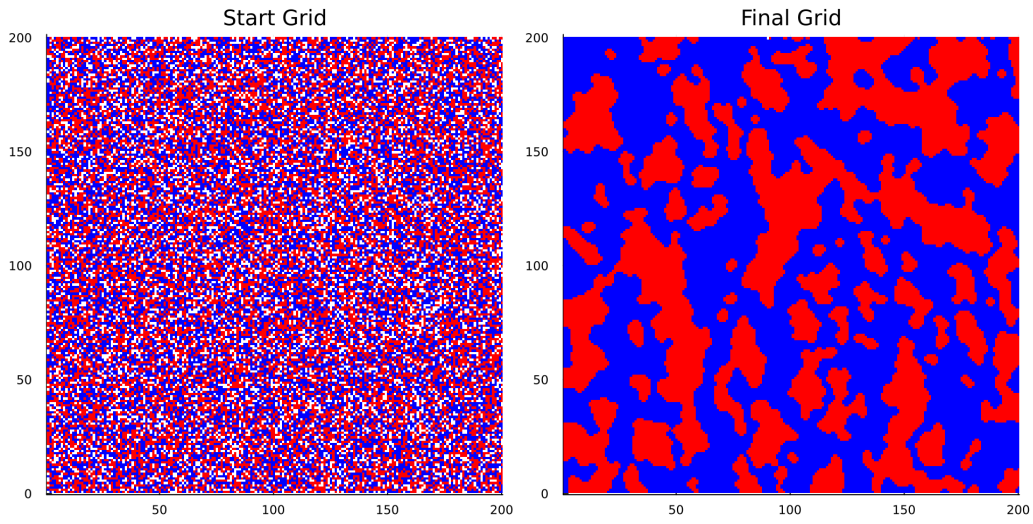

Figure 1: Initial configuration (left) and final configuration after convergence (right)

Comment on the Obtained Results

The simulation confirms Schelling's hypothesis: even with a low happiness threshold, agents form distinct, segregated clusters. The result illustrates how macro-level separation can arise from micro-level behavior without central coordination. The vector-based implementation in Haskell efficiently handles large grid operations and completes in a reasonable number of iterations.

Overall Conclusion

This assignment successfully combines Haskell's recursion and data structure strengths with Julia's visualization capabilities. The project demonstrates how functional programming paradigms can model complex social behavior and result in emergent phenomena. Moreover, the hybrid use of Haskell and Julia emphasizes the benefit of language interoperability in simulations.

References

- Thomas C. Schelling, "Dynamic Models of Segregation," *The Journal of Mathematical Sociology*, 1971.
- Antonello Lobianco, *Julia Quick Syntax Reference*, 2nd ed., Apress, 2025.