Game of Life

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CIS 4930: Concurrent Programming

Introduction

Jon Conway devised an algorithm to mimic cell automation in 1970, called the 'Game of Life'. Essentially, the game consists of a finite grid of cells that are either 'alive' or 'dead' and are dependent on the following rules:

- Any live cell with fewer than two live neighbours dies, as if caused by under-population.
- Any live cell with two or three live neighbours lives on to the next generation.
- Any live cell with more than three live neighbours dies, as if by overcrowding.
- Any dead cell with exactly three live neighbours becomes a live cell, as if by reproduction.

Objective

Our Game of Life implementation uses a server-client architecture, controlled and played on multiple clients. Iterations are computed on multiple clients; the server will constantly transmit the grid to clients after each iteration. When played, the server will distribute tasks of calculating iterations amongst the clients, and the calculations are returned to the server; it then merges the calculations, distributes the board and tasks to the clients again. Clients update grid size and initialialize living cells in order to play and then receive commands to calculate the next iteration. After these calculations are complete and sent to the server, client waits for future information.

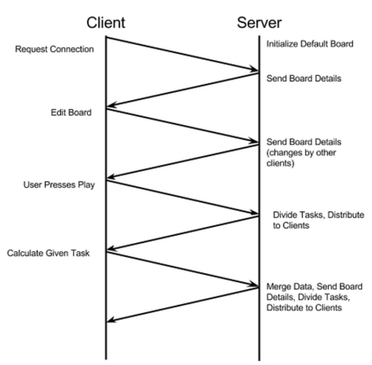

Figure 1: Client-server architecture

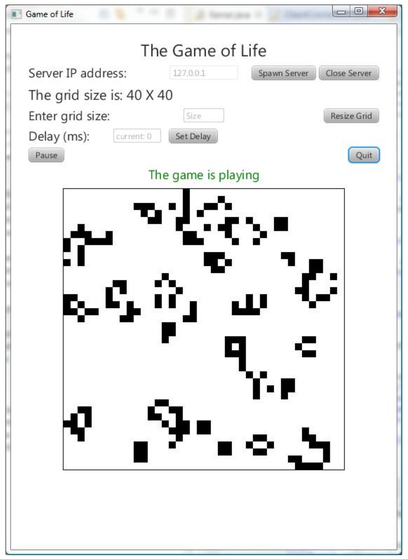

Figure 2: Game of Life in action!

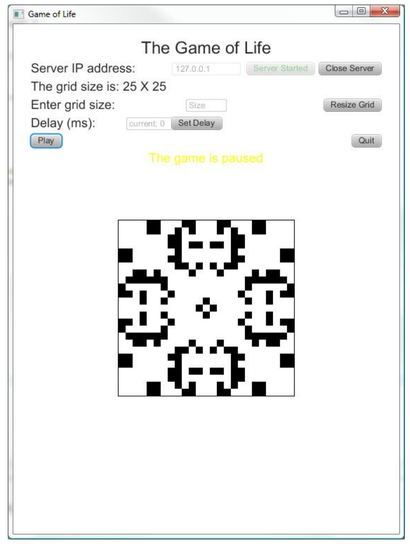

Figure 3: Unique patterns appear when ran long enough.

Results

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Concurrency Involved

Server:

- Synchronization on client list which is necessary to ensure a consistent view of the current clients before distributing tasks
- Utilizing a lock for hash maps associating Connections to Tasks and Tasks to Returned Components
- "Barrier" synchronization using Object.wait() and Object.notifyAll() to inform a thread when all clients have returned back partial calculation objects
- Use of atomic references to hold cells for eliminating race conditions

Client:

- GUI thread and ClientConnection thread
- ClientConnection uses JavaFX marshalling functions to receive information from Server and display the new grid to the user
- Calculates the next iteration from the tasked partial components by distributing amongst threads (relatively equivalent to the number of available processors), sending back to server after threads complete

Member Contributions

- **Devan Patel** developed a concurrent algorithm determining neighboring cells, calculating the next iteration, and synchonously updating the grid.
- **Kyle Koceski** managed the appropriate synchronization of multiple client threads and communication between clients and server.
- **Daniel Fuentes** designed the graphical user interface that allowed clients to interact with the board, as well as displaying the board's current status, and the changes as the game progressed.