Software Requirements Specification

for

Project 1

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CS3398

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide a working example of Team Lrr, Ruler of planet Omicron Persei 8's implementation of "Conway's Game of Life" program. Conway's Game of Life is a cellular automaton, which consists of a collection of cells. Based on a predetermined sequence of operations, the cells may live, die, or multiply. The first goal is to allow a user to select cells which will represent living cells at the initial state of the simulation. The second goal is to produce a visual model of the life, death, or growth of cells over time based on mathematical rules.

1.2 INTENDED AUDIENCE

This project is a simulation program which is restricted to Texas State University's course CS3398 for the Fall 2020 semester. This project has been implemented for use by the course professor, as well as members from Team Lrr, Ruler of planet Omicron Persei 8.

1.3 PRODUCT SCOPE

This document specifies requirements for a program simulating Conway's Game of Life.
The program:

- Shall provide a user interface.
- Shall allow the user to enter starting positions for cells.
- Shall enforce cell positions and states according to the following rules:
  a) Any live cell with fewer than two live neighbors dies (referred to as underpopulation or exposure).
  b) Any live cell with more than three live neighbors dies (referred to as overpopulation or overcrowding).
  c) Any live cell with two or three living neighbors lives, unchanged, to the next generation.
  d) Any dead cell with exactly three live neighbors will come to life.
- Shall allow a variable grid size, within an upper bound limit.
- Shall allow the user to select from a set amount of colors.
- Shall allow for a variable speed of the display from stage to stage.

- Shall have preset pattern options.
- Shall differentiate dead, live, and empty cells with different colors.
- Shall provide user-interface buttons for “Pause,” “.5X,” “Play,” “2X,” “Next,” “Reset”, .
- Shall have an application window of a fixed size.

1.4 REFERENCES

[1] Conway’s Game of Life. (16 September 2020) In *Wikipedia.* Retrieved from https://en.wikipedia.org/wiki/Conway%27s_Game_of_Life
[2] Conway’s Game of Life. (13 April 2020) In *LifeWiki.* Retrieved from https://www.conwaylife.com/wiki/Conway%27s_Game_of_Life
[3] Martin, E. (n.d.) John Conway’s Game of Life. Retrieved from https://bitstorm.org/gameoflife/

2. OVERALL DESCRIPTION

2.1 Product Functions

Variable Grid Size

The system shall allow a variable grid size that is within a fixed upper bound limit.

Selectable Cell Color

The system shall allow the user to select the color of a live cell, death cell, and empty cell from eight preselected different colors.

Variable Generation Speed

The system shall allow the user to select a preset playback speed for the game. The system shall give the following options: half-speed, regular speed, and twice the speed of generational update.

Visual Generation Number

While playing an active game of Conway’s Game of Life, the system shall display the number of generations that have gone by.

Visualize dead, live, and empty cells.

The system shall show the user the status of the cell by differentiating a dead, alive, or empty cell with different colors.

Preset Patterns

The system shall give the user the option to select from premade patterns.

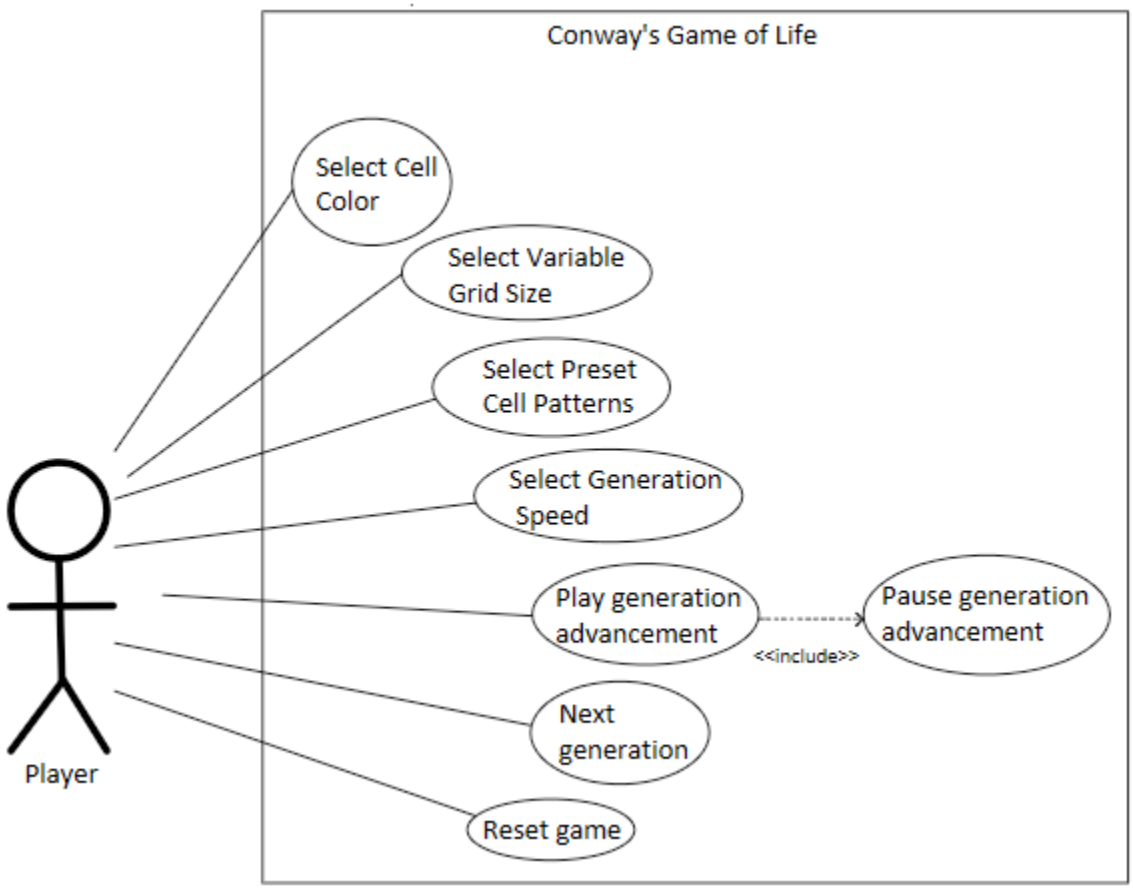
Fixed Window Size

The system window shall have a fixed size.

Next, Pause, End, and Play Options

The system shall provide User Interface buttons for: Next generation, Pause game, Reset game, and, Play game.

2.2 User Classes and Characteristics



User Types:

Player - A user that can use all the features of the Conmway's Game of Life application.

2.3 Operating Environment

Conway's Game of Life shall be fully functional on any desktop or laptop that is running on the Windows 10 OS. Conway's Game of Life will not be specifically designed to function on Linux, Unix, macOS, or mobile devices.

3. EXTERNAL INTERFACE REQUIREMENTS

3.1 User Interfaces

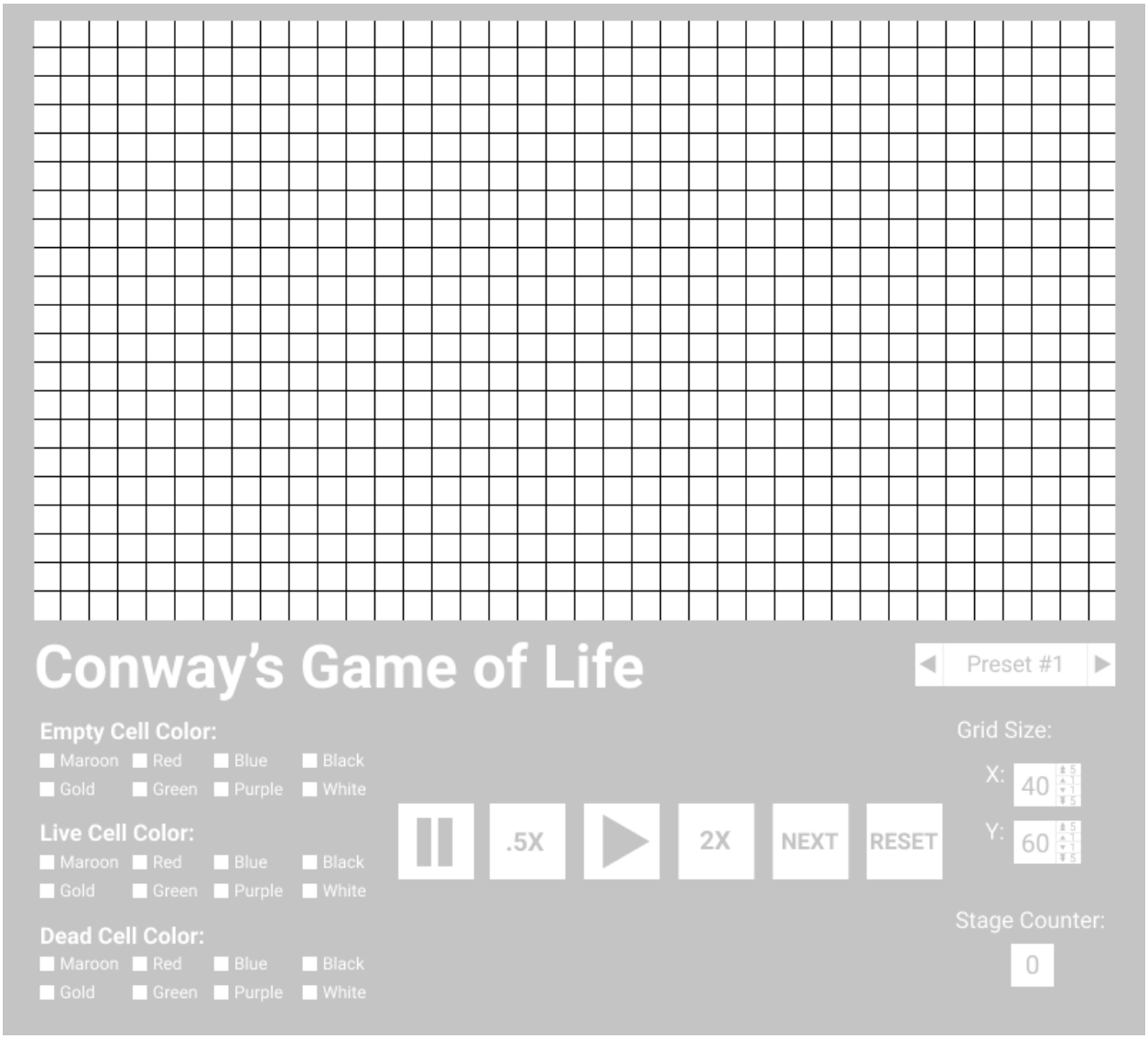


Figure 3.1.1
This is an interface that shall be displayed.

4. SYSTEM FEATURES

4.1 Selecting Grid Size

4.1.1 Description

The system shall provide displays to see the current size of the simulation's grid, measured in the number of cells per x and y axis. The system shall then also provide nearby buttons to increase or decrease the grid size within a TBD minimum and maximum size.

4.1.2 Functional Requirements

REQ 4.1.2a

Next to each grid size axis display, the system shall provide 4 buttons to modify that axis' size. These buttons shall be labeled as "+1, -1, +5, -5".

REQ 4.1.2b

If the simulation is currently running or has not been reset, all of these buttons shall be greyed out, and clicking on them shall not alter the state of the system. If the simulation has been stopped and the grid is clear, proceed to REQ 4.1.2c.

REQ 4.1.2c

If the maximum size for an axis has been reached, "+1" and "+5" shall be greyed out and if the minimum size for that axis has been reached, "-1" and "-5" shall be greyed out. If the user clicks on a button that is not greyed out, proceed to REQ 4.1.2d.

REQ 4.1.2d

If the user clicks on "+1", proceed to REQ 4.1.2e

If the user clicks on "-1", proceed to REQ 4.1.2f

If the user clicks on "+5", proceed to REQ 4.1.2g

If the user clicks on "-5", proceed to REQ 4.1.2h

REQ 4.1.2e

The system shall increase the size of the relevant axis by one cell.

REQ 4.1.2f

The system shall decrease the size of the relevant axis by one cell.

REQ 4.1.2g

The system shall check if increasing the size of the relevant axis by five cells would exceed the maximum allowed size. If the maximum allowed size would be exceeded, then the system shall set the size of the axis to the maximum allowed size. If the maximum allowed size would not be exceeded, the system shall increase the relevant axis size by five cells.

REQ 4.1.2h

The system shall check if decreasing the size of the relevant axis by five cells would be below the minimum allowed size. If the minimum allowed size would be exceeded, then the system shall set the size of the axis to the minimum allowed size. If the minimum allowed size would not be exceeded, the system shall decrease the relevant axis size by five cells.

4.2 Selecting Cell Colors

4.2.1 Description

The system shall allow the user to select the color of what is known as a live cell, a dead cell and an empty cell. The system shall also provide eight color options for each type of cell.

4.2.2 Functional Requirements

REQ 4.2.2a

The systems shall provide a UI component that enables the user to select from eight colors for dead cells, live cells and empty cells.

REQ 4.2.2b

The system shall not allow the user to use the same color for more than one cell type.

REQ 4.2.2c

The system shall allow the user to change colors only under two conditions, one, when the game is at stage zero and two, when the game is paused.

REQ 4.2.2d

The system shall disable functionality of the color selection while the game is not in one of the aforementioned stages.

4.3 Adding or Removing Live Cells from Grid

4.3.1 Description

The system shall allow the user to click a cell on the grid to change the cells type.

4.3.2 Functional Requirements

REQ 4.3.2a

The system shall upon detecting a user clicking a cell in the grid, change the state of the cell to the next option.

REQ 4.3.2b

The system shall change the state of a cell in the following order.

REQ 4.3.2b.I

A live cell shall turn into a dead cell.

REQ 4.3.2b.II

A dead cell shall turn into an empty cell.

REQ 4.3.2b.III

An empty cell shall turn into a live cell.

REQ 4.3.2c

The systems shall allow the user to change the state of a cell when only while the game is at stage zero, or when the game is paused.

4.4 Selecting Preset Grids

4.4.1 Description

The systems shall allow the user to select a preset. A preset is a preselected collection of settings.

4.4.2 Functional Requirements

REQ 4.4.2a

Presets provided by the system shall follow the same rules applied to users.

REQ 4.4.2b

The system shall provide a UI which will enable the user to select a preset.

REQ 4.4.2c

The system shall, upon registering a click from the user on a preset selection option, load the preset.

REQ 4.4.2d

The system shall only allow the user to select a preset during two cases. One, in which the game is at stage zero. Two, in which the game is paused.

REQ 4.4.2e

The system shall render the preset button non function while the game is not in one of the aforementioned stages.

4.5 Starting the Simulation

4.5.1 Description

Upon the user selecting the “Play” option, the system shall begin the life, death, or growth simulation of user selected cells based on aforementioned predetermined mathematical rules.

4.5.2 Functional Requirements

REQ 4.5.2a

The system shall run continuously, without any additional input required from the user.

REQ 4.5.2b

Once the “Play” operation has commenced, the system shall allow for the “Pause” and playback speed features to remain available to be selected from the user if so desired, further discussed in sections 4.6 and 4.7.

REQ 4.5.2c

If the game is in a paused state, the system shall allow the user to resume the simulation from the state at which the game is paused.

REQ 4.5.2d

The system shall display in real-time the visual life, death, or growth of cells based on user selected starting positions of live cells.

4.6 Pausing the Simulation

4.6.1 Description

The system shall allow the user to pause a simulation in progress, halting the “Play” operation.

4.6.2 Functional Requirements

REQ 4.6.2a

The system shall begin the game in a paused state.

REQ 4.6.2b

Upon the user selecting the “Pause” option, the system shall halt the “Play” operation.

REQ 4.6.2c

The system shall allow the user to select new live cells while in a paused state, if so desired.

REQ 4.6.2d

Upon selecting the “Play” option, the system shall automatically pause if no live cells are selected by the user.

REQ 4.6.2e

Upon selecting the “Play” option, the system shall automatically pause given the situation in which all live cells have died and there is no further life or growth to simulate.

4.7 Altering the Speed of the Simulation

4.7.1 Description

The system shall allow variable playback speeds as available options for the user.

4.7.2 Functional Requirements

REQ 4.7.2a

Upon selecting the option for ".5X," the system shall operate as if the "Play" function has been selected by the user. While ".5X" is selected, the system shall display the visual simulation at half the rate as would be displayed by the "Play" function.

REQ 4.7.2b

Upon selecting the option for "2X," the system shall operate as if the "Play" function has been selected by the user. While "2X" is selected, the system shall display the visual simulation at double the rate as would be displayed by the "Play" function.

REQ 4.7.2c

The system shall allow for the user to freely switch between ".5X," "Play," and "2X," features, so long as the game is in a state in which the "Play" function may operate.

4.8 Simulating a Single Generation

4.8.1 Description

Upon the user selecting the "Next" option, the system shall simulate the next generation, which consists of new live or dead cells.

4.8.2 Functional Requirements

REQ 4.8.2a

If any live cell has fewer than two live neighbors, then the live cell dies and is not present in the next generation (referred to as overpopulation or overcrowding).

REQ 4.8.2b

If any live cell has more than three live neighbors, then the live cell dies and is not present in the next generation (referred to as overpopulation or overcrowding).

REQ 4.8.2c

If any live cell has two or three living neighbors, then the live cell stays the same in the next generation.

REQ 4.8.2d

If any dead cell has exactly three live neighbors, the dead cell will come to life and will be present in the next generation.

4.9 Resetting the Simulation

4.9.1 Description

The system shall allow the user to stop and reset a simulation in progress, halting the “Play” operation.

4.9.2 Functional Requirements

REQ 4.9.2a

Upon the user selecting the “RESET” option, the system shall halt the “Play” operation.

REQ 4.9.2b

The system shall revert to the state displayed to its original state before the user selected the “Play” option.

REQ 4.9.2c

The system shall reset the “Stage Counter”, starting at 0.

REQ 4.9.2d

Upon the user selecting the “Play” option, the system shall begin the simulation without reference from previous simulations.