# New Geometries for Cellular Automata

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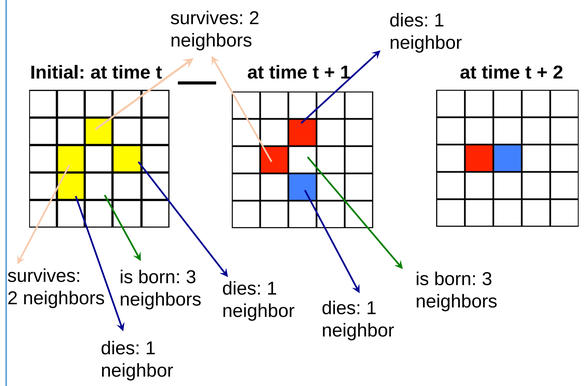
## INTRODUCTION

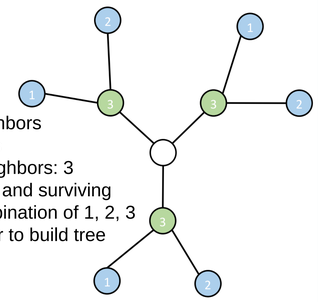
- Tree Life is adapted from an existing game called Game of Life (or simply Life) invented by John Conway
- Cellular automaton: game that is played by itself, giving results through its previous states after one initialization
- Uses 2D square grid where a cell has eight adjacent neighbors


- Two states only: a cell is either alive or dead
- Rules: At time t + 1, a cell survives if it had 2-3 neighbors at time t. At time t + 1, a dead cell comes alive (is born) if 3 of its neighbors were alive at time t.

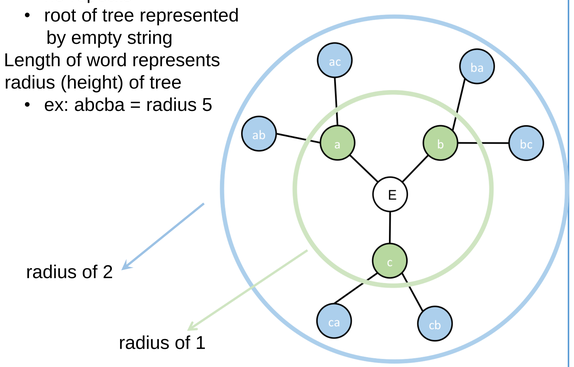
## GAME OF LIFE IN ACTION



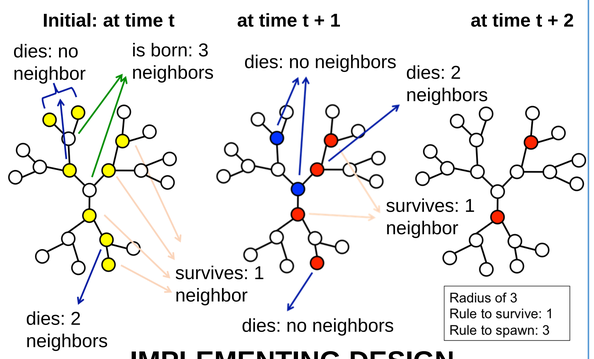

## TREE LIFE DESIGN




- Change in structure and neighbors
  - tree structure with nodes
  - maximum number of neighbors: 3
- Change in rules for spawning and surviving
  - Possible rules: any combination of 1, 2, 3
- Starts with root node in center to build tree
- Letters to represent nodes
  - a, b, c
  - no repeats
  - root of tree represented by empty string
- Length of word represents radius (height) of tree
  - ex: abcba = radius 5

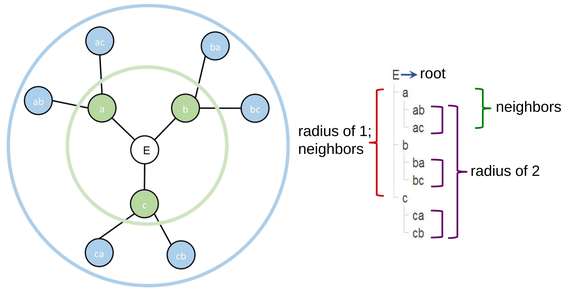



## TREE LIFE IN ACTION



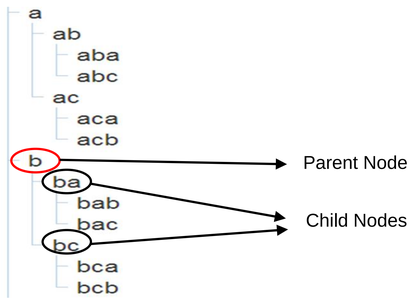

## IMPLEMENTING DESIGN

By choosing the identity E as the root, the tree is visualized as a file tree.

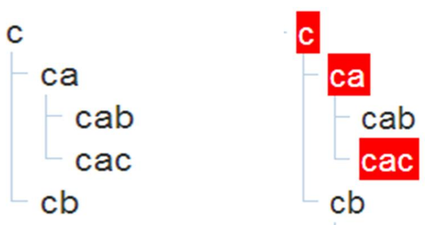



## TREE OF CELLS

- A graph with parent and child nodes




- The child node of a parent is the string of the parent name concatenated with a, b, or c, avoiding double letters
- Cells live or die with color change




## FEATURES

### Basic Features

| | |
|---|---|
| Create New Tree | New tree with the specified radius |
| Expand/Contract | Expands or contracts the child nodes |
| Delay | Sets the delay time between each pause |

### Random Selection

| | |
|---|---|
| Random # Cells | Sets randomly the inputted **number** of nodes as living |
| Random % Cells | Sets randomly the inputted **percentage** of nodes as living |

### File Functions

| | |
|---|---|
| Read Tree | Loads a file, reads the radius and the list of nodes, draws them on the visual tree |
| Save Tree | Prints on a file the radius and the list of nodes living |

### Algorithmic Functions

| | |
|---|---|
| TimeStep | Displays LIFE at time t+1 given the LIFE at time t |
| Rules | Sets rules for spawning and survival |
| Advance n Steps | Runs TimeStep n times |

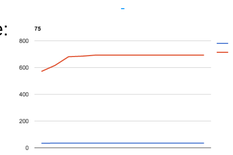
## POPULATION GROWTH

Results on number of survivors include:

- repeating/alternating numbers
- constant trends

Conclusion: most interesting rules are

- rule to survive: 1-1, 2-2, 3-3
- rule to spawn: 1-1, 1-2

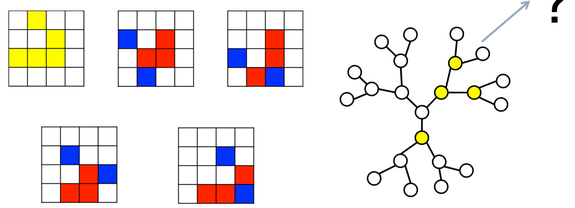



75%, RTS: 1-3, RTB: 1-1


100%, RTS: 1-1, RTB: 1-2

## OPEN QUESTION 1: GLIDER

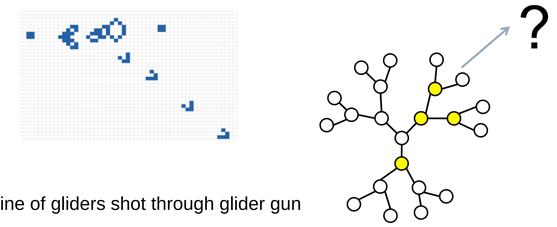
**Game of Life** **Tree Life**




the glider moves one square diagonally after 4 generations

## OPEN QUESTION 2: GLIDER GUN

**Game of Life** **Tree Life**




line of gliders shot through glider gun

**Poster presented at:**

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