Using an Adaptation of The Game Of Life To Measure Crowd Throughput

A FINAL YEAR PRSENTATION SUBMITTED IN PARTIAL FULFILMENT OF THE DEGREE:
BSC (HONOUR'S) COMPUTER GAMES TECHNOLOGY

BY [redacted]

AIMS AND OBJECTIVES

AIM: ***TO INVESTIGATE OVERCROWDING USING THE GAME OF LIFE AND DEPICT THE RESULTS WITH COUPLED MAP LATTICES.***

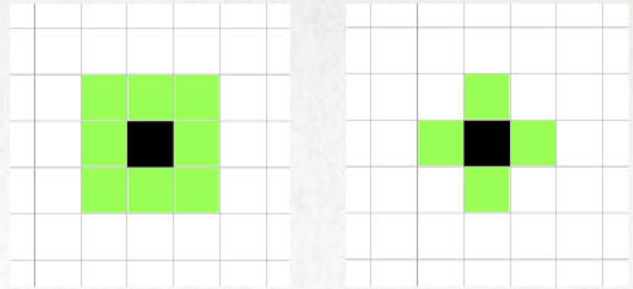
OBJECTIVES:

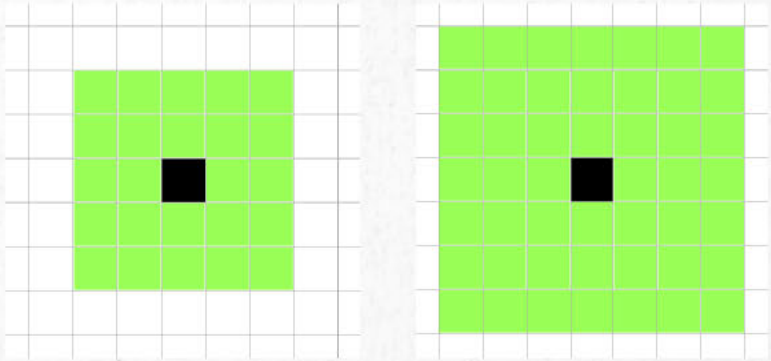
- Implement a working version of the Game of Life;
- Allow the Game to use an infinite plain and account for non-touching neighbours;
- Gather data which shows the relationship between overcrowding and overall movement speed;
- Research coupled map lattices and depict data graphically through use of them.

PROJECT BACKGROUND

GAME OF LIFE

- Runs on cellular automata
  - Grid of cells with two states.
  - Runs on its own from the rules set out at the beginning.
- Alive neighbours in this generation dictate its state in the next generation.
  - Alive and 2/3 alive neighbours -> Alive.
  - Dead and 3 neighbours -> Alive
  - Else -> Dead.

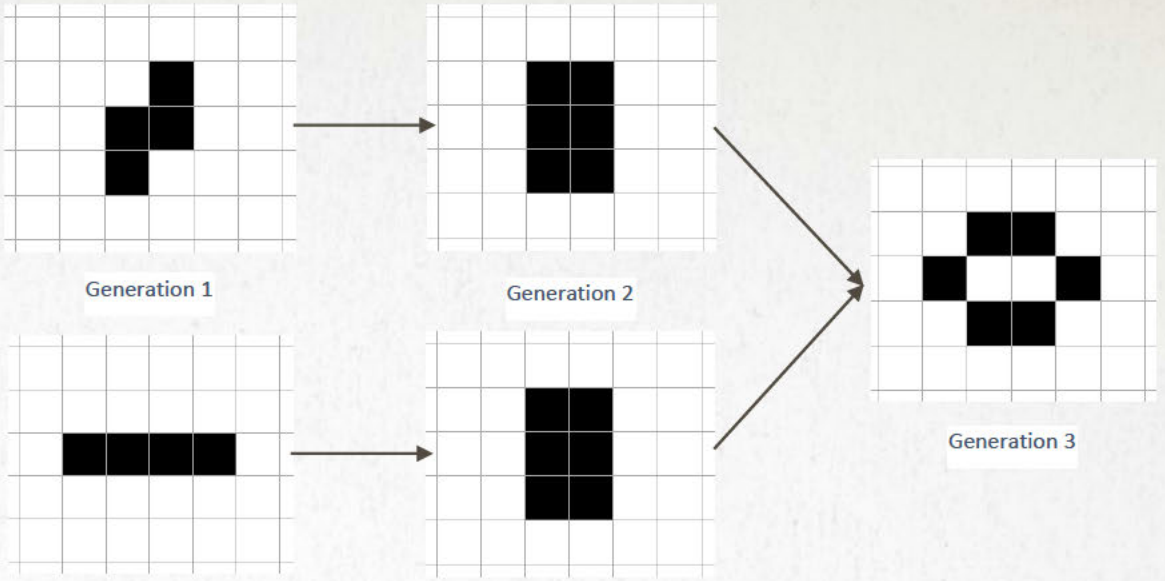




$$(2r + 1)^2 - 1$$

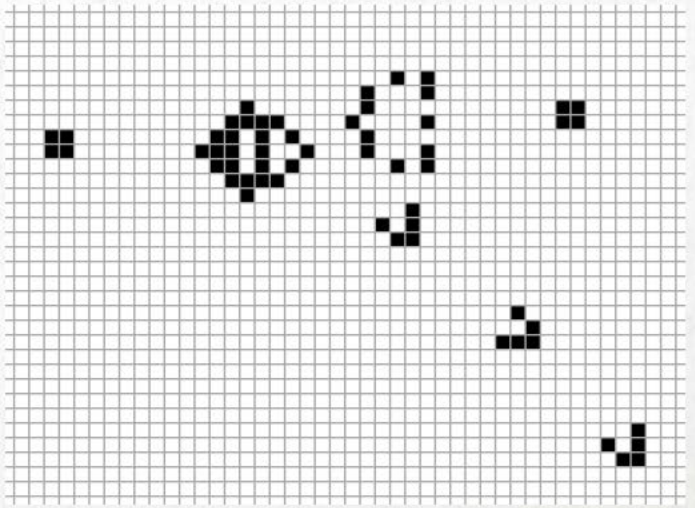
PROJECT BACKGROUND

PRACTICAL APPLICATIONS



- Encryption

- Computations

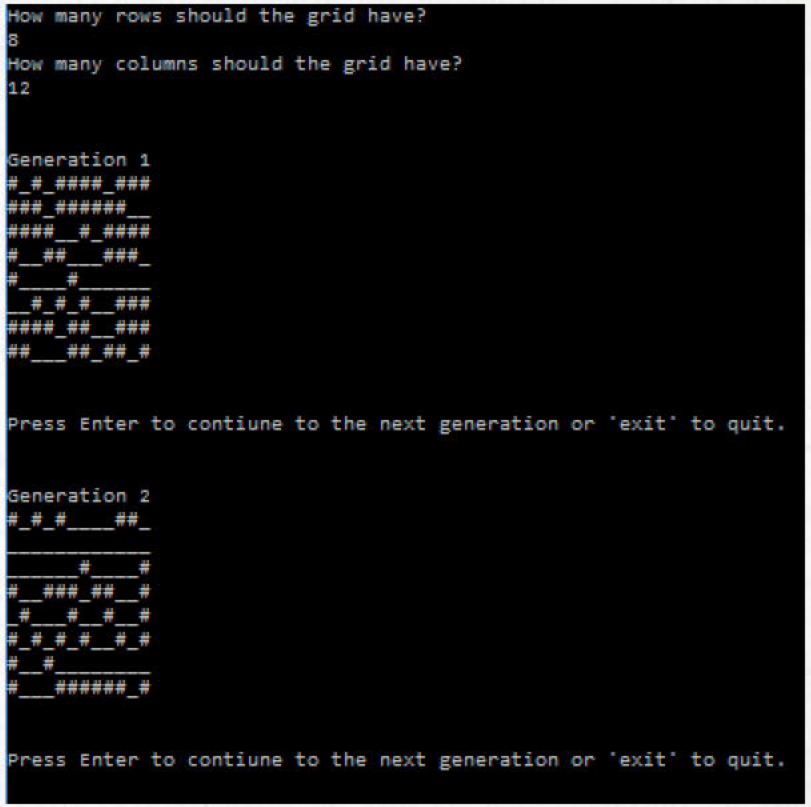


IMPLEMENTATION

FIRST ITERATION:

- Console application

- Dynamic grid sizes.
- Notable preset cell arrangements
- User feedback:
  - Generation count.
  - Alive cell count.

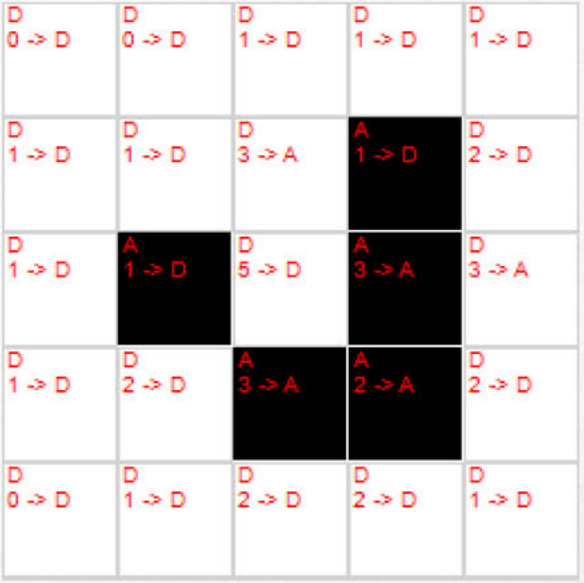


IMPLEMENTATION

```
public void Draw(Graphics graphics)
{
    if(Alive)
        graphics.FillRectangle(BlackBrush, x, y, width, height);
    else
        graphics.DrawRectangle(GrayPen, x, y, width, height);
}
```

SECOND ITERATION:

- Cell class draws squares:
  - Black filled square for Alive cells.
  - Grey outline for Dead cells.
- Toggle for displaying cell data.
- User interface with buttons for controlling functionality.

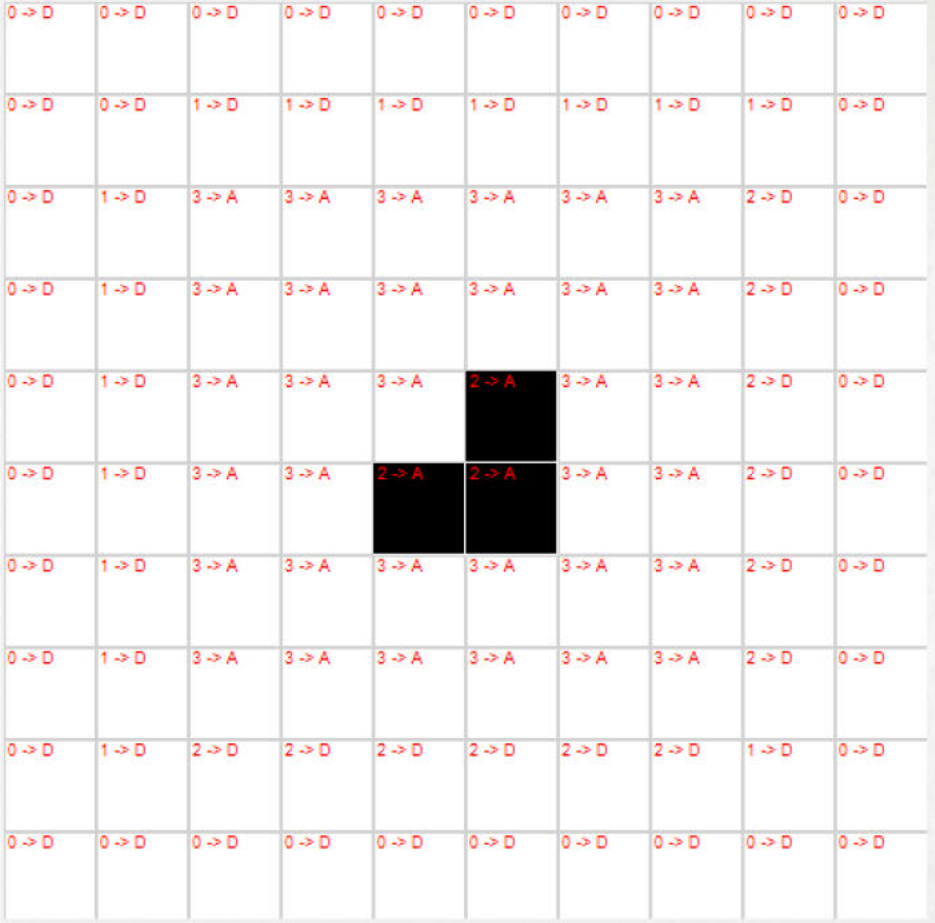


IMPLEMENTATION

EXTRA FEATURES:

- Game working on an infinite plain

- Ability to search for neighbours further away those that are touching.



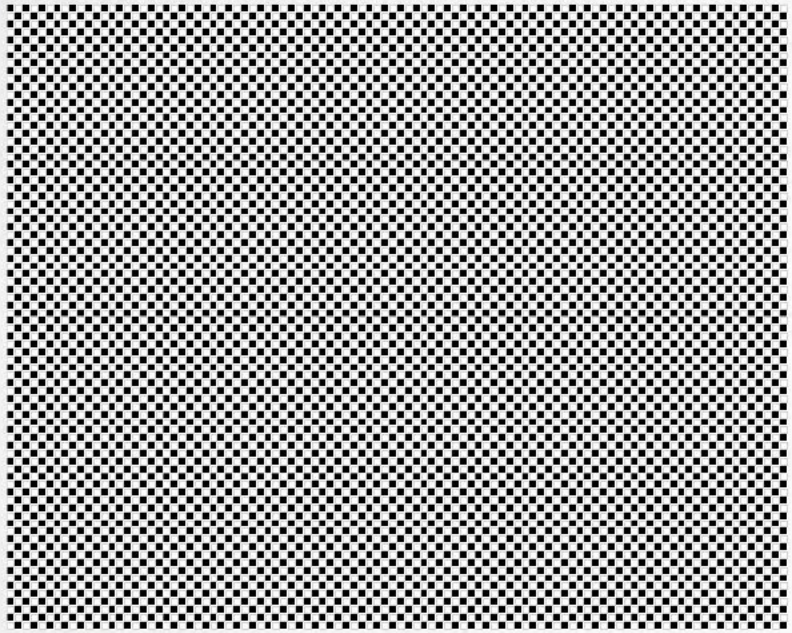
COUPLED MAP LATTICES

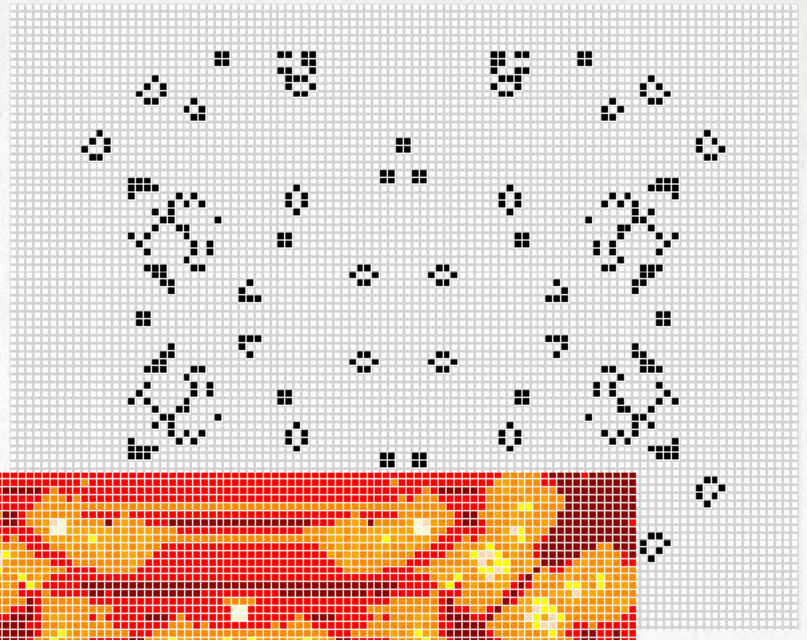
AIM: Research coupled map lattices and depict data graphically through use of them.

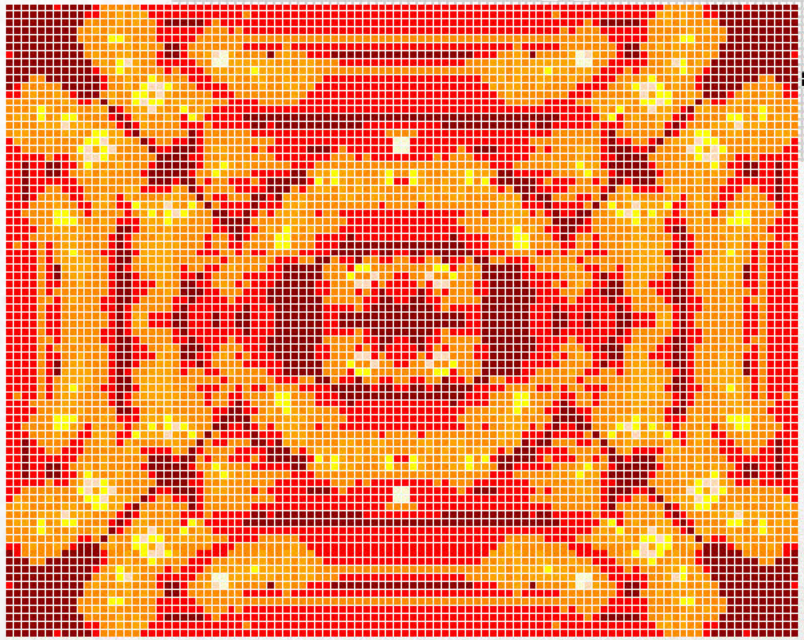
- Shows dynamic systems better.
- Ideal for Game of Life which changes over time.
- Will be used to show crowd movement data.

COUPLED MAP LATTICES

EXAMPLE 1:

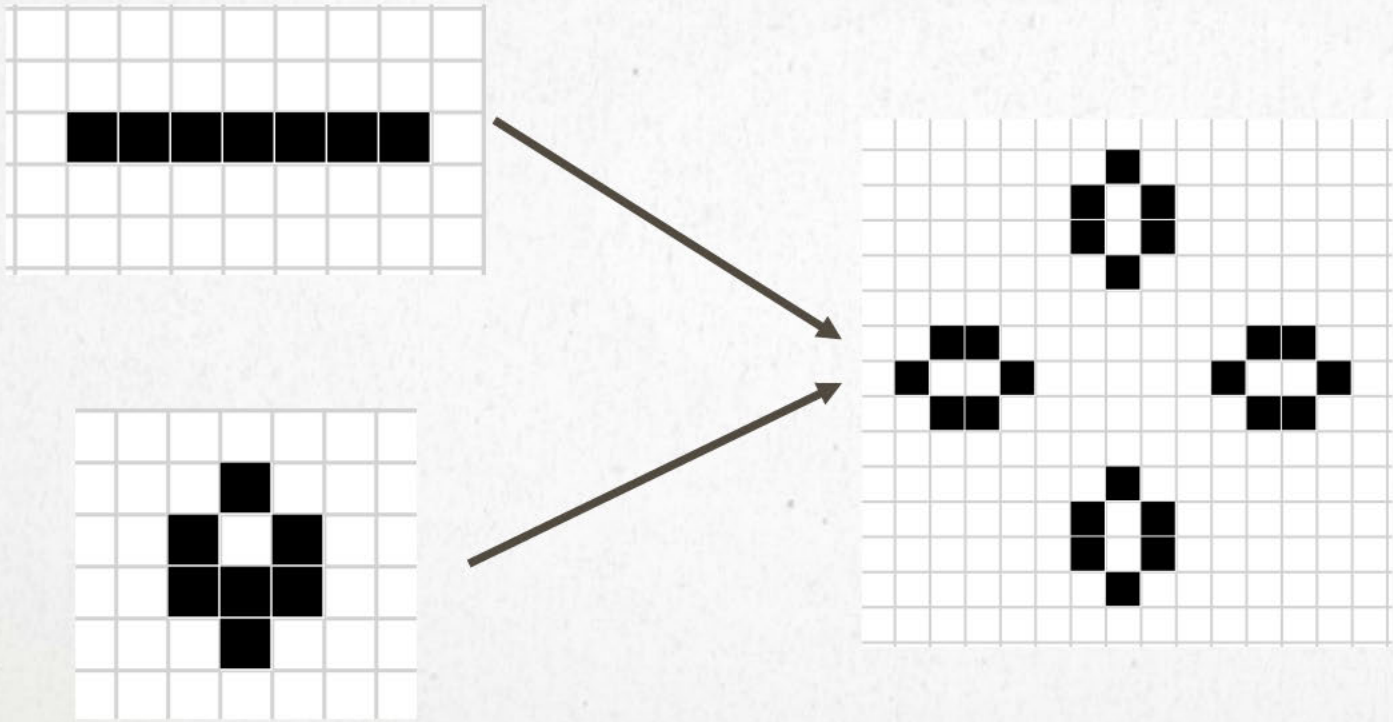


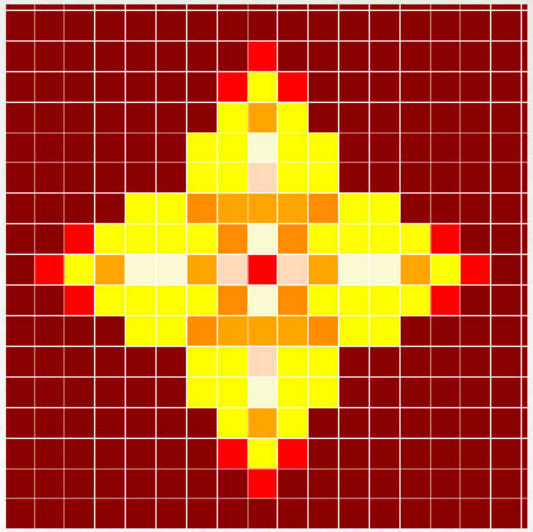


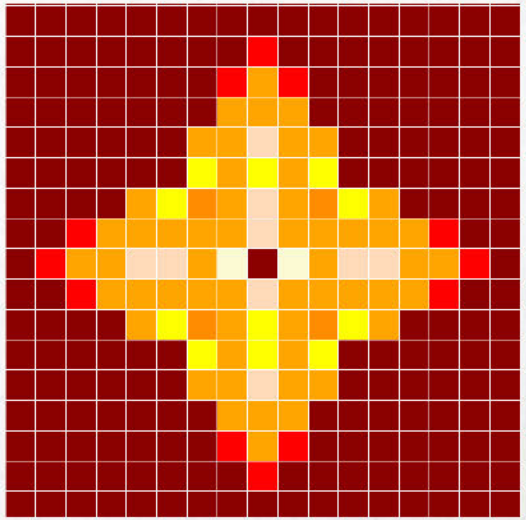


COUPLED MAP LATTICES

EXAMPLE 2:



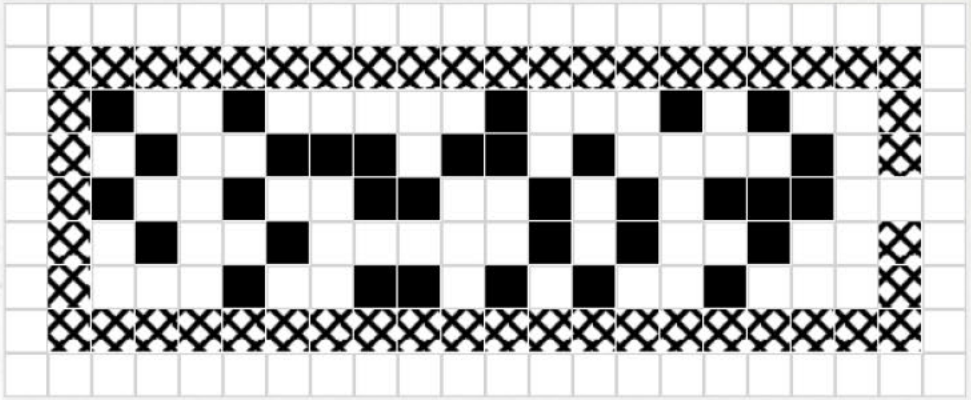


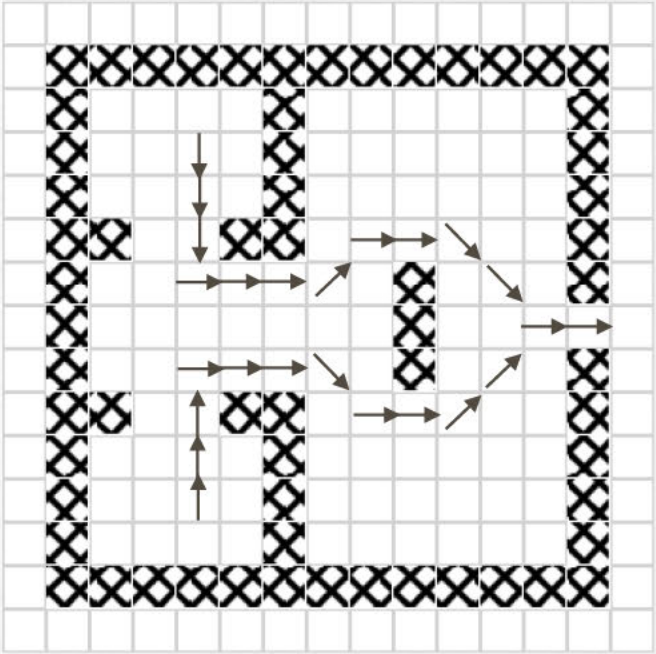


EXPERIMENTATION

ROOMS

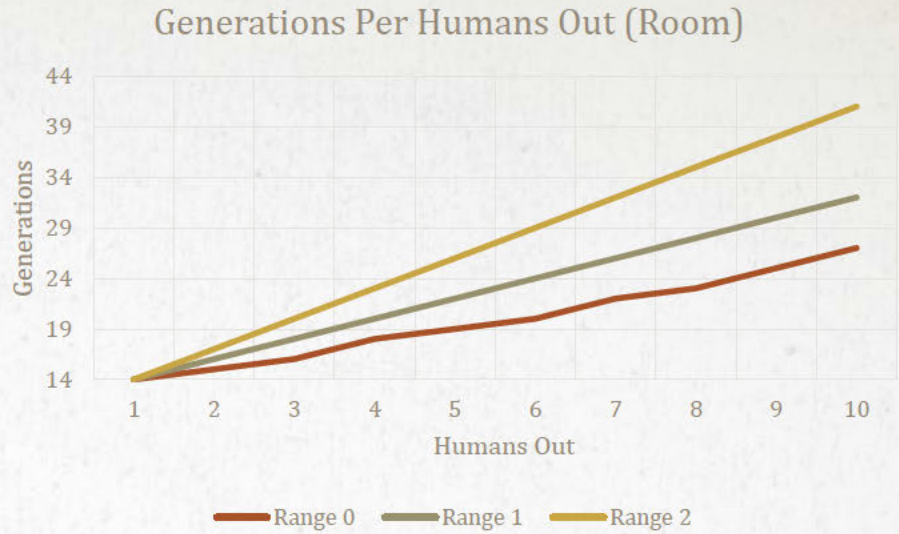
- Room filled with a crowd.
- Each cell contains directions pointing to the exit.
- Cell can only move for if it's not overcrowded.
- Same experiment run with different search ranges.
  - Recorded generations taken for humans to leave

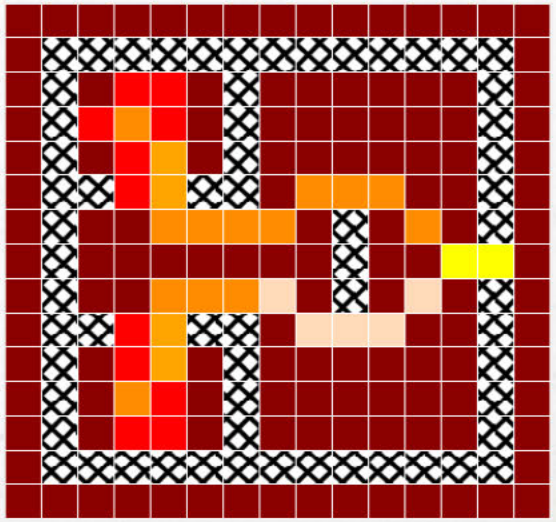




RESULTS ANALYSIS

- First human always took the same
- Coupled map lattices highlight areas where build up or slow movement occurred.
  - Usually at the start or at conjoining paths.





EVALUATION

SUCCESSES:

- Game of Life implementation.
  - Many features: debug, alternate rules, dynamic grid sizes, user feedback etc.
- Infinite plain by joining edges.
- Coupled map lattice option.
- Search over range functionality.

LIMITATIONS:

- Game of Life differs greatly from crowd movements.
  - Game of Life cells act independently.
  - A move in diagonal is worth double.
- The cell that is searched first is at an advantage to move away first.

FURTHER DEVELOPMENT

- More tests with different starting arrangements.
- Options to move vertically or horizontally if a diagonal move is unavailable.
- Options to support multiple routes and exits.
- Made using an application type that had better graphical performance.

PRODUCT DEMONSTRATION