Agent-based Modelling with Statecharts

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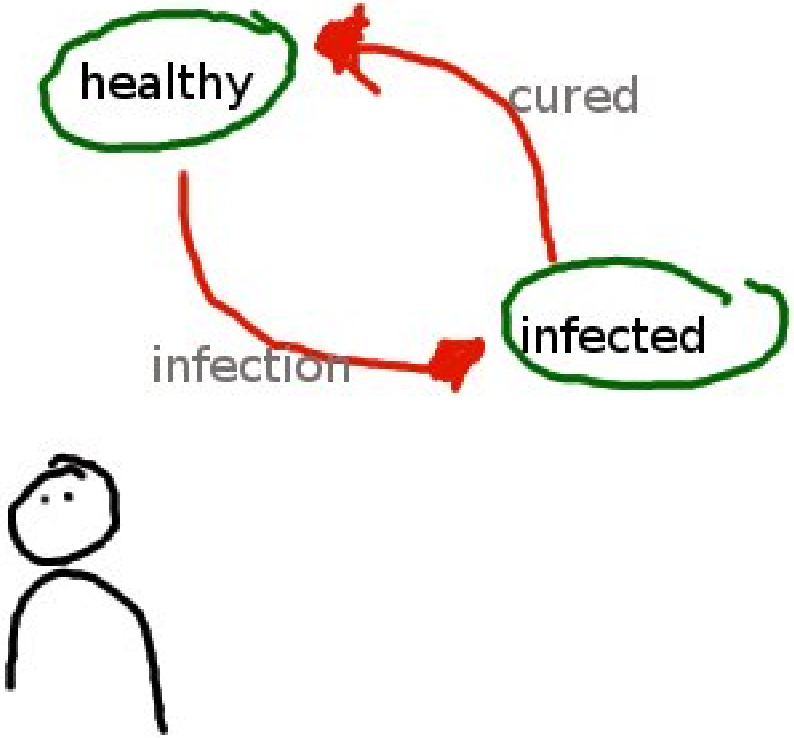
Modelling disease spreading

Agent Level

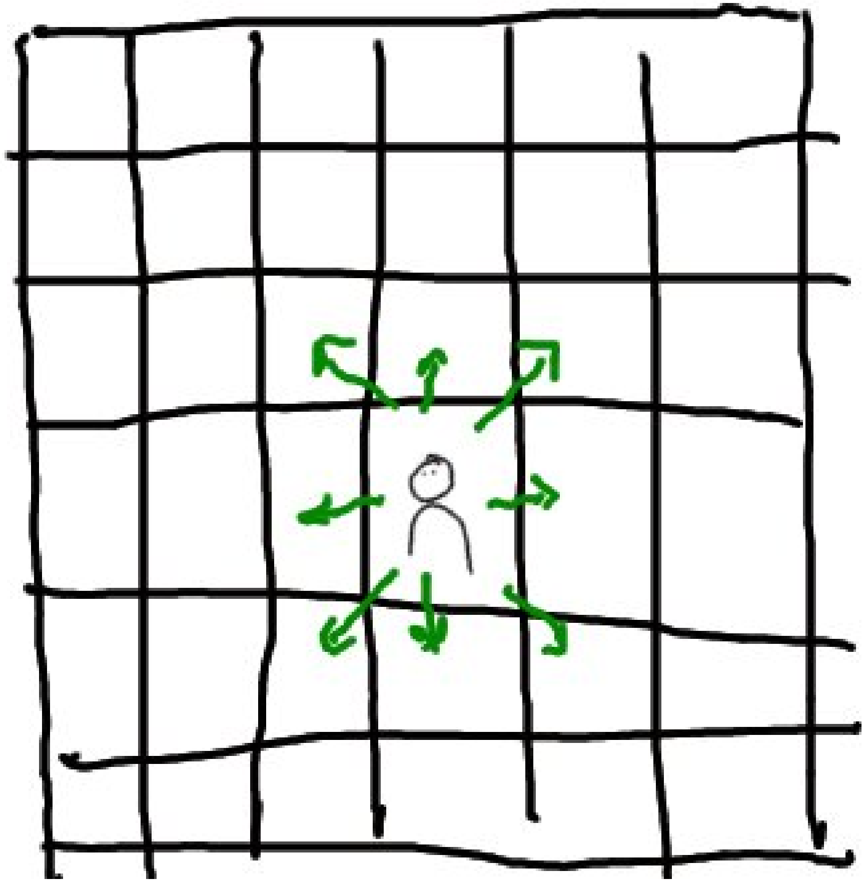
- Length of recovery time.
- How infection occurs.
- Immunization.
- Does an agent remain susceptible after recovery?

System Level

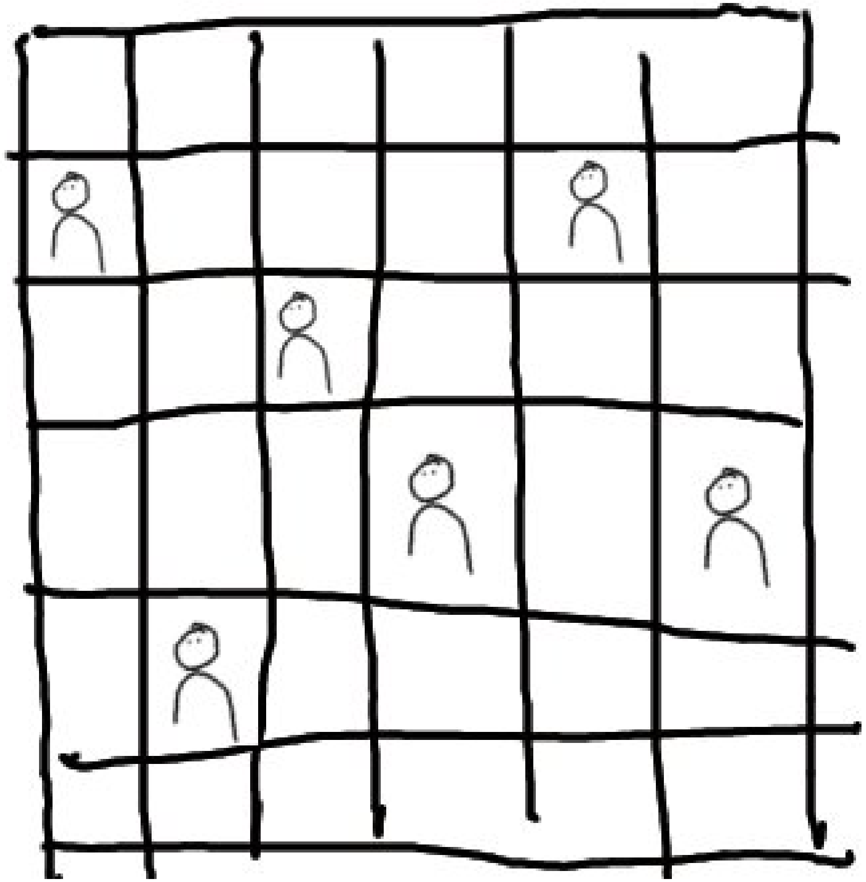
- Population density.
- Isolated infected agents.



1. Specify behaviour with Statechart.



2. Import into 2D layout.



3. Allow multiple instances.

Why combine the two formalisms?

Statecharts

- States
- Time-advances, triggers
- Orthogonals
- Default states
- Discrete-event formalism

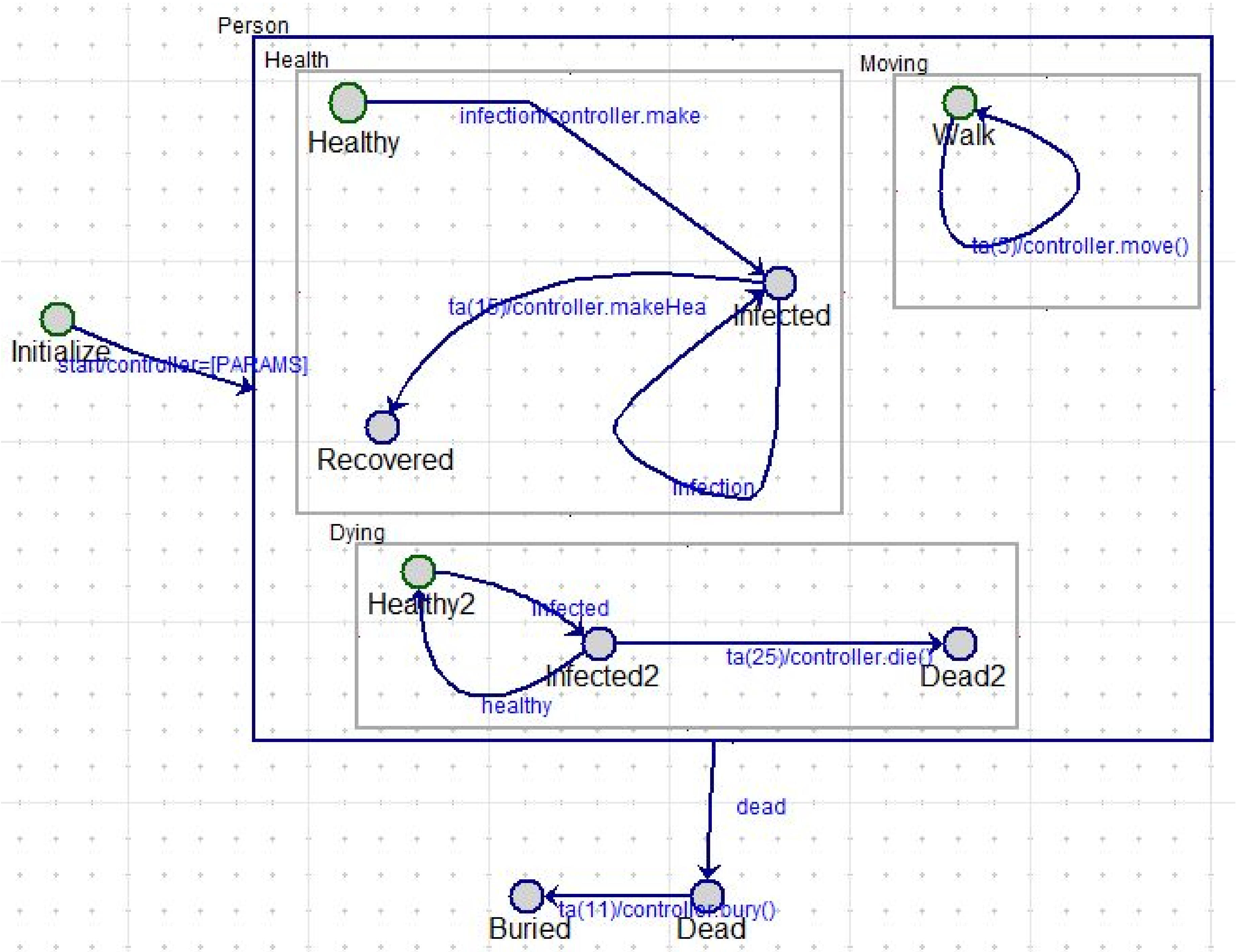
2D Layout
(Cellular Automaton)

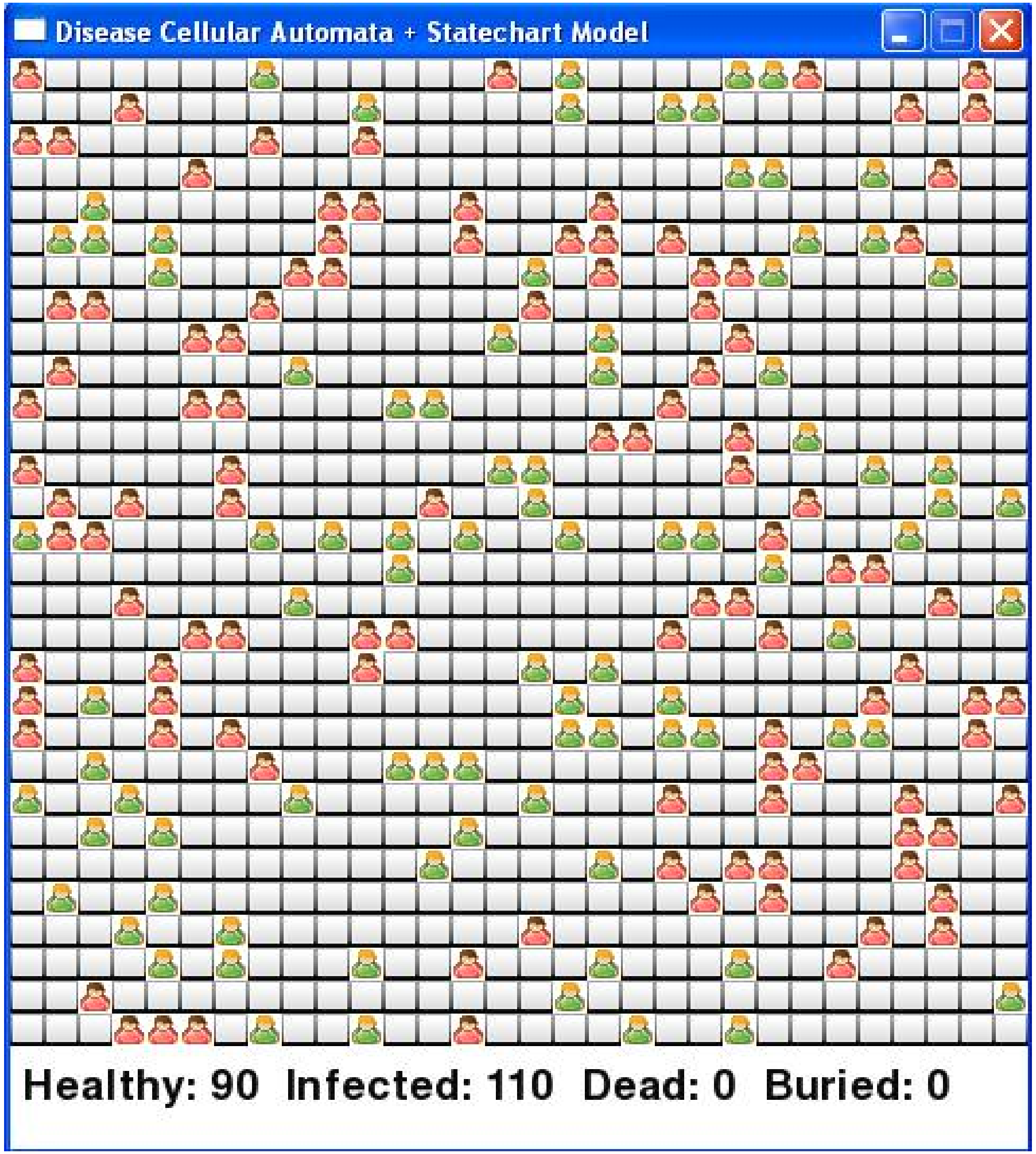
- Interactions between agents.
- Can see progress of model.
- Different parameters can be used to model different situations.
- Discrete-time formalism.

How was it implemented?

1. AToM3 used to create Statecharts (with DCharts formalism).
2. Statecharts exported into Python code.
3. Controller script written in Python to interface with Statechart.
4. 2D layout represented as array.
5. Agents move around canvas one square at a time in a random direction.
6. Extra functions coded to make sure agents wrap around the canvas.
7. Proximity to other agents triggers events in Statecharts.
8. pygame used to create graphical representation.

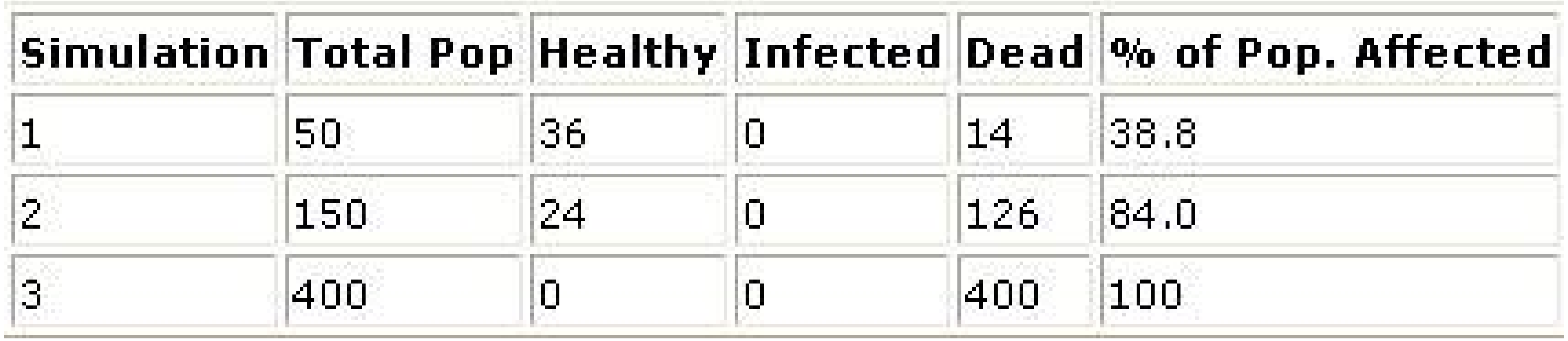
Demonstration


Person
Health
Moving
Healthy
infection/controller.make
Walk
ta(5)/controller.move()
ta(15)/controller.makeHea
Infected
Initialize
start/controller=[PARAMS]
Recovered
infection
Dying
Healthy2
infected
Infected2
ta(25)/controller.die()
Dead2
healthy
dead
Buried
ta(11)/controller.bury()
Dead



Disease Cellular Automata + Statechart Model

Healthy: 90 Infected: 110 Dead: 0 Buried: 0



Simulation	Total Pop	Healthy	Infected	Dead	% of Pop. Affected
1	50	36	0	14	38.8
2	150	24	0	126	84.0
3	400	0	0	400	100

Example of Simulation in Use: **Population Density**

Advantages

- Can define complex behaviour for agents.
- Do not need to deal with messy programming to change model. Parameters and Statechart can be modified easily.
- Easy and quick to vary parameters and view changes on the behaviour of the system.

Possible Extensions

- Add the notion of time, allows for plots that show the number of infected as a function of time.
- Incorporate parameter setting as part of a GUI.

Questions?