Geosimulation Modelling

Extending the Virus Model in NetLogo

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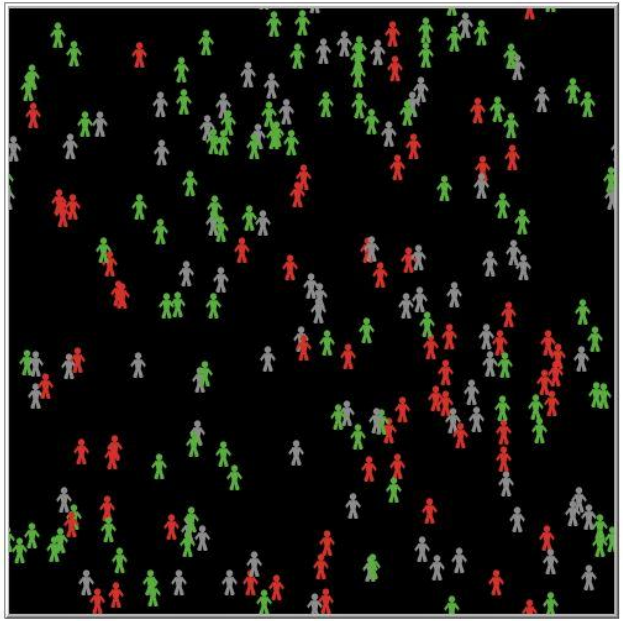
Virus Model - I

Simulation of the transmission and perpetuation of a virus in a human population

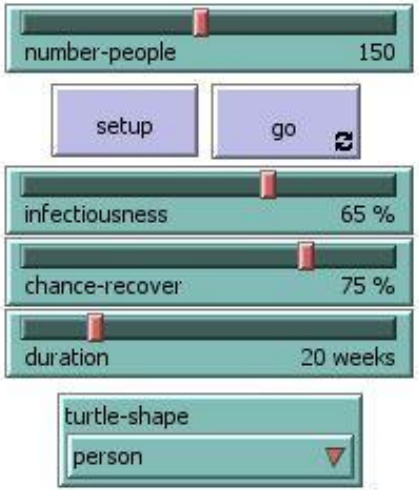
- People move randomly
- Three states
  - healthy (green)
  - sick (red)
  - immune (gray)
- People can die of infection or age
- People can reproduce



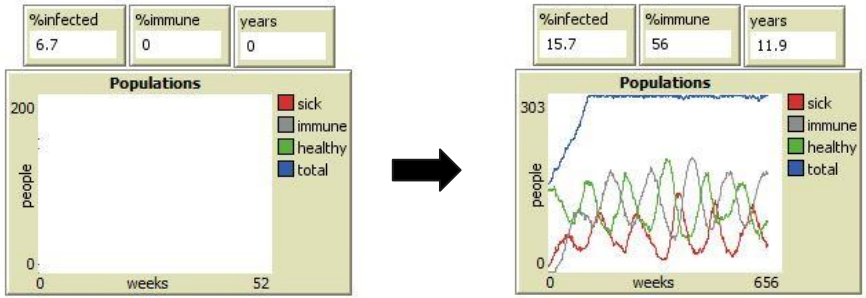
Viewport showing healthy, sick & immune persons

Virus Model - II

- **`number-people`** sets initial amount of people
- **`infectiousness`** determines the rate of transmission of the virus
- **`chance-recover`** controls probability of getting immune/recovered when sick
- **`duration`** determines when a sick person dies/recovers (in weeks)



Interactive panel in the interface



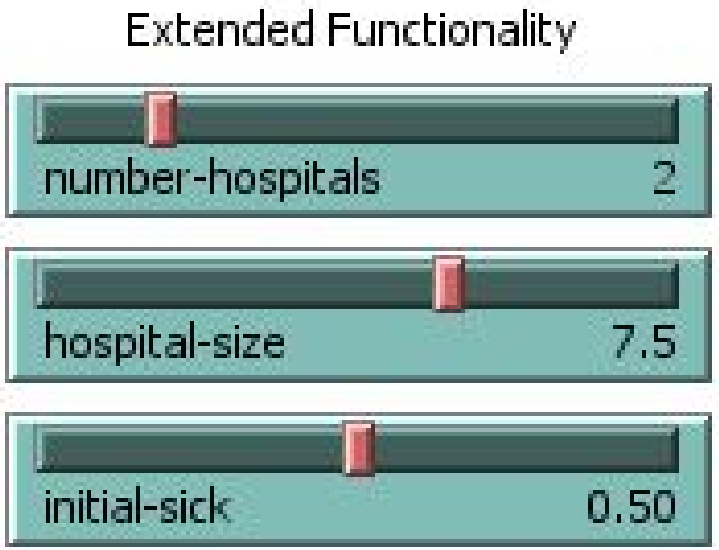
Different graphs in the interface

Our research question

How will the introduction of hospitals affect the population distribution of healthy, sick and immune people?

New sliders for choosing:

- ➔ Number of hospitals: total number of hospitals to be generated
- ➔ Reach of each hospital: length of the square - the area which each hospital can cater to
- ➔ Proportion of population which is sick initially



Sliders implementing extended functionality

Implementation

- Two breeds of turtles: **`hospitals`** and **`persons`**
- Hospitals generated at random coordinates with **`hospital-size`** defined by the user
- Initial number of sick persons is now a percentage **`initial-sick`** of the total population
- Implemented as a nested loop
- At each tick call **`go-to-hospital`** function
    - For each person (identified by **`who`**) save their coordinates
    - Compare the coordinates of this person with the coordinates of each hospital (identified by **`who`**)
        - If the person is within the area covered (**`hospital-size`**) by any hospital make him healthy and immune by calling function **`become-immune`**

Demo

Comparative study

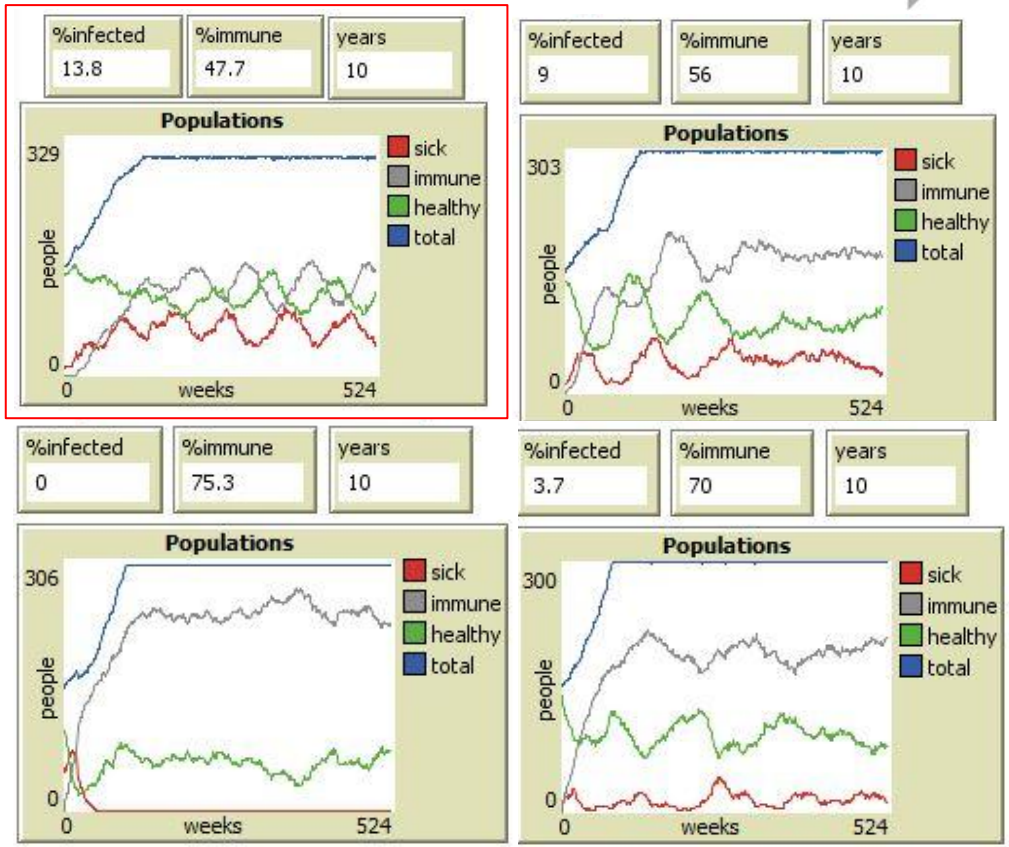
Plots comparing population distribution in different scenarios after 10 years.

Top Left: Original “Virus” model without hospitals with initial sick population = 10/150 = 7%

Top Right: Number of hospitals = 2, Hospital Size = 4.0, Initial sick population = 7%

Bottom Right: Number of hospitals = 3, Hospital Size = 6.0, Initial sick population = 7%

Bottom Left: Number of hospitals = 6, Hospital Size = 4.0, Initial sick population = 35%



Conclusion

- Population distribution of immune, sick and healthy persons at any given point depends on the count and size of hospitals as well as the total count of persons and the initial proportion of sick persons
- The spatial distribution of hospitals affect the population distribution of the sick, healthy and immune persons
    - Hospitals clustered together vs. hospitals distributed evenly
- Limitations and future scopes
    - set capacity of hospitals
    - set probability of getting cured if someone visits a hospital

Thank You!

Questions?

- **Link to our code:** https://github.com/RaphaelW1tt/GeoSim17-18
- References:

  - Wilensky, U. (1999). NetLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.
  - Wilensky, U. (1998). NetLogo Virus model. http://ccl.northwestern.edu/netlogo/models/Virus. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.