Smallpox Outbreak Modeling in Python

Joe Fetsch

Computer Systems Lab 2009-2010

Abstract

This project is intended to model a martyr-type scenario in which a small terrorist groups infiltrate a city after infecting themselves with Variola Major; they attack hospitals first, passing as flu sufferers until the virus becomes contagious. After panic begins to spread, as the population realizes that they would have to avoid medical facilities even if they become infected, the remaining faction infiltrates the city, possibly in health control uniforms, fostering distrust of the government, spreading the virus further. With the mass panic and disease spreading, the city shuts down. Nobody is allowed in or out, effectively quarantining the city. Residents panic and remain at home in fear of infection, at which point the city stops functioning completely, and chaos runs free as infections spread and disease control units are helpless to intervene due to the quarantine and the population's general panic and instilled fear of health officials, causing them to refuse to cooperate.

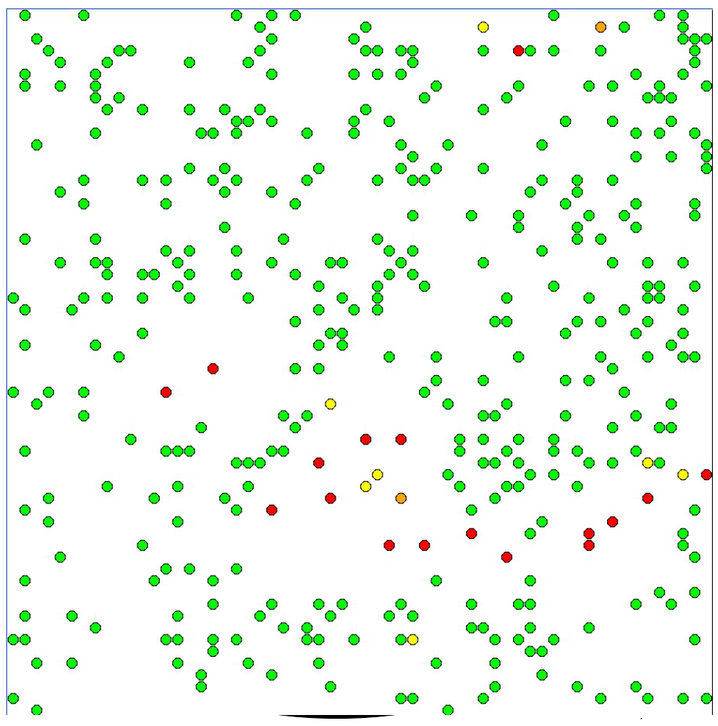

Figure 1: A typical display of the world where green agents are healthy, red are infected, orange are in the prodromal phase, blue are immune, and yellow agents are carriers of the smallpox virus – this image is from the early stages of the attack, about 20 days in; 8 days after the first symptoms are shown in the faction infiltrating the public.

Background and Introduction

Smallpox, also Variola Major, is a fast-spreading disease with a 100% susceptibility rate in humans who have not been immunized in the past 10 years. The only populations recently immunized are military or emergency health control workers. Smallpox has a 33% fatality rate and spreads like wildfire because of the 2 week incubation period in which no symptoms are shown from the infected person, as they travel around, moving to uninfected cities or healthy sections of a population before the sudden outbreak catches them by surprise, creating many more victims for the disease.
do not have access to this type of data.

Figure 2: a visual representation of the population over time using the color scheme described above. Time span graphed is about 4 months.

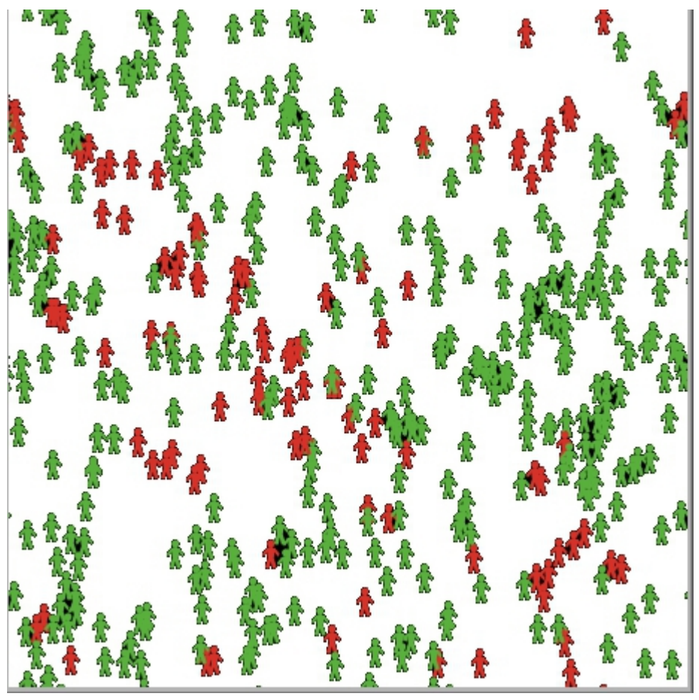

Figure 3:a NetLogo representation of a simpler world with a generic virus where red = infected and green = healthy

Discussion

Python will be used in the final project where NetLogo was used to obtain a basic understanding of the intended result of the project. Testing will be done with regard to statistics for previous outbreaks of smallpox and recorded death rates – this data will hopefully be obtained through contact with Dr. Hensley, head of Viral Therapeutics at USAMRIID in Fort Detrick, Maryland.

Results and Conclusions

This project can be expected to provide an understanding of the fatalities and infection rates of such a population in a major city in a scenario as described in the abstract. The chance of this type of scenario being a possibility ranges from predictions of 60% to 80%, and fatalities are estimated to be about ¼ of the population in the city, as infection rates are estimated to be about ¾ of the population of the city targeted after 4 to 6 months without control of the population.