Simulator of the spread of COVID-19 virus
CS177H

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1 Topic

To simulate the spread of COVID-19 virus in the crowd with several Epidemiological models. The simulator contains two parts corresponds to a video of dynamic tongji model with the parameter of virus' gene mutation rate, lasting days of antibodies, etc. And a game to simulate the spread of COVID-19 virus in university.

2 Basic Model(in progress)

We use some classic SIR model to develop the model and make some changes with vaccination and virus mutation in total population.

2.1 SIR Model

The classic SIR model is given by(Hethcote, 2000)

$$\begin{aligned}\frac{dS}{dt} &= \mu N - \mu S - \beta I \frac{S}{N} \\ \frac{dI}{dt} &= \beta I \frac{S}{N} - \gamma I - \mu I \\ \frac{dR}{dt} &= \gamma I - \mu R\end{aligned}$$

with the initial state $(S(0), I(0), R(0) = (S_0, I_0, R_0)$ and $S(t) + I(t) + R(t) = N$ where newborns and deaths get into each class at rate μ, contract rate λ and recovery rate γ

2.2 Model with Vaccination and Virus Mutation

We add some degrees of freedom about vaccination of newborns and non-newborns as well as virus mutation. And there are several different strategies to simulate the dynamics of this model(Levin, 2002; Brauer, 2008)
For vaccination in this epidemiological model, there are lots of reference to simulate the model.(Smith and Jones, 2012). And we will propose a new method to simulate the spread of virus with virus mutation.

3 Schedule

- **May 22 $\sim$ June 5** Complete the simulator developed by Pygame, and finish the validation with necessary parameters.
- **June 5 $\sim$ June 10** Finish the video about simulation of the spread of virus with addtional variables like vaccination and virus mutation. The video will be developed by manim.
- **June 10 $\sim$ June 15** Finish the report and representation.

4 Project Address(in progress)

Our project is proposed on github: CS177H-project

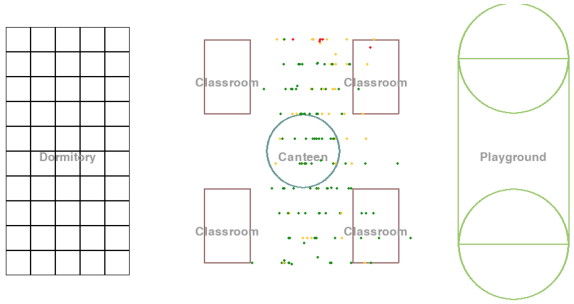

Figure 1: Game of virus spread in university

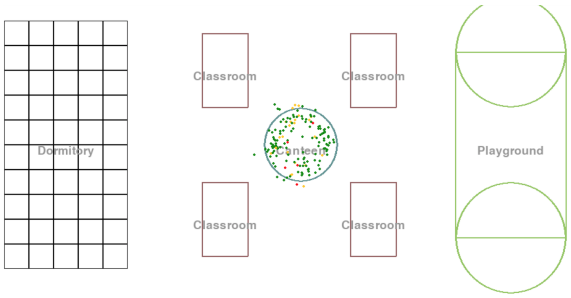

Figure 2: Game of virus spread in university

References

Brauer, F. (2008). An introduction to networks in epidemic modeling. In *Mathematical epidemiology*, pages 133–146. Springer.

Hethcote, H. W. (2000). The mathematics of infectious diseases. *SIAM review*, 42(4):599–653.

Levin, S. A. (2002). New directions in the mathematics of infectious disease. In *Mathematical approaches for emerging and reemerging infectious diseases: models, methods, and theory*, pages 1–5. Springer.

Smith, J. M. and Jones, A. B. (2012). *Chemistry*. Publisher, 7th edition.