**Mathematical Model**  + **Solution of the mathematical problem**

In reality, the spread  of disease is influenced by the complex network of interactions people have with each other on a daily basis as well as variations in the health and other habits of the individual. Diseases is more likely to spread within these more closely knit communities because of the increased amount of interaction. As we have no way of objectively forming such complex networks, we simplify this problem by assuming people interact only with people directly around them, and that the classroom is the main setting in which this interaction occurs.

In creating these random, localized communities, we can hopefully learn more about the more systematic transmission of disease across larger communities. This is similar to the SIR model discussed earlier, which ignores the nuances of these communities in order to study the spread of disease in a more general manner. Furthermore

*Monte carlo.*

*[Relate to SIR models in prior work: Susceptible-Infected-Recovered.]*

We use Monte Carlo simulations to determine how infected students counts change as the parameter varies.

Note: 47 classrooms, 4380 students in the model.

*How did you turn the simplified problem into a mathematical model? Is there a standard mathematical problem form that you are using, e.g., Markov Chains? If so, how does it relate to standard problems? Define all variables you use, explain your notation, etc.*

[Pseudocode for how we initialize the model (assigning students to classrooms, especially). Pseudocode for the update loop: what happens at each time step.]

**Pseudocode**

Initialization

\*\* For each classroom\_i, with rows\_i and columns\_i

\*\* generate an empty object array of simulation\_days x size row\_i x columns\_i.

\*\* fill each spot in day 1 of above array with a Student (object) from student body

\*\* for each student, look at adjacent seats and add students in those seats as neighbors

\*\* based on vaccination rate, assign some students to be vaccinated

\*\* of those, based on vaccine effectiveness assign some to be immune/recovered

\*\* assign randoms student in class to be sick (patient zero).

\*\* randomly assign recovery times to students based on geometric distribution

Update

\*\* If it is day\_m

\*\* For each classroom\_i

\*\* For each student\_k in classroom\_i

\*\*check if it is a weekend

\*\*if student\_k is infected, mark that student spent day\_m sick

\*\* check if student recovers (days sick >= recovery time set initially)

\*\*if student\_k is uninfected + not weekend, count number of infected neighbors

\*\*student becomes infected with probability related to number of  neighbors that are sick

*What techniques are used to solve the mathematical prob- lem? Are you able to use standard techniques, for example, turning it into a MILP? Do you need to develop a new algorithm to solve the problem, or use something different from the literature that we haven’t discussed in class? If so, explain how it works. Give a pseudocode description of the algorithms you use, whether you invented the algorithm or you found one in the literature. Use examples to illustrate the relevant mathematical concepts.*