Network Science		
Lecture 12: August 25, 2009	Scribe: Zhao Zhao	Lecturer: JiangZhuo Chen

High performance computing for Epidemics: EpiFast

12.1 Contact Network Epidemiology

12.1.1 Disease Transmission

Disease transmits from one to another with probability P.
Tools for simulating disease transmitting includes:

- Episims.
- Episimdemics.
- Epifast.

Two simulation frameworks involve with disease transmission.

- Model people activity(when and where they go).
- Model contact network of people.

Model People Activity:
People visit some location in some time. So if two people visit the same location with an overlapping time duration, it is possible that disease transmits from one to the other. People location graph can be illustrated in Fig. 12.1.

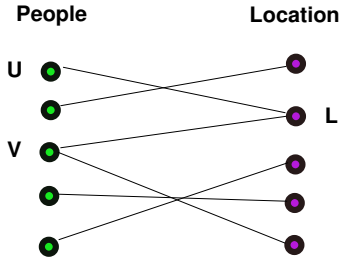

Figure 12.1: People-location bipartite graph

Model Contact Network:
For each pair of people who meet at some place, we can assign an edge between them. We also denote the time duration they meet. Therefore, a contact graph $G(V, E, D)$ can be built. Here V represent people, E represent edge, and D represent duration. In the contact network we used for Epifast, what time the meeting happens is not considered.

12.1.2 Disease Model

SEIR model is currently used by Epifast.
Here, **S: Susceptible, E: Exposed, I: Infectious, R: Removed(Recovered)**, are the four status an individual can has. An individual can change his status in the following pattern: We

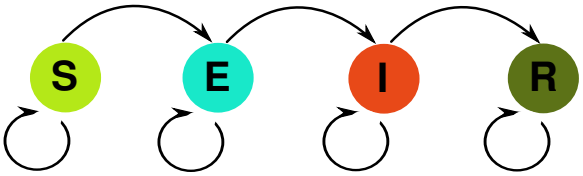

Figure 12.2: SEIR model

notice that R is the sink node.
We also define τ as the transmissibility, which represents the possibility in one unit time of infecting node v by an existing infectious node u.

$$\tau = P_r\{u \to v \mid u \in I, v \in S, (u, v) \in E(G)\} \tag{12.1}$$

If u and v contact for d unit of time, the possibility of v getting infected is:

$$1 - (1 - \tau)^d \approx 1 - e^{-\tau d} \tag{12.2}$$

The algorithm for simulation is:

Algorithm 1 Disease Transmission Simulation

DiseaseSim($G(V, E, D)$)
1: **for** each day **do**
2: **for** each $u \in V$, $u \in I$ **do**
3: check outgoing edges from u
4: **if** $u \to v$ **then**
5: update ListOfEIR

12.1.3 Interventions

Two intervention methods are applied commonly, which are:

- Pharmaceutical (vaccination, medical care, etc.)
- Non-pharmaceutical (school closure, isolation, etc.)