

Discrete Event Simulation for Pandemics

Consider an undirected graph $G=(V,E)$ representing a population. Nodes of the graph are individuals. The presence of an edge between two individuals indicates that they are in close contact with each other (e.g, sharing a home or a workplace).

Generate a graph on 100 nodes as follows: for each pair of nodes, toss a fair coin and put an edge between them if and only if you get a heads. This gives you a population graph.

Every individual is in one of the following states: susceptible, infected, or recovered (aka removed). The possible transition for each individual is *susceptible* to *infected* to *recovered*.

- Data Structures:
 - Sets **S**, **I** and **R**.
 - Binary heap with nodes having
 - **Node id**
 - **TimeStamp**
 - **Event type: Infection/Recovery**
- Initially all nodes are in S.
- Choose a starting node arbitrarily and call it **u**.
- **Insert** this infection event in the min-Queue **Q**, with timestamp 0.
- **While(;;)**
 - **e**←DeleteMin(Q)
 - If **e** is a Recovery event,
 - **R**← R U {e.nodeID}
 - **I**← I \{e.nodeID}
 - If **e** is an infection event,
 - **I**← I U {e.nodeID}
 - **S**← S \{e.nodeID}
 - **Forall** susceptible neighbors **u** of **e.nodeid**
 - **Generate an infectionTime as follows**
 - Toss a fair coin five times
 - Let **j** be the first time a head comes (if a head doesn't appear at all, **u** doesn't get infected because of **e.nodeid**), **continue** to next neighbor
 - **Insert** into **Q**:
 - **Node id**:u
 - **TimeStamp**: e.timeStamp+j
 - **Event type**: Infection
 - (If **u** did get infected) **generate recovery event**:
 - Generate a random number **k** uniformly between **e.timeStamp+j** and **e.timeStamp+j+5**
 - **Insert** into **Q**:
 - **Node id**:u
 - **TimeStamp**: k
 - **Event type**: Recovery

1. Plot the number of susceptible, infected and recovered individuals, against i .
2. Compare the instant at which a node gets infected with it's shortest distance from the start node s .