Epidemics

Social and Technological Networks

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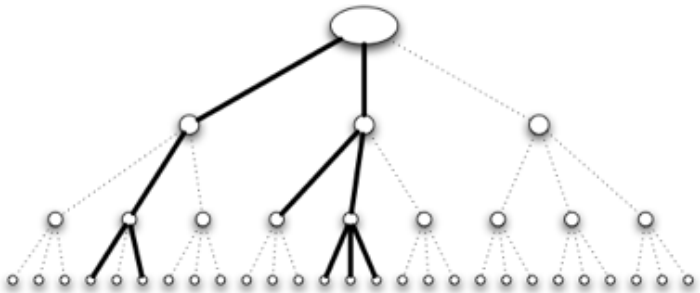
Spread of diseases

- Pattern depends on network structure
- e.g. spread of flu
- Network of people
- Network of airlines

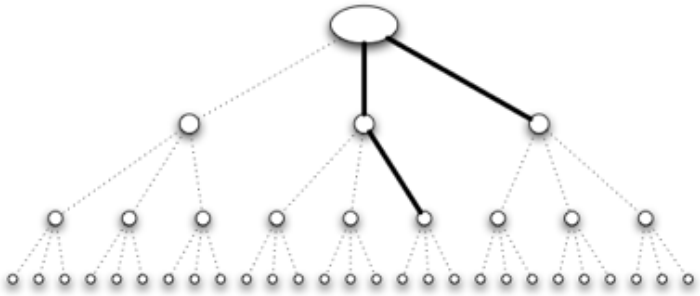
- Different from idea/innovation contagion
  - Does not need a “decision”
  - Does not need multiple support
    - Infectious disease passes easily with some probability

- Suppose everyone meets k new people and infects each with probability p
- That is, they infect R = kp people on average

- If p is high
- The disease will persists through rounds
- If p is low, it will die out after some rounds



(b) *With high contagion probability, the infection spreads widely*



Property

- When R > 1 number of infected people keeps increasing
  - Outbreak
- When R < 1 Number of infected people decreases
  - Disease dies out
- Phase transition at R = 1
- assuming there are enough “new” people supply to meet
- Generally true in the initial stages

- Around R = 1: small efforts can have large effects on epidemic
  - Awareness causing slight decrease in p
  - Quarantine/fear causing slight decrease in k

SIR Model

- Susceptible (initially)
- Infectious (after being infected)
  - While Infectious, it can pass disease to each neighbor in each step with prob. p
- Removed (after given duration as Infectious)
  - Immune/dead

SIS model

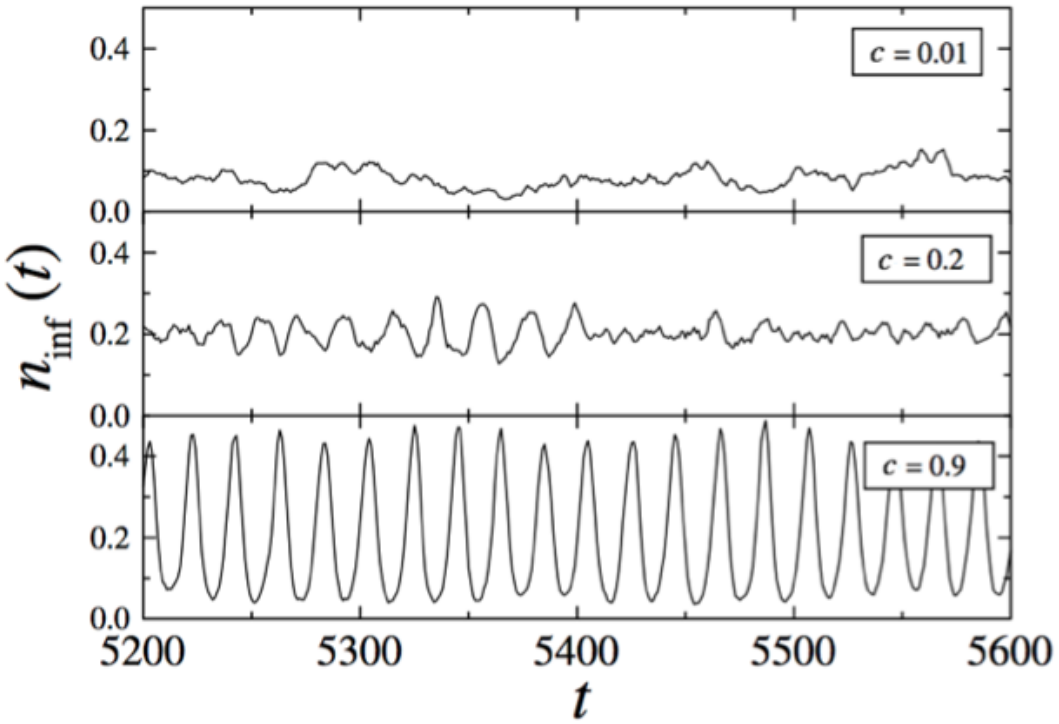
- No “Removed” state. Susceptible follows Infectious

SIRS model

- Susceptible
- Infectious
- Recovered (immune)
- Susceptible

SIRS oscillations in Watts-Strogatz Small worlds

- Nodes connected to few nighbors on a ring
- Fraction c of links modified to connect to random nodes



Epidemic or gossip algorithm

- Emulates the spread of epidemic or a rumor in a network
- A node speaks to a random neighbor to spread the rumor message
- Useful for spreading information in computer networks