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DEEMED TO BE UNIVERSITY

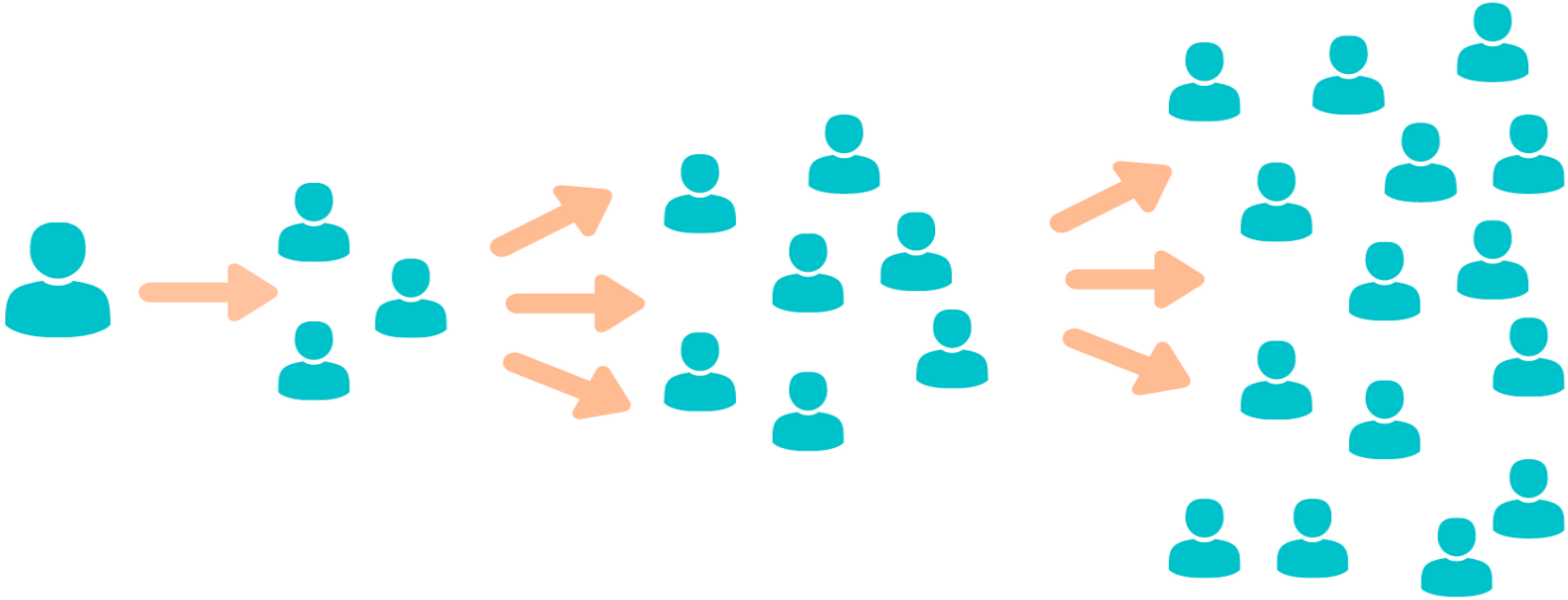
19CSE337 Social Networking and Security

Lecture 16

Topics to Discuss

- Contagion

Contagion



Contagion

- Contagion means spreading of diseases.
- In social network perspective, it is information spreading from person to person.
- Also termed as information diffusion or simply diffusion.
- Can be used to model infection spread, economic flow etc.

Contagion

- Social networks are prominent tool for information diffusion in society.
- Modelling and predicting information diffusion is very important.
- It is very useful in predicting, marketing, advertising, political campaigns etc.
- Tie strength is very important in information diffusion.

Social Contagion

- Phenomena or various processes that depend on individual propensity to adopt and diffuse knowledge, ideas and information.
- The spread of behaviours, attitudes and effect through crowds and other types of social aggregates from one member to other.

Simple Contagion

- Single exposure is sufficient for transmission.
- Eg; disease, information etc
- Various epidemic models are there to model simple contagion.
- Eg; SIR, SIS etc

Complex Contagion

- Single exposure is not sufficient for a transmission.
- Multiple exposures are needed.
- The behaviour is risky or technology requires coordination.
- Complex contagion can be modelled using threshold model, generalized epidemic model, diffusion percolation etc.
- Most of the real world networks are described by complex contagion models (spread of technology, trends in technology etc).

Simple Contagion Model

SIR Model

- S-Susceptible (groups under observation).
- I-Infected (already done).
- R-Recovered (recovered from the effect).

- S-I-R model is capable of predicting the number of people in S,I,R stages respectively.
- It is a compartmental model introduced in 1927.

SIR Model

- It is a differential equation model.
- There are dependent variables and independent variables to model disease situation.
- Dependent variables: people in each group, total population.
- Independent variable: Time t, measured in days/hrs.

SIR Model

- Susceptible individuals may become infected.
- This measures rate of transfer from susceptible to infected.
- The rate of transfer depends on number of individuals in each compartments and frequent contacts.
- The rate of contact which converts susceptible to infected is β.
- This β value can be reduced through quarantine, lockdowns etc.

SIR Model

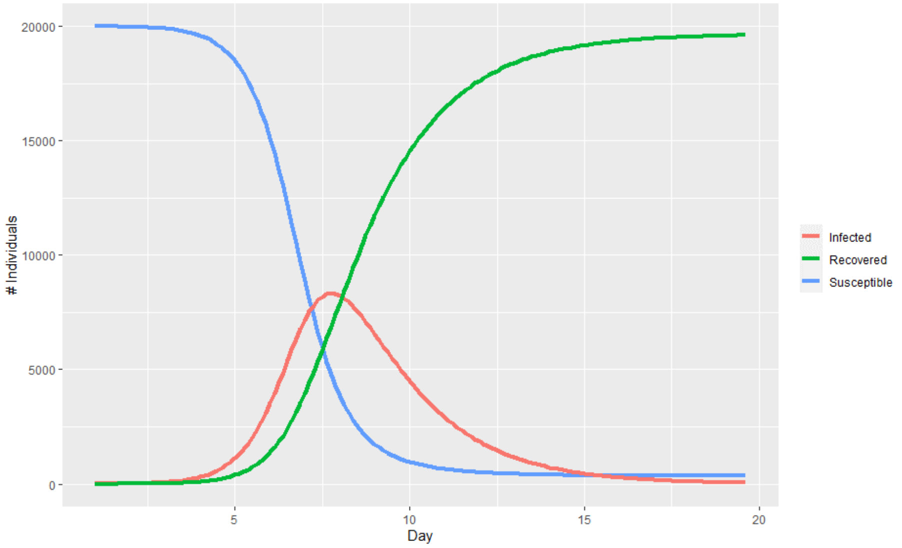
- Rate of recovery: infected to recovered.
- Also used as rate of mortality.
- R_0: basic reproduction number. The mean number of infections caused by a single infected individual over the course of their illness.
- R_0 is the ratio between β and γ.
- R_0 also known as contacts per infection.
- A decrease in β reduces R_0.
- If $R_0 > 1$, spread will increase in the upcoming days else reduced.

SIR Model

- Expressing S, I, R, in terms of t as S(t),I(t),R(t).
- The total population N= S(t)+I(t)+R(t).
- To form a differential equation, express S, I and R as rate of change of S,I,R with respect to time t as: dS/dt, dI/dt, dR/dt.

SIR Model

- The equations are:
  - $dS/dt=-\beta SI$ (-ve value as susceptible change to infected).
  - $dI/dt=\beta SI-\gamma I$
  - $dR/dt=\gamma I$



SIR Model

- From above equations:
  - $dS=-\beta SI*dt$
  - $dI=(\beta SI-\gamma I)dt$
  - $dR=\gamma I*dt$
- Change in S, $dS=S_{i+1}-S_i$

  $S_{i+1}-S_i = -\beta S_i I_i * dt$

  $S_{i+1}=S_i - (\beta S_i I_i)dt$

SIR Model

- Similarly,

  $I_{i+1}=I_i+(\beta SI_i -\gamma I_i)dt$

  $R_{i+1}=R_i+\gamma I_i dt$

Limitations

- Not including any other parameters other than S,I,R (other models include carriers, vaccinated etc).
- Assume homogenous mixing of population (SxI). In real world, human networks are highly local.

Problem

- Consider the statistics of an epidemic in country X. S=1000, I=10, R=0. The time t is measured in days. Each infected person would make infecting contacts every two days. The average recovery period is 3 days. Find S,I, and R on the second day of epidemic.

Thanks...........