Infectious Disease Spread

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**Introdution**

A Graph or Network consists in a mathematical structure used to model relations between pairs. This model consists in a set of nodes and each node can be connected with several others by links.

The interesting thing in this mathematical model is that he can be applied to a wide range of problem. In our project we use these model to represent a human contact network in a typical school day. But why is it interesting to understand the way we contact with each other in a school day?

Infectious Diseases are normally passed via droplets during close proximity interactions thus the pandemic spread of an infectious disease is a big threat to society and has a high economic impact. By modelling the contact network in a typical school day we can understand the dynamics of an infectious disease spread in a school.

“Schools are particularly vulnerable to infectious disease spread because of the high frequency of close proximity interactions” citação - <http://sing.stanford.edu/pubs/PNAS-2010-1009094108.pdf>

With all that said our goal for this project was to analyse the dataset flu-data from http://sing.stanford.edu/flu/ and demonstrate how complex networks theory can be applied to understand and possibly solve this problem.

**The Dataset**

In order to record the CPI’s a wireless sensor network (TelosB motes) was used by 789 individuals (655 students, 73 teachers, 55 staff and 5 other persons) representing 94% of the entire school population. Each sensor had a beaconing frequency of 0.05 s^1 (20 seconds) thus every time the beacon is activated the device records all close proximities (who is in a range of 3 meters from that individual). As an example, if student A and student B were talking within 3 meters of one another, for one minute 3 beacons would be activated which would result in 3 close proximity records (CPRs).

An interaction is a continuous sequence (>= 1) of close proximities between the same two individuals. Thus, a contact exists between 2 individuals if there is at least one interaction and the contact size is the sum of all interactions.

The entire dataset consists in 762,868 interactions and 118,291 contacts.

For the official project’s webpage, see <http://sing.stanford.edu/flu/>.

**Network Representation**

The aggregate network for the entire day can be represented by a weighted undirected network.

The nodes represent individuals wearing mote sensors (students, teachers, staff and other).

The edges represent the contacts between the individuals. The edge weight represents the duration of the contact. There are four different types of edge and weight representation, explained in the next session.

Nodes = 788 (655 students, 73 teachers, 55 staff, and 5 other persons)

Edges = 118,291 or 762,868 depending on the model used.

**Edge/Contact Representations**

**Network Metrics**

[RR] Degree Study

ToDo

[RR] Average Path Length

ToDo

[JR] Clustering Coefficient

ToDo

[RC] Diameter

ToDo

**Node Metrics**

[RC] Degree Centrality

ToDo

[RC] Eigenvector Centrality

ToDo

[JR] Closeness Centrality

ToDo

[JR] Betweeness Centrality

ToDo

**Conclusion**

ToDo