The Role of Social Network: Two Examples

Seminar XIII

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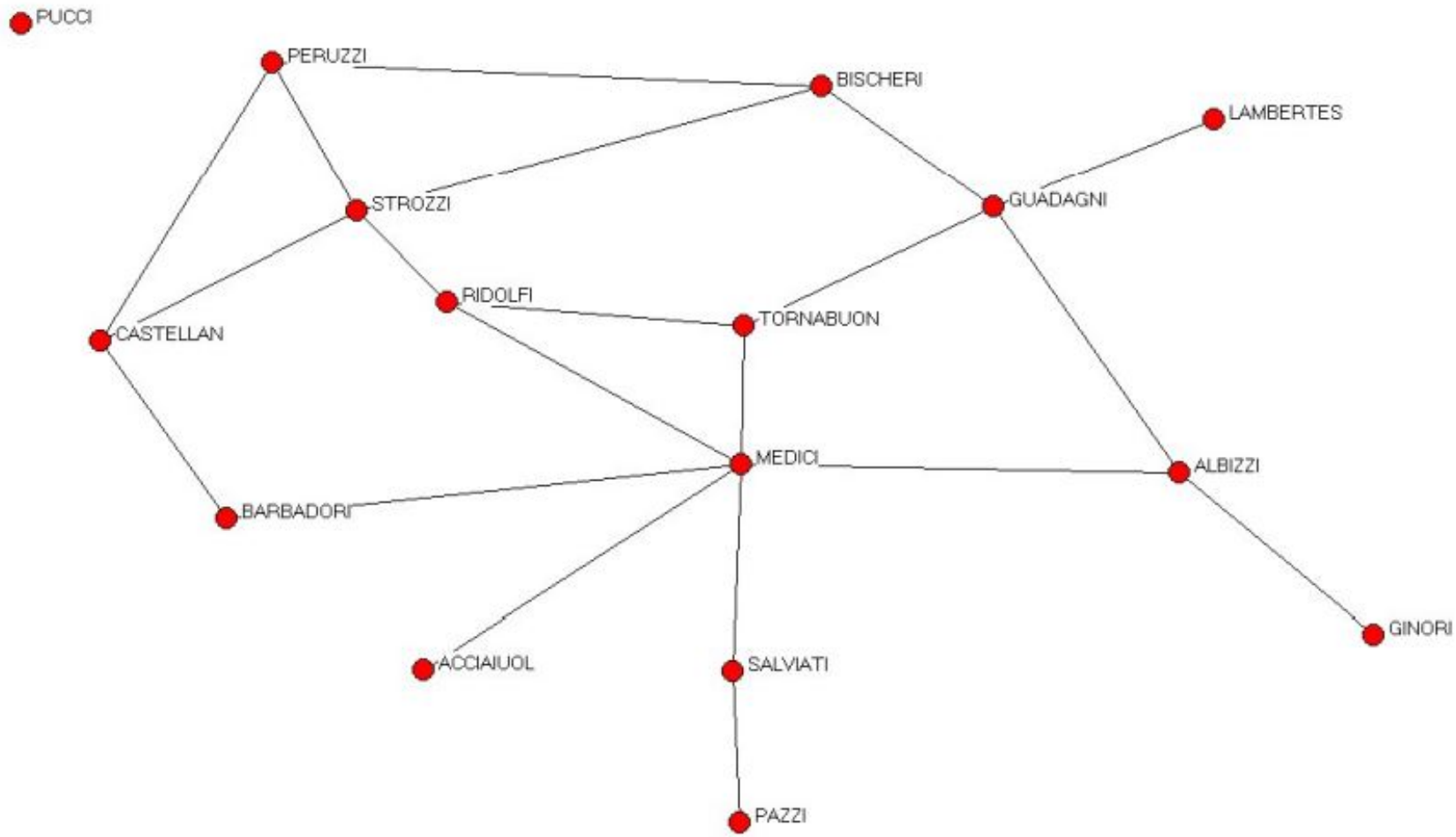
Florentine Marriages

- The Medici have been called the "godfathers of the Renaissance".
- Cosimo de' Medici consolidated political and economic power by leveraging the central position of the Medici in the network of family intermarriages, economic relationships, and political patronage.
- Padgett and Ansell (1993) provide powerful evidence documenting the network of marriages between some key families in Florence in the 1430s.

Florentine Marriages

- Previously, Florence was ruled by an oligarchy of elite families.
- However, Medici family did not stand out for wealth and political clout.
- The key to understand the family's rise can be seen in the network structure.

Florentine Marriages



Florentine Marriages

- Simply by counting how many families a given family is linked to through marriages, then the Medici come out on top (the **degree centrality**).
- However, they only edge out the Strozzi and the Guadagni by a ratio of 3 to 2. Not so dramatic as to be telling.
- We need to look to another *centrality* measure: the **betweenness** score.

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We can ask, for each pair of other families, on what fraction of the total number of shortest paths between the two the given family lies. Averaging across all pairs of other families gives the power measure proposed by Freeman (1977),

$$\sum_{ij:i\neq j,k\notin\{i.j\}} \frac{P_k(ij)/P(ij)}{(n-1)(n-2)/2}$$

for each family k.

Florentine Marriages

- This measure for the Medici family is 0.55, or they lie on more than half the paths connecting the network! (The Strozzi 0.103 or just over 10%)
- The marriage were keys to communicating informations, brokering business deals, and reaching political decisions.
- This analysis illustrates that the network structure is important for more than a count of how many social ties each member has and suggests that different measures of centrality will capture different aspects of the structure.

Centrality measures

The most common centrality measures are

- The **degree** centrality
- The **betweenness** centrality
- The **closeness** centrality
- The **eigenvector** centrality

The Degree Centrality

- It measure the number of ties owned by each single node. It is measure as

$$\frac{d_i}{(n-1)}$$

with $d_i \in [0, n-1]$ the number of links owned by i.

The Closeness Centrality

- It measure how close a given node is to any other node. Given a decay parameter $\delta \in (0, 1)$,

$$\sum_{j \neq i} \delta^{l(i,j)}$$

with $l(i, j) \in [1, \infty)$ is the distance between nodes i and j.

The Eigenvector Centrality

- A node's importance is determined by how important his neighbours are. That is

$$P_i^K(g) = \sum_{j \neq i} g_{ij} \frac{P_j^K(g)}{d_j(g)} \tag{1}$$

Let $\hat{g}_{ij}/d_j(g)$ the normalized adjacency matrix. Then we can rewrite the (1) as

$$P^K(g) = \hat{g} P^K(g)$$

or

$$(I - \hat{g}) P^K(g) = 0$$

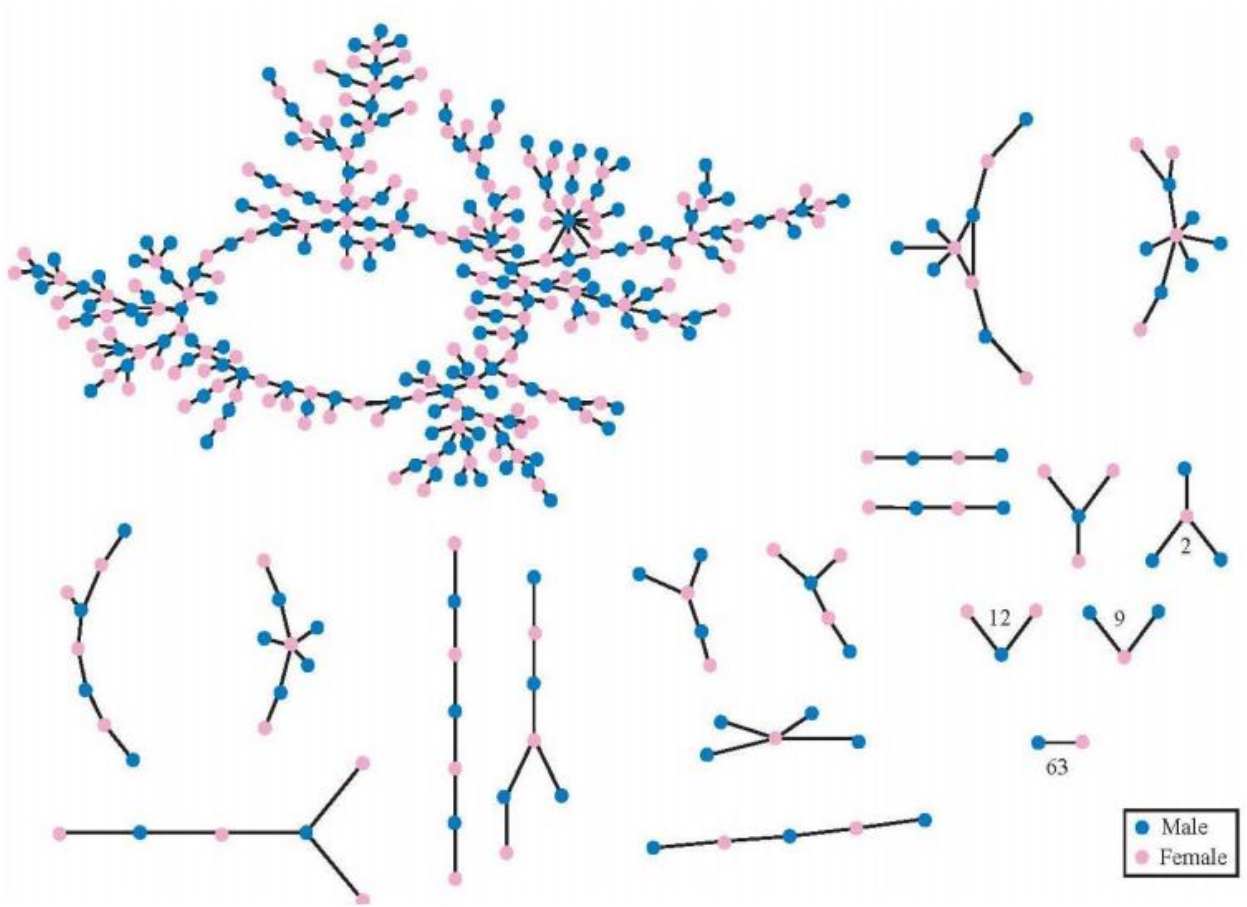
where P^K is written as a $n \times 1$ vector and I is the identity matrix.

Friendships and Romances among High School Students

- National Longitudinal Adolescent Health Data Set "Add Health". 90.000 students during mid-1990s survey together with various data on the students' socioeconomic background, behaviours, and opinions.

Friendships and Romances among High School Students

- Network of romantic relationships in one of the high schools in the study. The students were asked to list romantic liaisons that they had during the six months previous to the survey.



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- For example, there is a "giant component", in which more than 100 students are connected to. The next large component connected 10 students.
- This component structure has important implications for the diffusion of disease, information, and behaviours.

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- This means that walking along the links, most of the nodes we meet are new. This feature is important in the navigation of networks.

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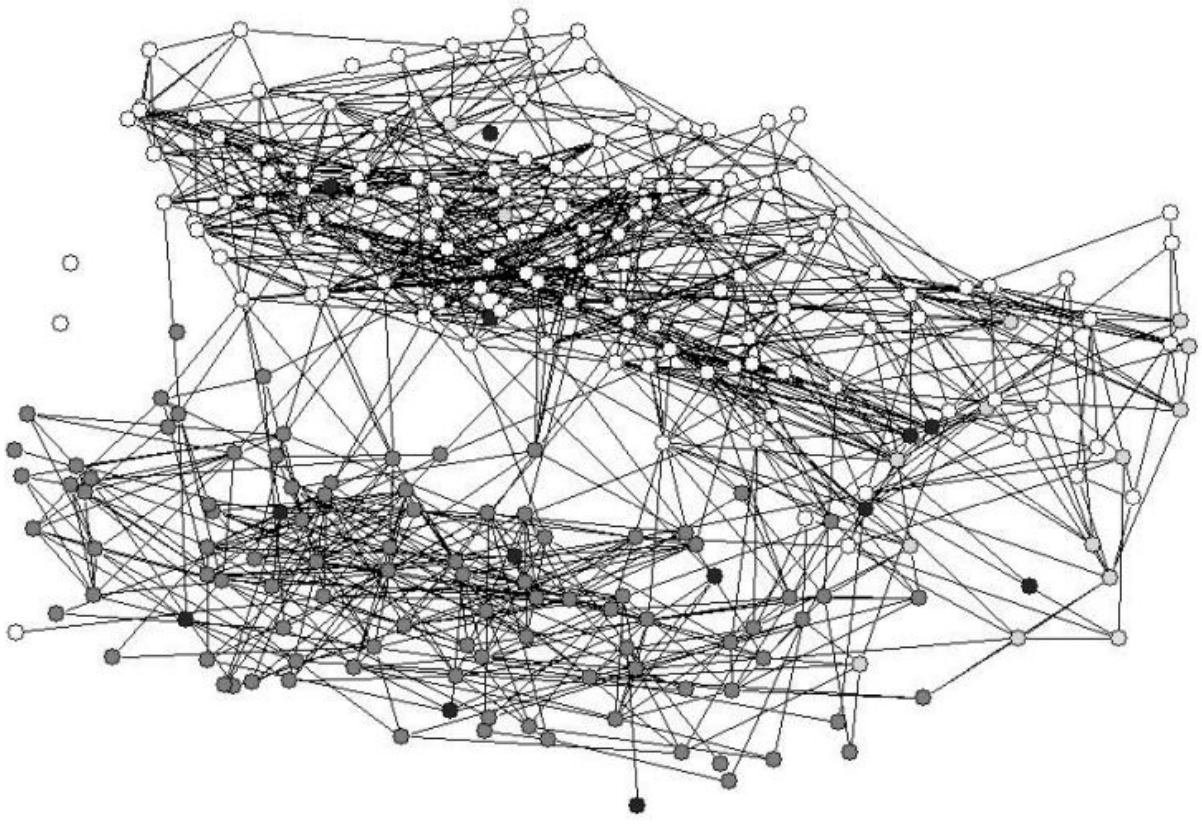

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- A strong feature present is *homophily*, a term that describes the bias in friendships toward similar individuals.
- In this school 52% of the students are white and yet 85% of white students' friendships are with other whites. Similarly, 38% of students are black and yet 85% of these students' friends are black. Hispanic students (5% of the students) are more integrated in this school having only 2% of their firendships with other Hispanic.

Friendships and Romances among High School Students

- This bias can have strong consequences. The students are somewhat segregated by race, which affects spread of information, learning, and speed with which things propagate through the network.

- We can also ask why we observe these specific network structures instead of others (dynamic formation)
- Or whether the resulting network was optimal from a variety of perspectives (welfare analysis)