Network Science

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Network Science investigates non-trivial features of graph problems that usually are not addressed by lattice theory or random graphs.
A popular subfield of Network Science is **Social Network Analysis**.
The foundation of Network Science is made out of **graph theory**.
a node = a person
a link = presence of relation between two people
1736
Leonhard Euler
Seven Bridges of Koenigsberg
1959
Paul Erdos & Alfred Renyi
On random graphs
1967
Stanley Milgram
The small world phenomenon
In average there are just 6 people (friend of friend) between each of us and every other human on this planet
On Facebook the average distance between two users is about 4.7
1973
Mark Granovetter
The strength of weak ties
A weak tie

= 

Friend that has no other friends in common with you
The majority of people get hired with the aid of weak ties
In large graphs clusters are connected through weak ties.
In the absence of weak ties graphs would not be connected
1980
Computing power became affordable
1990
WWW
1995
Detailed map making in biology and physics
1998
Barabasi & Albert
Scale free networks
number of friends = node degree
distribution of degree is of Pareto/Zipf type
Distribution of Olympic Medals, 2008

Number of Countries

Number of Medals

China  US
Homophily
The tendency of people that are alike to bond together
Preferential attachment
People have a tendency to make friends that have a lot of friends (are popular)
Applications of Network Science
Prevention of diseases spread
Security

Discovering ways to reach terrorist/dictators
Saddam Hussein was caught with the help of Network Science
The guy in the middle
Help establish good working environments for companies
Organisational Network Analysis (ONA) is the science that studies the formal or informal networks that appear within an organisation.
Let us analyse the flow of information into a company
A link between two nodes represents the relation of knowledge exchange.
Node size proportional with the number of connections

People that poses knowledge
Betweenness = Who controls the flow of information

When information travels through a network, it takes the most convenient path possible (shortest path). Betweenness centrality measures the number of shortest paths in which the user is in the sequence of nodes in the path.
Node size is proportional to betweenness centrality

Important people
Scenario
Tho companies merge into a bigger one
How do you help in creating a combined social environment?
Create graphs were the links state who eats with who during lunch breaks?
Thus we determine the social clusters
In each cluster we determine the most popular employee.
During next month the most social guys are put at the same eating table
Organisational Network Analysis

- Create graphs / networks
- Analise graphs
- Interpret results
Network Science helps in determining important nodes in different scenarios.
Thank you
Looking forward to study to work together with anyone interested