Consiglio Nazionale delle Ricerche

UNIVERSITÀ DI PISA

# Project 8: Spatial networks and small worlds

The small-world effect is a well-known phenomenon characterizing real-world social networks. Around a decade ago, the availability of data allowed scientists to discover the existence of this effect in several contexts, such as collaboration networks (see, e.g., the oracle of Bacon). Does a small world effect exist in human mobility as well?

Use the Brightkite, Gowalla and Foursquare datasets to construct an undirected network $M = (V, E)$ in which nodes in $V$ are individuals and a link in $E$ indicates that two individuals visited at least once the same location.

Analyze the structure of this network in terms of (use library networkx):

1. distribution of degree $P(k)$;
2. clustering coefficient $CC$;
3. average path length $< d >$;
4. betweenness centrality $BC$.

Comment on the results you find for points 1-4.

By small in the "small world phenomenon" we mean that the average path length $< d >$ depends logarithmically on the number of nodes (see here for details). Hence, “small” means that $< d >$ is proportional to $ln\, N$, rather than $N$ or some power of $N$. In other words, a network has the small-world effect if $d$ is around the natural logarithm of the number of nodes in the network. Is $M$ a small world? Why?

Compare the shape of $P(k)$ and the values of $CC$, $< d >$, and $BC$ of $M$ with those of a social network $G = (U, I)$ where $U$ are the users in the dataset used to construct $M$ and a link in $I$ indicates that two users are friends in the social network platform. Is $G$ a small world? What’s the smallest world between $M$ and $G$?