Complex Systems

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Exercise Sheet 6

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Network Analysis

Real-world problems usually have multiple relationships between records in the data. Consider for example an advertisement company that wants to promote its products through social networks. They might not have resources to contact everyone in the social network, but they can find the most important individuals, contact them, and incite them to promote their products. Or consider researchers from the life sciences that wish to understand how proteins regulate the actions of other proteins. These type of problems, which involve interdependencies, can be modelled as graphs, and scientists have devote a serious amount of research on the proposal of tools to identify and characterise the properties of these graphs.

In this practical assignment your goal is to use these tools, and analyse a real-world network by implementing several metrics that will allow you to understand the dynamics of the network.

6.1 Exercises

We will use The Facebook Ego Networks, public available here. You should download the `facebook_combined.txt` file.

This dataset contains the aggregated network of the individuals' Facebook friends list. Each network node represent individuals on the social network, and an edge between two users (vertices) indicate that they are friends. The graphical representation of the networks is shown in Fig. 6.1.

Exercise 6.1 **E**

Compute the number of nodes in the network.

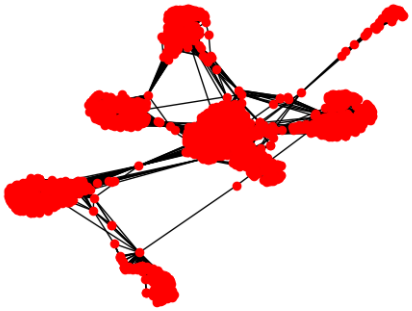

Figure 6.1: Facebook Ego Network

Exercise 6.2 E

Compute the number of edges in the network.

Exercise 6.3 E

Compute the Average Degree of the network.

Exercise 6.4 M

Compute and plot the average degree distribution.

Exercise 6.5 E

Compute the density of the network. Comment.

Exercise 6.6 E

Compute the eccentricity of the network.

Exercise 6.7 E

Compute the diameter of the network.

Exercise 6.8 E

Compute the radius of the network.

Exercise 6.9 H

Compute the betweenness centrality of the network. Plot the top 10 nodes with highest betweenness centrality.

Exercise 6.10 H

Compute and plot the communities that exist (if any) in the network. [1]

[1] It is recommend that you use the python module `community` built on top of networkx. For more details on the package, please refer to http://python-louvain.readthedocs.io/en/latest/