Computational Science 2

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Seminar
Exercises

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Exercise 8 (28.5.2019):

Preferential attachment model

from ***An Introduction to Computer Simulation Methods***,
Chapter 14, Problem 14.16

a) Write a target class that uses the `PreferentialAttachment` class and continuously creates new networks until stopped by the user (so we can compute averages over many networks). To speed up the computation, make it possible to optionally display the networks. The program should output the average degree distribution, $D(l)$.

b) Estimate the exponent α defined by $D(l) \sim l^{-\alpha}$ for $N = 100$ and $m = 2$. Repeat for $N = 500$. Does the exponent α change? If time permits, consider $N = 10000$. Does α depend on m?

c) Modify `PreferentialAttachment` so that the links are made randomly so that the number of links a node already has is irrelevant to adding a link. What functional form does the link distribution have now? Is this model equivalent to the Erdös-Rényi model?

d) Write a method to compute the clustering coefficient $C(N)$ which is defined as 3 times the number of triangles divided by the number of possible triples of connected nodes. Plot $\ln C(N)$ versus $\ln N$ for both the preferential attachment model and the Erdös-Rényi model. Compare and discuss your results in terms of the visual appearance of the networks.