

Lab 6 - CSN: Network dynamics

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Introduction

In this session, we had to model 3 different models following the dynamical principles of the Barabasi-Albert model. Those principles are: vertex growth and preferential attachment. The different models we needed to implement were the following:

- Barabasi-Albert with the dynamical principles
- Barabasi-Albert with random attachment instead of preferential attachment (only one dynamical principle).
- Barabasi-Albert with vertex growth suppressed (only one dynamical principle).

Those models were simulated and the data kept in files so we could analyze mathematical properties of those models.

In this report we will show our results regarding those models and their analysis. We will discuss those results and explain them. Then we will explain how we implemented the model simulations and what we used to analyze it in the Methods section.

Results

Discussion

As explained in section Methods, we used m_0 and n_0 always with the same values (which can be however different for each model). We never compared the models with different m_0 or n_0 for the same model. It could have indicated us if the model behaved differently given different graph input. We could have went further and do this but we preferred to focus on the analysis of our different models.

	Model 1	Model 2	Model 3
0	95.991	21.367	∞
1	95.984	21.366	2.098
2	95.746	21.253	1.834
3	95.727	21.257	1.889
4	96.003	21.352	∞
5	94.844	20.412	0.107
1+	0.000	0.000	1.965
2+	95.762	21.147	1.712
3+	95.647	21.108	1.763
4+	95.727	21.254	∞
5+	94.814	20.307	0.000

Table 1: AIC measures for the degree distribution.

Methods

For the default *Barabasi-Albert* and model with random attachment the initial graph was an empty graph with only one vertex.

For the model without vertex growth, we used an unconnected graph with t_{max} vertices. Because we have no vertex growth, the vertices are not increasing and $n_0 = n_{tmax}$.

For the three models we used $m_0 = 0$ to used "clean" and "empty" graphs.

We measured the growth of the vertex degree over time and the degree distribution for each model. The vertex degree was measured over the time for $t = 1, 10, 100, 1000, 10000$ successively.

We used python for generating the models, to store the results and to analyze the data.

The files can be found in directory *data*.

The degree sequence for each models are stored in the files *model*i*_hist_degree.txt* where *i* is equal to 1 for B-A model, 2 for B-A without preferential attachment, 3 for B-A without vertex growth.

The *model*i*_tis_degree.txt* files contains the degree for each vertices at time t_i where *i* is the same as explained previously. This file as 3 columns: first column is the vertex index, second column is the degree of this vertex, last column is at which t_i we collected this data. Therefore those *model*i*_tis_degree.txt* files contain all the data for all the iterations of t .