Social Networks & Recommendation Systems

VI. Evolving networks.

Grzegorz Siudem

Warsaw University of Technology

Warsaw University of Technology

MSc program in Data Science has been developed
as a part of task 10 of the project
„NERW PW. Science - Education - Development - Cooperation”
co-funded by European Union from European Social Fund.

Project

BA network – case study

Exercise 1.

Implement BA algorithm.

P6.0 Exercises 1-4 in total are worth 1*P* [1P]

BA network – case study

Exercise 1.

Implement BA algorithm.

Exercise 2.

Use it to create an animation of a growing graph.

P6.0 Exercises 1-4 in total are worth 1*P* [1P]

BA network – case study

Exercise 1.

Implement BA algorithm.

Exercise 2.

Use it to create an animation of a growing graph.

Exercise 3.

Plot the (averaged) histogram of the degree distribution at time t.

P6.0 Exercises 1-4 in total are worth 1P [1P]

BA network – case study

Exercise 1.
Implement BA algorithm.

Exercise 2.
Use it to create an animation of a growing graph.

Exercise 3.
Plot the (averaged) histogram of the degree distribution at time t.

Exercise 4.
Find the α coefficient for the data from the previous tasks. Does it agree with our theoretical result from the lecture?

P6.0 Exercises 1-4 in total are worth 1*P* [1P]

Random connections (A model)

P6.1 Fill the gaps in the following derivation [1P]

$$\Pi(k_i) = \frac{1}{t + m_0} \approx \frac{1}{t}.$$

Random connections (A model)

P6.1 Fill the gaps in the following derivation [1P]

$$\Pi(k_i) = \frac{1}{t + m_0} \approx \frac{1}{t}.$$

Solution:

Differential equation of the form

$$\frac{dk_i}{dt} = \frac{m}{t},$$

has solution

$$k_i(t) = m \ln\left(\frac{t}{t_i}\right) + m,$$

which leads to

$$\mathcal{P}(k) = \frac{e}{m} e^{-k/m}.$$

Network with fixed size (B model)

P6.2 Fill the gaps in the following derivation [1.5P]

With the mean-field approach (as far as possible!) determine the degree distribution of the network in which

- The number of vertices is from start constant and equal to N.
- The edges are distributed with preferential attachment rule.

Network with fixed size (B model)

P6.2 Fill the gaps in the following derivation [1.5P]

With the mean-field approach (as far as possible!) determine the degree distribution of the network in which

- The number of vertices is from start constant and equal to N.
- The edges are distributed with preferential attachment rule.

Solution:

Following differential equation

$$\frac{dk_i}{dt} = \frac{N-1}{N}\frac{k_i}{2t} + \frac{1}{N},$$

has the solution of the form

$$k_i(t) = \frac{2(N-1)}{N(N-2)}t \approx \frac{2}{N}t,$$

Other projects

P6.3 Check with simulations relation $k_i(t)$ for the original BA model. [1P]

P6.4 Check with simulations relation $k_i(t)$ for model A. [1P]

P6.5 Check with simulations relation $k_i(t)$ obtained for model B. [1P]

P6.6 Find empirically degree distribution for model B. [1P]

P6.6 How to derive distribution in model B? [2P]

Warsaw University of Technology

MSc program in Data Science has been developed
as a part of task 10 of the project
„NERW PW. Science - Education - Development - Cooperation”
co-funded by European Union from European Social Fund.

Thank you for your attention!