Social Networks & Recommendation Systems

III. Real networks properties and their visualization.

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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

Excercise 1.

Draw a histogram with marked sigma intervals for random variables from the normal distribution

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp\left(\frac{-x^2}{2}\right).$$

Excercise 2.

Check the Pareto rule for variables from the geometric distribution

$$p_k = (1-p)^{k-1} p.$$

Fat tails case

Excercise 3.

Draw a histogram with marked sigm intervals for variables drawn from a continuous power distribution

$$f(x) = \frac{\alpha - 1}{x_{\min}} \left(\frac{x}{x_{\min}} \right)^{-\alpha}.$$

Excercise 4.

Check the Pareto rule for variables from the zeta distribution

$$p_k = \frac{1}{\zeta(s)} k^{-s}.$$

Why power law networks are scale free?

Excercise 5. Empirical justification

- generate BA network and ER graphs using built-in functions.
- observe the presence of hubs.
- draw a vertex degree histogram.
- compute estimators of expectation and variance for vertex degrees.
- how are the two cases different?

Warning!

Excercises 1-5 in total are worth 2 points for the project.

Graph visualization methods

P3.1 Read documentation of the pre-defined graph layout functions in your chosen environment. For the selected real graph, test several visualization methods. [1.5P]

P3.2 Rewrite your code into functional form (applies to Wolfram language only). [1.5P]

P3.3 Implement the graph visualization based on the spring method according to the specification below [3P]

Graph visualization methods

Physical approach

- In every vertex we put the same electric charge,

Graph visualization methods

Physical approach

- In every vertex we put the same electric charge,
- every edge we replace with a spring,

Graph visualization methods

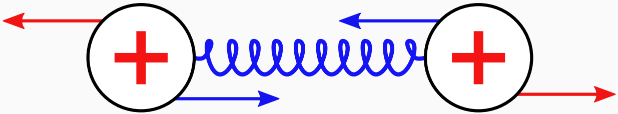
Physical approach

- In every vertex we put the same electric charge,
- every edge we replace with a spring,
- we start with the random configuration,

Graph visualization methods

Physical **approach**

- In every vertex we put the same electric charge,
- every edge we replace with a spring,
- we start with the random configuration,
- forces by minimizing electrostatic energy and potential elasticity do the work for us.



Work plan (Mathematica/Python/R)

- Write the energy of the spring system.

Project

Work plan (Mathematica/Python/R)

- Write the energy of the spring system.
- Draw the graph in *some* configuration.

Project

Work plan (Mathematica/Python/R)

- Write the energy of the spring system.
- Draw the graph in *some* configuration.
- Apply simulated annealing for finding optimal configuration.

Project

Work plan (Mathematica/Python/R)

- Write the energy of the spring system.
- Draw the graph in *some* configuration.
- Apply simulated annealing for finding optimal configuration.
- Prepare animation.

European Funds
Knowledge Education Development

Warsaw University
of Technology

European Union
European Social Fund

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