University of Konstanz
Algorithmics Group
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Network Modeling
Winter Term 2015/2016

Assignments № 6

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Task 1: Exponential random variable — 3 points

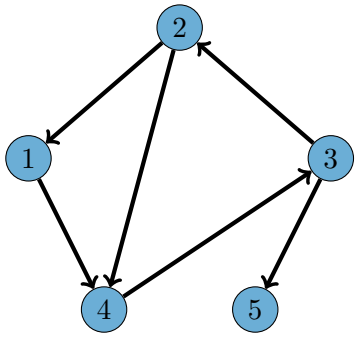
Let T an exponential random variable with probability density function

$$\varphi_T(t) = \lambda e^{-\lambda t}, \lambda > 0, t > 0$$

where λ is the rate parameter. Prove the memoryless property of T.

Task 2: Chain probability — 7 points

Consider the following network with 5 nodes



Let us assume that Actor 4 has the opportunity to make a change. His decision is based on an objective function including the following statistics: *outdegree*, *reciprocity*, *transitive triplets* and *three-cycle*. The values of the corresponding parameters are $\beta_{out} = -1.5$, $\beta_{rec} = 2.5$, $\beta_{tran} = 0.8$ and $\beta_{cyc} = -0.1$.
Compute the chain probability for Actor 4.

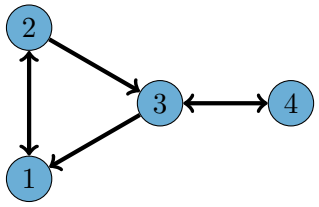
Task 3: Chain probability in R **10 points**

Write the following two functions in R:

(a) The function *netstats* should return the outdegree and the number of reciprocal dyads for an actor i. The arguments of the functions are an adjacency matrix x and an actor id i. The output must be a two dimensional vector returning the values of the outgoing and reciprocal ties statistics.

(b) The function $evalfct$ should return the vector of probabilities of all possible changes that an actor i can make. The arguments of the function are an actor id i, an adjacency matrix x and a vector β of the statistical parameters for outdegree and reciprocal dyads.

(c) Create the adjacency matrix of the following network



Set $\beta_{out} = -1$ and $\beta_{rec} = 1.2$.

i. Perform a micro-step for actor 3, i.e. calculate the tie change probabilities and flip the tie to actor j^* with the highest probability.

ii. Calculate the tie change probabilities for j^* to all other actors.