
Complex Network Models

You may hand in your solutions (handwritten or typeset in LaTeX) to konstantinos.lakis@inf.ethz.ch if you want to get feedback

Exercise 1

Let $d \in \mathbb{N}$. We consider the greedy routing algorithm in the Watts-Strogatz model with dimension d and n vertices, i.e. on the grid $\Gamma_{s,d} := \{1, \dots, s\}^d$ with $n = s^d$. For a random start vertex s and a random target vertex t , show that the algorithm needs $O(\min\{n^{1/d}, p^{-1/(d+1)}\})$ steps in expectation.

Exercise 2

Let $d \in \mathbb{N}$. We saw in the lecture that for a Kleinberg random graph with dimension d and n vertices, $\log^2 n$ steps were in expectation enough to reach a random vertex t starting from a random vertex s . In this exercise, we consider a variation of that model where the probability of adding an edge is $p(u, v) = \frac{1}{d_1(u, v)^{d+\varepsilon}}$ for whatever $\varepsilon > 0$. Show that a polynomial number of steps are needed in expectation.

Hint: What is the probability to do a jump of length r or more in one step? What is the probability that in k steps, at least one is a jump of length r or more? Choose r and k wisely!