Social Networks and Online Markets

Homework 3

Due: 17/6/2018, 23:59

Instructions

You must hand in the homeworks electronically and before the due date and time.

The homework has to be done by each **person individually**.

Handing in: You must hand in the homeworks by the due date and time by an email to `aris@dis.uniroma1.it` that will contain as attachment **(not links to some file-uploading server!)** a .zip or .pdf file with your answers.
After you submit, you will receive an acknowledgement email that your homework has been received and at what date and time. If you have not received an acknowledgement email within 2 days after you submit then contact Aris.

The solutions for the theoretical exercises must contain your answers either typed up or hand written clearly and scanned.

For information about collaboration, and about being late check the web page.

Problem 1. Do exercises 15.10.5 and 23.12.3 of the book.

Problem 2. Consider a non-atomic selfish routing game in a network with 2 nodes, s and t, and three edges from s to t. The first edge has travel-time function $c_1(x) = x$, the second edge has $c_2(x) = (1 + x)/2$, and the third edge has $c_3(x) = 2$. The demand between s and t equals a parameter δ. Determine the equilibrium flow as a function of the parameter δ, when δ varies continuously from 0 to 4.

Problem 3. Consider the following modification of the Barabassi–Albert preferential attachement model that we did in class: When a new node arrives at time t again it comes with ℓ edges. However, this time each edge selects a node v with probability proportional to the degree d_v plus a constant c, that is, the probability equals

$$\frac{d_v + c}{(t-1)(2\ell + c)},$$

where $c \geq -\ell$, as we describe at the end of Chapter 4 in the notes (so for $c = 0$ this is the Barabassi-Albert model). Show that the degree distribution that we obtain as $t \to \infty$ is approximately a power law with exponent $3 + c/\ell$.