University of Ioannina,
Computer Science Department

Assignment 4

The deadline for the Assignment is **Monday, June 18**. Submit your assignment via email. For late submissions the late policy on the page of the course will be applied.

Question 1

Prove that for an undirected graph the stationary distribution of a random walk is proportional to the degree of the nodes. If P is the transition matrix of the random walk, and π is the stationary distribution for which $\pi = \pi \cdot P$, show that for node i the probability π_i is proportional to d_i where d_i is the number of edges incident on node i.

Question 2

Suppose that you run a supermarket, and for each product of the store you have the list of customers that have purchased the product. You want to create a catalog to send out to your customers with offers for K products. If the catalog contains one of the products that a customer bought, then this customer is satisfied (and (s)he will return to the store). You want to select K products such that the number of satisfied customers is maximized. Show that the problem is NP-hard and that there is an approximation algorithm, with approximation ratio (1-1/e).

Question 3

In this question you will experiment with the PageRank algorithm. Download a directed graph from the Stanford Network Analysis Project page (the link is on the web page of the class), implement the PageRank algorithm, and run it on the graph that you downloaded. The wiki-vote graph is suggested, but you can use any graph you choose. For your implementation you should use a uniform jump vector, and restart (jump) probability 0.15. You can use any language you like. You will submit your code, and a file with the nodes of the graph ordered by the PageRank value, with the value, and a short report explaining how your code works.

Question 4

In this question you will experiment with random walks with absorbing nodes. From the web page of the class download the movie-actor graph, a bipartite graph with movies (2000-2010) and actors as

nodes, and edges between them if an actor appears in a movie. Select five or more action movies and five or more comedies and make them absorbing nodes. Give value 1 to the comedies and value -1 to the action movies. Using the process we described in class compute the expected value for the remaining nodes in the graph (movies and actors. Submit your code, and a short description of the code. Submit also a file with the movies that you selected as absorbing nodes (positive and negative) , and two files with the movies and the actors and the values that you computed. Write a short report discussing your results.