CS 271 (Spring 2013) — Assignment 11
Due: 05/03/2013

Homework 11 is completely optional. You will not receive a grade for this homework. If you turn it in by 3:00pm on Friday, we will make every effort to give you detailed feedback by Tuesday, May 6, so that it may be helpful to you in preparing for the final exam.

(1) Read Sections 10.1–10.4.

(2) Solve the following exercises from the textbook

(a) Section 10.1, Exercises 13, 21, 24, 25, 29

(b) Section 10.2, Exercises 14, 15, 18, 23, 24

(c) Section 10.3, Exercises 6, 12, 28

(d) Section 10.4, Exercises 5, 11, 15, 30, 43, 65

(3) In class, we talked about the PageRank algorithm for calculating the quality of a Web page from the graph structure alone. We used the (directed) graph's adjacency matrix A for the purpose. There are two natural other matrices one could use: $B = A^T A$, and $C = AA^T$. (Remember that A^T denotes the transpose of the matrix A.) One could then perform exactly the same type of calculations for the matrices B or C. In fact, when dealing with those matrices, it is not even necessary to add the random reset probabilities.

Try to figure out what useful interpretations there would be to the corresponding eigenvectors of these matrices; would they be useful for Web Search? When do you think they'd be more useful than the actual PageRank? As a first step, try to understand in graph-theoretic terms what the matrices B and C capture.

(4) [0 points]
Chocolate Problem (2 chocolate bars): (The chocolate problem can be submitted until 05/11.) Find a (reasonably large, i.e., at least 25-node) graph that you are interested in. This could be all your Facebook friends and their friendships, or a road system in the US, something from biology, computer networks, or whatever else excites you. Apply concepts from this class to this graph to determine some meaningful quantities (such as degrees, short paths, tour lengths, chromatic number, planarity, ...) and report on your findings in suitable forms (diagrams, tables, ...). You might want to code up some of the algorithms discussed here. In addition to raw data, provide some interpretation of your findings in terms of what it means for the particular domain your graph is drawn from.

Some of the algorithms and concepts alluded to above are ones we didn't manage to get to in class. You're strongly encourage to read all of Chapter 10 before embarking on this project.