CMPE 597: Spec. Topics Graph Algorithms
Homework 2 (due final exam submission date)

Problem 1

Suppose you want to solve the following problem related to the assignment of students to various projects in a course: All projects which are chosen by at least one student are to be supervised by one or more qualified teachers. Each student is supervised by one teacher only. There are n students, m different projects and t possible supervisors for the projects.

Let b_i, $i = 1, 2, \ldots, m$, denote the maximum number of students who may choose the same project (they work alone and hence individual supervision). For each project i, $i = 1, 2, \ldots, m$, there is a subset $A_i \subseteq \{1, \ldots, t\}$ of the teachers who are capable of supervising the ith project. Finally each teacher j, $j = 1, 2, \ldots, t$ has an upper limit of k_j on the number of students he/she can supervise.

Every student must be assigned exactly one project. Assume also that each student has ranked the projects from 1 to m according to the order of preference. Namely, the project the student would like best is ranked one. Denote the rank of project j by student i by r_{ij}.

The goal is to find an assignment $p(1), p(2), \ldots, p(n)$ of students to projects (that is student is assigned projects $p(i)$) which respects the demands above and at the same time minimizes the sum $\sum_{i=1}^{n} r_{ip(i)}$

Todo:

(a) Formulate the above problem as a network flow problem.

(b) Give an example instance of this problem with $n = 10, m = 12, t = 5$. Download the CS2 software from `http://www.avglab.com/andrew/soft.html` and solve this example problem with CS2.

Problem 2

Suppose you have the following web pages: Ekolay, Hurriyet, Milliyet Superonline, Netbul, ABHaber and Nethaber. These web pages give links to each other as follows:

1. Ekolay gives links to Hurriyet, Milliyet and Abhaber,
2. Hurriyet gives links to Milliyet, Superonline and Netbul

3. Milliyet gives links to Ekolay, Nethaber and Superonline
4. Superonline gives link to Netbul
5. Netbul gives link to Nethaber and Ekolay
6. ABHaber gives links to Nethaber and Milliyet
7. Nethaber gives links to Ekolay and Nethaber

Rank these web pages using Google's ranking mechanism.

Problem 3

Suppose you are given an undirected graph $G(V, E)$ with

$$V = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

and

$$E = \{(1,3), (3,5), (5,7), (2,4), (4,6), (6,8), (1,5), (1,7), (2,6), (2,8), (1,2), (3,4), (5,6), (7,8)\}$$

Partition G into 4 parts using spectral partitioning vector. To do the partitioning, calculate appropriate eigenvectors using MATLAB. You should also give the printouts of the eigenvectors you have found.