EE 597 Spring 2016
Project 1

First attempt due: 2/23
TA feedback: 2/26
Final attempt due: 3/1
Submission through Blackboard

1 Problem Statement

Recall the power control problem discussed in class, where SINR (signal to interference and noise ratio) constraint is:

$$SINR_i = \frac{P_{T_i} g_{ii}}{\sum\limits_{\forall j, j \neq i} P_{T_j} g_{ji} + N} > \theta \tag{1}$$

We noted that the condition for n parallel transmitter(Tx) - receiver(Rx) pairs to be able to simultaneously transmit data is given by

$$G\vec{P} \succcurlyeq \theta N \vec{1} \tag{2}$$

where the matrix G denote the gains on each link and the vector $\vec{P}$ denotes the power of transmitters. $\vec{1}$ represents vector of 1's. $\succcurlyeq$ refers to "element-wise greater than or equal to". Specifically,

$$[G]_{ij} = -\theta g_{ji} \quad \forall i \neq j,\ i, j \in [1, 2, \ldots, n] \tag{3}$$

$$[G]_{ii} = g_{ii} \quad \forall i \in [1, 2, \ldots, n] \tag{4}$$

N, θ denote the noise and the SINR threshold respectively. For the system of equations given by (2) to have a solution, we require that matrix G be invertible. In this assignment, the gains on each link may be such that G is singular. You are required to come up with an algorithm that will partition the n Tx-Rx pairs into k sets such that the pairs in a set are able to simultaneously transmit data. You may assume that each set participates in a TDMA protocol so that the transmission of one partition does not interfere with those of another. Clearly, the partitioning enables communication between pairs at the expense of throughput. For an algorithm that partitions our Tx-Rx pairs into k sets, we define our throughput to be $1/k$. Let C be a weighting parameter, a known constant greater than 0. Design a joint scheduling (partitioning) and power allocation algorithm to

$$\max_{k, P_{T_i}} \quad \frac{C}{k} - \sum_{i=1}^{n} P_{T_i} \tag{5}$$

$$\text{subject to } SINR_i > \theta \tag{6}$$

In (5), you have to determine both number of partitions (k) and values of power needed to assign to all of the transmitters such that the objective function is maximized. Note also that in (6) the interference only comes from other transmitters assigned to the same partition.

2 Input Data

Your algorithm will be tested against different values for n, g_{ij}, θ, C and N. They are provided in the following format:

- The file `gains.csv` contains g_{ij} in a matrix form. Specifically, the value at row i and column j corresponds to g_{ij}.
- The values of n, N, θ and C are provided in the file `params.csv`. The file contains a single row whose first, second, third and fourth elements are n, N, θ, and C respectively.

You may assume that $n \leq 100$.

3 Output

Your code should read the parameters correctly from the above values and output the following:

- A file named `pow.csv` that contains a single row whose i-th element is P_{T_i}
- A file named `partition.csv` that contains $k+1$ rows. The first row has a single element, namely k. The next k rows describe the generated partition. For example, if your second row is $1, 2, 3$ this indicates that your first partition contains the Tx-Rx pairs $1, 2, 3$.

4 Output evaluation

Evaluation file (evalP.m) and test cases are provided so that you can use to evaluate your algorithm's performance.

5 Guidelines

You will use MATLAB for this assignment. Your submission must contain a file named `report.pdf` that describes the partitioning algorithm used and its rationale. In addition, the submission must contain a folder named `code` that contains all the files required to run your code. This folder must contain a `README` file that adequately describes how to compile/run your code.

Note that we will be using a script to parse and evaluate the output of your code. Consequently, it is vital that you adhere to the naming conventions described in this document for your output files. In addition your output files must be a valid CSV file.

Your partitions should also be *valid*. Namely, your partitions must be disjoint and their union should equal the set $\{1, 2, \ldots, n\}$. In addition, your power vector must satisfy (2) for each partition.

6 Submission guidelines

You are required to submit the project in a two-step submission procedure through Blackboard:

- The first submission: the submission format should be the same as the final submission described in the previous section. You are encouraged to submit your project in order for coarse grained evaluation and feedback in terms of your relative performance with respected to other groups.
- The final grade is based on the final submission only.