18.06 Spring 2013 – Problem Set 4

This problem set is due Thursday, March 14th, 2013 at 4pm (hand in to Room 2-255). The textbook problems are out of the 4th edition. A correct answer will only earn you half of the available points. The other half of the points come from your explanation.

Note: Your recitation instructor is responsible for allowing late homework submissions, as well as the re-grading of your PSet. If there is any problem with your PSet, contact your recitation instructor!

1. (8 pts) Do Problem 8 from Section 8.2.
2. (8 pts) Do Problem 9 from Section 8.2.
3. (8 pts) Do Problem 11 from Section 8.2.
4. (8 pts) Do Problem 3 & Problem 9 from Section 4.1.
5. (8 pts) Do Problem 10 & Problem 11 from Section 4.1.
6. (8 pts) Do Problem 30 from Section 4.1.
7. (8 pts) Do Problem 3 & Problem 8 from Section 4.2.
8. (8 pts) Do Problem 11 from Section 4.2.
9. (8 pts) Do Problem 31 from Section 4.2.
10. (28 pts) A graph with five nodes and m directed edges can be described by an $m \times 2$ matrix M by the following rule:
    - label the edges as $1, 2, \ldots, m$.
    - row i of the matrix M is given by the vector

      $$\big[\text{starting node number of the edge } i, \text{ending node number of the edge } i\big].$$

    (a) (7 pts) Write a MATLAB code (or use another package) that creates the $m \times 5$ incidence matrix A from M. Print A for the complete graph with five nodes (labeled 1, 2, 3, 4 and 5) and all $m = 10$ edges such that:
    - the edges are always directed from a smaller node number to a larger node number
    - Both columns of M are increasing

    (b) (7 pts) Print basis for $C(A)$ and $C(A^T)$, the column space and the row space of A.

    (c) (7 pts) Print $L = A^T A$ and find the nullspace of L.

    (d) (7 pts) Compute the projection p of $b = (1, 2, ..., 10)$ onto the column space $C(A)$. Since the columns of A are dependent, you will have to remove column 5 of A and calculate again the 4×4 matrix L_1 as in part (c), so that L_1 is invertible, to solve $L_1 x = A^T b$ and compute $p = Ax$.