MATH 380: Homework #6

Due Thursday, 3/5, 11pm, on Canvas via a single PDF.

The homework exercises listed as numbers below are from the course textbook, Giordano, Fox, Horton, A First Course in Mathematical Modeling, 5th edition.

Follow the detailed instructions and rules for HWs given in the Course Information Handout and through Canvas and emailed comments.

Always remember that homework is NOT meant to be an examination, it is meant to assist in your learning and development. If you need help with any HW problem, don't hesitate to ask me. You are encouraged to ask questions during the *Class lectures*, through the *Canvas Discussion Forums*, during the *Office Hours*, during the *suggested TA office hours*, or through *Email to me*.

Submit solutions to five out of the seven problems below by skipping any two of the problems except problem 7. Problem 7 is compulsory. These problems, based on 3+ lectures, all have fairly short solutions.

1. Section 8.1: #7 (First, show how to set up this problem as graph coloring problem - define the vertices, edges, colors, etc.).
2. Section 8.1: #3.
3. Section 8.3: Project#3.
4. Section 8.2: #3.
5. Section 8.5: #1ab.
6. Section 8.5: #4.
7. [**Attempt this problem next week**] Let $G = (V(G), E(G))$ denote a directed graph (network) for transporting a commodity between the vertices in $V(G)$. We are given, for each $v_i \in V(G)$, a supply or demand $b(i) \in \mathbb{Z}$ for the commodity, such that $\sum_{v_i \in V} b(i) = 0$. We are also given for each edge (v_i, v_j): u_{ij}, the maximum capacity of edge from v_i to v_j; and c_{ij}, the transportation cost of sending one unit of the commodity from vertex v_i to v_j. We would like to send flow of commodity across such a network (that is decide how much flow of commodity to send on each edge) so that total transportation costs are minimized, and all demand is met. In class, I showed you how to formulate this problem as a linear program.

   Modify the linear program for the above problem to solve the following related problem: Let $G = (V(G), E(G))$ denote a directed graph (network) we are building for transporting a commodity between the vertices in $V(G)$. We are given, for each $v_i \in V(G)$, a supply or demand $b(i) \in \mathbb{Z}$ for the commodity, such that $\sum_{v_i \in V} b(i) = 0$. We are also given for each possible edge (v_i, v_j): u_{ij}, the maximum capacity of edge from v_i to v_j; c_{ij}, the transportation cost of sending one unit of the commodity from vertex v_i to v_j; and d_{ij}, the building cost of constructing an edge (transportation link) from vertex v_i to v_j. We would like to build and operate such a network, that is decide which edges to build and decide how much flow of commodity to send on each edge, so that total building and transportation costs are minimized, and all demand is met. Formulate this problem as a mixed integer linear program.