**IEDA 5230 Fall 2023**

**Homework Assignment 2**

**Due date: October 11th 2023**

Question 1: Refer to Lecture 4, slides 23 to 24

Slide 23 shows the optimal solutions to 5 instances of transportation problem with 3 source nodes and 4 destination nodes.

1. In all these optimal solutions, there are at most 6 non-zero flows. Is this a coincidence or is it always true?
2. For the problem of the grand coalition, the shadow price for one constraint is 0. Is this a coincidence or is it always true?

Question 2: Refer to Lecture 5, slides 13 to 16

It is found that the company does not have enough buses to serve all orders. The company considers two options, rejecting some orders and renting some outside buses. Assume that each order j has a profit pj, and the cost of renting one outside bus is b.

1. Develop a modified network flow model to determine which orders should be rejected.
2. Develop a modified network flow model to determine the number of outside buses to rent.
3. Is it possible to build a network flow model which can find an optimal decision that considers both options together?