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MCL765 Minor Exam (25 Sept 2022)

Avoid skipping steps. Cheating shall be heavily penalized. Max. marks: 20

1. (10 marks) Solve the following transportation problem in exactly the same way as shown during lectures, given that warehouse 1 has 40 units, warehouse 2 has 30 units, and warehouse 3 has 50 units and store 1 needs 50 units, store 2 needs 10 units, and store 3 needs 40 units. The table below gives the transportation costs.

	Store 1	Store 2	Store 3
Warehouse 1	8	3	2
Warehouse 2	3	5	7
Warehouse 3	6	4	5

2. (5 marks) A hospital employs volunteers to staff the reception desk between 8:00 A.M. and 10:00 P.M. Each volunteer works three consecutive hours except for those starting at 8:00 P.M. who work for two hours only. A minimum number of volunteers need to be present every hour. Assume that the minimum number of volunteers plotted against the hours of the day looks like a step function over 2-hour intervals starting at 8:00 A.M. and proceeding in steps as follows as 4, 6, 8, 6, 4, 6, 8. The volunteers are willing to offer their services at any hour of the day (8:00 A.M. to 10:00 P.M.). However, the hospital needs to minimize the number of volunteers. Model this as an LP.

3. (5 marks) Consider the following LP problem.

$$\begin{aligned} \min \quad & -2x_1 - 16x_2 - 2x_3 \\ \text{subject to} \quad & -2x_1 - x_2 + x_3 \geq 3 \\ & 3x_1 - x_2 - 2x_3 \geq -12 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

Write down its dual. Then prove that $x_1 = 0, x_2 = 2, x_3 = 5$ is the optimal solution of the primal by using the CS conditions and strong duality theorem.

Prof. Shaurya