Lab Assignment 2: Optimization for Machine Learning

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Write python codes of the following problems:

(1) Write a python code to solve the following LP

$$\begin{aligned} \min \quad & \max\{5x_1 + 2x_2 \quad , \quad 3x_1 + 7x_2\} \\ & s.t. \quad x_1 + 2x_2 \leq 3 \\ & \quad 4x_1 + 3x_2 \geq 6 \\ & \quad 3x_1 + x_2 = 3 \\ & \quad x_1, x_2 \geq 0 \end{aligned}$$

(2) Solve the following transportation problem

	S1	S2	S3	S4	S5	a_i
D1	4	2	3	2	6	8
D2	5	4	5	2	1	12
D3	6	5	4	7	7	14
b_j	7	5	6	8	8	

(3) Construct an LP of the following network flow problem and solve it.

Suppose that the following figure represents a railroad network. The numbers beside each arc represent the time it takes to traverse the arc. Three locomotives are stationed at point 2 and one locomotive at point 1. Four locomotives are needed at point 6. Find the minimum total time solution to get the power required to point 6.

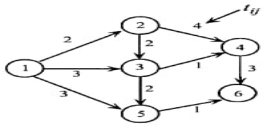

Figure 1: Network flow

(4) Construct an LP of the following network flow problem and solve it.

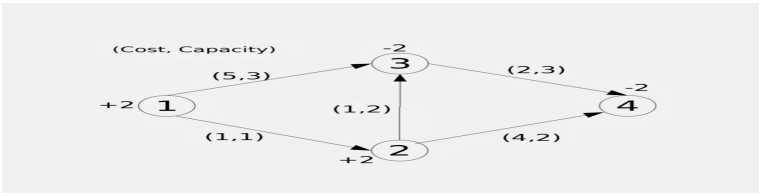

Figure 2: Network flow

Note: add constraints $x_{ij} \leq capacity$.

(5) Find the shortest path from 1 to 10.

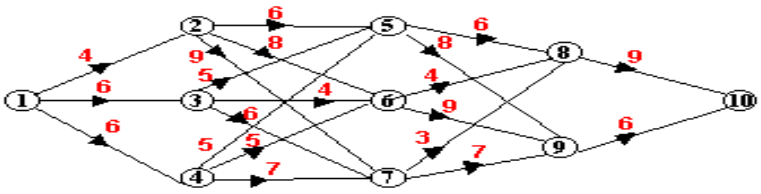

Figure 3: shortest path

(6) Construct an LP of the Assignment problem and solve it.

		Operators			
		1	2	3	4
	A	20	28	19	13
Tasks	B	15	30	31	28
	C	40	21	20	17
	D	21	28	26	12

Figure 4: Assignment problem

(7) Construct an LP of the Assignment problem and solve it.

Question 2 - Networks and Swimming

The coach of a swim team needs to assign swimmers to a 200-yard medley relay team to compete in a tournament. The problem facing him is that his best swimmers are good in more than one stroke, so it is not clear which swimmer to assign to which stroke. The 5 fastest swimmers and the best times (in seconds) they have achieved with each of the strokes (for 50 yards) are given below.

Stroke	Carl	Chris	David	Tony	Ken
Backstroke	37.7	32.9	33.8	37.0	35.4
Breaststroke	43.4	33.1	42.2	34.7	41.8
Butterfly	33.3	28.5	38.9	30.4	33.6
Freestyle	29.2	26.4	29.6	28.5	31.1

The problem is to try to minimize the sum of the best times for the people competing in the race.

Figure 5: Assignment problem

Note: This is an unbalance assignment problem. Add one dummy stroke with timing 0 by each swimmer.