IE 400-PROJECT

Spring 2020

Deadline:11.05.2020

A HW has to be assigned and evaluated in these Corona times. An Assistant with mask will take sterilized homeworks from the Professor of the course and distribute it to the students. There are N students in the course. All the students are located in different places and since they are doing social distancing they do not go anywhere and stay at home and also do not meet any friend. The Assistant has to distribute the HW to all the students one by one. The assistant waits for the student to complete her/his homework and take it back. Student i needs x_i minutes to complete the homework. Of course, it takes some time to go from one place to another and the assistant wants to minimize his time for doing this job. Therefore, he will take the HW from the Professor, go to each student exactly once and fnally bring back together all the solutions (of the students) to the Professor at the very end. Please help this Assistant in this work to minimize his time for doing this duty.

Question 1. Model this problem as an IP problem. (Please clearly state that which are parameters and which are decision variables)

Question 2. Model this problem as an DP problem. (Please clearly write functional equations and parameters and decision variables)

Question 3. For each student generate some random $x_i \in [300, 500]$ only once. Generate it for $N = 75$ students. For problem instances with smaller number of students, use this same data as follows: Use the first 5 values for $N = 5$, first 10 for $N = 10$ and so on. Now, for each $N = 5, 10, \ldots, 75$ number of students, generate $\lfloor N \ln(N)) \rfloor$ different random travel time matrices (each such matrix will provide a problem instance for you to use in your experiments) with random travel times in the range $[100, 300]$ between any pair of of those N students and between each student and the professor, e.g., for $N = 5$ generate 8 travel time matrices (8 instances). You will use these times in **Q4** and **Q5**.

Question 4. Solve the IP that you model in **Q1** using the data you generated in part 3. You may use any solver and any program modelling language of your choice (Xpress, Cplex, GAMS, etc.).

Question 5. Write a program in your choice of programming language to solve your DP in Q2. (Please make sure that you use the same randomly generated instances (data) for both **Q4** and **Q5** for comparison purposes).

Question 6. Write a project report that includes your modellings in **Q1** and **Q2**, random travel times and graphical illustrations of how the running time changes as N increases. Make comparisons between two algorithms and explain how the running time changes and why, as N changes. Your report should also include optimal values and the optimal paths of the assistant for all problems that you solve.

Question 7. Submit your report (including members full names and ID's) as well as your Xpress (or your choice of solver) and DP codes in electronic form to mucahit.aygun@bilkent.edu.tr

Question 8. You will have an oral exam where you will be asked random questions about using Xpress (or your choice of solver) and about your DP code. (**We will run your code for our data as well, so your models and codes should work for any input.**)

Here is a sample data. The optimal value is 355. You can check whether your algorithm works correctly or not by giving this example as an input.

Travel Time	Professor	Student 1	Student 2	Student 3	Student 4	Student 5
Professor	-	23	15	42	30	51
Student 1	23	-	34	28	35	45
Student 2	15	34	-	48	62	27
Student 3	42	28	48	-	21	19
Student 4	30	35	62	21	-	36
Student 5	51	45	27	19	36	-

The study times are as follows: $x_1 = 35, x_2 = 45, x_3 = 20, x_4 = 50, x_5 = 65$