IE102 Spring 2018 Homework II - Due: April 16, Monday 17:00

IMPORTANT: READ BEFORE YOU START WORKING ON THE HOMEWORK

Information on Homework II

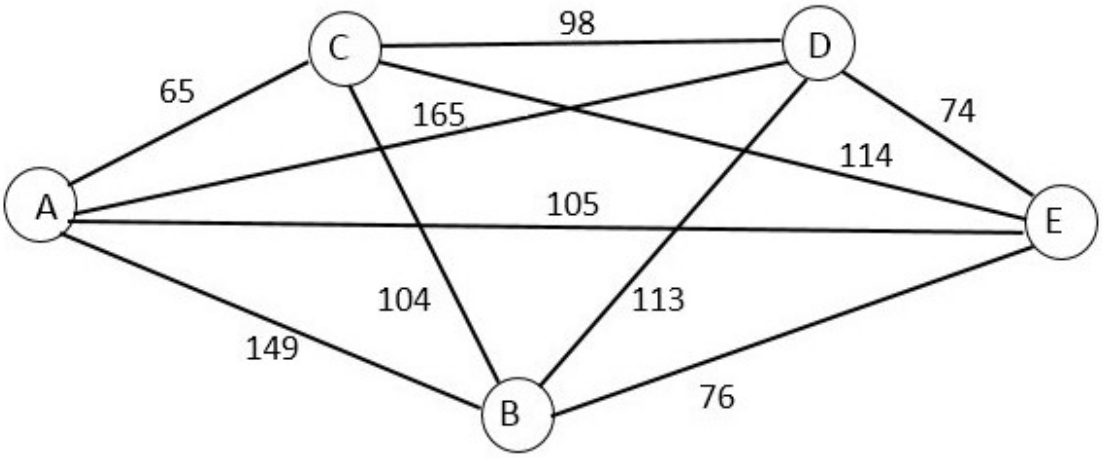
- Homework II is 3%. Make sure that you review course material before you start. Cite sources used if any.
- Homework assignment will be conducted in groups of 2. We randomly form the groups. You can find your group member and his/her contact information at the course website. If you cannot reach your group member by all means, indicate this on the cover page of your submission.
- Grading Policy: The homework grades will not be only based on the correctness of the answers provided, but on the perceived degree of effort on the returned assignment. There exists no motive for the students to copy the answers from someone else, since even without obtaining the correct answers one can obtain full credit. The grading scale for each question is 2 points (full effort), 1 point (some effort), and 0 (no effort or no submission).
- Academic Dishonesty (taken from IE102 Course Information): Academic misconduct is not tolerated, and violations will be treated in accordance with the university policy. For assignments: Discussion of the course material and working in groups are effective ways of learning. However, this does not mean that you can copy the assignment from one of your friends. You can discuss with your friends, but you should be alone, without any written solution in front of you, when you actually prepare your assignment. It is extremely important to understand the value of this exercise in the process of learning. Any violation of the above understanding will result measures outlined in the student rules and regulations.
- Submission Information: An assignment submission box will be placed in front of office EA327 on the morning of the submission date and will be removed at the time of the deadline. You need to put your assignment in the designated box before the submission deadline. Submission via e-mail is NOT accepted.

Contact TA Eren Özbay if you have questions related to this HW: *eren.ozbay@bilkent.edu.tr*

There will be an office hour prior to the submission deadline.

Question 1:

Consider the Traveling Salesman Problem (TSP) mentioned in class. Given the network below, where the numbers on the arcs represent the cost of traveling between corresponding vertices, answer the following questions.



a) Is CDBEBAC a possible solution for the TSP problem? Why?

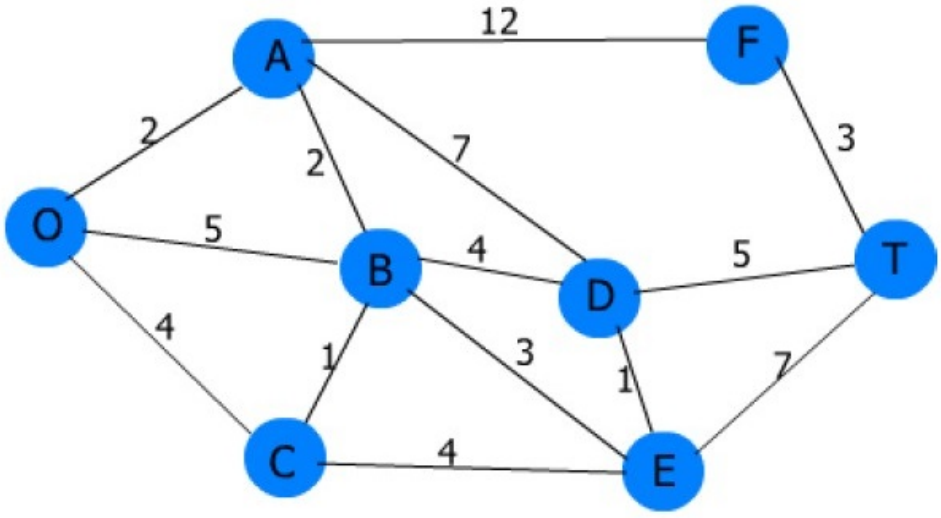
b) Consider all Hamiltonian tours starting with ADB. Select the least cost tour by your choice of heuristic. What is the cost of that tour? Can that tour be the least cost tour? Why?

c) Choose a vertex arbitrarily and apply Nearest Neighbour Heuristic. What is the cost of this tour? Is it better than the least cost tour you obtained in part (b)?

d) Apply Greedy Heuristic. What is the cost of this tour? Is it better than the least cost tour you obtained in part (b)? In part (c)?

Question 2:

Using Dijkstra's algorithm find the minimum distance route from the origin node **O** to the destination node **T**. Note that the numbers on the arcs correspond to the distance between the two nodes it is connecting. Explain each step of the algorithm for full credit.



Question 3:

A jelly bean company wants to separate its different flavoured jelly beans to be produced in different machines so that the flavours do not get mixed up throughout the production process. For this purpose, they are about to procure new machines and dedicate them to only one type of jelly bean. Below you can find the cost matrix of producing each type of jelly bean in the corresponding machine. Assign production of each type of jelly bean to only one machine. Explain your steps thoroughly for full credit.

Machines \ Flavours	Blueberry	Bubble Gum	Lemon Lime	Marshmallow	Raspberry
Q	36	82	33	28	63
W	84	23	52	76	49
E	21	55	56	22	67
R	81	92	54	13	15
T	42	61	21	68	57
Y	53	28	78	15	46

Question 4:

A manufacturer of vaccines want to open new distribution centers in a lacking city in Turkey to meet the vaccination demand. You have the following distance network at hand (neighbourhood 1 is denoted as N1, neighbourhood 2 is denoted as N2 and so on, distances are in seconds of walking distance):

	N1	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**
N1	0	1378	2257	2312	1257	1057	948
N2	1378	0	2453	1975	875	1351	1235
N3	2257	2453	0	932	532	486	935
N4	2312	1975	932	0	1324	1224	1257
N5	1257	875	532	1324	0	850	796
N6	1057	1351	486	1224	850	0	1350
N7	948	1235	935	1257	796	1350	0

a) Say that the walkable distance is 2 kilometers (assume that everyone can walk at a speed of 5 km/h). Construct the cover matrix. Is opening one DC enough? Where would it be?

b) What is the minimum distance that the patients need to walk at a speed of 5 km/h if the goal is to open only one DC?

c) Now, say that the walkable distance is now 2.1 kilometers but everyone can walk at a speed of 6 km/h. Construct the cover matrix. Is opening one DC enough? If it is, where would it be? If it is not, what are the options for two DC's?

d) Say that we have the funds to open two DC's and have figures as in part (c). As we have enough funds, we want open 2 DC's. Where would the DC's be located if our goal is to maximize the number of neighbourhoods twice covered? What if our goal is to minimize the maximum distance walked? What happens to these combinations if the patients are limited to travel with respect to the figures in part (a)?

e) Now we want to find, if possible, the best locations for 2 DC's. Remember the criteria discussed in class: total distance travelled, maximum distance walked and twice coverage occurences. In this part, you will, using figures in part (a), construct the cover matrix, generate alternatives for DC locations and their performance in respective objectives and choose the best combination by weighing the criteria as you like. Note that your choice of weights may cause alternative optima to arise.

Question 5:

An American manufacturer of automobile radiators has a factory located in Denver and 3 distribution centers (DCs) throughout the USA. The DCs collect customer orders and individually claim necessary units of radiators from the factory at the beginning of each month. The monthly demand at each of the three DCs along their distance to the factory located at Denver is shown below:

Distribution Center	Monthly Demand (#)	Distance from Denver (km)
New York	25,000	2,900
Los Angeles	35,000	1,600
Oklahoma City	20,000	1,100

The shipments can be delivered by train or truck. Capacity of each truck is 2,000 units and each train is 10,000 units. Transportation costs for each mode of transport is shown as following:

Truck: $ 100 + 0.6*x*
Train: $ 3,500 + 0.1*x*
(In these cost notations, *x* denotes the distance to be travelled in kilometers)

Using this information, identify the optimal transportation option (or transportation mix) and the associated cost for each DC for the given month.

Question 6:

Suppose you have just graduated from Bilkent University, and have received three job offers. In choosing which job offer to accept, you may consider the following criteria: (1) starting salary (SAL), (2) quality of life in city where job is located (QL), (3) interest in work (IW), and (4) job location near family and friends (NF). The tables below present the scale range and type used for each measure and data for each offer respectively.

Measure	Range
SAL	3,000 – 5,000
QL	1. Good 2. Average 3. Bad
IW	0-10
NF	1. Nearby 2. Within 4 hr drive 3. Far

Measure	Offer 1	Offer 2	Offer 3
SAL	4,250	3,100	5,000
QL	2	1	3
IW	8	6	5
NF	3	1	2

Which job offer will you accept by utilizing given information? Find out using MCDM methods that you learnt in class. (Assess your own weights for each measure).