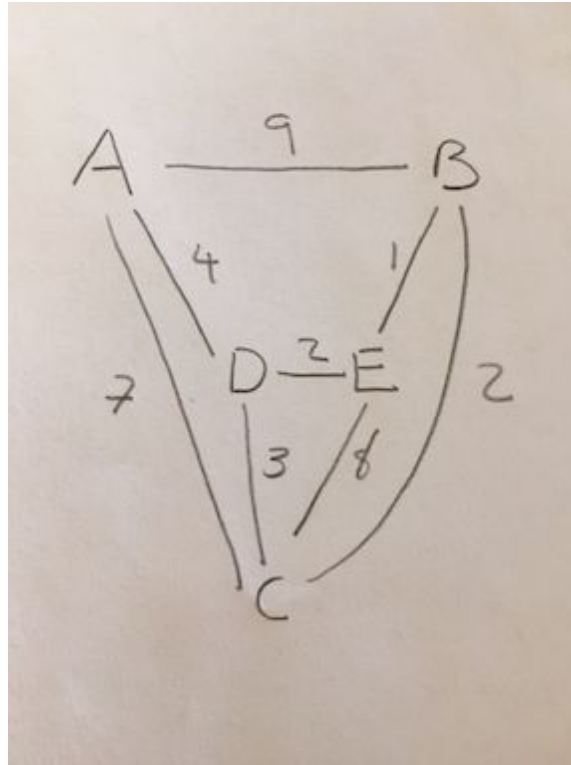## Homework-2

1.Suppose we start with the path ABCDE, what is its cost? Call two paths adjacent if they can be obtained from each other by a single swap. The result of the swap is required to be a path in the graph. For example, CBADE is adjacent to ABCDE, but DBCAE is not because the result is not a path in the graph above. Write down all the paths and their costs that are adjacent to ABCDE. Which is of least cost? Pick this smallest path as a start point and find its adjacent path of smallest cost. This would be the result of doing the hill-climbing algorithm for two steps.
ANS:

    a. Cost of the path ABCDE is 16. (9+2+3+2=16)

    b. All the paths and their costs that are adjacent to ABCDE.

Path	Cost
CBADE	2+9+4+2=17

BACDE	9+7+3+2=21
EBCDA	1+2+3+4=10 **least cost path**
ADCBE	4+3+2+1=10 **least cost path**
DBCAE	No path
BACDE	No path
ACBDE	No path
AECDB	No path

- EBCDA and ADCBE both have the least value cost which is 10.

All the paths and their cost that are adjacent to **ADCBE**	
Path	**Cost**
DACBE	4+7+2+1=14
CDABE	3+4+9+1=17
EDCBA	2+3+2+9=16
ABCDE	9+2+3+2=16
ADEBC	4+2+1+2=9 **least cost path**
ADCEB	4+3+8+1=16
BDCAE	No path
ACDBE	No path
AECBD	No path
ADBCE	No path

2.Give a path in the above graph which is not the path of minimal cost (ADEBC) but which is of local minimum cost with respect to its immediately adjacent paths.
 ANS:

All the paths and their costs that are adjacent to **ADEBC**	
Path	**Cost**
EDABC	2+4+9++2=17
CDEBA	3+2+1+9=15
ABEDC	9+1+2+3=15
ADCBE	4+3+2+1=10 **Local Minima**
ADECB	4+2+8+2=12
DAEBC	No path
BDEAC	No path
AEDBC	No path
ACEBD	No path
ADBEC	No path

ANS: Local minimum Path and its cost is (**ADCBE 4+3+2+1=10**)

3.Consider the following alternative notation for paths in the above graph: a sequence of five numbers, the first in the range 1 to 5, the second with range 1 to 4, etc. For example, 43221. The number 4 represents the fourth letter among the currently remaining letters A,B,C,D,E, so is the letter D. The number 3 represents third letter among the currently remaining letters A,B,C,E, so is C. Computing in this fashion, we get the path DCBEA (the last letter is always 1 so we could shorten the sequence to 4322). Generate two paths by rolling dice to pick numbers. If the number is too high for the current position re-roll. Use these two path as the starting paths for a 2-local beam search of traveling salesman paths

in this graph. Write the initial paths, generate and write down their adjacent paths with computed costs, pick the two of least costs and do this again one more time for these two paths, so you show you understand the idea of 2-local beam search.

ANS: Paths which are generated by rolling a dice are (DEBCA) and (DECBA)
- The first sequence of number from rolled dice is: 4422 (DEBCA)
- The second sequence of number from rolled dice is: 4432 (DECBA)

All the paths and their costs that are adjacent to **DEBCA**	
Path	Cost
BEDCA	1+2+3+7=13 **least cost**
DABCE	4+9+2+8=23
DECBA	2+8+2+9=21
DEBAC	2+1+9+7=19

All the paths and their costs that are adjacent to **DECBA**	
Path	Cost
EDCBA	2+3+2+9=16
BECDA	1+8+3+4=16
DCEBA	3+8+1+9=21
DACBE	4+7+2+1=14
DEBCA	2+1+2+7=12 **least cost**
DECAB	2+8+7+9=26

- Selecting least cost paths from above are BEDCA and DEBCA

All the paths and their costs that are adjacent to **BEDCA(Initial path)**	
Path	Cost
DEBCA	2+1+2+7=12 **least cost**
BADCE	9+4+3+8=24
BECDA	1+8+3+4=16
BEDAC	1+2+4+7=14

All the paths and their costs that are adjacent to **DEBCA(Initial path)**	
Path	Cost
BEDCA	1+2+3+7=13 **least cost**
DABCE	4+9+2+8=23
DECBA	2+8+2+9=21
DEBAC	2+1+9+7=19

4.Starting with the same two paths you rolled above in number notation, randomly pick a number between 1-3. Breed these two path by using the number you just rolled as a crossover point. Is the result a path? If not, are their any values between 1-3 which if used as a crossover point would result in paths? ANS:

- Paths selected from above are DEBCA and DECBA.
- Number picked between 1-3 is **3**
  DEB CA, **DEC** BA => DEBBA, DECCA (These are not valid paths)

- Number picked between 1-3: **2**
  DE BCA, **DE** CBA => DECBA, DEBCA (These are valid paths)