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Problem 2 Hill Climbing

(a) Number of neighboring states $= \frac{n(n-1)}{2}$. Since we don't have to worry about the same states, we are swapping a pair of locations from n other locations, between the start location and end location. The problem is equal to selecting two locations from n locations, without duplications pairs, which are equal to $\frac{n(n-1)}{2}$.

(b) Total size of the search space $= \begin{cases} \frac{n!}{2} & (for\ n \geq 2) \\ 1 & (for\ n = 1) \end{cases}$

To solve the total size of search space, we first calculate the size of search space contains same states. This is equal to finding the number of permutations we can get from n locations, which is equal to $n!$. (To get permutations for n locations, on first spot we can have n choices, (n-1) on second spot, (n-2) on third spot, …, 1 choice on Nth spot. After multiplying all together, we get $n!$). The next step is to remove the duplicate states, according to the definition, symmetric path is considered to be the same state. Each state would have and only have one symmetric path, therefore, the permutation is divided by 2 to get the number of distinct states in total. One special case to consider is that we only have one locations in between, its symmetric path is itself so we won't need to divide it by 2.

(c) Initial State: <M-E-C-S-W-M> 0.8+1.5+1.3+0.3+0.6 = 4.5

Successors:

1) M-C-E-S-W-M 0.9+1.5+0.2+0.3+0.6 = 3.5
2) M-S-C-E-W-M 0.7+1.3+1.5+0.2+0.6 = 4.3
3) M-W-C-S-E-M 0.6+1.3+1.3+0.2+0.8 = 4.2 (same state as 4)
4) M-E-S-C-W-M 0.8+0.2+1.3+1.3+0.6 = 4.2 (same state as 3)
5) M-E-W-S-C-M 0.8+0.2+0.3+1.3+0.9 = 3.5
6) M-E-C-W-S-M 0.8+1.5+1.3+0.3+0.7 = 4.6

Since we are finding the minimum, we pick the successor with the smallest f (using alphabetical order to break ties), which is the first one, M-C-E-S-W-M.

M-C-W-E-S-M 0.9+1.3+0.2+0.2+0.7 = 3.3
M-C-W-S-E-M 0.9+1.3+0.3+0.2+0.8 = 3.5
M-C-E-W-S-M 0.9+1.5+0.2+0.3+0.6 = 3.5
M-C-S-E-W-M 0.9+1.3+0.2+0.2+0.6 = 3.2
M-W-C-E-S-M 0.6+1.3+1.5+0.2+0.7 = 4.3
M-E-W-C-S-M 0.8+0.2+1.3+1.3+0.7 = 4.3

The global optimal solution could be found by hill-climbing from this initial state. Because after listing the state space, the state with minimum f value is M-C-S-E-W-M. I found that this optimal state is the neighbor of the M-C-E-S-M, which the state we made the first move.

Sequence of States in the optimal tour: **M-C-S-E-W-M or (M-W-E-S-C-M)**