CO 322 Data Structures and Algorithms

Lab 02 - Dynamic Programming

4.Task

(b) What is the runtime complexity of your implementation.

Recursive implementation of the minCost function outputs the following result for runtime complexities from station 0 to each of the next stations.

Complexity=1
Complexity=3
Complexity=9
Complexity=27
Complexity=81
Complexity=243
Complexity=729

Hence, the runtime complexity is **O(3^n)**

(c) Argue that dynamic programming can be used to improve the runtime.

Since in this problem, we use a recursive solution that has repeated calls for the same inputs, we can optimize it using **dynamic programming**. Here the key point is to simply store the results of subproblems **using a hashmap**, so that we do not have to re-compute them when needed later. This simple optimization reduces time complexities from exponential to polynomial, improving the runtime drastically.

(e) Calculate the runtime of your implementation in part 4 above. Assume, hashing is O(1).

The new implementation (using minCostDynamicPro function) outputs the following result for runtime complexities from station 0 to each of the next stations.

Complexity=2
Complexity=3
Complexity=7
Complexity=13
Complexity=21
Complexity=31
Complexity=43

Here the runtime complexity can be considered as **polynomial**.