

1) Time complexity =  $O(2^N)$

2) A problem can be optimized using dynamic programming if it:

- a. has an optimal substructure.
- b. has overlapping subproblems.

If a problem meets those two criteria, then we know for a fact that it can be optimized using dynamic programming.

Dynamic programming is an optimization technique that we can use to solve problems where the same work is being repeated over and over. It is a method for solving a complex problem by breaking it down into a collection of simpler subproblems, solving each of those subproblems just once, and storing their solutions using a memory-based data structure (array, map, etc). So the amount of run time which will be in without using dynamic programming will be higher than the runtime when using dynamic programming since it reduces the occurrences/repetitions by storing the solutions of the repeating solutions and using it whenever needed without calculating again and again.

5) Concept used here is the minimum cost

Hashing –  $O(1)$

time complexity is  $O(N \times N) = O(N^2)$