Assignment: Backtracking & Greedy Algorithms

1. **Implement a backtracking algorithm**

   You are given a numbers k and n. Find all unique combinations of numbers of length k that add to n. The condition on choosing a number of length k is that:

   You can use only numbers from 1 to 9.

   You cannot repeat a digit a number.

   Assume, k will not be greater than 9.

   Example 1:

   Input: k = 3, n = 6

   Output: [[1,2,3]]

   Example 2:

   Input k = 3, n = 9

   Output: [[1,2,6], [1,3,5], [2,3,4]]

   a. Describe a backtracking algorithm to solve the problem.
   b. Write the pseudocode for the algorithm that you described in a. Your function signature should be **combination(n, k)** and it should return an array of all the combinations as shown in the example.
   c. Implement the pseudocode to solve the problem. Name your file **Sum.py**

2. **Implement a Greedy algorithm**

   You are a pet store owner and you own few dogs. Each dog has a specific hunger level given by array hunger_level [1..n] (ith dog has hunger level of hunger_level [i]). You have couple of dog biscuits of size given by biscuit_size [1…m]. Your goal to satisfy maximum number of hungry dogs. You need to find the number of dogs we can satisfy.

   If a dog has hunger hunger_level[i], it can be satisfied only by taking a biscuit of size biscuit_size [j] >= hunger_level [i] (i.e biscuit size should be greater than or equal to hunger level to satisfy a dog.)

   Conditions:

   You cannot give same biscuit to two dogs.

   Each dog can get only one biscuit.

   Example 1:

   Input: hunger_level[1,2,3], biscuit_size[1,1]

   Output: 1

   Explanation: Only one dog with hunger level of 1 can be satisfied with one cookie of size 1.

   Example 2:

   Input: hunger_level[1,2], biscuit_size[1,2,3]

   Output: 2

   Explanation: Two dogs can be satisfied. The biscuit sizes are big enough to satisfy the hunger level of both the dogs.

   a. Describe a greedy algorithm to solve this problem
   b. Write an algorithm implementing the approach. Your function signature should be **feedDog(hunger_level[], biscuit_size[])**. Name your file **FeedDog.py**
   c. Analyse the time complexity of the approach.

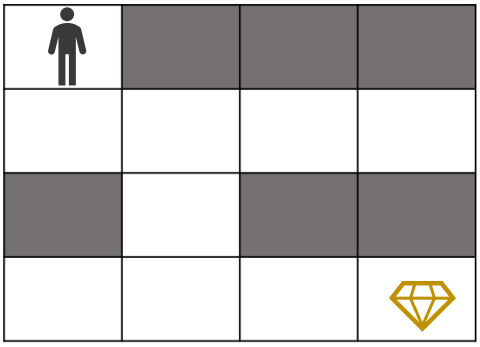
----------(Ungraded question: you can try this question if time permits)----------

You are given a puzzle in the form of a nxn matrix. Your location is in the start of a matrix at top left corner (location [0][0]) location and there is treasure location at the destination of the matrix at the bottom right corner of the matrix (location [n-1][n-1]). You can only move left/right or up/down in the puzzle. Your goals is to find out if you can reach the treasure or not.

Matrix is marked with 1 where there is a path and with 0 where is a wall.

For example, this matrix represents below shown puzzle.

Matrix: [[1, 0, 0,0],[1, 1, 1, 1], [0, 1, 0, 0], [1, 1, 1,1]]



a. Describe a backtracking algorithm to solve the puzzle, you goal is to return True if you can reach the destination or return False otherwise.
b. Write the pseudocode for the algorithm that you described in a. Your function signature should be **reachTreasure (puzzle)** and it should return True/False
c. Implement the pseudocode to solve the problem. Name your file **Puzzle.py**

Debriefing (required!): ----------

Report:

1. Approximately how many hours did you spend on this assignment?
2. Would you rate it as easy, moderate, or difficult?
3. How deeply do you feel you understand the material it covers (0%–100%)?
4. Any other comments?

Note: ‘Debriefing’ section is intended to help us calibrate the assignments.