2023-09-30 - Handout – TOPOLOGICAL SORTING

Q1. Course Schedule

Link: https://leetcode.com/problems/course-schedule/

There are a total of numCourses courses you have to take, labeled from 0 to numCourses - 1. You are given an array prerequisites where prerequisites[i] = [ai, bi] indicates that you **must** take course bi first if you want to take course ai. For example, the pair [0, 1], indicates that to take course 0 you have to first take course 1.

Return true if you can finish all courses. Otherwise, return false.

EXAMPLE 1:
Input: numCourses = 2, prerequisites = [[1,0]]
Output: true
Explanation: There are a total of 2 courses to take. To take course 1 you should have finished course 0. So it is possible.

EXAMPLE 2:
Input: numCourses = 2, prerequisites = [[1,0],[0,1]]
Output: false
Explanation: There are a total of 2 courses to take. To take course 1 you should have finished course 0, and to take course 0 you should also have finished course 1. So it is impossible.

Q2. Course Schedule II

Link: https://leetcode.com/problems/course-schedule-ii/

There are a total of numCourses courses you have to take, labeled from 0 to numCourses - 1. You are given an array prerequisites where prerequisites[i] = [ai, bi] indicates that you **must** take course bi first if you want to take course ai. For example, the pair [0, 1], indicates that to take course 0 you have to first take course 1. Return the ordering of courses you should take to finish all courses. If there are many valid answers, return **any** of them. If it is impossible to finish all courses, return **an empty array**.

EXAMPLE 1:
Input: numCourses = 2, prerequisites = [[1,0]]
Output: [0,1]
Explanation: There are a total of 2 courses to take. To take course 1 you should have finished course 0. So the correct course order is [0,1].

EXAMPLE 2:
Input: numCourses = 4, prerequisites = [[1,0],[2,0],[3,1],[3,2]]
Output: [0,2,1,3]
Explanation: There are a total of 4 courses to take. To take course 3 you should have finished both courses 1 and 2. Both courses 1 and 2 should be taken after you finished course 0.
So one correct course order is [0,1,2,3]. Another correct ordering is [0,2,1,3].

Q3. Alien Dictionary

Link: https://leetcode.com/problems/alien-dictionary/

There is a new alien language that uses the English alphabet. However, the order of the letters is unknown to you. You are given a list of strings words from the alien language's dictionary. Now it is claimed that the strings in words are sorted lexicographically by the rules of this new

language. If this claim is incorrect, and the given arrangement of string in `words` cannot correspond to any order of letters, return `""`. Otherwise, return a string of the unique letters in the new alien language sorted in **lexicographically increasing order** by the new language's rules. If there are multiple solutions, return **any of them**.

Example 1:
Input: words = ["wrt","wrf","er","ett","rftt"]
Output: "wertf"

EXAMPLE 2:
Input: words = ["z","x","z"]
Output: ""
Explanation: The order is invalid, so return "".

Q4. 444. Sequence Reconstruction

Link: https://leetcode.com/problems/sequence-reconstruction/

You are given an integer array `nums` of length `n` where `nums` is a permutation of the integers in the range `[1, n]`. You are also given a 2D integer array `sequences` where `sequences[i]` is a subsequence of `nums`. Check if `nums` is the shortest possible and the only **supersequence**. The shortest **supersequence** is a sequence **with the shortest length** and has all `sequences[i]` as subsequences. There could be multiple valid **supersequences** for the given array `sequences`.

- For example, for `sequences = [[1,2],[1,3]]`, there are two shortest **supersequences**, `[1,2,3]` and `[1,3,2]`.
- While for `sequences = [[1,2],[1,3],[1,2,3]]`, the only shortest **supersequence** possible is `[1,2,3]`. `[1,2,3,4]` is a possible supersequence but not the shortest.

Return `true` *if* `nums` *is the only shortest* ***supersequence*** *for* `sequences`*, or* `false` *otherwise. A* ***subsequence*** *is a sequence that can be derived from another sequence by deleting some or no elements without changing the order of the remaining elements.*

EXAMPLE 1 :
Input: nums = [1,2,3], sequences = [[1,2],[1,3]]
Output: false
Explanation: There are two possible supersequences: [1,2,3] and [1,3,2].
The sequence [1,2] is a subsequence of both: [**1**,**2**,3] and [**1**,3,**2**].
The sequence [1,3] is a subsequence of both: [**1**,2,**3**] and [**1**,**3**,2].
Since nums is not the only shortest supersequence, we return false.

EXAMPLE 2 :
Input: nums = [1,2,3], sequences = [[1,2],[1,3],[2,3]]
Output: true
Explanation: The shortest possible supersequence is [1,2,3].
The sequence [1,2] is a subsequence of it: [**1**,**2**,3].
The sequence [1,3] is a subsequence of it: [**1**,2,**3**].
The sequence [2,3] is a subsequence of it: [1,**2**,**3**].
Since nums is the only shortest supersequence, we return true.