2023-04-30 - Handout – Graphs

Q1. Find if Path Exists in Graph

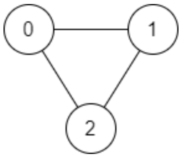
Link: https://leetcode.com/problems/find-if-path-exists-in-graph/

There is a **bi-directional** graph with n vertices, where each vertex is labeled from 0 to n - 1 (**inclusive**). The edges in the graph are represented as a 2D integer array edges, where each edges[i] = [u_i, v_i] denotes a bi-directional edge between vertex u_i and vertex v_i. Every vertex pair is connected by **at most one** edge, and no vertex has an edge to itself.

You want to determine if there is a **valid path** that exists from vertex source to vertex destination.

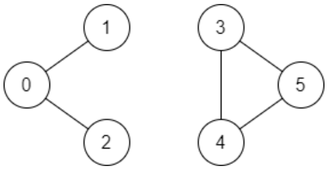
Given edges and the integers n, source, and destination, return true *if there is a* ***valid path*** *from* source *to* destination*, or* false *otherwise*.

Example 1:



```
Input: n = 3, edges = [[0,1],[1,2],[2,0]], source
= 0, destination = 2

Output: true

Explanation: There are two paths from vertex 0
to vertex 2:

- 0 → 1 → 2

- 0 → 2
```

Example 2:



```
Input: n = 6, edges = [[0,1],[0,2],[3,5],[5,4],[4,3]],
source = 0, destination = 5

Output: false

Explanation: There is no path from vertex 0 to vertex 5.
```

Constraints:

- 1 <= n <= 2 * 105
- 0 <= edges.length <= 2 * 105
- edges[i].length == 2
- 0 <= ui, vi <= n - 1
- ui != vi
- 0 <= source, destination <= n - 1
- There are no duplicate edges.
- There are no self edges.

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] = [a_i, b_i] indicates that you **must** take course b_i first if you want to take course a_i.

- 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].
```

```
Example 3:

Input: numCourses = 1,
prerequisites = []

Output: [0]
```

Constraints:

- 1 <= numCourses <= 2000
- 0 <= prerequisites.length <= numCourses * (numCourses - 1)
- prerequisites[i].length == 2
- 0 <= ai, bi < numCourses
- ai != bi
- All the pairs [ai, bi] are distinct.

Q3. Count Ways to Build Rooms in an Ant Colony

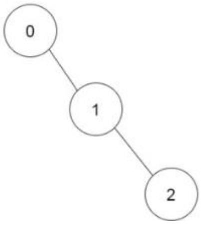
Link: https://leetcode.com/problems/count-ways-to-build-rooms-in-an-ant-colony/

You are an ant tasked with adding n new rooms numbered 0 to n-1 to your colony. You are given the expansion plan as a **0-indexed** integer array of length n, prevRoom, where prevRoom[i] indicates that you must build room prevRoom[i] before building room i, and these two rooms must be connected **directly**. Room 0 is already built, so prevRoom[0] = -1. The expansion plan is given such that once all the rooms are built, every room will be reachable from room 0.

You can only build **one room** at a time, and you can travel freely between rooms you have **already built** only if they are **connected**. You can choose to build **any room** as long as its **previous room** is already built.

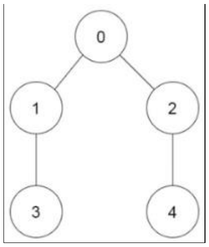
Return *the **number of different orders** you can build all the rooms in*. Since the answer may be large, return it **modulo** $10^9 + 7$.

```
Example 1:
```



```
Input: prevRoom = [-1,0,1]

Output: 1

Explanation: There is only one way to build the
additional rooms: 0 → 1 → 2
```

```
Example 2:
```



```
Input: prevRoom = [-1,0,0,1,2]

Output: 6

Explanation:

The 6 ways are:

0 → 1 → 3 → 2 → 4

0 → 2 → 4 → 1 → 3

0 → 1 → 2 → 3 → 4

0 → 1 → 2 → 4 → 3

0 → 2 → 1 → 3 → 4

0 → 2 → 1 → 4 → 3
```

Constraints:

- n == prevRoom.length
- 2 <= n <= 105
- prevRoom[0] == -1
- 0 <= prevRoom[i] < n for all 1 <= i < n
- Every room is reachable from room 0 once all the rooms are built.