Algorithms

Topological Homework 1

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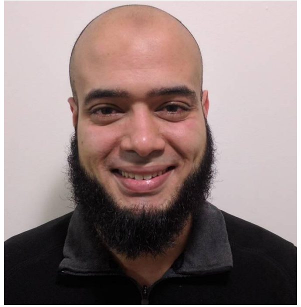
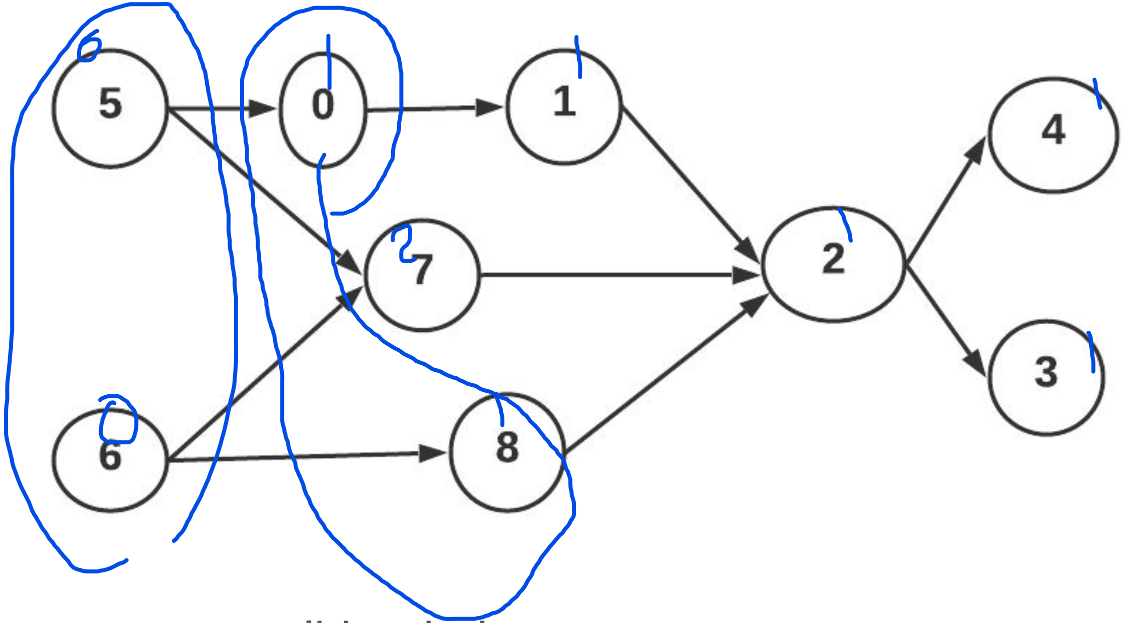
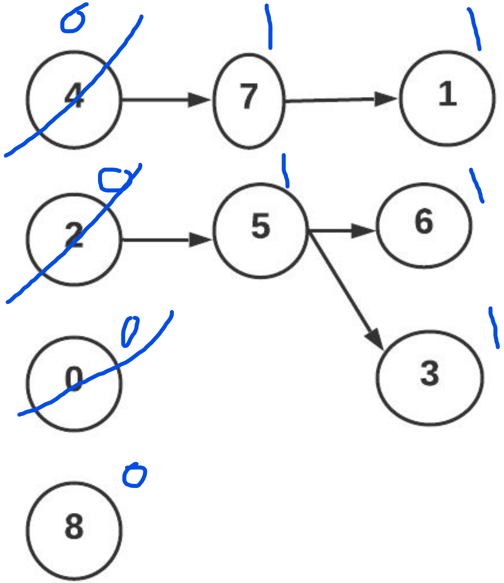


Problem #1: The lexicographical order

- In the lecture code, we learned there are many valid topological orders for a DAG
- Change the code to print the lexicographically smallest ordering
  - Imagine all different ordering
  - The **most sorted** array among them
- Example 1: In a tree of 4 nodes with no edges, we have 4! Ordering
  - [0, 1, 2, 3] is the lexicographically smallest ordering



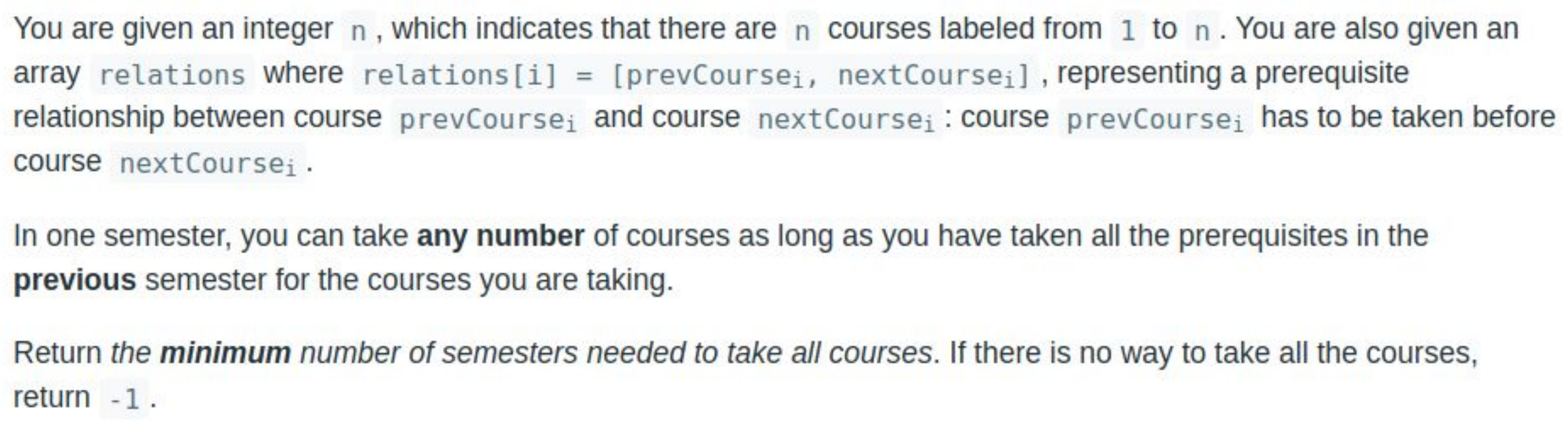
- There are many valid ordering
  - 5 6 0 7 8 1 2 4 3
- The **lexicographically smallest** ordering
  - 5 0 1 6 7 8 2 3 4



- Answer: 0 2 4 5 3 6 7 1 8

q {4 , 2 , 0 , 8 3

Problem #2: LeetCode 1136 - Parallel Courses



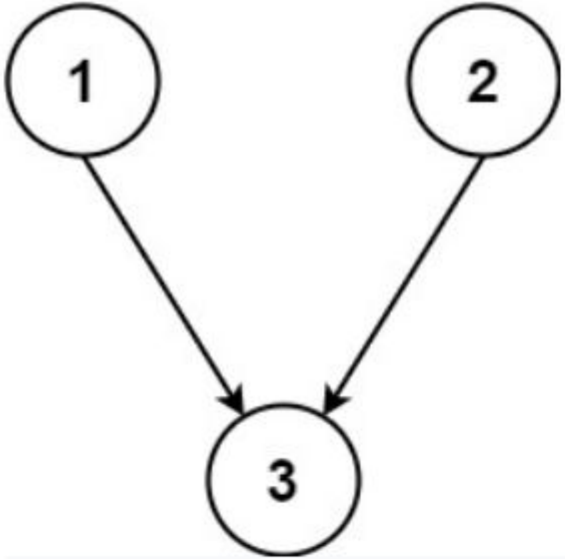
You are given an integer n, which indicates that there are n courses labeled from 1 to n. You are also given an array relations where relations[i] = [$\texttt{prevCourse}_i$, $\texttt{nextCourse}_i$], representing a prerequisite relationship between course $\texttt{prevCourse}_i$ and course $\texttt{nextCourse}_i$: course $\texttt{prevCourse}_i$ has to be taken before course $\texttt{nextCourse}_i$.

In one semester, you can take **any number** of courses as long as you have taken all the prerequisites in the **previous** semester for the courses you are taking.

Return *the **minimum** number of semesters needed to take all courses*. If there is no way to take all the courses, return -1.

- C++: int minimumSemesters(int n, vector<vector<int>>& relations)
- Java: public int minimumSemesters(int n, int[][] relations)
- Python: def minimumSemesters(self, n: int, relations: List[List[int]]) -> int
- JavaScript: var minimumSemesters = function(n, relations)

Example 1:



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Input: n = 3, relations = [[1,3],[2,3]]
Output: 2
Explanation: The figure above represents the given graph
In the first semester, you can take courses 1 and 2.
In the second semester, you can take course 3.
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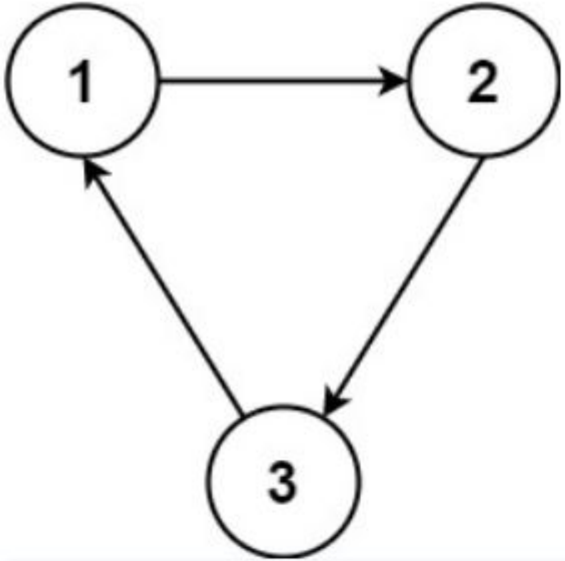
- `1 <= n <= 5000`
- `1 <= relations.length <= 5000`
- `relations[i].length == 2`
- `1 <= prevCourse`$_i$`, nextCourse`$_i$` <= n`
- `prevCourse`$_i$` != nextCourse`$_i$
- All the pairs `[prevCourse`$_i$`, nextCourse`$_i$`]` are **unique**.

Example 2:



Input: n = 3, relations = [[1,2],[2,3],[3,1]]

Output: -1

Explanation: No course can be studied because they are prerequisites of each other.

“Acquire knowledge and impart it to the people.”

“Seek knowledge from the Cradle to the Grave.”