Graph Concepts & Qns

Video - 43

POTD
Leetcode
- 2097
Hard

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YOUR HARD WORK
IS PAYING OFF!

Motivation :-

Every tough topic becomes easy with Persistence and curiosity. Each attempt brings you closer to understanding, and every small effort adds up. ❤️

MIK...

Remember, even experts were once
beginners — Keep going, and no challenge
will be too big to conquer !!!

We've already studied Eulerian

Graphs
↳ video - 40 : Part - 1 ✓
↳ video - 41 : Part - 2 ✓
↳ video - 42 : Part - 3 ✓

2097. Valid Arrangement of Pairs

Euler Path -

Hard   ◇ Topics   🔒 Companies   💡 Hint

You are given a **0-indexed** 2D integer array `pairs` where `pairs[i] = [start_i, end_i]`. An arrangement of `pairs` is valid if for every index `i` where `1 <= i < pairs.length`, we have $end_{i-1} == start_i$.
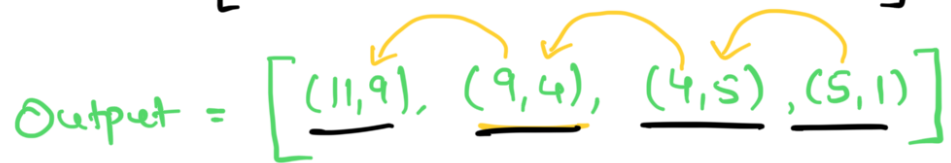
Return **any** valid arrangement of `pairs`.

Note: The inputs will be generated such that there exists a valid arrangement

Example:- pairs = $\left[(5,1), (4,5), (11,9), (9,4) \right]$

Output = $\left[(11,9), (9,4), (4,5), (5,1) \right]$
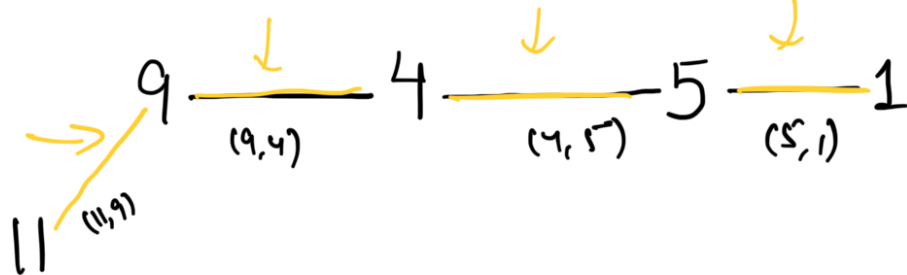
① How is this problem related to Euler ???

② What is it asking from us ???

③ How to find Euler Path ???

"Hierholzer's Algorithm" ✓✓

. . . _____ . . .

pairs = $\left[(5,1), (4,5), (11,9), (9,4) \right]$

Output = $\left[(11,9), (9,4), (4,5), (5,1) \right]$

$$11 \rightarrow 9 \rightarrow 4 \rightarrow 5 \rightarrow 1$$

once.

$$9 \underset{(9,4)}{\overset{\downarrow}{\rule{2cm}{0.4pt}}} 4 \underset{(4,5)}{\overset{\downarrow}{\rule{2cm}{0.4pt}}} 5 \underset{(5,1)}{\overset{\downarrow}{\rule{2cm}{0.4pt}}} 1$$

$$11 \overset{(11,9)}{\nearrow}$$

Directed Graph

4 —— 5 —— 1

11 → 9 — 4
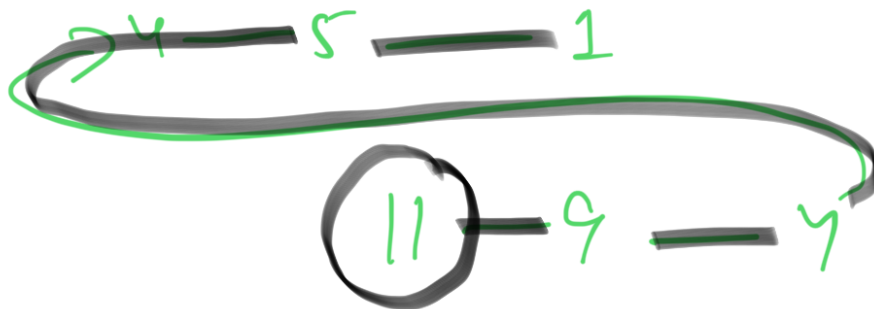
Euler path $\begin{cases} (\cdot) & \text{Starting point} \\ (\cdot) & \text{visting all edges} \\ (\cdot) & \text{visiting all edge only once.} \end{cases}$

Euler Graph:-

$$\Big[(1,2), \quad (1,3), \quad (2,1) \Big]$$

$$(1,2) \rightarrow (2,1) \quad (1,3)$$
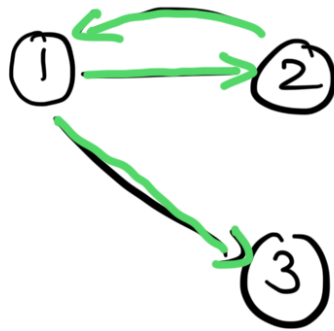
(·) All edge visited only once.

Euler Path.

$$1 - 2 - 1 - 3$$

Start (E·P) →

indegree

outdegree

outdegree[x] − indegree(x) == 1 ✓

StartNode = x ;

Start Node.

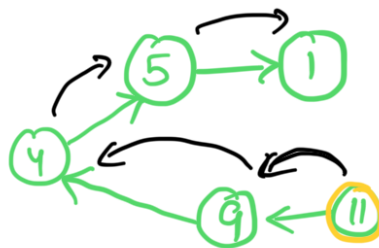End: ind(1) ~ out(4) == 1

→ DFS·

Hierholzer's Algorithm

⇒ (•) Build adjacency list → Graph बनाओ |

⇒ (•) Build indegree & outdegree

⇒ (•) Find the (StartNode of Euler Path)

(•) vector<int> EulerPath

adj:
$5 \to \{1\}$
$4 \to \{5\}$
$11 \to \{9\}$
$9 \to \{4\}$

$$[(5,1), (4,5), (11,9), (9,4)]$$

⑨ → ④

$5 \to \{\cancel{1}\}$
$4 \to \{\cancel{5}\}$
$11 \to \{\cancel{9}\}$
$9 \to \{\cancel{4}\}$

stack

indeg.

①	4	5	9	⑪
①	1	1	1	0

outdeg.

1	4	5	9	⑪
0	1	1	1	①

$curr = st.top() = \cancel{1}\,\cancel{4}\,\cancel{9}_{11}$

{ Start = ⑪ ✓
  End = ① }

Path = $\{1, 5, 4, 9, 11\}$

reverse = $\{11, 9, 4, 5, 1\}$

$$\{ (11,9) , (9,4) , (4,5) , (5,1) \}$$

$$T \cdot C = O(V + E) \quad DFS.$$

$$S C = O(V + E).$$