

Day 19 Topological Sort

ITSRUNTYM

What is Topological Sort?

Topological Sort is **linear ordering** of vertices in a **Directed Acyclic Graph (DAG)** such that for every directed edge $u \rightarrow v$, vertex u comes **before** v in the ordering.

Only applicable for **Directed Acyclic Graphs (DAG)**.

Where is Topological Sort Used?

- Task Scheduling (tasks with dependencies)
- Course Prerequisites
- Compilation Order
- Build Systems (like Makefile)
- Package Dependency Management

Approaches to Topological Sort

1. **DFS-based (Depth-First Search)**
2. **BFS-based (Kahn's Algorithm using in-degree)**

DFS-Based Topological Sort (Using Stack)

Key Idea:

- Perform DFS.
- On returning from DFS call, push the node to a **stack**.
- Finally, pop elements from the stack — that's your topological sort.

Steps:

1. Create a visited array.
2. For each unvisited node, call DFS.
3. In DFS:
 - Visit neighbours.
 - After all neighbours are done, push node to stack.
4. At the end, reverse the stack (or just print in pop order).

BFS-Based Topological Sort (Kahn's Algorithm)

Key Idea:

- Track **in-degree** (number of incoming edges) for each node.
- Push all nodes with in-degree = 0 into queue.

- While queue not empty:
 - Pop node → add to result.
 - For each neighbour, reduce its in-degree by 1.
 - If in-degree becomes 0, push into queue.

#	Problem Title	Key Concept	Link
1	Course Schedule	Cycle Detection in DAG (BFS/DFS)	LeetCode 207
2	Course Schedule II	Topological Sort (Return order)	LeetCode 210
3	Alien Dictionary	Topo Sort from character constraints	LeetCode 269 (Premium)
4	Minimum Height Trees	Reverse Leaf Removal	LeetCode 310
5	Parallel Courses	Level-wise BFS (Kahn's)	LeetCode 1136
6	Parallel Courses II	Bitmask + Topo Sort + DP	LeetCode 1494
7	Sequence Reconstruction	Unique Topo Sort check	LeetCode 444 (Premium)
8	Longest Path in a DAG (<i>custom implementation</i>)	Topo Sort + DP	No direct LeetCode — Try on [GFG]
9	Build System / Task Scheduler (<i>custom implementation</i>)	Topo sort in build tools	[Conceptual only, simulate your own]
10	Course Schedule IV (<i>is u prerequisite of v</i>)	Multi-source reachability + Topo	LeetCode 1462