Project 1

A company is planning a **multi-team event** where multiple **dependent tasks** must be completed before the event occurs. Each task:

- **Has dependencies** on other tasks (must be completed before starting).
- **Requires a limited number of resources (workers, machines, or venues).**
- **Has a variable duration** due to uncertainty (e.g., worker efficiency, unpredictable delays).
- **Can have strict deadlines, costs, or priority constraints.**
- **May be dynamically inserted, modified, or removed** after scheduling starts.

The system should generate an **optimized schedule** that considers all these constraints and adapts dynamically to new tasks.

Input Format

1. **Task List with Dependencies**
    - Each task has a **duration**, **dependencies**, and a **priority level**.
    - Some tasks may have **hard deadlines** that cannot be exceeded.
2. **Resource Constraints**
    - Each task requires a specific number of **workers/machines**.
    - The system must allocate resources optimally to minimize delays.
3. **Uncertainty Modeling (Hard Mode Feature)**
    - Tasks may have **probabilistic durations** (e.g., completion times follow a **normal distribution**).
    - The system must compute **expected completion times** and provide **confidence intervals**.
4. **Dynamic Task Modifications** (Real-Time Adaptation)
    - Tasks can be **added**, **removed**, or **reprioritized** while scheduling is in progress.

Example Input:

Tasks:

A: Duration = 2, Dependencies = [], Workers Required = 1

B: Duration = 3, Dependencies = [A], Workers Required = 2

C: Duration = 4, Dependencies = [A], Workers Required = 1

D: Duration = 2, Dependencies = [B, C], Workers Required = 3

E: Duration = 5, Dependencies = [B], Workers Required = 2

F: Duration = 3, Dependencies = [D, E], Workers Required = 1

Resources Available: 4 Workers

Hard Deadline: Task F must finish before day 12

Expected Output:

Sorted Task Execution Order (Topological Sort): ['A', 'B', 'C', 'D', 'E', 'F']

Task Schedule:

Task A: Start at 0, End at 2

Task B: Start at 2, End at 5

Task C: Start at 2, End at 6

Task D: Start at 6, End at 8

Task E: Start at 5, End at 10

Task F: Start at 10, End at 13

Total Project Completion Time: 13 (Missed Deadline!)