HUST

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HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

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Applied Algorithm Lab

Make span schedule

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Make span schedule

- Make a schedule for a project with many tasks.
- A project has n tasks 1,..., n:
  - Task i has duration d(i) to be completed
  - Precedence constraints Q: for each (i,j) in Q, task j cannot be started before the completion of task i.
- **Objective:** Arrange task the project to complete as soon as possible.
- **Input:** n, |Q|, d(1),..., d(n), the set Q
- **Output:** The earliest completion time of the project.

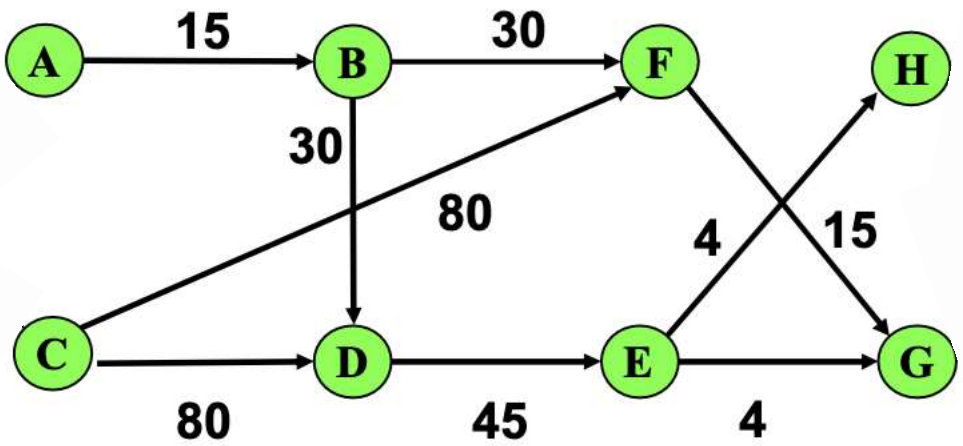
Make span schedule

- Example

Input	Output
8 9 15 30 80 45 4 15 15 19 1 2 2 4 3 4 4 5 2 6 3 6 5 7 6 7 5 8	148

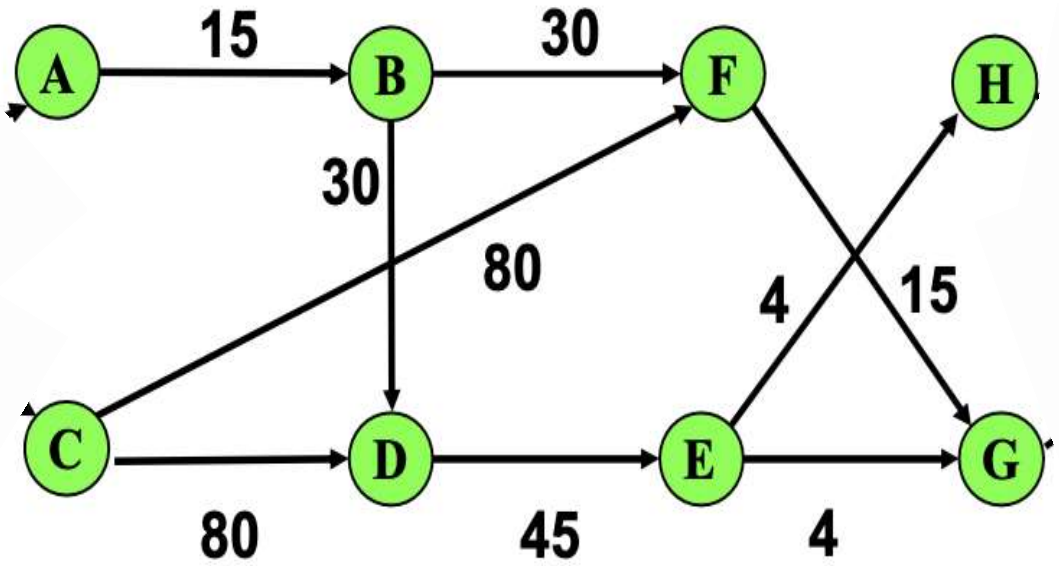
Make span schedule

- Idea to solve: Formulate the problem using directed graph
  - A graph with n nodes as n tasks
  - If (i,j) ∈ Q, we draw an edge (i, j) on graph
    - weight of edge (i,j) is t[i]
  - The node having in-degree 0 : we can perform the corresponding task since t = 0



Make span schedule

- Idea to solve: BFS
  - The node having in-degree 0 -> not affected by any other, but may affect some other nodes
  - We use BFS to traverse, from a node y having in-degree 0
    - Use auxiliary variable dist[x]: the first starting time of x
  - After BFS all node: retrieve the node with maximal dist[]



Make span schedule - Implementation

```cpp
#include <bits/stdc++.h>
using namespace std;

#define N 10001
int n, m, in_deg[N];
vector<int> Adj[N];
int t[N], firstTime[N], finishTime[N];
int min_finishTime = 0;

void input() {
    scanf("%d%d", &n, &m);
    for (int i = 1; i <= n; i++) {
        scanf("%d", &t[i]);
        firstTime[i] = 0;
    }
    for (int i = 1; i <= m; i++) {
        int u, v;
        scanf("%d%d", &u, &v);
        Adj[u].push_back(v);
        in_deg[v]++;
    }
}
```

Make span schedule - Implementation

```cpp
int main() {
    input();
    for (int i = 1; i <= n; i++) {
        if (in_deg[i] == 0) { // BFS từ i
            firstTime[i] = 0;
            queue<int> q;
            q.push(i);
            while (!q.empty()) {
                int u = q.front();
                q.pop();
                for (int v : Adj[u]) {
                    if (firstTime[v] < firstTime[u] + t[u]) {
                        firstTime[v] = firstTime[u] + t[u];
                        finishTime[v] = firstTime[v] + t[v];
                        q.push(v);
                    }
                }
            }
        }
    }
    for (int i = 1; i <= n; i++) {
        min_finishTime = max(min_finishTime, finishTime[i]);
    }
    cout << min_finishTime << endl;
    return 0;
}
```

THANK YOU !