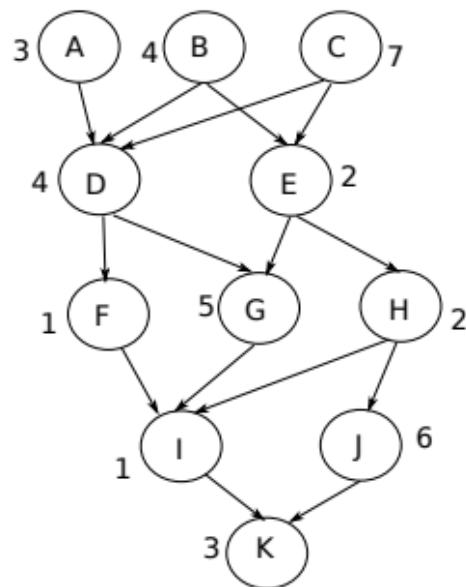


Name : Aravinda Reddy Gangalakunta

Student Id : 801393674

## Homework Assignment 2 : Formal Representation of Parallelism

Question 1 :

1) **Work** : Work is total sum of weights on all nodes

- Total Work is independent of task dependencies.
- Total Work only considers the computation costs (weights).

$$TW = \sum (\text{weight of each node})$$

$$TW = \sum (W_a + W_b + W_c + W_d + \dots)$$

$$= \sum (3 + 4 + 7 + 4 + 2 + 1 + 5 + 2 + 1 + 6 + 3)$$

$$= 38$$

2) **Width** is the maximum number of tasks that do not have direct dependencies or transitive dependencies on each other, often described as the longest antichain in the graph.

- 3) **Critical chain** is the longest path from start to finish in the graph. Its length is the total time along path

All Possible Paths:

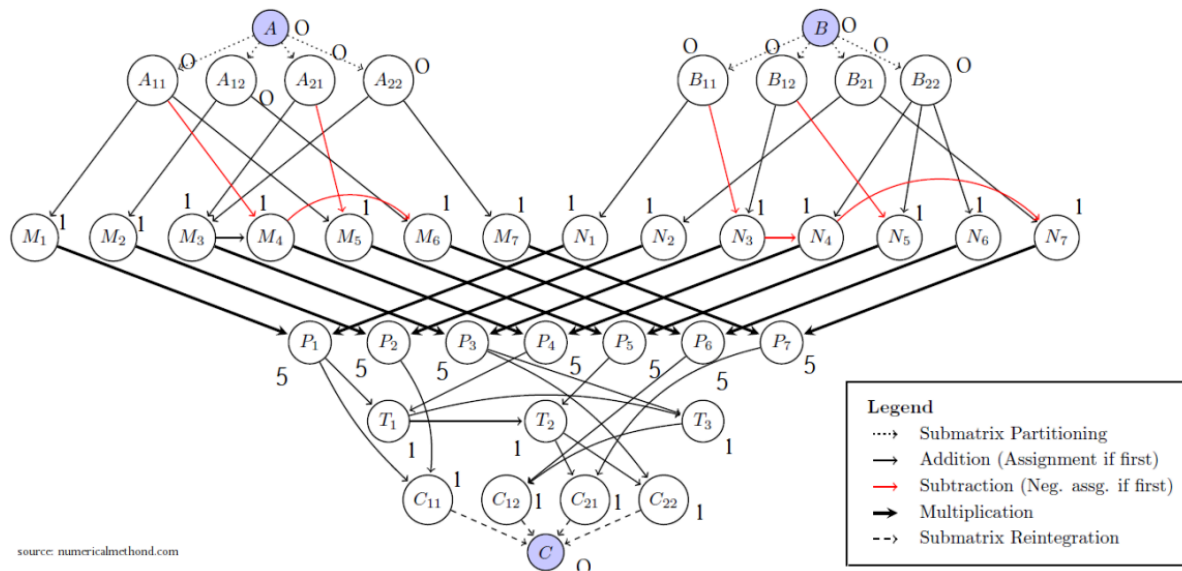
1. A->D ->F->I->K: 12
2. A -> D ->G->I->K: 16
3. B->D ->F->I->K: 13
4. B ->D->G ->I->K: 17
5. B->E->G->I->K: 15
6. B ->E->H->I->K: 12
7. B > E > H -> J ->K: 17
8. C->D->F->I->K: 16
9. C->D->G ->I->K:20
10. C->E->G->I->K: 18
11. C->E->H->I->K: 15
12. C->E->H->J->K:20

Longest Path is

- C->D->G ->I->K: 20
- C->E->H->J->K: 20

Length time is 20 units

## Question 2:



1) Work of the task graph: The work is the sum of all task durations. Counting the nodes:

- 8 nodes with value 0 (A and B matrices)
- 21 nodes with value 1 (M, N, T and C matrices)
- 7 nodes with value 5 (P matrices)
- 1 node with value 0 (final C matrix)

$$\text{Total work: } (8 * 0) + (21 * 1) + (7 * 5) + (0 * 1) = 21 + 35 = 56$$

2) Width:

First level (A and B matrices): 8 tasks

Second level (M and N calculations):  $7 + 7 = 14$  tasks

Third level (P calculations): 7 tasks

Fourth level (T calculations): 3 tasks

Fifth level (C calculations): 4 tasks

Last level (final C matrix): 1 task

The maximum number of tasks running in parallel is **14** (from the second level with the M and N calculations).

Width = 14

- 3) Critical Path: The critical chain is the longest path in the graph, summing the task durations along the path.

A or B matrix (0) -> M or N calculation (1) -> P calculation (5) -> T calculation (1) -> C calculation (1) -> final C matrix (0)

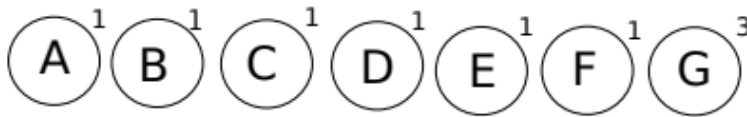
The length of this critical chain is the sum of these durations:

$$0 + 1 + 5 + 1 + 1 + 0 = 8$$

critical chain length = 8.

Question 3:

### 3 Independent Tasks 1 (25 pts)



- 1) Work : The concept of work represents the total amount of effort or processing time required if all tasks were executed sequentially, one after the other. It doesn't take into account the parallel execution capabilities or dependencies

So Work is  $TW = \sum (\text{weight of each node})$

$$TW = 9$$

- 2) Width: The width of a task graph is the maximum number of tasks that can be executed in parallel. In this case, all tasks are independent and can be executed simultaneously.

$$\text{Width} = 7$$

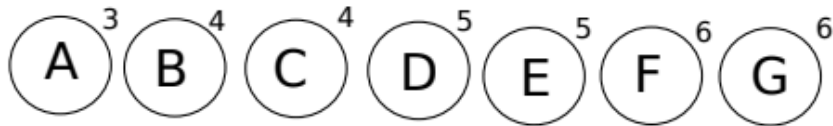
- 3) Critical Chain : The task with the longest duration, as it determines the overall completion time. Here, task G has the longest duration of 3 time units.

Critical chain: G

Length of the critical chain: 3 units

Question 4:

## 4 Independent Tasks 2 (25 pts)



**Question:** What is the work of this task graph?

**Question:** What is the width of this task graph?

**Question:** What is the critical chain of this task graph? What is its length?

1) Work :  $TW = \sum (\text{weight of each node})$

$$TW = 33$$

2) Width : The width of this task graph is **7** (since there are 7 tasks, A through G)

$$\text{Width} = 7$$

3) Critical Chain : The critical chain is the longest chain of dependent tasks, but since these tasks are independent, the critical chain consists of a single task with the longest duration. Looking at the durations, F and G have the longest durations (6).

Chain : F or G

Length : 6