Project 4: Finding critical paths in PERT charts

CS 5V81.001: Implementation of data structures and algorithms

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Introduction

- The Critical Path Method or Critical Path Analysis, is a mathematically based algorithm for scheduling a set of project activities.
- Commonly used with all forms of projects, including construction, software development, research projects, product development, engineering, and plant maintenance, among others
- Any project with interdependent activities can apply this method of scheduling
- The essential technique for using CPM is to construct a model of the project that includes the following:
    - A list of all activities required to complete the project (also known as Work Breakdown Structure)
    - The time (duration) that each activity will take to completion
    - The dependencies between the activities.

Definitions

- **Critical Path** - Critical path is the sequence of activities which add up to the longest overall duration. It is the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date (there is no float on the critical path).
- **Earliest Completion Time (EC)** – Earliest completion time of a given task.
- **Latest Completion Time (LC)** – Latest completion time of a task that does not delay the time at which all tasks are completed.
- **Slack** - amount of time that a task can be delayed without causing a delay to subsequent tasks and project completion date.

Implementation

Firstly, the project is represented as a DAG. A topological ordering is calculated for the DAG. A dummy start node and end node is added to the DAG both of which has a zero task duration. Once the order is obtained, the EC and LC for each of the tasks and their respective slacks are also calculated.

Next, we calculate multiple critical paths that might exit in the DAG. This is done by running a DFS search from the source node to destination node. The critical path length is calculated by adding the duration of each of the tasks in the critical path.

Input

https://www.utdallas.edu/~rbk/teach/2015s/projects/data/p4-s1.zip

https://www.utdallas.edu/~rbk/teach/2015s/projects/data/p4-s2.zip

Output

File	Vertices	Edges	Critical Path Length	Critical Node Count	Critical Path Count
In-c.txt	100	300	183	18	2
In-d.txt	500	6000	596	55	2
In-k.txt	1000	6000	323	40	2