Optimizing Project Management Using Graph Theory

CS 5002 Final Project

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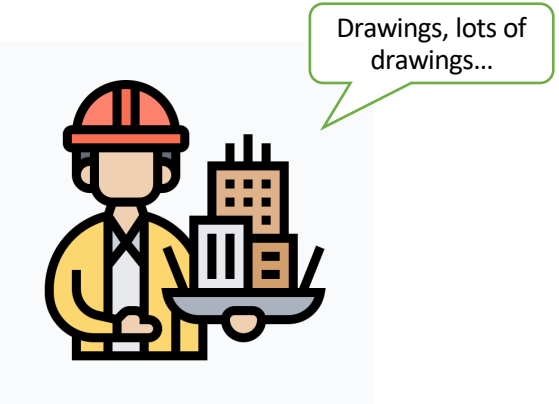
Agenda

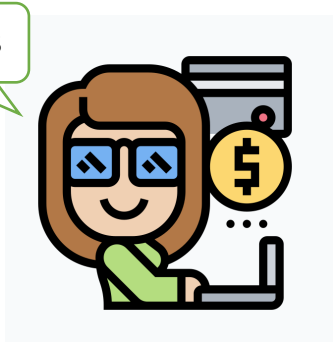
1. Team Background
2. Graphs Theory @ Project Management
3. Questions and Hypothesis
4. Existing Theory: Critical Path Method (CPM)
5. Promotional Event Challenges
6. Python Based Analysis
7. Output and Interpretation
8. Reflections and Future Directions

1. Team Background



- Zhiwei's Background:
  - Architectural Designer
  - Design Documents Phasing
  - Building Permits
  - Construction Administration

- Qiuying's Background:
  - Investment Banker
  - IPO & MA projects
  - Cross-team and Cross-company Coordination



2. Graphs Theory @ Project Management

- Project Management as a common task for both of us in our previous jobs
- Explore the way to promote Project Management by using Discrete Math
- Benefits: Make project Delivery on time, within budget, and with the desired quality

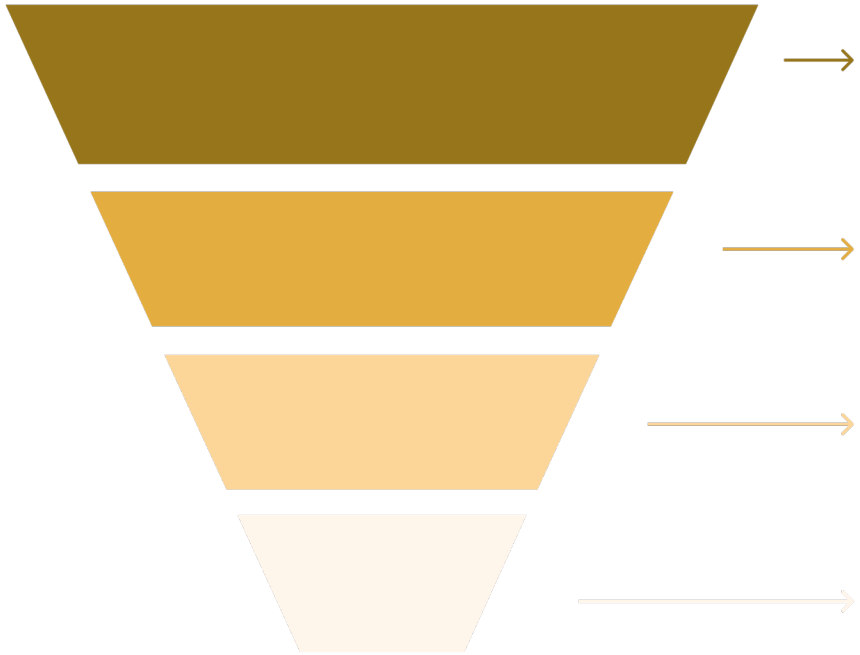
3. Questions and Hypothesis

1. How can Graph Theory be applied to optimize DAG-type projects, especially those time-sensitive ones, in various industries?

2. What is the earliest completion time for the project, and how can it be found?

3. Which activities can be delayed, and by how long, without affecting the minimum completion time?

4. Existing Theory: Critical Path Method (CPM)



Core Theory to Apply:
Critical Path Method (CPM)

The critical path and its relation to graph theory

Incorporating graph theory in project management

Finding the longest path
(the critical path)

5. Promotional Event Challenges

Item	Description	Days
A	Plan the event (Event Coordinator)	5
B	Select products (Purchaser)	4
C	Design promotional materials (Graphic Designer)	8
D	Coordinate with suppliers (Purchaser)	5
E	Prepare email content (Marketing)	4
F	Print promotional materials (Printer)	4
G	Assemble email campaign (Marketing)	3
H	Distribute promotional materials	3
I	Launch email campaign (Marketing)	1
J	Execute promotional event (Retail Staff)	2

The event is super super super urgent! Pls finish it in **30** days!!!

OMG! In total it takes **39** days!

Another mission impossible!

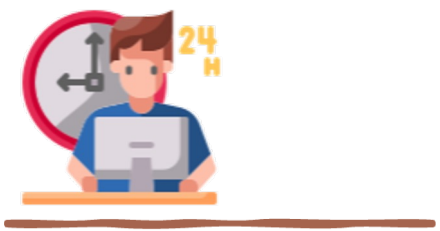
5. Promotional Event Challenges (Cont.)

Opportunities to optimize?

- Parallelization

Breaking down tasks

- Task dependencies?



Item	Description	Days	Preceding Works
A	Plan the event (Event Coordinator)	5	
B	Select products (Purchaser)	4	
C	Design promotional materials (Graphic Designer)	8	A, B
D	Coordinate with suppliers (Purchaser)	5	C
E	Prepare email content (Marketing)	4	C
F	Print promotional materials (Printer)	4	D, E
G	Assemble email campaign (Marketing)	3	C
H	Distribute promotional materials	3	F, G
I	Launch email campaign (Marketing)	1	G
J	Execute promotional event (Retail Staff)	2	H, I

6. Python Based Analysis

Step 1: Process input data (CSV)

Step 2: Represent the Directed Acyclical Graph using **NetworkX**

Step 3: Find the critical path / the longest path

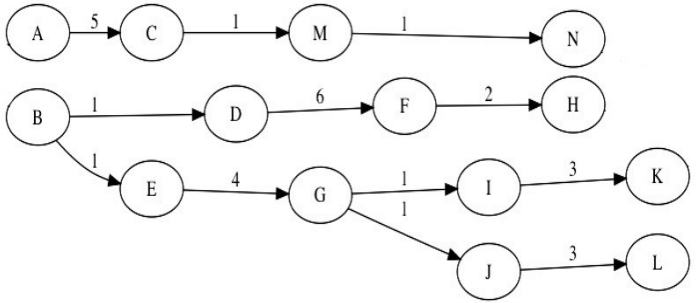
Step 4: Format and plot using **Matplotlib**

Step 5: Generate summarized message

6. Python Based Analysis: Highlight

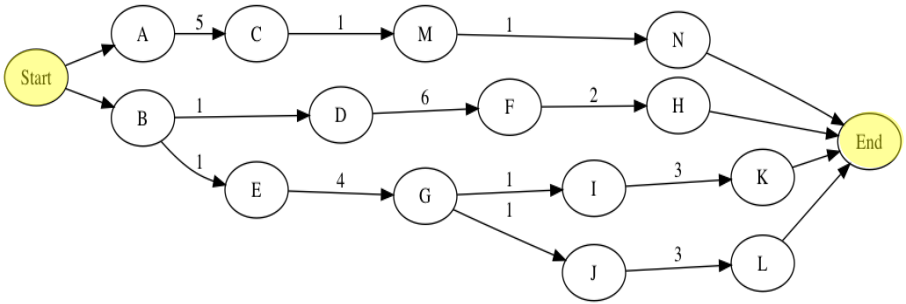
Issues

A project might start with several parallel projects
A project might end with several parallel projects



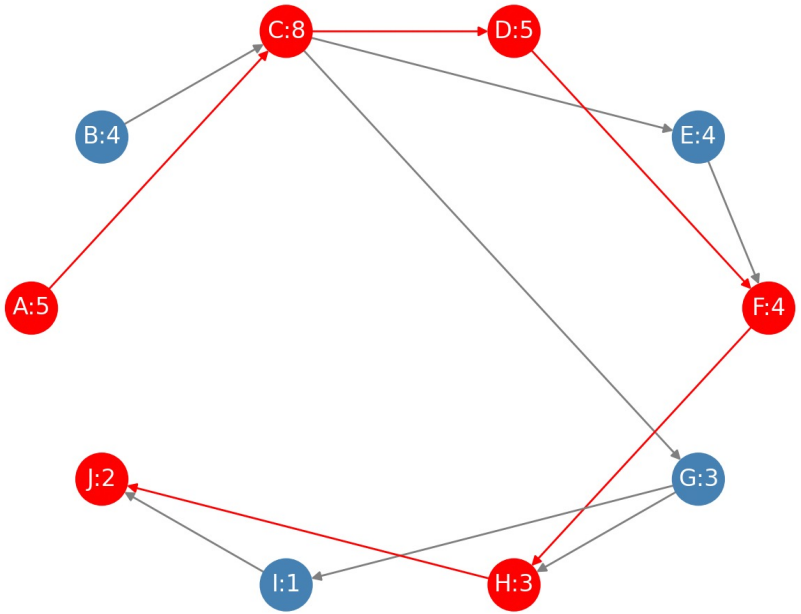
Solution

Adding virtual start and end nodes
Ensuring the start and end point is unique



Figures are extracted and adapted from [What is the 'critical path' when drawing an activity-on-node network diagram that doesn't converge?]

7. Output and Interpretation



SUMMARY

The critical path consists of the following tasks:
1. A: Plan the event (Event Coordinator) (5 days)
2. C: Design promotional materials (Graphic Designer) (8 days)
3. D: Coordinate with suppliers (Purchaser) (5 days)
4. F: Print promotional materials (Printer) (4 days)
5. H: Distribute promotional materials (Retail Staff) (3 days)
6. J: Execute promotional event (Retail Staff) (2 days)

The total duration of the critical path is **27 days**.

REFERENCE

The tasks NOT on the critical path are:
B: Select products (Purchaser) (4 days)
E: Prepare email content (Marketing) (4 days)
G: Assemble email campaign (Marketing) (3 days)
I: Launch email campaign (Marketing) (1 days)

7. Output and Interpretation (Cont.)

Critical path total duration: 27 days

Project completion possible within 30-day deadline

Non-critical tasks with scheduling flexibility

Inform decisions on resource allocation and task prioritization

8. Reflections and Future Directions

Benefits for Project Management and beyond

Things to improve

Future Development Directions

9. References

- The ABCs of the Critical Path Method from Harvard Business Review
- Building DAGs / Directed Acyclic Graphs with Python from MungingData
- What is the "critical path" when drawing an activity-on-node network diagram that doesn't converge
- Notebook 2.2- Weighted and directed graphs
- HiLite.me to insert code snippet in the word document
- Customizing NetworkX Graphs by Aren Carpenter

THE END

THANKS