

This assignment involves creating a proposal for a software development project for a group of restaurant owners in Marlborough, Massachusetts. The main deliverable is a consumer-focused recommendation system for over a hundred restaurants, with data sourced from Yelp reviews. The system will be updated monthly for the list of restaurants and daily for the Yelp reviews.

As the owner of my own data science and software engineering firm, I will be involved in all aspects of the recommender system. My team includes a project manager (myself), frontend developer, backend developer, data engineer, data scientist, and database administrator.

The project consists of eight general tasks, one of which includes eight software development subtasks. An Excel spreadsheet outlines these tasks along with their immediate predecessors. The spreadsheet also includes columns for the workers assigned to the project, which will be useful for future task scheduling.

My team has determined best-case, expected, and worst-case estimates for the number of hours needed for each of the sixteen tasks, as well as the hourly rate of \$55 for each worker role. Using these estimates, we have specified a linear programming model with a minimum time objective for all three scenarios, and used the solution to determine the minimum cost, identify the critical path, and develop the Gantt charts.

The figure below shows the activities, their predecessors, the estimates of hours required for each activity in the three different scenarios, as well as the number of different types of workers assigned for each activity. Note that the hours assigned for

each task under each scenario are the total hours to be split among all the workers working on that task.

taskID	task	predecessor TaskIDs	bestCaseHours	expectedHours	worstCaseHours	projectManager	frontendDeveloper	backendDeveloper	dataScientist	dataEngineer	databaseAdministrator
A	Describe product		30	50	60	1			1		
B	Develop marketing strategy		30	40	60	1					
C	Design brochure	A	10	16	20	1					
D	Develop product prototype										
D1	Requirements analysis	A	25	40	60	1					
D2	Software design	D1	25	40	60		1	1	1	1	
D3	System design	D1	20	32	40		1	1	1	1	1
D4	Coding	D2, D3	120	160	300		2	2		1	
D5	Write documentation	D4	15	25	40		1	1	1	1	1
D6	Unit testing	D4	45	50	100		2	2		1	
D7	System testing	D6	30	50	100		2	2		1	
D8	Package deliverables	D5, D7	20	25	40	1					
E	Survey potential market	B, C	25	40	60	1					
F	Develop pricing plan	D8, E	25	40	60	1					
G	Develop implementation plan	A, D8	40	60	80	1					
H	Write client proposal	F, G	16	24	32	1					

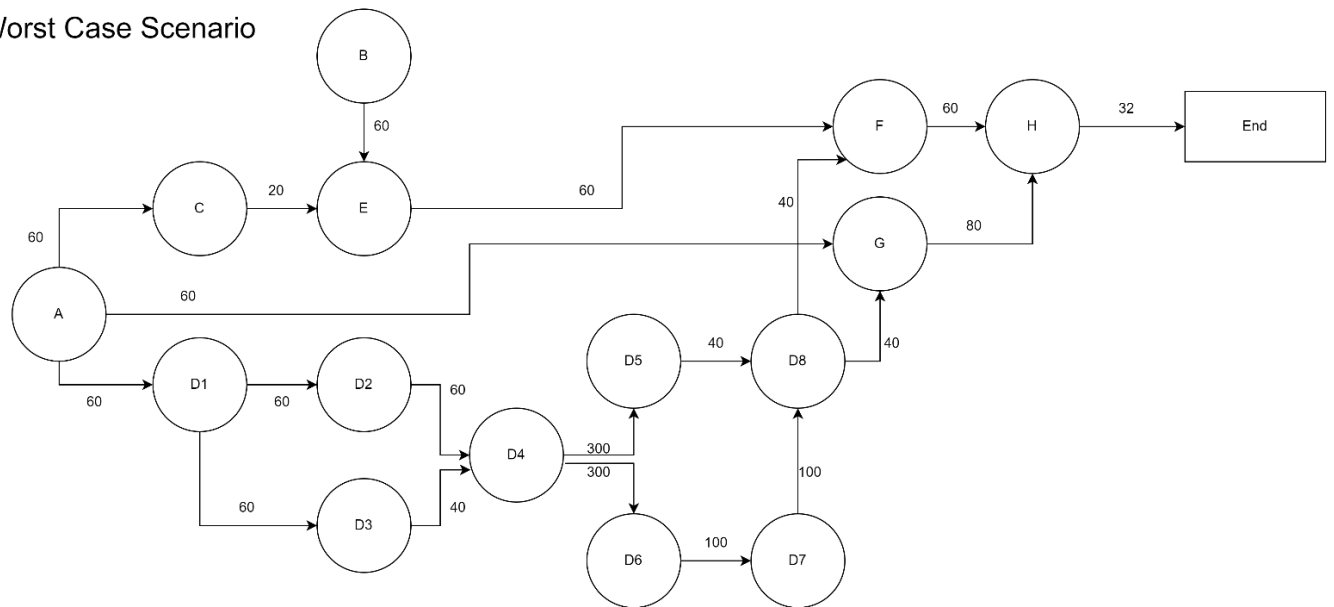
As seen in the figure above, a bulk of the hours are assigned to activity D4, coding, because that typically takes up more time compared to the other activities in the project lifecycle.

Some uncertainties the team had related to this assignment were around the Yelp API, the chosen technologies, and the availability of the different workers. Additionally, the estimates for the best-case, expected, and worst-case number of hours needed for each task are based on assumptions and could vary. The hourly rate for each worker role is assumed to be \$55 per hour, realistically this rate would vary based on factors like experience level, market rates, etc. However, for the purpose of this assignment in specifying the objective function, we are making the simplifying assumption that all contributors to the project charge the same hourly rate.

The figures below show the directed graphs for each scenario, with the values on the arrows being the total duration of a task in hours.

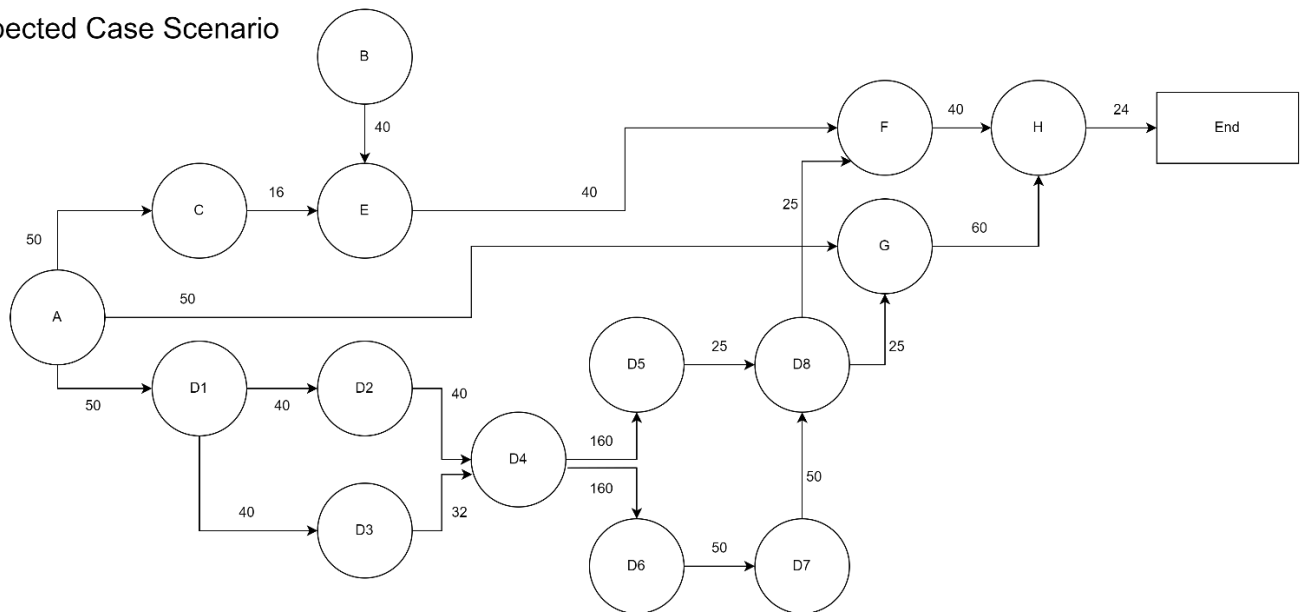
Worst-case Scenario

Worst Case Scenario



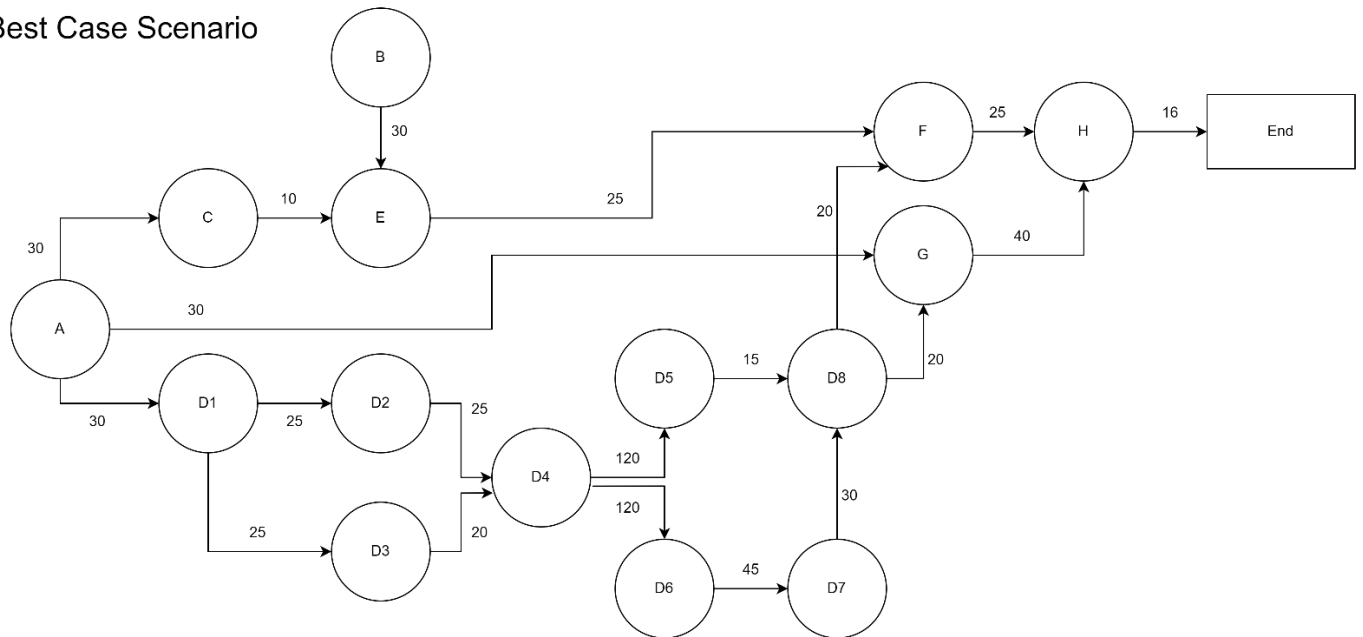
Expected Scenario

Expected Case Scenario



Best-case Scenario

Best Case Scenario



Tasks that do not have any predecessors or whose predecessors have been completed can be done in parallel. From the given task list, tasks A and B can start at the same time as they do not have any predecessors. Tasks C and D1 can be done in parallel as they both depend on task A. Similarly, tasks D2 and D3 can be done in parallel as they both depend on task D1. Tasks D5 and D6 can be also done in parallel since they both depend on task D4.

A linear programming model was specified and implemented for each scenario with the minimum time objective, using the Python PuLP library. This code has been posted to the Github repository for this assignment.

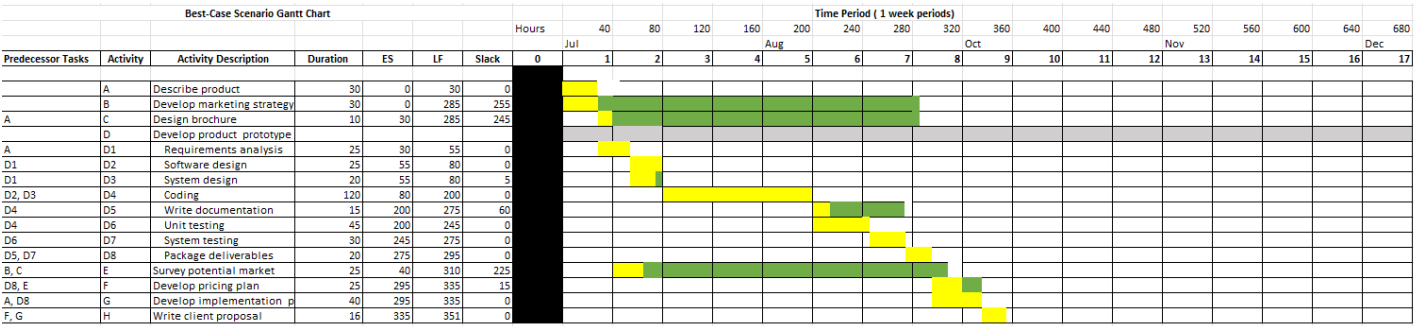
For the best-case scenario, the critical path duration was 351 hours and the minimum cost was \$26,180. For the expected scenario, the critical path duration was 499 hours and the minimum cost was \$38,060. For the worst case scenario, the critical path duration was 832

The figures below show the Gantt charts developed for all three scenarios, where the yellow bars represent the duration of the activity and the green bars represent the amount of slack an activity has, in hours.

Worst Case Scenario Gantt Chart							Time Period (1 week periods)																												
							Hours																												
								40	80	120	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800	840	880	920					
							Jul	1	2	3	4	Aug	5	6	7	8	Oct	9	10	11	12	Nov	13	14	15	16	Dec	17	18	19	20	Jan	21	22	23
Predecessor	Activity	Activity Description	Duration	ES	LF	Slack	0																												
	A	Describe product	60	0	60	0																													
	B	Develop marketing strategy	60	0	60	620																													
A	C	Design brochure	20	60	680	600																													
	D	Develop product prototype																																	
A	D1	Requirements analysis	60	60	120	0																													
D1	D2	Software design	60	120	180	0																													
D1	D3	System design	40	120	160	20																													
D3, D3	D4	Coding	300	180	480	0																													
D4	D5	Write documentation	40	480	680	160																													
D4	D6	Unit testing	100	480	580	0																													
D6	D7	System testing	100	580	680	0																													
D5, D7	D8	Package deliverables	40	680	720	0																													
B, C	E	Survey potential market	60	80	740	600																													
D8, E	F	Develop pricing plan	60	720	800	20																													
A, D8	G	Develop implementation plan	80	720	800	0																													
F, G	H	Write client proposal	32	800	832	0																													

[illegible]

Best-case Scenario



Project Overview

Project Title: Marlborough Restaurant Recommendation System

Client: Restaurants Association, Marlborough

Objective: Develop a consumer-focused recommendation system for target set of restaurants, using Yelp reviews as the primary data source.

Main Deliverable: A user-friendly recommendation system that provides personalized restaurant recommendations based on Yelp reviews.

Key Features:

- Personalized recommendations for customers
- Integration with Yelp API for real-time data updates
- Intelligent machine learning based recommendation generation
- Friendly user interface for browsing and selecting restaurants
- Monthly update for the list of restaurants and daily update for Yelp reviews

Project Timeline: 4-5 months

Cost Estimate: \$75,000

Project Phases:

1. **Planning (2 weeks):** Gather requirements, define scope, and create a detailed project plan.
2. **Development (8-10 weeks):** Build the recommendation system, integrate with Yelp API, and implement machine learning algorithms.
3. **Testing (2-3 weeks):** Conduct thorough testing to ensure the system is accurate, reliable, and user-friendly.
4. **Deployment (2. Weeks):** Deploy the system to a production environment and provide training and support to restaurant owners.

Key Benefits:

- Increased customer satisfaction through personalized recommendations
- Improved business performance for restaurants
- Access to real-time data for informed decision-making

Payment Terms:

- 20% on acceptance of proposal

- 20% on sign off of requirements and design
- 30% on signoff of acceptance testing
- 30% on implementation

The Marlborough Restaurant Recommendation System will act as significant business development channel for restaurant owners in Marlborough attract and help develop and retain customers.

We will charge \$75,000 for the project. This gives a margin of 100% in the expected case and in the worst-case scenario the margin drops to 25% but we still make some money.

Also, we will deliver the project in 4-5 months. If we added additional independent contractors we can shave 4-6 weeks across system analysis, design, coding and unit testing phases leading to the reduction in delivery time of the overall project by 4-6 weeks.