

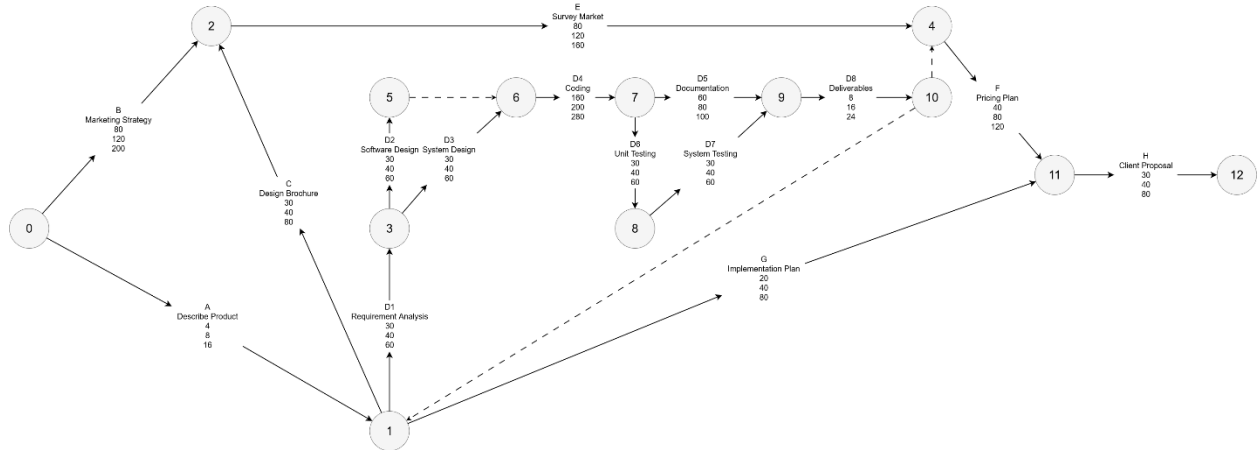
Part 1.

This is a proposal for the development and eventual rolling out of a restaurant recommendation system for the city of Marlborough, Massachusetts. A very high-level overview of the project has been proposed in which the front-end development will be accomplished through Tailwind CSS and Alpine.js, with the back-end using GraphQL API and Go web and database server. Python will be used for the analytics, due to the wide-array of analytics packages available. PostgreSQL will provide persistent data storage and Google Cloud Platform will host the service to allow for easy accessibility through web browsers.

Included below is an expected project development timeline, of an expected 13 week-long development cycle, along with required roles for software development and implementation. I will be acting as Project Manager, as well as fulfilling Data Scientist duties for wider ranging product rollout topics, including market analysis and implementation. All working hour costs have been estimated for expected, best, and worst case scenarios, from previous product development data. Worst-case scenario is not expected, as this is a relatively “by-the-books” product development, but is included to make up for any unforeseen changes in expected project costs.

taskID	task	predecessorTaskIDs	bestCaseHours	expectedHours	worstCaseHours	projectManager/dataScientist	frontEndDeveloper	backEndDeveloper	databaseAdministrator	dataEngineer	
A	Describe product		4	8	16	1					
B	Develop marketing strategy		80	120	200	1					
C	Design brochure	A	30	40	80	1					
D	Develop product prototype		378	496	704						
D1	Requirements analysis	A	30	40	60	1				1	
D2	Software design	D1	30	40	60		1	1	1		
D3	System design	D1	30	40	60				1	1	
D4	Coding	D2, D3	160	200	280		2	2		1	
D5	Write documentation	D4	60	80	100				1		
D6	Unit testing	D4	30	40	60					1	
D7	System testing	D6	30	40	60				1	1	
D8	Package deliverables	D5, D7	8	16	24	1					
E	Survey potential market	B, C	80	120	160	1					
F	Develop pricing plan	D8, E	40	80	120	1					
G	Develop implementation plan	A, D8	20	40	80	1					
H	Write client proposal	F, G	30	40	80	1					
Totals			1040	1440	2144	20930	19250	17500	7500	18200	83380
						32760	24200	22000	10000	23400	112360
						53300	34100	31000	14000	33800	166200

A graph diagram is supplied to illustrate the scheduling network for the various milestones set for project development.



Part 2.

We introduce variables of the form t_i as start time representations for each node in the network graph, with i being the number of the node 0 to 11, with the finish node, node 12, represented as t_{12} . Our goal is then to minimize t_{12} with regards to constraints following the form for each arc:

$$-t_{starting\ node} + t_{ending\ node} \geq duration\ of\ task$$

With dummy tasks, represented by dashed arcs, having a duration of 0. Resulting in a total of 18 constraints. The objective function for our model is:

$$t_{12} = \sum cost * task\ duration$$

But as we are simplifying by assuming that cost is the same hourly rate for each contributor, we will be minimizing t_{12} with the objective function of:

$$t_{12} = \sum task\ duration$$

Part 3.

Code for this portion of the assignment is supplied in Github

https://github.com/jjakubonis/Jakubonis_MSDS_460_Assignment_2.git

Part 4.

All three scenarios were solved for using PuLP and following are solutions for the minimum-time objective and their respective critical paths in each scenario. These solutions were formed under the assumption that there are no resource constraints and all costs per contributor were set to be the same. This creates a simple critical path for us to follow (highlighted in orange for each subsequent Gantt Chart).

Critical Path time for best scenario:

H ends at 362.0 hours in duration

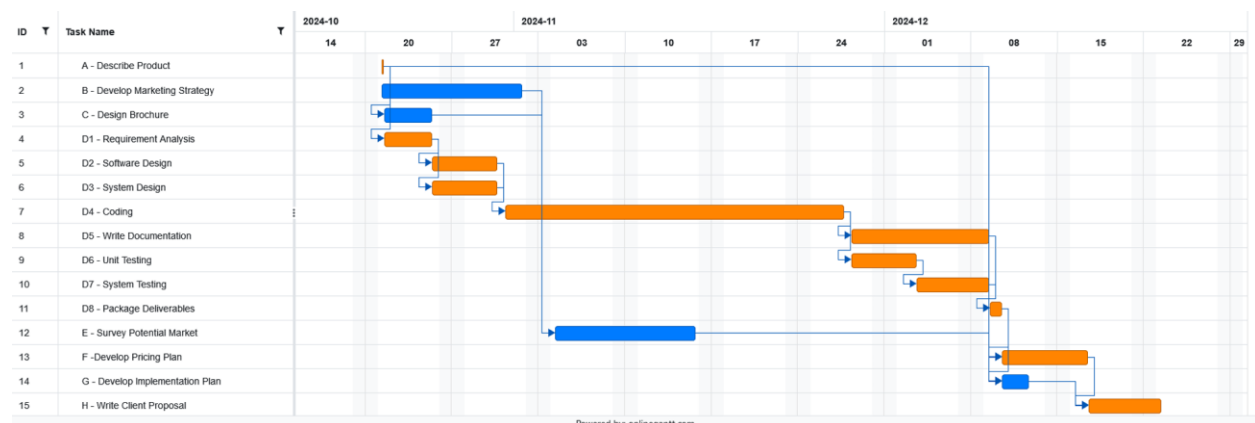
Critical Path(s):

A-D1-D2-D4-D5-D8-F-H

A-D1-D2-D4-D6-D7-D8-F-H

A-D1-D3-D4-D5-D8-F-H

A-D1-D3-D4-D6-D7-D8-F-H



Critical Path time for expected scenario:

H ends at 504.0 hours in duration

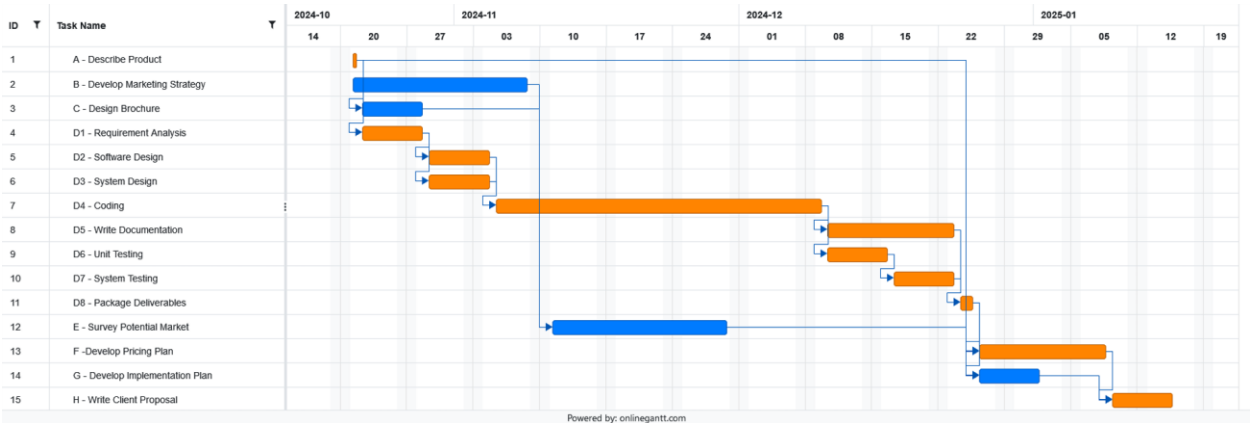
Critical Path(s):

A-D1-D2-D4-D5-D8-F-H

A-D1-D2-D4-D6-D7-D8-F-H

A-D1-D3-D4-D5-D8-F-H

A-D1-D3-D4-D6-D7-D8-F-H



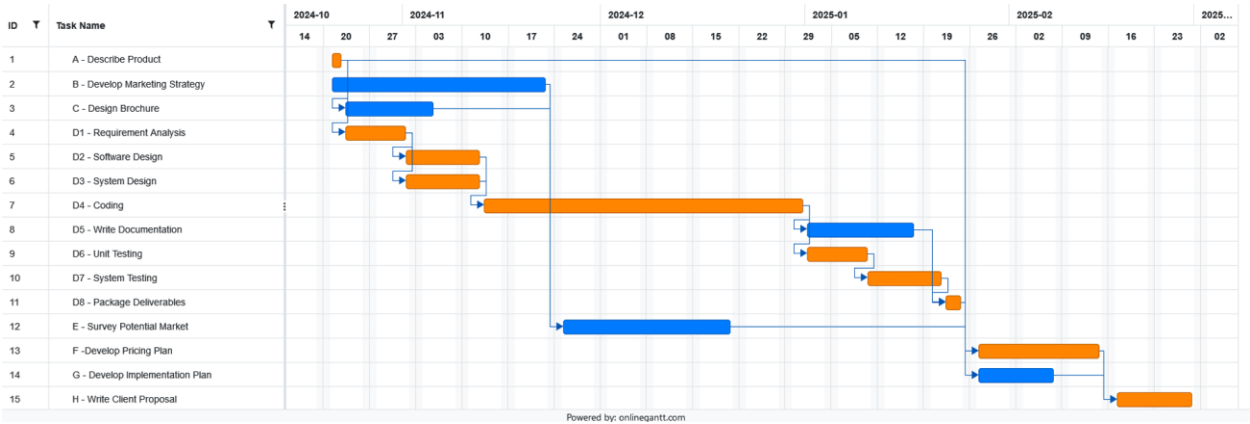
Critical Path time for worst scenario:

H ends at 760.0 hours in duration

Critical Path(s):

A-D1-D2-D4-D6-D7-D8-F-H

A-D1-D3-D4-D6-D7-D8-F-H



Part 5.

Under expected conditions of project workflow, it is determined that a product prototype can be delivered within a 13 week period at a cost of about \$115,000. The cost only involves costs associated with product development and not licensing, maintenance, or marketing costs. All functionalities for the system would include web browser-based restaurant recommendations in Marlborough, Massachusetts gathered through Yelp data aggregation. While addition of extra resources in the form of contractors may proportionally impact the lowering of the minimum time completion for the project, there are limits to these benefits, best represented through the best-case scenario, which would be a development cycle of approximately 9 weeks.