Milestone 1: Understanding the problems

GitHub Repository Link: https://github.com/Angellsh/COP4533-Group-13.git

Team members:

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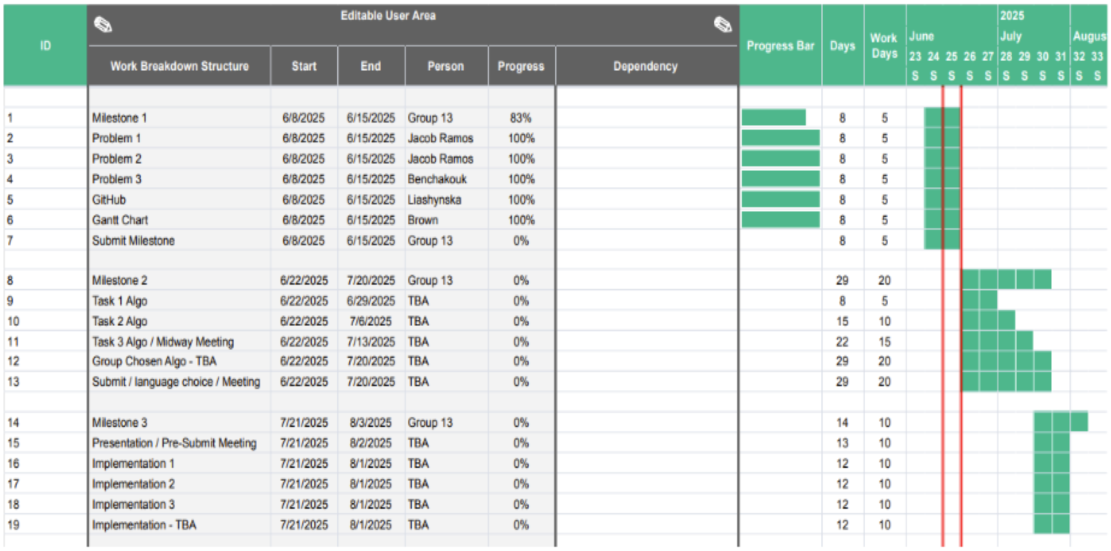
Member Roles:

- **Jacob Ramos**: Problem 1 & 2 completed both tasks (100% progress)
- **Loubna Benchakouk**: Problem 3 completed (100% progress)
- **Anhelina Liashynska**: GitHub setup
- **Dani Brown**: Gantt Chart
- Roles for upcoming milestones will be assigned later

Communication methods: We use Discord for regular communication and Google Docs for document collaboration.

Project Gantt Chart:



ID	Editable User Area						Progress Bar	Days	Work Days	June					2025 July				Augus	
	Work Breakdown Structure	Start	End	Person	Progress	Dependency				23	24	25	26	27	28	29	30	31	32	33
										S	S	S	S	S	S	S	S	S	S	S
1	Milestone 1	6/8/2025	6/15/2025	Group 13	83%		🟩	8	5		🟩	🟩								
2	Problem 1	6/8/2025	6/15/2025	Jacob Ramos	100%		🟩	8	5		🟩	🟩								
3	Problem 2	6/8/2025	6/15/2025	Jacob Ramos	100%		🟩	8	5		🟩	🟩								
4	Problem 3	6/8/2025	6/15/2025	Benchakouk	100%		🟩	8	5		🟩	🟩								
5	GitHub	6/8/2025	6/15/2025	Liashynska	100%		🟩	8	5		🟩	🟩								
6	Gantt Chart	6/8/2025	6/15/2025	Brown	100%		🟩	8	5		🟩	🟩								
7	Submit Milestone	6/8/2025	6/15/2025	Group 13	0%			8	5		🟩	🟩								
8	Milestone 2	6/22/2025	7/20/2025	Group 13	0%			29	20				🟩	🟩	🟩	🟩	🟩			
9	Task 1 Algo	6/22/2025	6/29/2025	TBA	0%			8	5				🟩	🟩						
10	Task 2 Algo	6/22/2025	7/6/2025	TBA	0%			15	10				🟩	🟩	🟩					
11	Task 3 Algo / Midway Meeting	6/22/2025	7/13/2025	TBA	0%			22	15				🟩	🟩	🟩	🟩				
12	Group Chosen Algo - TBA	6/22/2025	7/20/2025	TBA	0%			29	20				🟩	🟩	🟩	🟩	🟩			
13	Submit / language choice / Meeting	6/22/2025	7/20/2025	TBA	0%			29	20				🟩	🟩	🟩	🟩	🟩			
14	Milestone 3	7/21/2025	8/3/2025	Group 13	0%			14	10								🟩	🟩	🟩	
15	Presentation / Pre-Submit Meeting	7/21/2025	8/2/2025	TBA	0%			13	10								🟩	🟩		
16	Implementation 1	7/21/2025	8/1/2025	TBA	0%			12	10								🟩	🟩		
17	Implementation 2	7/21/2025	8/1/2025	TBA	0%			12	10								🟩	🟩		
18	Implementation 3	7/21/2025	8/1/2025	TBA	0%			12	10								🟩	🟩		
19	Implementation - TBA	7/21/2025	8/1/2025	TBA	0%			12	10								🟩	🟩		

Problem 1

We are given a matrix of stock prices where each row represents a different stock and each column will represent a different day. We calculate the maximum potential profit for each specific stock using a 1-based index.

Each stock/day combination maximum profit: (1,2,5,15) (2,1,3,9) (3,1,2,2) (4,2,5,7)

Answer: Stock/Day Combination Maximum Profit: (1,2,5,15)

Explanation:

- Stock 1 yields the maximum when bought on the 2nd day and sold on the 5th day for a profit of 15.
- Stock 2 yields the maximum profit when bought on day 1 and sold on day 3 yielding a profit of 9.
- Stock 3 yields the maximum potential profit when bought on day 1 and sold on day 2 yielding a profit of 2.
- Finally, stock 4 yields the maximum potential profit when bought on day 2 and sold on day 5 yielding a profit of 7.

Problem 2

We are given a matrix where each row represents a different stock and each column will represent a different day. We are given an integer k which will represent the maximum number of non-overlapping transactions permitted, in this case k = 3. For each transaction we must buy and sell one stock.

Answer: (4,1,2), (2,2,3), (1,3,5) total profit = 90

Explanation:

1. Stock 4: Buy on the 1st day at price 5, sell on the 2nd day at price 50 for a profit of 45.
2. Stock 2: Buy on the 2nd day at price 20, sell on the 3rd day at price 30 for a profit of 10.
3. Stock 1: Buy on the 3rd day at price 15, sell on the 5th day at price 50 for a profit of 35.
4. Total profit = 45 + 10 + 35 = 90

Problem 3

Problem Statement

We are given a matrix where each row represents a different stock and each column will represent a different day. Additionally, we are given an integer c which will represent a cooldown period where we cannot buy any stock for c days after selling any stock. If a stock is sold on day i, the next stock will not be eligible for purchase until day i + c + 1. For this example, c = 2.

Answer: (3,1,3), (3,6,7) total profit = 4 + 7 = 11

Explanation:

1. First transaction we buy stock 3 on day 1 and sell on day 3 for a profit of 4
2. Since the stock was sold on day 3 we cannot purchase another stock till day 6
3. On day 6, we buy stock 3 again and sell on day 7 for a profit of 7
4. The total profit is 11

Transaction rules:

1. We can only buy before we sell, and only once per transaction.

2. Resting period: after we sell on day j2 we need to wait until (j2+c+1) day to buy.

3. We can perform multiple transactions on any stock while following the cooldown rule.

4. Main objective is to maximize the total profit across all valid transactions.

Input:

We have a matrix A where each:

Row = one stock

Column = one day

A[i][j] = price of stock(i + 1) on day(j + 1)

Matrix A:

Day	1	2	3	4	5	6	7
Stock_1	7	1	5	3	6	8	9
Stock_2	2	4	3	7	9	1	8
Stock_3	5	8	9	1	2	3	10
Stock_4	9	3	4	8	7	4	1
Stock_5	3	1	5	8	9	6	4

Cooldown period: c = 2

To solve this problem we need to find all profitable transactions for each stock(row in the matrix)

1. Choose a buy day and then try all sell days that come after that buy day
2. For each(buy, sell) day, check if the price on the sell day is higher than the price on the buy day.
3. Keep just the profitable pairs(i, j, l)

Step 1: Identify All Possible Profitable Transactions

For each stock, we need to check all (buy, sell) pairs where buyDay < sellDay and profit > 0:

Stock 1: [7, 1, 5, 3, 6, 8, 9]

BuyDay	SellDay	BuyPrice	SellPrice	Profit	NextBuy	ValidTransaction
1	2	7	1	-6		
	3	7	5	-2		
	4	7	3	-4		
	5	7	6	-1		
	6	7	8	1	Day9(6+2+1)	No
	7	7	9	2	Day10(7+2+1)	No
2	3	1	5	4	Day6(3+2+1)	(6,7)
	4	1	3	2	Day7(4+2+1)	(7,7)
	5	1	6	5	Day8(5+2+1)	No
	6	1	8	7	Day9(6+2+1)	No
	7	1	9	8	Day10(7+2+1)	No
3	4	5	3	-2		
	5	5	6	1	Day8(5+2+1)	No
	6	5	8	3	Day9	No
	7	5	9	4	Day10	No
4	5	3	6	3	Day8	No
	6	3	8	5	Day9	No
	7	3	9	6	Day10	No
5	6	6	8	2	Day9	No
	7	6	9	3	Day10	No
6	7	8	9	1	Day10	No

From the table we see that the best combination for Stock 1: (2,7) with profit = 8

Stock 2: [2, 4, 3, 7, 9, 1, 8]

BuyDay	SellDay	BuyPrice	SellPrice	Profit	NextBuy	ValidTransaction
1	2	2	4	2	Day5(2+2+1)	(5, 6); (5, 7); (6, 7)
	3		3	1	Day6	(6, 7)
	4		7	5	Day7	(7, 7)
	5		9	7	Day8	No
	6		1	-1		
	7		8	6	Day10	No
2	3	4	3	-1		
	4		7	3	Day7	(7, 7)
	5		9	5	Day8	No
	6		1	-3		
	7		8	4	Day10	No
3	4	3	7	4	Day7	(7, 7)
	5		9	6	Day8	No
	6		1	-2		
	7		8	5	Day10	No
4	5	7	9	2	Day8	No
	6		1	-6		
	7		8	1	Day10	No
5	6	9	1	-8		
	7		8	-1		
6	7	1	8	7	Day9	No

Best single transaction for Stock 2: (1,5) with profit = 7

Stock 3: [5, 8, 9, 1, 2, 3, 10]

BuyDay	SellDay	BuyPrice	SellPrice	Profit	NextBuy	ValidTransaction
1	2	5	8	3	Day5	(5, 6); (5, 7); (6, 7)
	3		9	4	Day6	(6, 7)
	4		1	-4		
	5		2	-3		
	6		3	-2		
	7		10	5	Day10	No
2	3	8	9	1	Day6	(6, 7)
	4		1	-7		
	5		2	-6		
	6		3	-5		
	7		10	2	Day10	No
3	4	9	1	-8		
	5		2	-7		
	6		3	-6		

	7		10	1	Day10	No
4	5	1	2	1	Day8	No
	6		3	2	Day9	No
	7		10	9	Day10	No
5	6	2	3	1	Day9	No
	7		10	8	Day10	No
6	7	3	10	7	Day10	No

Best single transaction for Stock 3: (4,7) with profit = 9

Stock 4: [9, 3, 4, 8, 7, 4, 1]

BuyDay	SellDay	BuyPrice	SellPrice	Profit	NextBuy	ValidTransaction
1	2	9	3	-6		
	3		4	-5		
	4		8	-1		
	5		7	-2		
	6		4	-5		
	7		1	-8		
2	3	3	4	1	Day6(3+2+1)	(6, 7)
	4		8	5	Day7	(7, 7)
	5		7	4	Day8	No
	6		4	1	Day9	No
	7		1	-2		
3	4	4	8	4	Day7	(7, 7)
	5		7	3	Day8	No
	6		4	0	Day9	No
	7		1	-3		
4	5	8	7	-1		
	6		4	-4		
	7		1	-7		
5	6	7	4	-3		
	7		1	-6		
6	7	4	1	-3		

Best single transaction for Stock 4: (2,4) with profit = 5

Stock 5: [3, 1, 5, 8, 9, 6, 4]

BuyDay	SellDay	BuyPrice	SellPrice	Profit	NextBuy	ValidTransaction
1	2	3	1	-2		
	3		5	2	Day6(3+2+1)	(6, 7)
	4		8	5	Day7	(7, 7)
	5		9	6	Day8	No
	6		6	3	Day9	No
	7		4	1	Day10	No
2	3	1	5	4	Day6	(6, 7)
	4		8	7	Day7	(7, 7)
	5		9	8	Day8	No
	6		6	5	Day9	No
	7		4	3	Day10	No
3	4	5	8	3	Day7	(7, 7)
	5		9	4	Day8	No
	6		6	1	Day9	No
	7		4	-1		
4	5	8	9	1	Day8	No
	6		6	-2		
	7		4	-4		
5	6	9	6	-3		
	7		4	-5		
6	7	6	4	-2		

Best single transaction for Stock 5: (2,5) with profit = 8

Since we know the best individual transactions per stock. Now we check if we can combine some of them to build a valid sequence.

Starting with stock 1, the best transaction is: buy on day 2, sell on day 7 with profit = 8. After applying the cooldown rule the next valid buy day is day 10 but our max day is 7. Therefore, we can’t combine it with any other transaction

⇨ Sequence (1, 2, 7) with total profit = 8

Stock 2: The best transaction is to buy on day 1 and sell on day 5 with profit = 7 and since the next buy day is day 8 we can’t make an extra transaction.

⇨ Sequence (2, 1, 5) with total profit = 7

but we have another transaction with a smaller profit of 2 if we buy on day 1 and sell on day 2, after the resting period we can buy stock 3 on day 5, sell on day 7 with profit =8

⇨ Sequence (2, 1, 2), (3, 5, 7) with total profit = 10

Stock 3 we found that the best transaction is to buy on day 4, sell on day 7 with profit = 9 and since we need to wait for day10 (invalid) to make another transaction

⇨ Sequence (3, 4, 7) with total profit = 9

But if we buy on day 1 and sell on day 3 with profit = 4, we can combine it with Stock 2 on day 6 after the cooldown period, we buy on day 6 and sell on day 7 with profit = 7

⇨ Sequence (3, 1, 3), (2, 6, 7) with total profit = 11

Stock 4, we have the best profit = 5 if we buy on day 2 and sell on day 4, since the next valid buy day is day 7 and there is no available transaction starting day 7

⇨ Sequence (4, 2, 4) with total profit = 5

For Stock 5 the best transaction is when we buy on day 2 and sell on day 5 with profit = 8, after applying the cooldown rule, we don't get a valid day

⇨ Sequence (5, 2, 5) with total profit = 8

From the above, the maximum profit = 11 from the sequence (3, 1, 4), (2, 6, 7)

⇨ To achieve the maximum profit, buy 3rd stock on day 1, sell it on day 3. buy 2nd stock on day 6 and sell it on day 7 adhering to 2 days waiting period