Best Time to Buy and Sell Stock IV

#188

Problem

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Given an array of prices and a max number of transactions you can execute, what is the max profit you can make?

- Transaction: 1 buy and 1 sell back to back (eg, buy on day 2 and sell on day 3)
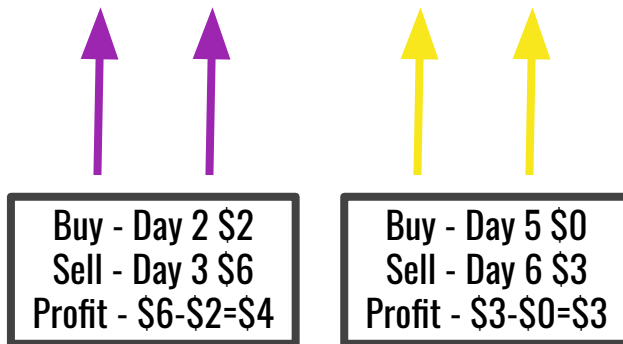- You cannot hold more than 1 stock at a time (ie, you cannot execute more than 1 buy without a sell)

Example 1

# Transactions	2

Prices	3	2	6	5	0	3

Example 1: Solution

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# Transactions	2

Prices	3	2	6	5	0	3

Total Profit - $4+$3=$7

Buy - Day 2 $2
Sell - Day 3 $6
Profit - $6-$2=$4

Buy - Day 5 $0
Sell - Day 6 $3
Profit - $3-$0=$3

How can you have stocks?

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1. You had stocks yesterday and you don't sell today
2. You didn't have stocks yesterday and you buy today

How can you not stocks?

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1. You didn't have stocks yesterday and today you still don't have stocks
2. You had stocks yesterday and you sell today

Example 1: Algorithm

# Transactions	2

Prices	3	2	6	5	0	3

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Transaction 0						
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Not Holding Profit

Holding Profit

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Not Holding Profit

Not holding stocks means you didn't buy anything on the first day which means you have the same profit you started with: $0

Holding Profit

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End of day can result in:
1. **Holding stocks**
2. Not holding stocks

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Transaction 1						
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HOLDING (CAN SELL)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
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Holding stocks means you bought stocks that day which means you end up with a profit of the cost of the stocks

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-$3

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End of day can result in:
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Not Holding Profit

You can not hold stock by taking the value of the last day's "not holding"

Holding Profit

Example 1: Algorithm

| Prices | 3 | 2 | 6 | 5 | 0 | 3 |

End of day can result in:
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<u>Not Holding Profit</u>
-$3 + $2 = -$1

You can also not hold stock by selling the last day's "holding"

<u>Holding Profit</u>

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Not Holding Profit

If we don't have data for the previous day when selling, we still don't have data today

Holding Profit

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If we are buying today, we can't have a 0 transaction

Holding Profit

Example 1: Algorithm

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Prices	3	2	6	5	0	3

End of day can result in:
1. <u>Holding stocks</u>
2. Not holding stocks

NOT HOLDING (CAN BUY)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Transaction 0	0	0				
Transaction 1		-1				
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<u>Not Holding Profit</u>

If we are buying today, we can't have a 0 transaction

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Not Holding Profit

We can hold stocks by not selling the stocks we had yesterday

Holding Profit

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End of day can result in:
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2. Not holding stocks

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We can also hold stocks by buying today

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End of day can result in:
1. <u>Holding stocks</u>
2. Not holding stocks

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Transaction 0						
Transaction 1	-3	-3				
Transaction 2		-2				

<u>Not Holding Profit</u>

We can also hold stocks by buying today

<u>Holding Profit</u>
-$2

Algorithm

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1. Create a profits array that hold
   a. Day
   b. # Transactions used
   c. Yes/No stocks are currently held
2. Set the first day's possible profits
3. For each day
   a. For each transaction number
      i. Set the "Not Holding" as the max between
         1. You didn't have anything yesterday and didn't buy today
         2. You did have something yesterday and sold today
      ii. Set the "Holding" as the max between
         1. You had something yesterday and didn't sell today
         2. You didn't have something yesterday (prior transaction) and bought today
4. The max profit is the max profit from the last day for any number of transactions