Dynamic Programming and Greedy Approach

Scenario:

Part-1

Assume that you are the owner of a car company. Your company has enough employees to produce **'p'** cars for each month. However, the number of the demand for the cars differs from month to month. You should design a sales plan for the next ***'x'*** months. Consider ***'i'*** is the index of each month (*i=1,…,x)* and m_i is the demand for i^{th} month. If your company needs to produce more than ***'p'*** cars for a month, you can hire some interns, paying ***'d'*** TL per car for that month. Moreover, if your company keeps any unsold car at the end the month, you should pay a **'garage cost'.** The garage cost will be calculated by the function *G(j)*, where,

$G(j) < G(j+1)\ ,\ j > 0$

$G(j) > 0$

To understand the problem: Your current employees can produce p=5 cars in a month, for the three month (x=3), m[ ] = { 7, 3, 6 } and G(1) = 5, G(2)= 7, G(3)=10, G(4)=12, G(5)=13, etc... and d=5 TL.

For the first month, your employees can produce 5 cars, however, the demand is 7. You can hire interns with the cost of *d*(7-5)* TL.

For the second month, the demand is 3, will you produce 5 and keep 2 cars in the garage for the next months for not paying intern costs? Or will you just produce 3 cars?

Part-2

Besides, you must invest the payment that earned from your sales. Cost of each car is **'B'** TL and you get half of the price at the beginning of the month and the rest will be taken at the end of the month. You have offers from **'c'** different investment companies. Each investment company offers different rate for each month. At the end of each month, you can change your investment company by paying a taxes at a rate **'t'** of your invested money or continue with the same investment company without paying any taxes.

To understand the problem: Consider *B=100* TL, *c=3* -> C_1 ={ 10, 8, 6 }, C_2 ={ 8, 10, 6 }, C_3 ={ 6, 8, 10 } and *t* is 2%.

For the first month, the demand was 7, so half of it is 7*100/2 = 350 TL. Your company can invest 350 TL at the begining of 1st month. For only one month, C_1 seems as the best option. 10% of 350 = 35 TL, at the end of the month, it will be 385 TL in total. Should you change C_1 with C_2 or C_3 ?

Hint: Income at the end of 1st month = the second half of 1st month (350 TL) + the first half of 2nd month (3*100/2=150 TL) = 350 + 150 = 400 TL.

If you change the investment company you must pay 2% of 385, then add 400 on your money for the second month. If you don't change the company 385+400 will be invested in the same invesment company.

There is a design of a dynamic programming approach that **minimizes** the production costs and **maximizes** the profit from invesments at the end of the ***'x'*** months. In order to evaluate the dynamic programming method, you are also expected to develop a greedy approach for these plans.

Some variables are given in ***'month_demand.txt'*** , ***'garage_cost.txt'*** and ***'invesment.txt'*** files.

The rest of variables (***'x', 'p', 'd', 'B', 'c'*** and ***'t'***) will be default at the beginning of the code as shown in table-1.

*The program prints the difference between "total **profit** from invesments" (Part-2) and "the **cost** comes from interns and garage costs" (Part-1) at the end of x^{th} months.*