LA REPORT

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1 PROBLEM1

BONUS QUESTION: If it is not possible to prepare the potion (i.e. no possible solution) because of limitation in ingredient quantity, can you tell the maximum amount of potion that can be prepared out of the given ingredients?

Solution:

Because of lack of ingredients if it is not possible to prepare the required amount of potion, then the maximum amount of potion we can prepare is by using all ingredient from the inventory that is if we use all the available ingredients i.e. maxpotion=Am.

2 PROBLEM2

2.1 SECOND PART

You will have to report the time taken for the process to complete. Compare it with the standard library API available in Python and mention the difference. Can you find a way to improve the effieciency of your algorithm in terms of time taken?

Solution:

1. On one instance:
My code:0.0150001049042, Numpy Code: 0.0019998550415
2. On second instance:
My code:0.0159997940063, Numpy Code: 0.00499987602234
3. On third instance:
My code:0.00399994850159, Numpy Code: 0.00300002098083
4. On forth instance:
My code:0.00399994850159, Numpy Code: 0.00398994850159
5. On fifth instance:
My code:0.0160000324249, Numpy Code: 0.00499994850159
6. On sixth instance:
My code:0.00699996948242, Numpy Code: 0.00399978256226

We can compute inverse efficiently by QR decomposition also.

$$\text{A=QR} \implies A^{-1} = R^{-1}Q^T$$

2.2 THIRD PART

Consider you are given the same three operations, but this time instead of row operations you are allowed to do column operations. Can you find an inverse? Explain why or why not.

Solution:

Yes, we still can find the inverse if we use the column operations instead of the row operations. Let A be the given matrix and $E_1, E_2, ..., E_n$be the elementary column operation matrices used to convert A to I.

Therefore,

$$\begin{gathered}\text{A}E_1, E_2, ..., E_n\text{=I} \\ A^{-1}\text{A}E_1, E_2, ..., E_n\text{=}A^{-1}\text{I} \\ E_1, E_2, ..., E_n\text{=}A^{-1}\end{gathered}$$

2.3 BONUS QUESTION

Say you have only two out of the three operations at your disposal. Given a matrix, is it possible to get identity matrix? Also, what can you say about the complexity of the algorithm?

Solution:

We can still get the identity if the removed operation is the **S**WAP operation as we can make **S**WAP operation using the other two operations. Let A,B be the two rows of matrix M and a,b be the original content of thee two rows i.e.

$$\begin{gathered}\text{A=a} \\ \text{B=b}\end{gathered}$$

Now, we have to swap these two rows.

$$\begin{aligned}&1.A \leftarrow A + B \implies A = a + b \; and \; B = b \\ &2.B \leftarrow B - A \implies A = a + b \; and \; B = -a \\ &3.B \leftarrow -B \implies A = a + b \; and \; B = a \\ &4.A \leftarrow A - B \implies A = b \; and \; B = a\end{aligned}$$

Thus we can duplicate **S**WAP operation using other two operations but with **S**WAP operation we can do that in one step, so its a overhead. So, with only two operations time complexity increases as we have to perform three operations instead of just one operation. So,time taken by this method is more than the time taken by the method in which we have all the three operations.