Python for Data Science
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Lecture - 16
Linear algebra Part-2

Welcome to the lecture. In this lecture, we are going to see the applications of systems of equations.

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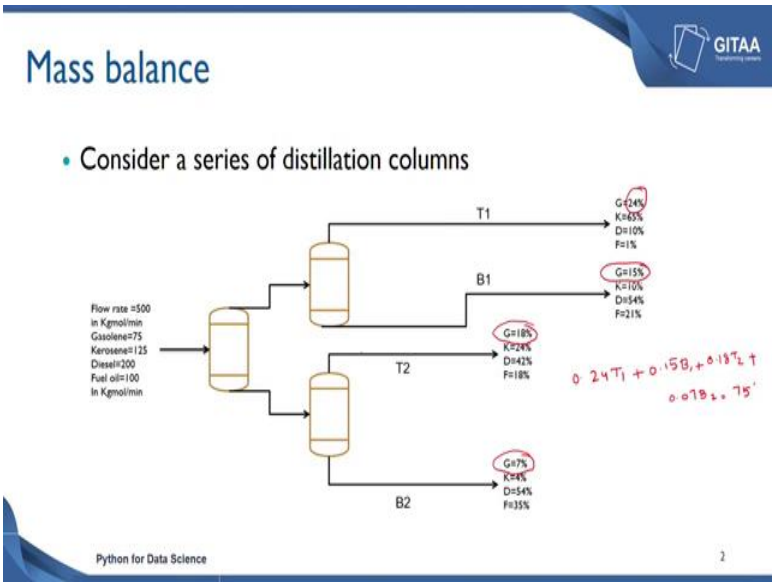

Let us take a mass balance problem. We will consider the series of distillation column. So, let us say so, I have a distillation tower in which we have gasoline, kerosene, diesel, fuel, oil. These are basically the input flow rates, which are passing through the distillation tower. So, they represented in kgmol/min. So, when you look at T1 So, T1, T2 are basically the top products B1 and B2 are the bottom products. So, the output flow rates they are given in percentage. So, G for basically for gasoline, K for kerosene, D for diesel and F for fuel oil.

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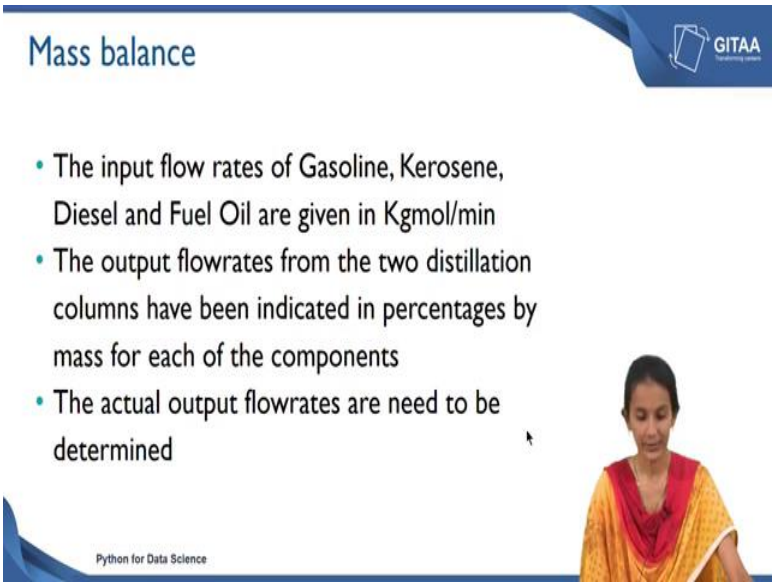

So, our input flow rates are they are given in kgmol/min; and the output flow rates from the two distillation columns are been indicated in percentage by mass for the each of the components. So, each of the components in sense so, we have gasoline, kerosene, diesel and fuel oil. So, the main objective is we have to find out the actual flow rates in kgmol/min. So, let us form a system of equations using this flow rates diagram. So, the first equation will be written in the format of so, for that T1 top product.

So, we have G gasoline, which is 24 percentage and for the bottom product of B1. So, we have G 15 percentage of gasoline. For the top product 2; we have gasoline is a 18 percentage; for the bottom product B2 we have gasoline 7 percentage. So, now, will write the system of equations; so, this will be 0.24 of T1 plus 0.15 of B1 + 0.18 of T2 + 0.07 of B2 which is = 75. So, basically input flow rates must be = the output flow rates. So, this is for the first one similarly we have to do for the kerosene diesel and fuel oil.

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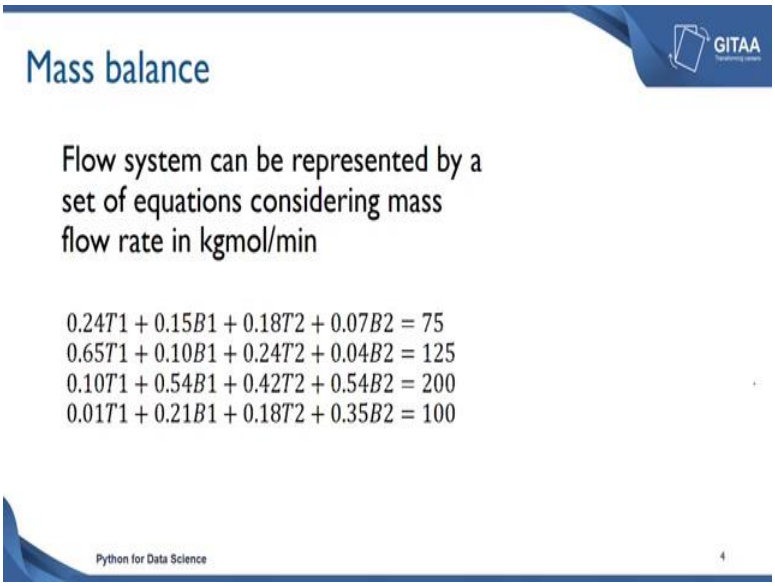

The first equation will be 0.24 T1 + 0.15 B1 + 0.18 T2 + 0.07 B2 = 75. So, second one is 0.65 T1 + 0.10 B1 + 0.24 T2 + 0.04 B2 = 125. Similarly, we have to do for the other ones. So, these are the four sets of equations. Now, we have got the system of equations it has to be written in the format of A x is = B right. So, we need to find out the actual output flow rates in

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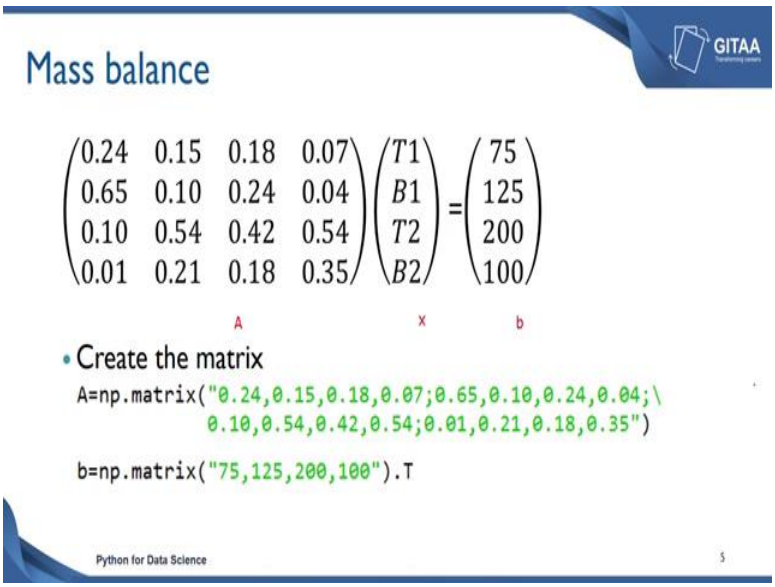

So, now I have written in the matrix formats. So, we have got four equations, SO which means we have to find out the four unknowns. So, first matrix it will be A will be a 4

cross 4 matrix with the values; and x are the unknowns, T1, B1, T2, B2 are the unknowns and b these are the constants. So, using this information now we will create a matrix and we will try to solve this problem. So, we will create a 4 cross 4 matrix you can give the values for the first row.

So, it is 0.24 comma, 0.15 comma, 0.18 comma, 0.07 after the first row you have to separate with semi colon. Similarly you can write the values for the second row third row and fourth row. So, this is our matrix A; similarly we need to create a matrix b. We have four constants, 75, 125, 200 and 100, we wanted in the format of 4 cross 1 which is 4 rows and one columns. So, that is why I use a dot T which is basically for the transpose.

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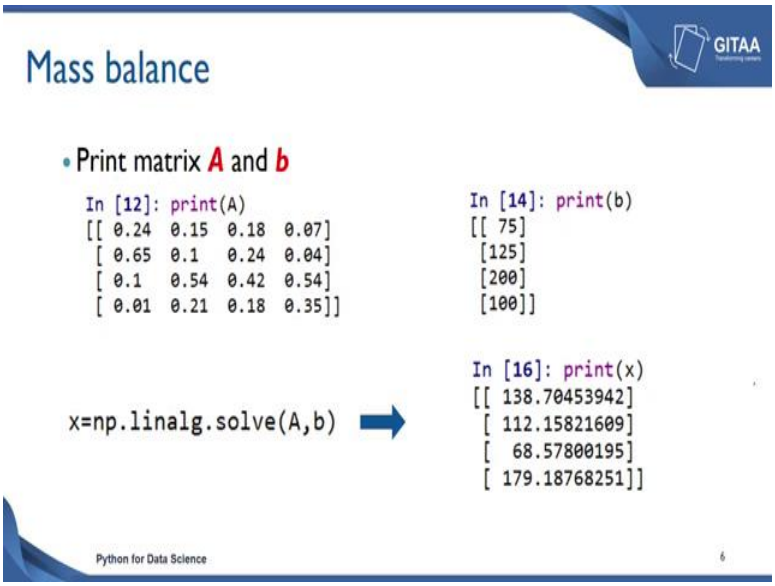

Now, let us print the matrix which we are created. So, this is our A matrix; it is a 4 cross 4 matrix; and b matrix will be a 4 cross 1 matrix let us see, how to solve this? So, the command will be num np dot linalg dot solve. So, before calling the n p we have to import the numpy by package import numpy has np inside the parenthesis we have to pass the matrix which you are created. So, A will be a 4 cross 4 matrix and b will be a 4 cross 1 matrix; and you can store it in the variable x; when we print x.

So, these are the 4 values which we have got. So, first value is 138.70453942 this is for the T1. Similarly we have got the values for the other ones. Now, we have got the actual output flow rates in kgmol/min. Hope this session was very useful to you people.

Thank you.