Computational Systems Biology
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Lecture – 10
Lab: MATLAB Basics

So, in this continuation of the previous lab video, we will look at indexing in MATLAB and why it's a very attractive thing for many engineers to work with MATLAB for solving difficult problems, the kind of indexing the MATLAB allows you to do.

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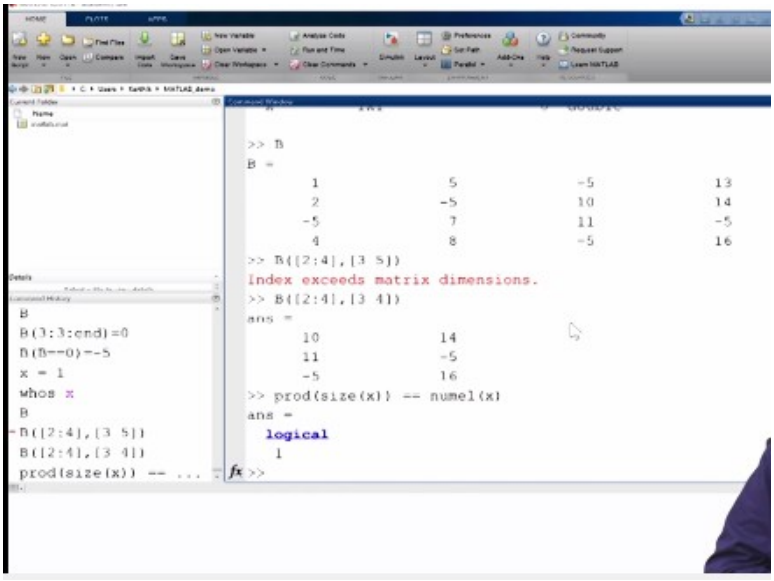

So, the next thing you need to really understand about MATLAB is how do you index something. Let's create a special matrix, this is called the hilbert matrix, let's make a smaller version of it and also say so, this is the hilbert matrix, where

Aij =1/(i+j-1)

This is a useful matrix because if I say, it's a very very small number, the determinant of the matrix becomes vanishingly small.

So, even though this matrix is not singular, you will struggle to invert it, so it's always a classic example that one, classic matrix that somebody looks at when you study linear algebra algorithms but here I am using this as a point to show you indexing. So, now if I say A: what does this give? **"Student conversation"** Full matrix? Sure? So, what is the size of A: ?

size(A:) = 16,1.

So, A: stretches out the matrix, it gives you a column vector of the entire matrix. So, in fact a usual hack that people use is something of this sort, y=(x(:)') this makes sure that you have a row vector at the end of the operation, right? You take x: which will give you a column vector of whatever you have and then you make it into a row vector by transposing it, okay. So, size of A: and yeah, so now can you index only this part of the matrix, can you index the second row?

How do you index the second row?

A(2,:)

So, ':' is like a wild card, ':' means pick all rows, and you also have other nicer things. You can say A(:, 2:end), you can say A(:,2:end-1). You can say A(:,1:end-1), right. And let's once again look at another simple example, now we have

B = zeros(4)

So, I can also say; let just say

B=1:16 and

B=reshape(B,4,4)

So this is now B.

Now, what if you want to set every multiple of, say every 3rd number in the matrix to 0?

B(3:3:end)=0

What if you want to change all the 0s to -5?

B(B==0)=-5

This is something known as logical indexing, this is one of the most powerful concepts in MATLAB, this is something you need to understand if you are going to write nice MATLAB code.

The first rule, zeroth rule of MATLAB programming is everything is a matrix practically, everything that is output in MATLAB is a matrix, right. So, in fact let's say x=1, it is a 1x1 matrix, right? So, everything is a matrix that is the zeroth rule. The first rule, you should not use loops, never use loops as long as, as far as possible. I will show you nice example of couple of

classes down the line, when I will show you incrementally faster codes to compute the Barabasi Albert graph.

There is a graph known as the Barabasi Albert graph which we will cover maybe in the next class and then I will show you how you can incrementally write better codes to make the Barabasi Albert graph and in fact, for a lot of cases, you will see that instead of writing 10 lines of code with loops and all that you will end up using like some 3 operations or 3 lines, so MATLAB can be very expressive, so, MATLAB is a high level programming language and is meant to be very expressive.

So, how do you enter a matrix? You can just use spare brackets and keep entering, you can put either semi colon or column breaks or enter to give line breaks and you can do any kind of sub matrix indexing. So, let's just say B, so I can say B([2:4],[3 4]), so this gets me the second, third and fourth rows and the third and fourth columns, so this part of the matrix, so 10, 14, 11, -5 and -5, 16, right, you can do any kind of sub matrix indexing in MATLAB.

So, prod will basically multiply everything that you give it, size(x) will tell you what are the, what is the dimensions of x and you can basically see if what are the number of elements of x- numel(x) that is the other way to count the number of elements in x.

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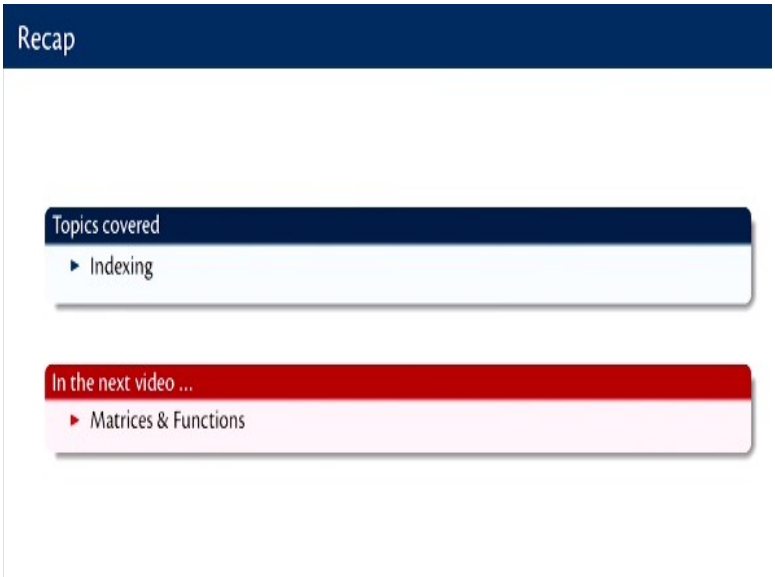

So, in today's video, I hope you had a very nice introduction to how indexing happens in MATLAB which is probably markedly different from how it happens in many other programming languages and in the next video, we will look at what MATLAB is famous for, matrices, special kind of matrices and so on and how do you write functions and so on.