Calculations with Vectors

Created by MathWorks for Structural Dynamics

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$$f(x) = 3x^2 + 2x - 6$$

x		y
-2		2
-1		-5
0	$f(x)$	-6
1		-1
2		10

In many applications we need to perform calculations on entire vectors.

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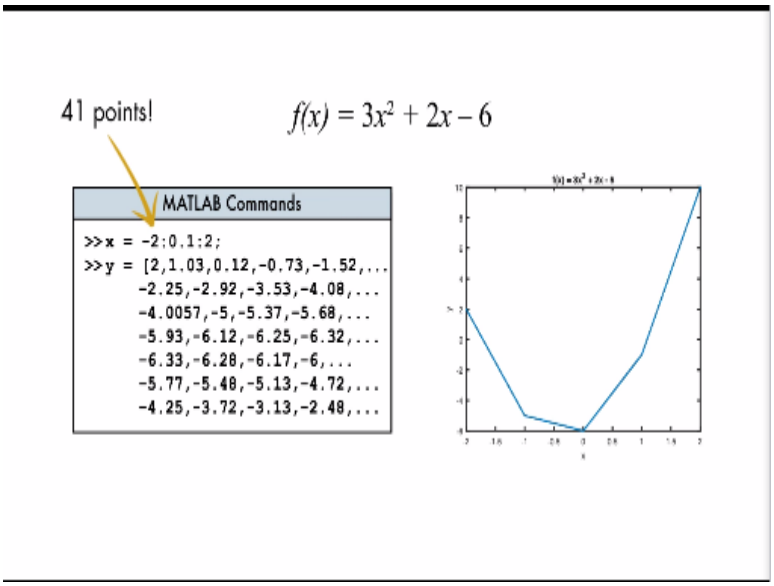

Take for example, plotting an equation here we calculated each value individually so we only did five points resulting in a rough plot, to make a smoother curve we would need to repeat the calculation for many values of x, we can create a large vector of x values using the colon operator. But do we still have to calculate the y values individually.

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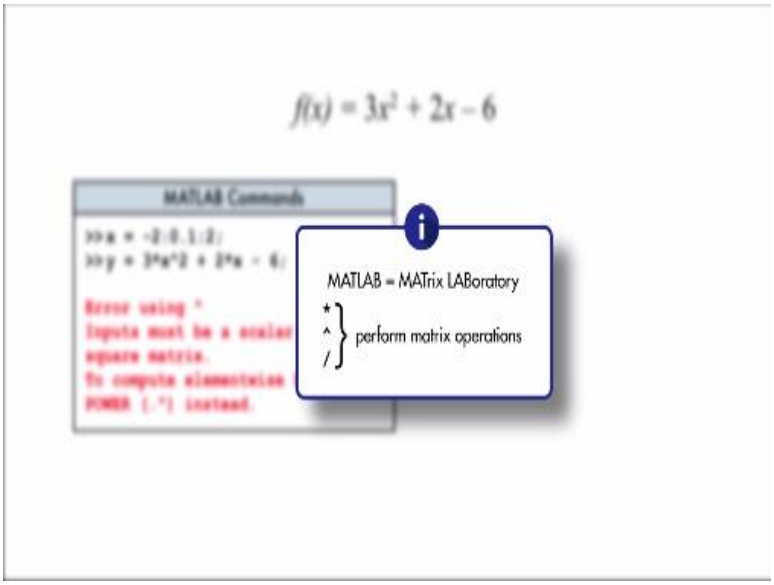

Let us try using the vector X and a calculation the same way we previously used a scalar and see what happens. Oh! What is going on MATLAB is designed to perform operations on matrices in fact MATLAB is short for matrix laboratory, the multiplication, power and division operators are reserved to work with matrices which is not what we want to do here. We need to square each element of X.

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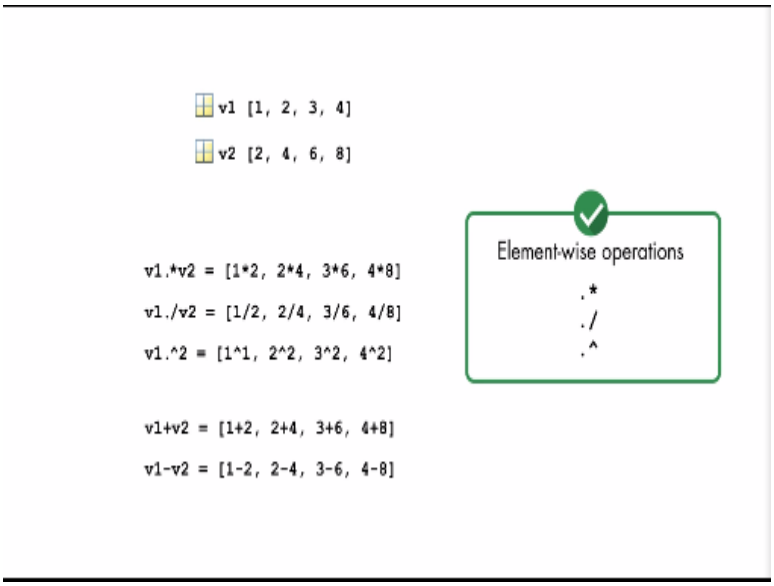

No problem with one small change we can perform element wise operations take these two vectors as an example to multiply the corresponding elements of the vectors v1and v2 we use the element wise multiplication operator .*. Similarly we can do element wise division and exponentiation by adding a dot before the division and power operators.

There are no special operator for element wise addition and subtraction because they are the same for scalars vectors and matrices.

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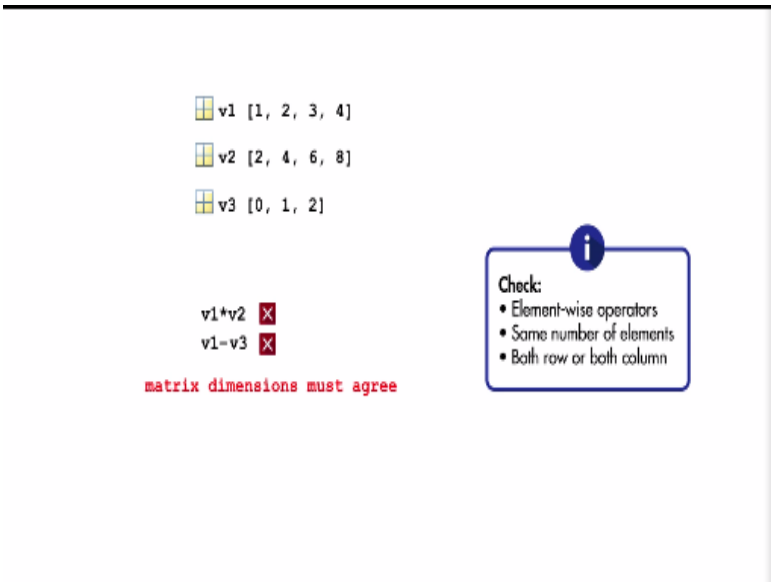

There are a couple of common mistakes to watch out for it is easy to forget the dot when doing element wise operations or to accidentally use vectors of different sizes. When this happens we get an error message about matrix dimensions what do not worry if you are not using matrices but get a matrix dimension error while trying to perform an operation on corresponding elements of two vectors check that you are using the element-wise operators that your vectors have the same number of elements. And that the vectors are both row or both column vectors.

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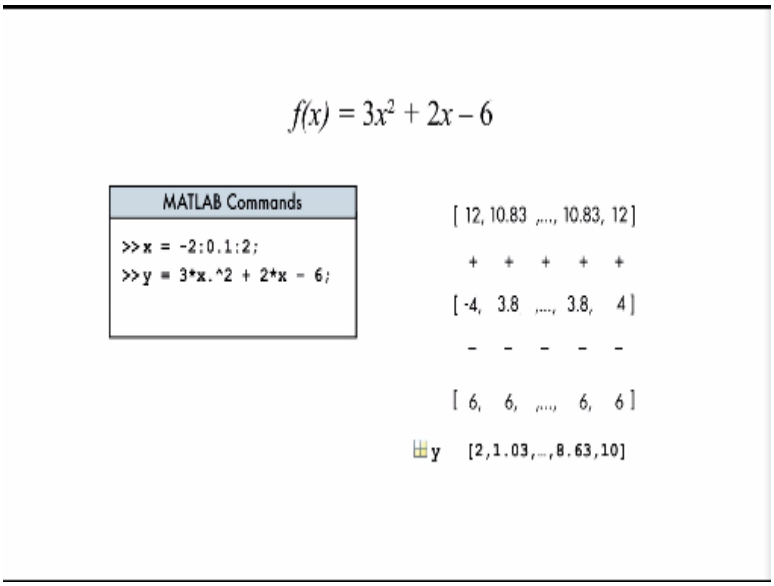

Now back to that function we want a plot, since X is a vector we need to use the element wise power operator to square each element of X. Let us see how this expression is evaluated first each element of X is squared then each element of the two vectors are multiplied by the scalar. Finally when adding or subtracting scalars and vectors, the scalar is automatically expanded to match the size of the vector before performing the addition or subtraction.

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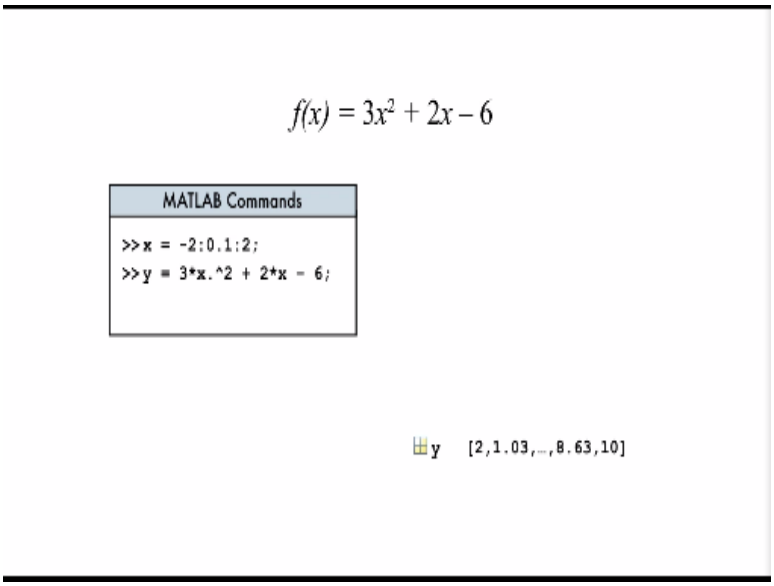

And there you go using element wise operations we created a vector of Y values calculated for each point in X.

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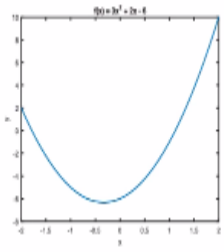
$$f(x) = 3x^2 + 2x - 6$$

MATLAB Commands

```
>>x = -2:0.1:2;
>>y = 3*x.^2 + 2*x - 6;
>>plot(x,y)
```



Now this plot more accurately represents the function try plotting a few equations yourself, use the colon operator to create a vector of closely spaced X values and element wise operators to calculate all the Y values in a single expression.

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