Common Confusion 05
Matrix vs. Element-Wise Multiplication
Matthew Woodring

This issue commonly confuses students for the first couple of weeks, but they usually get the hang of it rather quickly. This distinction is one of the most important things to understand when starting to learn MATLAB.

Imagine that you have two matrices, ‘A’ and ‘B’, as defined below:

‘A = [1, 2; 3, 4]’ and ‘B = [1, 0; -1, 1]’

If you wanted to perform matrix multiplication, like you would in courses such as engineering math or linear algebra, then you would *not* need the dot operator. Performing ‘A’ multiplied by ‘B’ and storing it in ‘C’ would look like:

‘C = A * B’

Remember, this would result in matrix multiplication, *not* element-wise multiplication. The resulting value of ‘C’ would be:

‘C = [-1, 2; -1, 4]’

In this class, we rarely use matrix multiplication. However, it is important to understand because you do need to know why we use the dot operator.

Now, if you had the same matrices ‘A’ and ‘B’ defined above, but wanted to perform element-wise multiplication, then it would look like:

‘C = A .* B’

By using the dot operator, MATLAB now performs element-wise multiplication of ‘A’ and ‘B’ and stores the following result in ‘C’:

‘C = [1, 0; -3, 4]’

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This is because the element stored at the index (1, 1) of ‘A’ is multiplied by the element stored at index (1, 1) of ‘B’ which results in the index (1, 1) of ‘C’ having a value of ‘1’. Then, the same thing happens for each element in ‘A’ and ‘B’ yielding the final result of ‘C’. Essentially, the elements stored at each particular index in ‘A’ are multiplied by the element in the same index of ‘B’ and are stored in the same index of ‘C’.

Element-wise multiplication is more important for this class than matrix multiplication. When in doubt, use element-wise multiplication *unless* you need to use matrix multiplication or know that using it will *not* affect the result. For example, when multiplying anything in MATLAB by a scalar, you do not need to use the dot operator to indicate element-wise multiplication.