# Matrix Multiplication

A. **A Matrix** is a rectangular array of numbers, in other words, numbers in rows and columns.

B. **The Order of a Matrix** is its size. The order is always given as the number of rows by the number of columns ( R x C ).

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$$

3 x 2

rows columns

$$\begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix}$$

2 x 5

C. **For two matrices to be multiplied,** the number of columns of the first must equal the number of rows of the second.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$$

3 x 2

$$\begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix}$$

2 x 5

Since these two numbers are the same, these matrices may be multiplied.

D. **The outside numbers tell the size or the order of the resulting matrix.**

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$$

3 x 2

$$\begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix}$$

2 x 5

The answer will be a 3 x 5 matrix.

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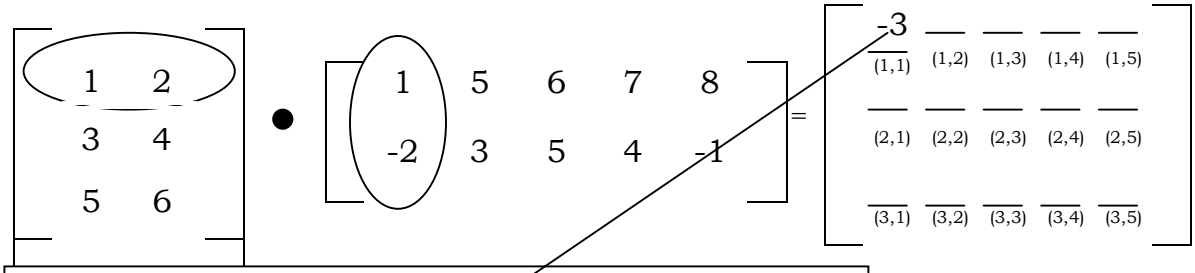
*(Matrix Multiplication, cont.)*

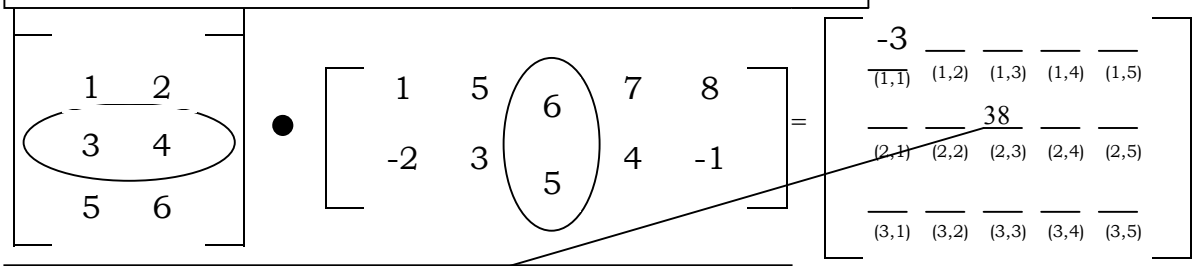
E. **The position of each element** (row and column) in the answer is a clue to how to multiply.




The number needed for this location will be the RESULT of multiplying ROW 1 times COLUMN 1.

The way we multiply is to find the add the products of the corresponding elements, advancing through the elements as we go.

In the (1,1) position will be (1 x 1) + (2 x -2) = -3.




The number needed for this location will be the RESULT of multiplying ROW 2 times COLUMN 3.

In the (2,3) position will be (3 x 6) + (4 x 5) = 38.

**SUMMARY:**

1. In order for two matrices to be multiplied, the number of columns of the first must equal the number of rows of the second (innermost numbers equal).

2. If they can be multiplied, the number of rows of the first matrix by the number of columns of the second matrix (the outermost numbers) will tell us the size or order of the resulting matrix.

3. The positions of the elements in the product, given by the row number and then the column number, will remind us of how to multiply in order to get that element.