

[◀ Back to Week 1](#)[✕ Lessons](#)[Prev](#)[Next](#)

# Matrix-Vector Multiplication

We map the column of the vector onto each row of the matrix, multiplying each element and summing the result.

$$\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix} * \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} a * x + b * y \\ c * x + d * y \\ e * x + f * y \end{bmatrix}$$

The result is a **vector**. The number of **columns** of the matrix must equal the number of **rows** of the vector.

An **m x n matrix** multiplied by an **n x 1 vector** results in an **m x 1 vector**.

Below is an example of a matrix-vector multiplication. Make sure you understand how the multiplication works. Feel free to try different matrix-vector multiplications.

```
1 % Initialize matrix A
2 A = [1, 2, 3; 4, 5, 6; 7, 8, 9]
3
4 % Initialize vector v
5 v = [1; 1; 1]
6
7 % Multiply A * v
8 Av = A * v
9
10
```

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