Week 5 Tutorial 6

The purpose of this tutorial is show the mathematical process of matrix multiplication.

```
% Always clear workspace variables before a new tutorial or program.
clear
clc
```

Edit the code below and update the variable named **name** with your name for this tutorial in the code below.

```
name="";
fprintf("Output for Tutorial_05_6 run by %s.\n", name)
```

Input

For element-wise multiplication, two arrays/matrices must be of the same size or one be a scalar value.

```
% Given matrices
a = [1 2; 3 4; 5 6]
b = [1 3 5 7; 2 4 6 8]
```

Manipulation

Simply perform the built-in matrix multiplication process

```
% Perform the matrix multiplication using asterisk
c= a*b
```

Output

Show the manual process to matrix multiplication

```
% Shows how the overall size of c is related to rows of a and columns of b.
fprintf("Rows of c = %i = Rows of a = %i\n", size(c,1), size(a,1))
fprintf("columns of c = %i = columns of b = %i\n\n", size(c,2), size(b,2))

% This block shows the operations performed to fill matrix c.
% Note that a(1,:)*b(:,1) is matrix multiplication between the first row
% of a and the first column of b. The product has only one row and one column.

% 1st row of a * 1st column of b
fprintf("c(1,1) = a(1,1)*b(1,1) + a(1,2)*b(2,1) = %i*%i + %i*%i = %i\n",...
                a(1,1), b(1,1), a(1,2), b(2,1), a(1,:)*b(:,1))
% 2nd row of a * 1st column of b
fprintf("c(2,1) = a(2,1)*b(1,1) + a(2,2)*b(2,1) = %i*%i + %i*%i = %i\n",...
                a(2,1), b(1,1), a(2,2), b(2,1), a(2,:)*b(:,1))
% 3rd row of a * 1st column of b
fprintf("c(3,1) = a(3,1)*b(1,1) + a(3,2)*b(2,1) = %i*%i + %i*%i = %i\n\n",...
                a(3,1), b(1,1), a(3,2), b(2,1), a(3,:)*b(:,1))
% 1st row of a * 2nd column of b
fprintf("c(1,2) = a(1,1)*b(1,2) + a(1,2)*b(2,2) = %i*%i + %i*%i = %i\n",...
```

```matlab
                    a(1,1), b(1,2), a(1,2), b(2,2), a(1,:)*b(:,2))
% 2nd row of a * 2nd column of b
fprintf("c(2,2) = a(2,1)*b(1,2) + a(2,2)*b(2,2) = %i*%i + %i*%i = %i\n",...
                    a(2,1), b(1,2), a(2,2), b(2,2), a(2,:)*b(:,2))
% 3rd row of a * 2nd column of b
fprintf("c(3,2) = a(3,1)*b(1,2) + a(3,2)*b(2,2) = %i*%i + %i*%i = %i\n\n",...
                    a(3,1), b(1,2), a(3,2), b(2,2), a(3,:)*b(:,2))
% 1st row of a * 3rd column of b
fprintf("c(1,3) = a(1,1)*b(1,3) + a(1,2)*b(2,3) = %i*%i + %i*%i = %i\n",...
                    a(1,1), b(1,3), a(1,2), b(2,3), a(1,:)*b(:,3))
% 2nd row of a * 3rd column of b
fprintf("c(2,3) = a(2,1)*b(1,3) + a(2,2)*b(2,3) = %i*%i + %i*%i = %i\n",...
                    a(2,1), b(1,3), a(2,2), b(2,3), a(2,:)*b(:,3))
% 3rd row of a * 3rd column of b
fprintf("c(3,3) = a(3,1)*b(1,3) + a(3,2)*b(2,3) = %i*%i + %i*%i = %i\n\n",...
                    a(3,1), b(1,3), a(3,2), b(2,3), a(3,:)*b(:,3))
% 1st row of a * 4th column of b
fprintf("c(1,4) = a(1,1)*b(1,4) + a(1,2)*b(2,4) = %i*%i + %i*%i = %i\n",...
                    a(1,1), b(1,4), a(1,2), b(2,4), a(1,:)*b(:,4))
% 2nd row of a * 4th column of b
fprintf("c(2,4) = a(2,1)*b(1,4) + a(2,2)*b(2,4) = %i*%i + %i*%i = %i\n",...
                    a(2,1), b(1,4), a(2,2), b(2,4), a(2,:)*b(:,4))
% 2nd row of a * 4th column of b
fprintf("c(3,4) = a(3,1)*b(1,4) + a(3,2)*b(2,4) = %i*%i + %i*%i = %i\n\n",...
                    a(3,1), b(1,4), a(3,2), b(2,4), a(3,:)*b(:,4))
```

Example output

If you were to run your tutorial (enter **Tutorial_05_06** into the command window) your output should appear as follows.

```
Output for Tutorial_05_6 run by Geoff Berl.
a =
     1     2
     3     4
     5     6
b =
     1     3     5     7
     2     4     6     8
c =
     5    11    17    23
    11    25    39    53
    17    39    61    83
Rows of c = 3 = Rows of a = 3
columns of c = 4 = columns of b = 4

c(1,1) = a(1,1)*b(1,1) + a(1,2)*b(2,1) = 1*1 + 2*2 = 5
c(2,1) = a(2,1)*b(1,1) + a(2,2)*b(2,1) = 3*1 + 4*2 = 11
c(3,1) = a(3,1)*b(1,1) + a(3,2)*b(2,1) = 5*1 + 6*2 = 17

c(1,2) = a(1,1)*b(1,2) + a(1,2)*b(2,2) = 1*3 + 2*4 = 11
c(2,2) = a(2,1)*b(1,2) + a(2,2)*b(2,2) = 3*3 + 4*4 = 25
c(3,2) = a(3,1)*b(1,2) + a(3,2)*b(2,2) = 5*3 + 6*4 = 39

c(1,3) = a(1,1)*b(1,3) + a(1,2)*b(2,3) = 1*5 + 2*6 = 17
c(2,3) = a(2,1)*b(1,3) + a(2,2)*b(2,3) = 3*5 + 4*6 = 39
c(3,3) = a(3,1)*b(1,3) + a(3,2)*b(2,3) = 5*5 + 6*6 = 61

c(1,4) = a(1,1)*b(1,4) + a(1,2)*b(2,4) = 1*7 + 2*8 = 23
c(2,4) = a(2,1)*b(1,4) + a(2,2)*b(2,4) = 3*7 + 4*8 = 53
c(3,4) = a(3,1)*b(1,4) + a(3,2)*b(2,4) = 5*7 + 6*8 = 83
```

Additional Notes:

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