

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

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Q1

Suppose I first execute the following Octave commands:

```
A = [1 2; 3 4; 5 6];
B = [1 2 3; 4 5 6];
```

Which of the following are then valid Octave commands? Check all that apply and assume all options are written in an Octave command. (Hint: A' denotes the transpose of A.)

- ☐ C = A' + B;
- ☒ C = B \* A;
- ☐ C = A + B;
- ☐ C = B' \* A;

Question text

Let  $A = \begin{bmatrix} 16 & 2 & 3 & 13 \\ 5 & 11 & 10 & 8 \\ 9 & 7 & 6 & 12 \\ 4 & 14 & 15 & 1 \end{bmatrix}$ .

Q2

Which of the following indexing expressions gives  $B = \begin{bmatrix} 16 & 2 \\ 5 & 11 \\ 9 & 7 \\ 4 & 14 \end{bmatrix}$ ? Check all that apply.

- ☐ B = A(:, 1:2);
- ☐ B = A(1:4, 1:2);
- ☐ B = A(0:2, 0:4)
- ☐ B = A(1:2, 1:4);

Q3

Let  $A$  be a  $10 \times 10$  matrix and  $x$  be a 10-element vector. Your friend wants to compute the product  $Ax$  and writes the following code:

```
v = zeros(10, 1);
for i = 1:10
    for j = 1:10
        v(i) = v(i) + A(i, j) * x(j);
    end
end
```

How would you vectorize this code to run without any for loops? Check all that apply.

- ☒  $v = A * x;$
- ☐  $v = Ax;$
- ☐  $v = x' * A;$
- ☐  $v = \text{sum}(A * x);$

Q4

Say you have two column vectors  $v$  and  $w$ , each with 7 elements (i.e., they have dimensions  $7 \times 1$ ). Consider the following code:

```
z = 0;
for i = 1:7
    z = z + v(i) * w(i)
end
```

Which of the following vectorizations correctly compute  $z$ ? Check all that apply.

- ☒  $z = \text{sum}(v .* w);$
- ☒  $z = v' * w;$
- ☐  $z = v * w';$
- ☐  $z = v .* w;$

$$v = [1, 2, 3, 4, 5]$$

$$w = [6, 7, 8, 9, 10]$$

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix} \cdot \begin{bmatrix} 6 \\ 7 \\ 8 \\ 9 \\ 10 \end{bmatrix}$$

$1 \times 7 \quad \cdot \quad 7 \times 1$

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

Q5

In Octave, many functions work on single numbers, vectors, and matrices. For example, the `sin` function when applied to a matrix will return a new matrix with the `sin` of each element. But you have to be careful, as certain functions have different behavior. Suppose you have an  $7 \times 7$  matrix  $X$ . You want to compute the log of every element, the square of every element, add 1 to every element, and divide every element by 4. You will store the results in four matrices,  $A, B, C, D$ . One way to do so is the following code:

```
for i = 1:7
  for j = 1:7
    A(i, j) = log(X(i, j));
    B(i, j) = X(i, j) ^ 2;
    C(i, j) = X(i, j) + 1;
    D(i, j) = X(i, j) / 4;
  end
end
```

Which of the following correctly compute  $A, B, C$ , or  $D$ ? Check all that apply.

☐  $C = X + 1;$

☒  $D = X / 4;$

☐  $B = X.^2;$

☐  $B = X^2;$