

Quiz questions for §1, *Matrix terminology and notation*.

True or false?

1. By convention, we consider $[0.1 \ 0.3]$ and $\begin{bmatrix} 0.1 \\ 0.3 \end{bmatrix}$ to be the same.
2. The matrix $\begin{bmatrix} 1 & 2 \\ 0 & 1 \\ -2 & 1 \end{bmatrix}$ has dimensions 2×3 .
3. The matrices $\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ and $\begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 0 \end{bmatrix}$ are equal, since they differ in the last column only, which is zero.
4. The 2, 1 entry of $\begin{bmatrix} 1 & 2 \\ 0 & 1 \\ -2 & 1 \end{bmatrix}$ is 0.
5. The matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is an identity matrix.
6. Suppose we know that $\begin{bmatrix} a \\ b \\ c \end{bmatrix} = e_2$, the second unit vector (or standard basis vector).
Then we can conclude $a = 0$.

Quiz questions for §2, *Matrix operations*.

1. The transpose of the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$ is
 - (a) $\begin{bmatrix} 2 & 1 \\ 4 & 3 \\ 6 & 5 \end{bmatrix}$
 - (b) $\begin{bmatrix} 5 & 6 \\ 3 & 4 \\ 1 & 2 \end{bmatrix}$
 - (c) $\begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}$
 - (d) $\begin{bmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \end{bmatrix}$

- (e) not defined
- (f) none of the above

2. $[1 \ 2 \ 3]^T + \begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}$ is

(a) $\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{bmatrix}$

(b) $\begin{bmatrix} 5 \\ 7 \\ 9 \end{bmatrix}$

(c) $[5 \ 7 \ 9]$

(d) not defined

(e) none of the above

3. If $Q = [1 \ 2 \ 0]$ and $R = \begin{bmatrix} -2 \\ -1 \\ 3 \end{bmatrix}$, then the product RQ is

(a) the scalar (or 1×1 matrix) -2

(b) the matrix $\begin{bmatrix} -2 & -4 & 0 \\ -1 & -2 & 0 \\ 3 & 6 & 0 \end{bmatrix}$

(c) not defined

(d) none of the above

4. If A and B are 3×3 matrices, then $AB \neq BA$.

False. We usually do not have $AB = BA$, but there are cases when we do have $AB = BA$. One example: take $A = B = I$.

5. Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$. Then:

(a) A is singular

(b) $A^{-1} = A^T$

- (c) $A^{-1} = -A$
- (d) $A^{-1} = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix}$
- (e) none of the above

6. Suppose A and B are 5×5 matrices. What is $(A + B)^2 - (A - B)^2$?
- (a) this expression doesn't make sense
- (b) $4AB$
- (c) $2AB + 2BA$
- (d) none of the above

Quiz questions for §3, *Linear equations and matrices*.

1. Which of the following are linear functions? Here $y = f(x)$, where x is a 2-vector, and y is a 2-vector.
- I. $y_1 = (x_1 - x_2)/2, y_2 = (x_1 + x_2)/2$.
- II. $y_1 = 1 - x_1 + x_2, y_2 = x_1$.
- (a) Both I and II.
- (b) I but not II.
- (c) II but not I.
- (d) Neither is linear.
2. Which of the following are linear functions? Here $y = f(x)$, where x is a 3-vector, and y is a 2-vector.
- I. $y_1 = 3x_3 - x_2, y_2 = x_2 + 2x_3 - x_1^2$.
- II. $y_1 = x_2, y_2 = 0$.
- (a) Both I and II.
- (b) I but not II.
- (c) II but not I.
- (d) Neither is linear.
3. The set of linear equations

$$x_1 + x_2 = x_3 - x_1, \quad 3 - x_2 = 2x_1$$

can be represented as $Ax = b$, for which of the following A, b ?

I. $A = \begin{bmatrix} 2 & 1 & 0 \\ 2 & 1 & -1 \end{bmatrix}, b = \begin{bmatrix} 3 \\ 0 \end{bmatrix}.$

II. $A = \begin{bmatrix} 2 & 1 & -1 \\ -2 & -1 & 0 \end{bmatrix}, b = \begin{bmatrix} 0 \\ -3 \end{bmatrix}.$

- (a) Both I and II.
 (b) I but not II.
 (c) II but not I.
 (d) Neither.
4. Which of the following matrix expressions gives the values of three numbers $x_1, x_2,$ and x_3 , that satisfy the following:
- The average of the first two numbers is 1.
 - The average of the last two numbers is 3.
 - The average of all three numbers is 2.

We define $A = \begin{bmatrix} 1/2 & 1/2 & 0 \\ 0 & 1/2 & 1/2 \\ 1/3 & 1/3 & 1/3 \end{bmatrix}, b = \begin{bmatrix} 1 \\ 3 \\ 2 \end{bmatrix}.$

- (a) $x = bA^{-1}$
 (b) $x = A^{-1}b$
 (c) $x = Ab$
 (d) $x = bA$
 (e) $x = A^T b$
 (f) $x = b^T A$
5. Solving a set of 100 linear equations in 100 variables
- (a) is easily done by hand
 (b) is a dangerous task that should be done by certified professionals only
 (c) can be done in less than a second on a small PC
 (d) is a problem that rarely comes up in practical situations
 (e) requires about a minute on a professional workstation computer
6. If the 5-vector x is the solution of the linear equations $Ax = b$, where A is a 5×5 nonsingular matrix, and y is the solution of the linear equations $Ay = 2b$, what can you say about x and y ?

(a) $y = x/2$

(b) $y = 2x$

(c) nothing, because the relation between x and y is complicated

(d) $x = y$