10. Matrices and Vectors

Objectives:

- Recognize the dimensions of the product of two or more matrices.
- Understand the concept of rank of a matrix, and how it relates to the invertibility of an $n \times n$ matrix.
- (Optional) Understand the concept of **eigenvalues** and **eigenvectors** of an $n \times n$ matrix.

Matrix Vector Product 1

1/1 point (graded)

Let $\mathbf{A} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 1 & 2 & 1 \end{bmatrix}$.

Let $g = \begin{bmatrix} 2 & 1 & 3 \end{bmatrix}$.

Can we compute $g\mathbf{A}$?

- (•) yes
- ( ) no

✔

Solution:

The dimension of g is 1×3 and the dimension of A is 3×3. Since the number of columns in g equals the number of rows in A, the product exists.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Matrix Vector Product 2

1/1 point (graded)

Let g and $\mathbf{A}$ be as above. Can we compute $\mathbf{A}g$?

- ( ) yes
- (•) no

✔

Solution:

Unlike part c), the dimension of A is 3×3 and the dimension of g is 1×3. Since the number of columns in A does not equal the number of rows in g, the product does not exist. Note that this example shows that matrix multiplication is not commutative, i.e., $AB \neq BA$.

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Answers are displayed within the problem

Find the Rank

1/1 point (graded)

Let $\mathbf{B} = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 4 & 4 \\ 5 & 6 & 4 \end{bmatrix}$. Determine the rank of $\mathbf{B}$. Recall that the rank of a matrix is the number of linearly independent rows or columns.

The notion of linear independence and rank is reviewed on the tab after the next one, titled *Linear Independence, Subspaces and Dimension*.

$\mathrm{rank}\,(\mathbf{B}) =$ 2 ✔ **Answer:** 2

Solution:

Note that the first two rows of B are linearly independent since they are not multiples of each other. Now solve the system $\begin{bmatrix} 2a + b = 5c \\ a + 4b = 6c \\ 4b = 4c \end{bmatrix}$. Recall that these three vectors will be linearly independent if the only solution to this set of equations is the zero vector. Since we find that this system has the solution $\begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}$, these vectors are not linearly independent and the rank of the matrix is 2.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Matrix Times its Inverse

1/1 point (graded)

Let $\mathbf{M}^{-1}$ denote the inverse of a matrix $\mathbf{M}$. Let $\mathbf{A}$ be as defined above. Compute $\mathbf{A}^{-1}$. What matrix does the product $\mathbf{A}\mathbf{A}^{-1}$ produce?

- (•) identity matrix
- ( ) zero matrix

✔

Solution:

For any matrix $\mathbf{A}$, $\mathbf{A}\mathbf{A}^{-1} = \mathbf{A}^{-1}\mathbf{A} = I$, where I is the identity matrix.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

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? Inverse does not exist — 2
Dear staff, Concerning the question with the inverse product calculation. The inverse of this ...

no. of attempts — 4
Hello staff, This is for the question 'rank of a matrix'. Given 3 attempts to find the rank of a 3 ...

Hint for those on Transpose — 1
Keep in mind the "g" on the first question is not transposed. The majority of examples in thes...

? How do quickly verify linear independence ? 3

While I understand the concept of linear independence, I have trouble to recognise it in pract...

Community TA

? How to interpret the horizontally located vector [2,1,3] ? 3

Hi, staff! Do you mean g.T when locates vector horizontally or student must to guess what yo...

? [Staff] Questions start at 3(c)? 5

Is there supposed to a 3(A) and 3(B) to the question? A is not defined as a scalar or a matrix o...

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