MATH 110, Fall 2013
Tutorial #6
October 16, 2013

Today's main problems

1. Find the inverse of $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$ if it exists or show that it is not invertible.

2. Solve the system
$$\begin{aligned} x + 2y + 3z &= 3 \\ 2x + 5y + 3z &= 1 \\ x + 8z &= 3 \end{aligned}$$

3. For an unknown matrix B, we know
$$AB = \begin{bmatrix} -6 & 12 & 20 \\ -5 & 21 & 37 \\ -18 & 16 & 23 \end{bmatrix}.$$
Find B.

4. For an unknown matrix C, we know
$$CA = \begin{bmatrix} -1 & -3 & 0 \\ 0 & -3 & 8 \\ 0 & 0 & 0 \end{bmatrix}.$$
Find C.

Further Questions

5. The solution to $D\vec{x} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ is $\begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}$; the solution to $D\vec{x} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ is $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$; and the solution to $D\vec{x} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ is $\begin{bmatrix} -3 \\ 7 \\ -1 \end{bmatrix}$. Find D and D^{-1} if possible or explain why it cannot be done.

6. A solution to $E\vec{x} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ is $\begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}$; a solution to $E\vec{x} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ is $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$; and $E\vec{x} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ has no solution. Find E and E^{-1} if possible or explain why it cannot be done.

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Challenge questions

7. For some unknown column vector v, $V = vv^T$. Could V ever be invertible?

8. For some unknown row vector w, $W = ww^T$. Could W ever be invertible?

9. Suppose that A and B are invertible symmetric matrices with $AB = BA$. Show that $C = AB^{-1}$ is symmetric.

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Tutorial #6. Instructions for TAs

Objectives

Practice computing matrix inverses and using them to solve matrix equations, with special care taken to remember that when solving matrix equations, multiplying on the left is different than multiplying on the right.

Hidden objectives

Matrix inverses are a nice way to consolidate all the information we know about solving a system of equations into one object. Let's see how they relate to some things we've done before so that some time in the future it can 'click.'

Suggestions

Wrapup

Choose a question that most of the class has started but not yet finished, or a question that people particularly struggled with.

Solutions

1.