

Ţ <u>Help</u>

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■ Calculator

Exam 2 due Dec 3, 2023 04:42 IST Completed

E2.3.1 Questions 1-2

Question 1

10.0/10.0 points (graded) (10 points)

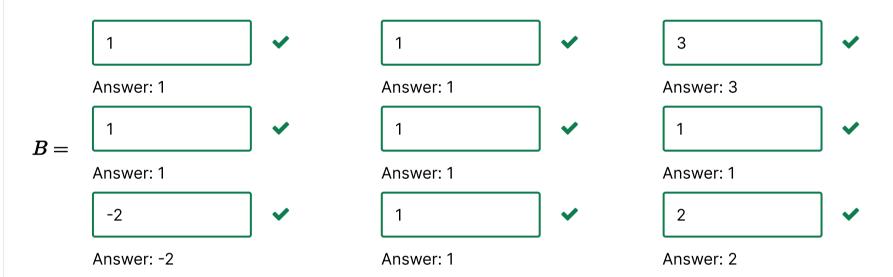
Let $L_A:\mathbb{R}^3 o\mathbb{R}^3$ and $L_B:\mathbb{R}^3 o\mathbb{R}^3$ be linear transformations with

$$L_B\left(egin{pmatrix}1\0\0\end{pmatrix}
ight)=egin{pmatrix}1\1\-2\end{pmatrix}, L_B\left(egin{pmatrix}0\1\0\end{pmatrix}
ight)=egin{pmatrix}1\1\1\end{pmatrix}, L_B\left(egin{pmatrix}0\0\1\end{pmatrix}
ight)=egin{pmatrix}3\1\2\end{pmatrix}$$

and

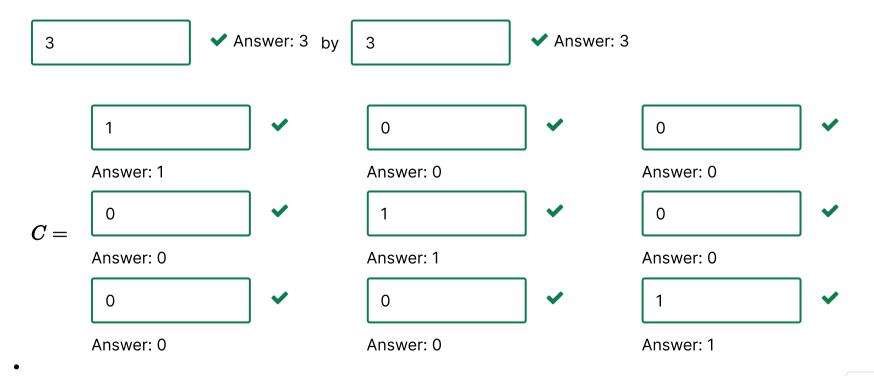
$$L_A\left(egin{pmatrix}1\1\-2\end{pmatrix}
ight)=egin{pmatrix}1\0\0\end{pmatrix},L_A\left(egin{pmatrix}1\1\1\end{pmatrix}
ight)=egin{pmatrix}0\1\1\end{pmatrix}$$

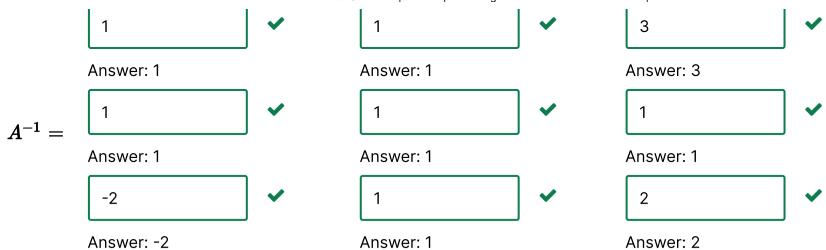
(a) Let B equal the matrix that represents the linear transformation L_B . (In other words, $Bx=L_B\left(x
ight)$ for all $x\in\mathbb{R}^3$). Then



(b) Let C equal the matrix such that $Cx=L_{A}\left(L_{B}\left(x
ight)
ight)$ for all $x\in\mathbb{R}^{3}$.

• What are the row and column sizes of C?





1. (10 points) Let $L_A: \mathbb{R}^3 \to \mathbb{R}^3$ and $L_B: \mathbb{R}^3 \to \mathbb{R}^3$ be linear transformations with

$$L_{B}\left(\left(\begin{array}{c}1\\0\\0\end{array}\right)\right) = \left(\begin{array}{c}1\\1\\-2\end{array}\right), L_{B}\left(\left(\begin{array}{c}0\\1\\0\end{array}\right)\right) = \left(\begin{array}{c}1\\1\\1\end{array}\right), L_{B}\left(\left(\begin{array}{c}0\\0\\1\end{array}\right)\right) = \left(\begin{array}{c}3\\1\\2\end{array}\right)$$

and

$$L_A\left(\left(\begin{array}{c}1\\1\\-2\end{array}\right)\right)=\left(\begin{array}{c}1\\0\\0\end{array}\right),L_A\left(\left(\begin{array}{c}1\\1\\1\end{array}\right)\right)=\left(\begin{array}{c}0\\1\\0\end{array}\right),L_A\left(\left(\begin{array}{c}3\\1\\2\end{array}\right)\right)=\left(\begin{array}{c}0\\0\\1\end{array}\right)$$

(a) Let B equal the matrix that represents the linear transformation L_B . (In other words, $Bx = L_B(x)$ for all $x \in \mathbb{R}^3$). Then

$$B = \left(\begin{array}{rrr} 1 & 1 & 3 \\ 1 & 1 & 1 \\ -2 & 1 & 2 \end{array}\right)$$

Answer: The columns of B equal the vectors that result from evaluating $L_B(x)$ with the unit basis vectors.

- (b) Let C equal the matrix such that $Cx = L_A(L_B(x))$ for all $x \in \mathbb{R}^3$.
 - What are the row and column sizes of C? 3×3

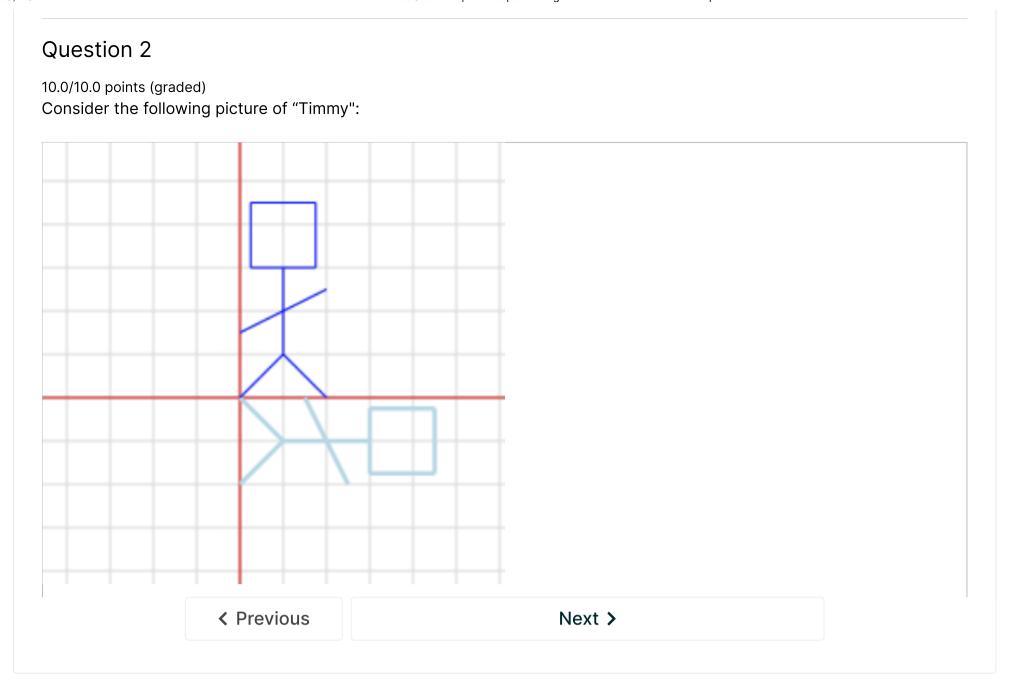
$$\bullet \ \ C = \left(\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right)$$

Answer:
$$L_C\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = L_A(L_B\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}) = L_A\begin{pmatrix} 1 \\ 1 \\ -2 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$
. The other

columns of C can be computed similarly.

•
$$A^{-1} = B$$

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