F.3.1 Final Questions 1-2

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F.3.1 Final Questions 1-2

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Question 1

17/17 points (graded)

Compute

1. $\begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix}^T \begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix} =$ 25 ✔ Answer: 25

$$\begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix} \begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix} = \begin{pmatrix} -3 & 0 & 4 \end{pmatrix} \begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix}$$
$$= (-3)(-3) + (0)(0) + (4)(4)$$
$$= 9 + 16$$
$$= 25$$

2. $\left\| \begin{pmatrix} -3 \\ 0 \\ 4 \end{pmatrix} \right\|_2 =$ 5 ✔ Answer: 5

Recall that $\| \cdot \|_2$ equals the 2-norm, which is another way of denoting the length of a vector.

$$\sqrt{(-3)^2 + 0^2 + (4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5.$$

Or you can recognize that

$$\|x\|_2 = \sqrt{x^T x}$$

Calculator

and use the result from the last part of this question.

$$\begin{pmatrix}0\\1\\2\\3\end{pmatrix}\begin{pmatrix}-1\\0\\2\end{pmatrix}^T =$$

0 ✔	0 ✔	0 ✔
Answer: 0	Answer: 0	Answer: 0
-1 ✔	0 ✔	2 ✔
Answer: -1	Answer: 0	Answer: 2
-2 ✔	0 ✔	4 ✔
Answer: -2	Answer: 0	Answer: 4
-3 ✔	0 ✔	6 ✔
Answer: -3	Answer: 0	Answer: 6

3.

$$\begin{pmatrix}0\\1\\2\\3\end{pmatrix}\begin{pmatrix}-1 & 0 & 2\end{pmatrix} = \begin{pmatrix}0 & 0 & 0\\-1 & 0 & 2\\-2 & 0 & 4\\-3 & 0 & 6\end{pmatrix}$$

4. $\begin{pmatrix}-1\\0\\2\end{pmatrix}^T \begin{pmatrix}2 & -1 & 1\\1 & 0 & -2\\-1 & 0 & 1\end{pmatrix} =$

-4	1	1
✔ Answer: -4	✔ Answer: 1	✔ Answer: 1

$$\begin{pmatrix}-1\\0\\2\end{pmatrix}^T \begin{pmatrix}2 & -1 & 1\\1 & 0 & -2\\-1 & 0 & 1\end{pmatrix} = \begin{pmatrix}-1 & 0 & 2\end{pmatrix}\begin{pmatrix}2 & -1 & 1\\1 & 0 & -2\\-1 & 0 & 1\end{pmatrix}$$

$$= \begin{pmatrix}-4 & 1 & 1\end{pmatrix}$$

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Answers are displayed within the problem

Question 2

10.0/10.0 points (graded)
Consider

$$\begin{pmatrix}-1 & 2 & 1\end{pmatrix}\begin{pmatrix}\chi_0\\ \end{pmatrix} = \begin{pmatrix}2\end{pmatrix}$$

Calculator

$$\begin{pmatrix} 1 & -2 & 1 \\ -1 & 4 & 0 \end{pmatrix} \begin{pmatrix} \chi_1 \\ \chi_2 \end{pmatrix} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}.$$

- Write the system of linear equations $Ax = b$ and reduce it to row echolon form, yielding

$$\left(\begin{array}{ccc|c} \alpha_{0,0} & \alpha_{0,1} & \alpha_{0,2} & \beta_0 \\ \alpha_{1,0} & \alpha_{1,1} & \alpha_{1,2} & \beta_1 \end{array} \right)$$

$$\begin{pmatrix} \alpha_{0,0} & \alpha_{0,1} & \alpha_{0,2} \\ \alpha_{1,0} & \alpha_{1,1} & \alpha_{1,2} \end{pmatrix} = \begin{matrix} \text{1} & \text{-2} & \text{1} \\ \text{✔ Answer: 1} & \text{✔ Answer: -2} & \text{✔ Answer: 1} \\ \text{0} & \text{2} & \text{1} \\ \text{✔ Answer: 0} & \text{✔ Answer: 2} & \text{✔ Answer: 1} \end{matrix}$$

-

$$\begin{pmatrix} \beta_0 \\ \beta_1 \end{pmatrix} = \begin{matrix} \text{-2} \\ \text{✔ Answer: -2} \\ \text{3} \\ \text{✔ Answer: 3} \end{matrix}$$

-

$$\left(\begin{array}{ccc|c} \boxed{1} & -2 & 1 & -2 \\ 0 & \boxed{2} & 1 & 3 \end{array} \right)$$

- For each variable, identify whether it is a free variable or dependent variable:
  - χ_0:

    Dependent ✔ Answer: Dependent
  - χ_1:

    Dependent ✔ Answer: Dependent
  - χ_2:

    Free ✔ Answer: Free
- Which of the following is a specific (particular) solution: (Mark all correct answers)
  - $\begin{pmatrix} 1 \\ 1/2 \\ 0 \end{pmatrix}$

    FALSE ✔ Answer: FALSE
  - $\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$

    TRUE ✔ Answer: TRUE
  - $\begin{pmatrix} -1 \\ \end{pmatrix}$

Calculator

- $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$

FALSE ✔ Answer: FALSE

- Which of the following is a vector in the null space: (Mark all correct answers)

☐ $\begin{pmatrix} -1 \\ -1 \\ 1 \end{pmatrix}$

☑ $\begin{pmatrix} -2 \\ -1/2 \\ 1 \end{pmatrix}$

☐ $\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$

✔

- Which of the following expressed a general (total) solution: (Mark all correct answers)

☐ $\begin{pmatrix} -1 \\ 1/2 \\ 0 \end{pmatrix} + \gamma \begin{pmatrix} -1 \\ -1 \\ 1 \end{pmatrix}$

☐ $\begin{pmatrix} -1 \\ 1/2 \\ 0 \end{pmatrix} + \gamma \begin{pmatrix} -2 \\ -1/2 \\ 1 \end{pmatrix}$

☑ $\begin{pmatrix} 1 \\ 3/2 \\ 0 \end{pmatrix} + \gamma \begin{pmatrix} -2 \\ -1/2 \\ 1 \end{pmatrix}$

✔

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Answers are displayed within the problem

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Calculator