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F.3.4 Final Questions 7-8

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Final Exam due Jan 5, 2024 00:12 IST Completed

F.3.4 Final Questions 7-8

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? QUESTION 7, "basis for the column space"?

2

Why is (d) (1, -2) and (2, -5) correct? I read the answer key but am still confused? How does the span of these vectors equal the column space o...

QUESTION 7

10.0/10.0 points (graded) Consider the matrix

$$A = \left(egin{array}{cccc} 1 & -1 & 3 & 2 \ -2 & 3 & -6 & -5 \end{array}
ight).$$

Reduce \boldsymbol{A} to row echelon form.

Which of the following form a basis for the column space of A: (Mark all)

$$egin{array}{c} igcap ig(1 \ -2 ig) ext{ and } ig(3 \ -6 ig). \end{array}$$

$$egin{array}{c} iggl(1 \ -2 iggr), iggl(3 \ -6 iggr), ext{ and } iggl(3 \ -6 iggr). \end{array}$$

$$igcup (egin{array}{c} 1 \ -2 \end{array})$$
 and $ig(egin{array}{c} -1 \ 3 \end{array})$.

$$igwedge^{igwedge} igg(egin{array}{c} 1 \ -2 \end{array} \ ext{and} \ igg(egin{array}{c} 2 \ -5 \end{array} .$$

Which of the following vectors are in the row space of \boldsymbol{A} : (Mark all)



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3



$$egin{pmatrix} -2 \ 3 \ -6 \ -5 \end{pmatrix}$$

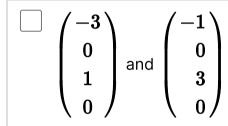


$$\begin{pmatrix} 0\\1\\0\\-1 \end{pmatrix}$$



Which of the following form a basis for the the null space of $m{A}$. (Mark all)

and





$$egin{pmatrix} -3 \ 0 \ 1 \ 0 \end{pmatrix}$$
 and $egin{pmatrix} -1 \ 1 \ 0 \ 1 \end{pmatrix}$



- (a) Which of the following form a basis for the column space of A:
 - Reduce A to row echelon form.

Answer:

(2 x 4 array of boxes here)

$$\left(\begin{array}{cccc}1 & -1 & 3 & 2\\0 & 1 & 0 & -1\end{array}\right)$$

• $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$.

True/False

False. These two vectors are linearly dependent.
• $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$, $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$, and $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$.

True/False

False. The span of these vectors equals the column space of A, but they are not linearly independent and hence not a basis.

 $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ True/False

True. The span of these vectors equals the column space of \boldsymbol{A} and they are linearly independent.

• $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$. True/False

True. It is not the set of vectors that you get from the procedure was given, but the span of these vectors equals the column space of A and they are linearly independent.

The point: The solution is not unique.

- (b) Which of the following vectors are in the row space of A:
 - (1 −1 3 2)

True/False

False: it should be a column vector



$$\bullet \begin{pmatrix} -2 \\ 3 \\ -6 \\ -5 \end{pmatrix}$$
True/False

•
$$\begin{pmatrix} 0\\1\\0\\-1 \end{pmatrix}$$
True/False

True

(c) Which of the following form a basis for the the null space of A.

$$\bullet \left(\begin{array}{c} 1\\ -1\\ 3\\ 2 \end{array} \right) \text{ and } \left(\begin{array}{c} 0\\ 1\\ 0\\ 1 \end{array} \right)$$

True/False

$$\bullet \left(\begin{array}{c} -1/3 \\ 0 \\ 1 \\ 0 \end{array} \right) \text{ and } \left(\begin{array}{c} -1 \\ 0 \\ 3 \\ 0 \end{array} \right)$$

True/False

False. They are not linearly independent nor do they span the

$$\bullet \begin{pmatrix} -3 \\ 0 \\ 1 \\ 0 \end{pmatrix} \text{ and } \begin{pmatrix} -1 \\ 1 \\ 0 \\ 1 \end{pmatrix}$$

True. They result from the suggested procedure.

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Answers are displayed within the problem

Question 8

10.0/10.0 points (graded)

Consider
$$A=egin{pmatrix} 2 & 3 \ 2 & 1 \end{pmatrix}$$

1. The largest eigenvalue (in magnitude) is:

The smallest eigenvalue (in magnitude) is:

$$\det (A - \lambda I) = \det \left(\begin{pmatrix} 2 - \lambda & 3 \\ 2 & 1 - \lambda \end{pmatrix} \right)$$

$$= (2 - \lambda) (1 - \lambda) - (3) (2)$$

$$= \lambda^2 - 3\lambda + 2 - 6$$

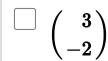
$$= \lambda^2 - 3\lambda - 4$$

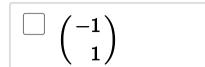
$$= (\lambda - 4) (\lambda + 1)$$

Thus, the roots of the characteristic polynomial are $\bf 4$ and $\bf -1$, which are then the eigenvalues of $\bf A$.

2. Which of the following is an eigenvector associated with the largest eigenvalue of $m{A}$ (in magnitude): (Mark all)









To find an eigenvector associated with $\lambda=4$: Consider

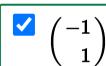
$$A-\lambda=\left(egin{array}{cc} 2-4 & 3 \ 2 & 1-4 \end{array}
ight)=\left(egin{array}{cc} -2 & 3 \ 2 & -3 \end{array}
ight)$$

By examination, the vector $inom{3}{2}$ is an eigenvector. So is any multiple of this vector.

3. Which of the following is an eigenvector associated with the smallest eigenvalue of $m{A}$ (in magnitude): (Mark all)

 $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$







To find an eigenvector associated with $\lambda=-1$: Consider

$$A-\lambda=\left(egin{array}{cc} 2-(-1) & 3 \ 2 & 1-(-1) \end{array}
ight)=\left(egin{array}{cc} 3 & 3 \ 2 & 2 \end{array}
ight)$$

By examination, the vector $\begin{pmatrix} -1 \\ 1 \end{pmatrix}$ is an eigenvector. So is any multiple of this vector.

- 4. Consider the matrix B=2A.
 - ullet The largest eigenvalue of $oldsymbol{B}$ is

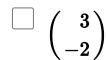
8 Answer: 8

• The smallest eigenvalue of $m{B}$ is

-2 ✓ Answer: -2

ullet Which of the following is an eigenvector associated with the largest eigenvalue of $oldsymbol{B}$ (in magnitude): (Mark all)





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$egin{pmatrix} -1 \ 1 \end{pmatrix}$
✓
If $Ax=\lambda x$ then $(2A)x=(2\lambda x)$ and hence the eigenvectors of A are the eigenvectors of B . Thus, the answers are the same as for the same question asked with matrix A .
Which of the following is an eigenvector associated with the smallest eigenvalue of $m{B}$ (in magnitude): (Mark all)
$egin{array}{c} egin{array}{c} 3 \ 2 \end{pmatrix}$
$egin{array}{c} igcup \ -2 \end{array}$
$igcup_{igcup_1}^{igcup_2} ig(egin{array}{c} -1 \ 1 \ \end{pmatrix}$
If $Ax=\lambda x$ then $(2A)x=(2\lambda x)$ and hence the eigenvectors of A are the eigenvectors of B . Thus, the answers are the same as for the same question asked with matrix A .

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