

Answers to lecture problems

Lecture 1

Slide 1

Value of the component in row 2 and column 3 of the matrix: -3 .

Order: 3×4 .

Matrix is: $\begin{pmatrix} -1 & 6 \\ 0 & 2 \end{pmatrix}$

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$$\begin{pmatrix} 1 & 1 & 2 \\ 3 & 3 & 3 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 2 \\ -1 & 3 \end{pmatrix}$$

$$\begin{pmatrix} 0 & 2 \\ -5 & -7 \\ 6 & 10 \end{pmatrix}$$

-1

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False

True

EF and **FG** defined, **EG** not.

E.g. $3 \begin{pmatrix} 1 & -2 \\ -3 & 1 \\ -2 & 4 \end{pmatrix}$

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$$\begin{aligned} x + 2y - z \\ -y + z \\ 2x + 3y - 2z \end{aligned}$$

$$\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 12 \\ 7 \end{pmatrix}$$

$$\begin{pmatrix} -1 & 2 & 2 \\ -3 & 2 & -1 \\ -1 & 5 & 1 \\ 0 & 2 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 12 \\ 5 \\ 0 \\ -3 \end{pmatrix}$$

Yes.

Lecture 2

Slide 2

$$\begin{pmatrix} -5 & -6 & -3 \\ -5 & 2 & 1 \\ 0 & 4 & -8 \end{pmatrix}$$

-20

$$\frac{1}{20} \begin{pmatrix} 5 & 6 & 3 \\ 5 & -2 & -1 \\ 0 & -4 & 8 \end{pmatrix}$$

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$$a \begin{vmatrix} f & g & h \\ j & k & l \\ n & o & p \end{vmatrix} - b \begin{vmatrix} e & g & h \\ i & k & l \\ m & o & p \end{vmatrix} + c \begin{vmatrix} e & f & h \\ i & j & l \\ m & n & p \end{vmatrix} - d \begin{vmatrix} e & f & g \\ i & j & k \\ m & n & o \end{vmatrix}$$

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$$\begin{pmatrix} 3 & 1 \\ \frac{3}{5} & \frac{1}{5} \\ 2 & 1 \\ -\frac{2}{5} & \frac{1}{5} \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ \frac{1}{2} & 0 \\ \frac{1}{2} & -1 \end{pmatrix}$$

A

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$$\begin{pmatrix} 11 & 12 & 13 \\ 21 & 22 & 23 \\ 31 & 32 & 33 \end{pmatrix}$$

Lecture 3

Slide 2

Eigenvalues 2 and 5

Eigenvectors $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

Eigenvalues 2, -1 and 4

Eigenvectors $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$, $\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$

Lecture 4

Slide 2

Atmospheric pressure: scalar field

Ocean currents: vector field

Height above sea level: scalar field

$$\vec{E} = \begin{pmatrix} 0 \\ 0 \\ -4 \end{pmatrix}$$

Slide 4

$$-4\sin x - 2z\exp[-2xz]$$

$$-2x\exp[-2xz]$$

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$$0$$

$$\sqrt{3}$$

$$\frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$$

Lecture 5

Slide 1

Divergence positive for top two points

$$4x + xy$$

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$$3\cos x - 2z$$

$$2$$

Lecture 6

Slide 1

Curl positive on LHS

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

Slide 5

$$\begin{pmatrix} 0 \\ 0 \\ -2\sin x \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix}$$