WeBWorK ReadingHomework1 is due : 09/27/2010 at 11:59pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

Which of the following equations is linear? Select all that apply.

- A. $\sqrt{x} = y$
- B. $12x = 11y - 20$
- C. $\dfrac{4x-2y}{7} = \dfrac{-4x+5y}{19}$
- D. $\dfrac{4x-2y}{7} = \dfrac{19}{-4x+5y}$
- E. $\sin x + 9y = -6$
- F. $x^2 + y^2 = -6$
- G. $12x + 11y = -20$

Compute the product: $\begin{bmatrix} 5 & -4 \\ 2 & 6 \end{bmatrix} \begin{bmatrix} -3 \\ -2 \end{bmatrix} = \begin{bmatrix} \_\_ \\ \_\_ \end{bmatrix}$

WeBWorK ReadingHomework2 is due : 09/29/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Consider the following augmented matrix: $\left[\begin{array}{cccc|c} 1 & 3 & 19 & 21 & 29 \\ 9 & 5 & 15 & 27 & 25 \\ 11 & 7 & 23 & 13 & 17 \end{array}\right]$

Using the notation from the lecture notes, what are the values of the following entries?

$a^2_1 =$ ___
$a^3_2 =$ ___
$b^2 =$ ___
$a^1_3 =$ ___
$b^1 =$ ___

Warning: The superscripts here (and in the lecture notes) are NOT exponents.

The system of equations

$$8x-10y+5z=6$$

$$-2x-2y+9z=58$$

$$9x+9y-3z=39$$

has the following augmented matrix: $\left[\begin{array}{ccc|c} 8 & -10 & 5 & 6 \\ -2 & -2 & 9 & 58 \\ 9 & 9 & -3 & 39 \end{array}\right]$

The reduced row echelon form of this matrix is: $\left[\begin{array}{ccc|c} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 1 & 8 \end{array}\right]$ What is the solution to the original system of equations?

$x =$ ___
$y =$ ___
$z =$ ___

WeBWorK ReadingHomework3 is due : 10/01/2010 at 03:00pm PDT.

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To which of the three elementary row operations does step 2 of the Gaussian elimination algorithm correspond? [?]

To which of the three elementary row operations does step 3 of the Gaussian elimination algorithm correspond? [?]

To which of the three elementary row operations does step 4 of the Gaussian elimination algorithm correspond? [?]

WeBWorK ReadingHomework4 is due : 10/04/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Geometrically describe the set of solutions to the following system:

$$\begin{cases} 3x + 6y = 24 \\ 6x + 3y = 21 \end{cases}$$

?

Geometrically describe the set of solutions to the following system:

$$\begin{cases} 3x + 6y = 24 \\ 9x + 18y = 72 \end{cases}$$

?

Geometrically describe the set of solutions to the following system:

$$\begin{cases} 3x + 6y = 24 \\ 9x + 18y = 24 \end{cases}$$

?

Geometrically describe the set of solutions to the following system:

$$0x+0y=0$$

?

Suppose that $MX = V$ is a linear system, for some matrix M and some vector V. Let the vector P be a particular solution to the system and the vector H a homogeneous solution to the system. Which of the following vectors must be a particular solution to the system? Select all that apply.

- A. $P+2H$
- B. $H-P$
- C. $2H-P$
- D. $2P+2H$
- E. $P+3H$
- F. $2P+H$
- G. $3P+3H$
- H. $2H-P$
- I. $P-H$
- J. $3P+H$
- K. P
- L. $P+H$
- M. $3H-P$
- N. $P-2H$
- O. $P-3H$
- P. H

WeBWorK ReadingHomework5 is due : 10/06/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Let a,b,c,d,e and f be vectors such that $\langle a,b\rangle = -4$, $\langle a,c\rangle = -5$, $\langle b,c\rangle = 1$, $b+c=d$, $-6a+2b=e$ and $-5b+3c=f$. Compute the following inner products:

$\langle b,a\rangle =$ __________

$\langle a,d\rangle =$ __________

$\langle e,c\rangle =$ __________

$\langle a,f\rangle =$ __________

Suppose that u and v are vectors and that $\|u\| = 6$ and $\|v\| = 5$.

Which of the following could be the value of $u \cdot v$? Select all that apply.

- A. -30
- B. 15
- C. -27
- D. -15
- E. 0
- F. 6
- G. -35
- H. 30
- I. 25
- J. -60
- K. 60
- L. 33
- M. 5

Which of the following could be the value of $\|u+v\|$? Select all that apply.

- A. 16
- B. 11
- C. 1
- D. -11
- E. -1
- F. 17
- G. 5
- H. 6

WeBWorK ReadingHomework6 is due : 10/08/2010 at 03:00pm PDT.

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The vector space

$$V=\{f|f:\mathbb{N}\to\mathbb{R}\}$$

consists of functions from $\mathbb{N}$ to $\mathbb{R}$. Another way to think of these functions is as "infinite column vectors": $f(0)$ is the first entry, $f(1)$ is the second entry, and so on. Then for example the function $f(n)=n^3$ would look like this:

$$f=\begin{bmatrix}0\\1\\8\\27\\\vdots\\n^3\\\vdots\end{bmatrix}$$

Then V is the space of all "infinite column vectors".

Notice that for any "infinite column vector"

$$f=\begin{bmatrix}f(0)\\f(1)\\f(2)\\f(3)\\\vdots\end{bmatrix}$$

and any scalar c we have

$$c\cdot f=\begin{bmatrix}c\cdot f(0)\\c\cdot f(1)\\c\cdot f(2)\\c\cdot f(3)\\\vdots\end{bmatrix}=\begin{bmatrix}cf(0)\\cf(1)\\cf(2)\\cf(3)\\\vdots\end{bmatrix}$$

is itself an infinite column vector.

This is an illustration of which of the vector space axioms?
[?]

Notice that we have

$$f\cdot 1=\begin{bmatrix}f(0)\\f(1)\\f(2)\\f(3)\\\vdots\end{bmatrix}\cdot\begin{bmatrix}1\\1\\1\\1\\\vdots\end{bmatrix}=\begin{bmatrix}f(0)\cdot 1\\f(1)\cdot 1\\f(2)\cdot 1\\f(3)\cdot 1\\\vdots\end{bmatrix}=\begin{bmatrix}f(0)\\f(1)\\f(2)\\f(3)\\\vdots\end{bmatrix}=f.$$

This is an illustration of which of the vector space axioms?
[?]

Notice that for any

$$g=\begin{bmatrix}g(0)\\g(1)\\g(2)\\g(3)\\\vdots\end{bmatrix}$$

we have

$$f+g=\begin{bmatrix}f(0)\\f(1)\\f(2)\\f(3)\\\vdots\end{bmatrix}+\begin{bmatrix}g(0)\\g(1)\\g(2)\\g(3)\\\vdots\end{bmatrix}=\begin{bmatrix}f(0)+g(0)\\f(1)+g(1)\\f(2)+g(2)\\f(3)+g(3)\\\vdots\end{bmatrix}=\begin{bmatrix}g(0)+f(0)\\g(1)+f(1)\\g(2)+f(2)\\g(3)+f(3)\\\vdots\end{bmatrix}=$$

This is an illustration of which of the vector space axioms?
[?]

WeBWorK ReadingHomework7 is due : 10/11/2010 at 03:00pm PDT.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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Suppose that V is a vector space and that u and v are two vectors in V. The linear transformation $L\colon V \to \mathbb{R}$ is such that $L(u) = -4$ and $L(v) = -5$. What is the value of $L(2u+5v)$?

$L(2u+5v) =$ ______

Let $L\colon \mathbb{R}^3 \to \mathbb{R}^3$ be a linear transformation defined by

$$L\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 4x-y \\ 7y-z \\ x+y \end{pmatrix}$$

Write L using a matrix:

$$L\begin{pmatrix} x \\ y \\ z \end{pmatrix} =$$

$$L\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

WeBWorK ReadingHomework8 is due : 10/13/2010 at 03:00pm PDT.

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Suppose that A is a 7×10 matrix and that B is a 10×2 matrix. What are the dimensions of the product AB ?
AB is a ___ $\times$ ___ matrix. (Enter "DNE" in both spaces if the product does not exist, that is, if A and B cannot be multiplied together.)

Suppose that A is a 10×7 matrix and that B is a 10×2 matrix. What are the dimensions of the product AB ?
AB is a ___ $\times$ ___ matrix. (Enter "DNE" in both spaces if the product does not exist, that is, if A and B cannot be multiplied together.)

Suppose that A is a 7×10 matrix and that B is a 2×10 matrix. What are the dimensions of the product AB ?
AB is a ___ $\times$ ___ matrix. (Enter "DNE" in both spaces if the product does not exist, that is, if A and B cannot be multiplied together.)

Suppose that A is a 10×7 matrix and that B is a 2×10 matrix. What are the dimensions of the product AB ?
AB is a ___ $\times$ ___ matrix. (Enter "DNE" in both spaces if the product does not exist, that is, if A and B cannot be multiplied together.)

The matrix A is given by

$$A = \begin{pmatrix} 1 & -19 & 3 \\ -17 & 9 & 10 \\ 2 & -7 & 10 \end{pmatrix}.$$

What is A^T?

$$A^T = \begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix}$$

WeBWorK ReadingHomework9 is due : 10/15/2010 at 03:00pm PDT.

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The matrix M is given by

$$M=\begin{pmatrix} -14 & -11 & -5 & -11 & 16 \\ 19 & -13 & -2 & 18 & -4 \\ -6 & 11 & -16 & -4 & -4 \\ -10 & 19 & 11 & 15 & 3 \\ -1 & 19 & 5 & 6 & 4 \end{pmatrix}.$$

Which of the following makes sense as a block decomposition of M? Select all that apply.

- A. $\left(\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right)$ where

$A=\begin{pmatrix} -14 & -11 \\ 19 & -13 \end{pmatrix}$, $B=\begin{pmatrix} -5 & -11 & 16 \\ -2 & 18 & -4 \end{pmatrix}$, $C=\begin{pmatrix} -6 & 11 \\ -10 & 19 \\ -1 & 19 \end{pmatrix}$, $D=\begin{pmatrix} -16 & -4 & -4 \\ 11 & 15 & 3 \\ 5 & 6 & 4 \end{pmatrix}$

- B. $\left(\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right)$ where

$A=\begin{pmatrix} -14 & -11 \\ 19 & -13 \end{pmatrix}$, $B=\begin{pmatrix} -11 & 16 \\ 18 & -4 \\ -4 & -4 \end{pmatrix}$, $C=\begin{pmatrix} -10 & 19 & 11 \\ -1 & 19 & 5 \end{pmatrix}$

- C. $\left(\begin{array}{c|c|c} A & B & C \\ \hline D & E & F \\ \hline G & H & I \end{array}\right)$ where

$A=\begin{pmatrix} -14 & -11 \\ 19 & -13 \end{pmatrix}$, $B=\begin{pmatrix} -5 \\ -2 \end{pmatrix}$, $C=\begin{pmatrix} -11 & 16 \\ 18 & -4 \end{pmatrix}$, $D=($

$F=\begin{pmatrix} -4 & -4 \end{pmatrix}$, $G=\begin{pmatrix} -10 & 19 \\ -1 & 19 \end{pmatrix}$, $H=\begin{pmatrix} 11 \\ 5 \end{pmatrix}$, $I=\begin{pmatrix} 15 \\ 6 \end{pmatrix}$

- D. $\left(\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right)$ where

$A=\begin{pmatrix} -14 & -11 & -5 \\ 19 & -13 & -2 \\ -6 & 11 & -16 \end{pmatrix}$, $B=\begin{pmatrix} -11 & 16 \\ 18 & -4 \end{pmatrix}$, $C=\begin{pmatrix} -10 & 19 \\ -1 & 19 \end{pmatrix}$

- E. None of the above

WeBWorK ReadingHomework10 is due : 10/18/2010 at 03:00pm PDT.

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The matrix M is given by

$$M = \begin{pmatrix} 15 & 2 & 53 \\ -8 & -3 & -36 \\ 21 & -3 & 51 \end{pmatrix}.$$

Further, M is row-equivalent to the matrix N which is given by

$$N = \begin{pmatrix} 1 & 0 & 3 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \end{pmatrix}.$$

Which of the following is true? Select all that apply.

- A. The matrix M^{-1} does not exist.
- B. $NM = I$.
- C. It is impossible to tell whether M has an inverse without writing the augmented matrix $(M|I)$ and row-reducing.
- D. The matrix M^{-1} is equal to N.
- E. $MN = I$.
- F. The matrix M^{-1} exists; to compute it, we would need to write the augmented matrix $(M|I)$ and row-reduce.
- G. None of the above

The system

$$\begin{cases} 2x & +1y & +6z & = 9 \\ -5x & -2y & -2z & = 5 \\ -12x & -4y & +16z & = 56 \end{cases}$$

has solution set

$$\left\{ \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -23 \\ 55 \\ 0 \end{pmatrix} + \lambda \begin{pmatrix} 10 \\ -26 \\ 1 \end{pmatrix} \right\}.$$

Compute the inverse of the matrix $A = \begin{pmatrix} 2 & 1 & 6 \\ -5 & -2 & -2 \\ -12 & -4 & 16 \end{pmatrix}$.

$A^{-1} = \begin{bmatrix} \_\_\_ & \_\_\_ & \_\_\_ \\ \_\_\_ & \_\_\_ & \_\_\_ \\ \_\_\_ & \_\_\_ & \_\_\_ \end{bmatrix}$ (Enter "DNE" in all spaces if the inverse does not exist.)

WeBWorK ReadingHomework11 is due : 10/22/2010 at 03:00pm PDT.

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You can use the Feedback button on each problem page to send e-mail to the professor.

Suppose that the matrix A is given by $A=\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$. Then multiplying on the left by A corresponds to which of the three elementary row operations? For example,

$$\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}\begin{pmatrix} 9 & -7 \\ -8 & 7 \end{pmatrix}=\begin{pmatrix} 9 & -7 \\ 10 & -7 \end{pmatrix}.$$

Multiplying on the left by A corresponds to: [?]

Suppose that the matrix B is given by $B=\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$. Then multiplying on the left by B corresponds to which of the three elementary row operations? For example,

$$\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 9 & -7 \\ -8 & 7 \end{pmatrix}=\begin{pmatrix} 27 & -21 \\ -8 & 7 \end{pmatrix}.$$

Multiplying on the left by B corresponds to: [?]

Suppose that the matrix C is given by $C=\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. Then multiplying on the left by C corresponds to which of the three elementary row operations? For example,

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 9 & -7 \\ -8 & 7 \end{pmatrix}=\begin{pmatrix} -8 & 7 \\ 9 & -7 \end{pmatrix}.$$

Multiplying on the left by C corresponds to: [?]

Let λ be a non-zero scalar. The product $\begin{pmatrix} a^1_1 & a^1_2 & a^1_3 \\ a^2_1 & a^2_2 & a^2_3 \\ a^3_1 & a^3_2 & a^3_3 \end{pmatrix}\begin{pmatrix} b^1_1 & b^1_2 & b^1_3 \\ b^2_1 & b^2_2 & b^2_3 \\ b^3_1 & b^3_2 & b^3_3 \end{pmatrix}$ is the same as which of the following products? Select all that apply.

Hint: Think, don't calculate!

- A. $\begin{pmatrix} \frac{1}{\lambda}a^1_1 & a^1_2 & a^1_3 \\ a^2_1 & \frac{1}{\lambda}a^2_2 & a^2_3 \\ a^3_1 & a^3_2 & \frac{1}{\lambda}a^3_3 \end{pmatrix}\begin{pmatrix} \lambda b^1_1 & b^1_2 & b^1_3 \\ b^2_1 & \lambda b^2_2 & b^2_3 \\ b^3_1 & b^3_2 & \lambda b^3_3 \end{pmatrix}$
- B. $\begin{pmatrix} a^1_1 & a^1_2 & a^1_3 \\ a^2_1 & a^2_2 & a^2_3 \\ \lambda a^3_1 & \lambda a^3_2 & \lambda a^3_3 \end{pmatrix}\begin{pmatrix} b^1_1 & b^1_2 & \frac{1}{\lambda}b^1_3 \\ b^2_1 & b^2_2 & \frac{1}{\lambda}b^2_3 \\ b^3_1 & b^3_2 & \frac{1}{\lambda}b^3_3 \end{pmatrix}$
- C. $\begin{pmatrix} a^1_1 & \lambda a^1_2 & a^1_3 \\ a^2_1 & \lambda a^2_2 & a^2_3 \\ a^3_1 & \lambda a^3_2 & a^3_3 \end{pmatrix}\begin{pmatrix} b^1_1 & b^1_2 & b^1_3 \\ \frac{1}{\lambda}b^2_1 & \frac{1}{\lambda}b^2_2 & \frac{1}{\lambda}b^2_3 \\ b^3_1 & b^3_2 & b^3_3 \end{pmatrix}$
- D. $\begin{pmatrix} a^1_1 & a^1_2 & a^1_3 \\ \frac{1}{\lambda}a^2_1 & \frac{1}{\lambda}a^2_2 & \frac{1}{\lambda}a^2_3 \\ a^3_1 & a^3_2 & a^3_3 \end{pmatrix}\begin{pmatrix} b^1_1 & \frac{1}{\lambda}b^1_2 & b^1_3 \\ b^2_1 & \frac{1}{\lambda}b^2_2 & b^2_3 \\ b^3_1 & \frac{1}{\lambda}b^3_2 & b^3_3 \end{pmatrix}$
- E. $\begin{pmatrix} \frac{1}{\lambda}a^1_1 & a^1_2 & a^1_3 \\ \frac{1}{\lambda}a^2_1 & a^2_2 & a^2_3 \\ \frac{1}{\lambda}a^3_1 & a^3_2 & a^3_3 \end{pmatrix}\begin{pmatrix} \lambda b^1_1 & \lambda b^1_2 & \lambda b^1_3 \\ b^2_1 & b^2_2 & b^2_3 \\ b^3_1 & b^3_2 & b^3_3 \end{pmatrix}$
- F. $\begin{pmatrix} \frac{1}{\lambda}a^1_1 & \frac{1}{\lambda}a^1_2 & \frac{1}{\lambda}a^1_3 \\ \frac{1}{\lambda}a^2_1 & \frac{1}{\lambda}a^2_2 & \frac{1}{\lambda}a^2_3 \\ \frac{1}{\lambda}a^3_1 & \frac{1}{\lambda}a^3_2 & \frac{1}{\lambda}a^3_3 \end{pmatrix}\begin{pmatrix} \lambda b^1_1 & \lambda b^1_2 & \lambda b^1_3 \\ \lambda b^2_1 & \lambda b^2_2 & \lambda b^2_3 \\ \lambda b^3_1 & \lambda b^3_2 & \lambda b^3_3 \end{pmatrix}$
- G. $\begin{pmatrix} \lambda a^1_1 & \lambda a^1_2 & \lambda a^1_3 \\ a^2_1 & a^2_2 & a^2_3 \\ a^3_1 & a^3_2 & a^3_3 \end{pmatrix}\begin{pmatrix} b^1_1 & \frac{1}{\lambda}b^1_2 & b^1_3 \\ b^2_1 & \frac{1}{\lambda}b^2_2 & b^2_3 \\ b^3_1 & \frac{1}{\lambda}b^3_2 & b^3_3 \end{pmatrix}$
- H. None of the above

WeBWorK ReadingHomework12 is due : 10/25/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2\wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e\wedge(ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5))\wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

Let σ_1 be the permutation given by $\sigma_1 = [1,2,3]$. What is its sign?
$\mathrm{sgn}(\sigma_1) =$ ___

Let σ_2 be the permutation given by $\sigma_2 = [1,3,2]$. What is its sign?
$\mathrm{sgn}(\sigma_2) =$ ___

Let σ_3 be the permutation given by $\sigma_3 = [2,1,3]$. What is its sign?
$\mathrm{sgn}(\sigma_3) =$ ___

Let σ_4 be the permutation given by $\sigma_4 = [2,3,1]$. What is its sign?
$\mathrm{sgn}(\sigma_4) =$ ___

Let σ_5 be the permutation given by $\sigma_5 = [3,1,2]$. What is its sign?
$\mathrm{sgn}(\sigma_5) =$ ___

Let σ_6 be the permutation given by $\sigma_6 = [3,2,1]$. What is its sign?
$\mathrm{sgn}(\sigma_6) =$ ___

Compute

$$\det\begin{pmatrix} 2 & 4 & 6 \\ 35 & 40 & 50 \\ 28 & 35 & 42 \end{pmatrix},$$

given that

$$\det\begin{pmatrix} 2 & 4 & 6 \\ 28 & 35 & 42 \\ 35 & 40 & 50 \end{pmatrix} = -210.$$

The determinant of the first matrix is equal to ___.

WeBWorK ReadingHomework13 is due : 10/27/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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The determinant of $A = \begin{pmatrix} 4 & 8 & 12 \\ 28 & 35 & 42 \\ 42 & 48 & 60 \end{pmatrix}$ is equal to -504.

Using this fact, compute the determinants of the matrices $B = \begin{pmatrix} 8 & 16 & 24 \\ 28 & 35 & 42 \\ 42 & 48 & 60 \end{pmatrix}$ and $C = \begin{pmatrix} 4 & 8 & 12 \\ 32 & 43 & 54 \\ 42 & 48 & 60 \end{pmatrix}$.

$\det B =$ ___ Hint: compare the first row of B to the first row of A.

$\det C =$ ___ Hint: compare the second row of C to the first two rows of A.

The matrix M is equal to the product of matrices M_1 through M_{10}:

$$M = M_1 M_2 M_3 M_4 M_5 M_6 M_7 M_8 M_9 M_{10},$$

where the matrices M_i are as follows:

$$M_1 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & 0 & 1 \end{pmatrix}, \quad M_2 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \quad M_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 4 \end{pmatrix},$$

$$M_4 = \begin{pmatrix} 1 & -2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad M_5 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad M_6 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -5 & 0 \\ 0 & 0 & 1 \end{pmatrix},$$

$$M_7 = \begin{pmatrix} 1 & 0 & 0 \\ 6 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad M_8 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad M_9 = \begin{pmatrix} -3 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix},$$

$$M_{10} = \begin{pmatrix} 1 & 0 & 0 \\ -6 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}.$$

Compute the determinant of M.

$\det M =$ _____

WeBWorK ReadingHomework14 is due : 10/29/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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The permutation σ is given by $\sigma = [3 \quad 1 \quad 2 \quad 4]$. Compute the inverse of σ.

$\sigma^{-1} = [$ ___ ___ ___ ___ $]$

The sign of the permutation σ above is given by $\mathrm{sgn}(\sigma) = 1$. Compute the sign of σ^{-1}.

$\mathrm{sgn}\left(\sigma^{-1}\right) =$ ___

The matrix A is given by $A = \begin{pmatrix} 46 & 33 & 12 & -7 \\ 32 & -9 & -50 & -9 \\ -47 & -16 & 12 & 23 \\ 44 & 8 & -11 & -49 \end{pmatrix}$.

Then the adjoint matrix $B = \mathrm{adj}A$ is given by $\mathrm{adj}A = \begin{pmatrix} b_1^1 & b_2^1 & b_3^1 & b_4^1 \\ b_1^2 & b_2^2 & b_3^2 & b_4^2 \\ b_1^3 & b_2^3 & b_3^3 & b_4^3 \\ b_1^4 & b_2^4 & b_3^4 & b_4^4 \end{pmatrix}$.

Express b_1^1 as ± 1 times the determinant of a 3×3 matrix:

$b_1^1 =$ [?] det $\begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix}$

Express b_3^2 as ± 1 times the determinant of a 3×3 matrix:

$b_3^2 =$ [?] det $\begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix}$

Express b_2^4 as ± 1 times the determinant of a 3×3 matrix:

$b_2^4 =$ [?] det $\begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix}$

Andrew Waldron **MAT22A-Waldron-Fall-2010**

WeBWorK ReadingHomework15 is due : 11/01/2010 at 03:00pm PDT.

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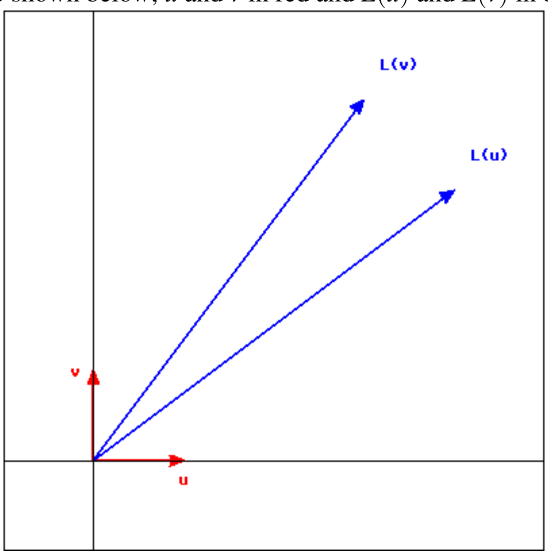
Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

The linear transformation $L\colon \mathbb{R}^2 \to \mathbb{R}^2$ maps the vector u to $L(u)$ and the vector v to $L(v)$. The vectors $u, v, L(u)$, and $L(v)$ are shown below; u and v in red and $L(u)$ and $L(v)$ in blue.



Which of the following could be an eigenvector of L ? Select all that apply.

- A. $u-3v$
- B. $-u-v$
- C. u
- D. $u-v$
- E. v
- F. $u+v$
- G. $v-u$
- H. $2u+v$
- I. None of the above

The linear transformation $L\colon \mathbb{R}^2 \to \mathbb{R}^2$ has eigenvalues 2 and 3. The vector u is an eigenvector of L for the eigenvalue 2, and the vector v is an eigenvector of L for the eigenvalue 3.

If $w = xu + yv$, then compute $L(w)$ in terms of u and v.
$L(w) = (\_\_\_\_\ x)u + (\_\_\_\_\ y)v.$

Let $\begin{pmatrix} x \\ y \end{pmatrix}$ denote the vector $xu+yv$. In terms of this notation, write a matrix for L.

$$L\begin{pmatrix} x \\ y \end{pmatrix} = \begin{bmatrix} \_\_ & \_\_ \\ \_\_ & \_\_ \end{bmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

WeBWorK ReadingHomework16 is due : 11/03/2010 at 03:00pm PDT.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

Let M be a matrix with eigenvalues 5 and 9. Suppose that u and v are eigenvectors of M associated to the eigenvalue 5 and that w is an eigenvector of M associated to the eigenvalue 9.

Which of the following must also be an eigenvector of M ? Select all that apply.

- A. $5u$
- B. $v+w$
- C. $u+w$
- D. $14w$
- E. $-5u$
- F. $u-v$
- G. $w-u$
- H. $5u+9w$
- I. $-9v$
- J. $u+v$
- K. $9v$
- L. $v-w$
- M. $9v+5w$
- N. $9u+5v$
- O. $-14w$
- P. None of the above

WeBWorK ReadingHomework17 is due : 11/05/2010 at 03:00pm PDT.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

Which of the following are vector spaces? Select all that apply.

- A. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $y = z$.
- B. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $x^2 + y^2 = z$.
- C. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $x = 7$.
- D. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $y = 0$.
- E. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $|x| = |y|$.
- F. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $x = y + 9$.
- G. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $7x + 9y = 0$.
- H. The set of all vectors $\begin{pmatrix} x \\ y \\ z \end{pmatrix} \in \mathbb{R}^3$ such that $x + y + z = 0$.
- I. None of the above

Let S be the set of vectors given by $S = \left\{ \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ -1 \end{pmatrix} \right\}$.

Which of the following are in span(S) ? Select all that apply.

- A. $\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$
- B. $\begin{pmatrix} 6 \\ 18 \\ 0 \\ 18 \\ 0 \\ 0 \end{pmatrix}$
- C. $\begin{pmatrix} 0 \\ 6 \\ 0 \\ 6 \\ 0 \\ 0 \end{pmatrix}$
- D. $\begin{pmatrix} 6 \\ 3 \\ 0 \\ 6 \\ 0 \\ 0 \end{pmatrix}$
- E. $\begin{pmatrix} 0 \\ 0 \\ 3 \\ 0 \\ 6 \\ 6 \end{pmatrix}$
- F. $\begin{pmatrix} 3 \\ 6 \\ 6 \\ 6 \\ 6 \\ 6 \end{pmatrix}$

- G. $\begin{pmatrix} 3 \\ 3 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$
- H. $\begin{pmatrix} 3 \\ 6 \\ 6 \\ 6 \\ 6 \\ -6 \end{pmatrix}$
- I. $\begin{pmatrix} 3 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$
- J. $\begin{pmatrix} 0 \\ 0 \\ 6 \\ 0 \\ -6 \\ 6 \end{pmatrix}$
- K. None of the above

WeBWorK ReadingHomework18 is due : 11/08/2010 at 03:00pm PST.

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Suppose that vectors v_1,v_2,v_3 are such that $9v_1+5v_2-5v_3=0$. Are the three vectors linearly independent? [?]

Suppose that vectors v_1,v_2,v_3 are such that $9v_1+5v_2=-5v_3$. Are the three vectors linearly independent? [?]

Suppose that vectors v_1,v_2,v_3,v_4 are such that $9v_1+5v_2=-5v_3-4v_4$. Are the four vectors linearly independent? [?]

Suppose that vectors v_1,v_2,v_3,v_4 are such that $9v_1=-5v_3-4v_4$. Are the four vectors linearly independent? [?]

Suppose that vectors v_1,v_2,v_3,v_4 are such that $9v_1=-5v_4$. Are the four vectors linearly independent? [?]

Suppose that vectors v_1,v_2,v_3,v_4 are such that $9v_1+5v_2-5v_3=5v_2-5v_3-4v_4$. Are the four vectors linearly independent? [?]

Which of the following sets of vectors in $\mathbb{R}^6$ are linearly independent? Select all that apply.

- A. $\begin{pmatrix}0\\0\\7\\7\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\3\\0\\0\\3\\0\end{pmatrix}$, $\begin{pmatrix}14\\0\\0\\0\\0\\14\end{pmatrix}$
- B. $\begin{pmatrix}7\\0\\0\\7\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\3\\0\\0\\3\\0\end{pmatrix}$, $\begin{pmatrix}0\\0\\14\\0\\0\\14\end{pmatrix}$
- C. $\begin{pmatrix}7\\0\\0\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}3\\0\\0\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\14\\0\\0\\0\\14\end{pmatrix}$
- D. $\begin{pmatrix}0\\7\\7\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\0\\0\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}14\\0\\0\\0\\0\\14\end{pmatrix}$
- E. $\begin{pmatrix}7\\0\\0\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\3\\0\\0\\0\\0\end{pmatrix}$, $\begin{pmatrix}0\\0\\14\\0\\0\\0\end{pmatrix}$
- F. $\begin{pmatrix}7\\0\\7\\0\\7\\0\end{pmatrix}$, $\begin{pmatrix}0\\7\\0\\7\\0\\7\end{pmatrix}$, $\begin{pmatrix}7\\7\\7\\7\\7\\7\end{pmatrix}$
- G. None of the above

WeBWorK ReadingHomework19 is due : 11/10/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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We are going to follow the idea of the proof of lemma 19.2 in order to show that a particular set of set T of linearly independent vectors in $\mathbb{R}^3$ has no more elements than a particular basis S of the vector space $\mathbb{R}^3$.

Let the set S be given by

$$S = \left\{ \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \right\}.$$

You can check for yourself that S is a basis for $\mathbb{R}^3$.

Let the set T be given by

$$T = \left\{ \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 6 \\ 6 \\ 6 \end{pmatrix} \right\}.$$

You can check for yourself that the vectors in T are linearly independent.

Express $\begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix}$ as a linear combination of elements in S.

$$\begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix} = \_\_\_\_ \cdot \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

Use the equation you found to express $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ as a linear combination of the vectors in the set $S' = \left\{ \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \right\}$.

$$\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \_\_\_\_ \cdot \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

This means that the set S' is a basis for $\mathbb{R}^3$. You can check for yourself that it is a basis.

Express $\begin{pmatrix} 6 \\ 6 \\ 6 \end{pmatrix}$ as a linear combination of elements in S'.

$$\begin{pmatrix} 6 \\ 6 \\ 6 \end{pmatrix} = \_\_\_\_ \cdot \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

Use the equation you found to express $\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$ as a linear combination of the vectors in the set $S'' = \left\{ \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 6 \\ 6 \\ 6 \end{pmatrix} \right\}$.

$$\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \_\_\_\_ \cdot \begin{pmatrix} 9 \\ 9 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + \_\_\_\_ \cdot \begin{pmatrix} 6 \\ 6 \\ 6 \end{pmatrix}$$

This means that the set S'' is a basis for $\mathbb{R}^3$. You can check for yourself that it is a basis.

We've made a new basis from S by replacing some of its elements with elements of T. Since all the elements of T are in this new basis S'', and the new basis S'' has exactly as many elements as S did, we can conclude that the number of elements in T is less than or equal to the number of elements in S.

Of course, we could have just counted the number of elements in T and the number of elements of S at the beginning, but the point is that this process always works: if S is any basis for a vector space V and T is any set of linearly independent vectors in V, then we can do what we did above to conclude that the number of elements in T is less than or equal to the number of elements in S.

Suppose that the set $S = \{v_1, v_2, \ldots, v_n\}$ is a basis for the vector space V. Decide whether each of the following statements is true or false. If you do not have enough information to decide whether a statement is true or false, select "Impossible to tell".

1. The vectors $v_1, \ldots, v_n$ span V. ?

2. The vectors $v_1, \ldots, v_n$ are linearly independent. ?

3. If $T = \{w_1, w_2, \ldots, w_m\}$ is a different basis for V, then m could be equal to $n+1$. ?

4. If x is any vector in V, then it may be impossible to write x as a linear combination of elements of S. ?

5. There exist nonzero constants $c^1, \ldots, c^n$ such that $c^1 v_1 + \cdots + c^n v_n = 0$. ?

6. The dimension of V is equal to n. ?

WeBWorK ReadingHomework20 is due : 11/17/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professor.

Let $\{e_1, e_2, e_3\}$ be a basis for $\mathbb{R}^3$ and let $\{f_1, f_2, f_3, f_4\}$ be a basis for $\mathbb{R}^4$. Let $L\colon \mathbb{R}^3 \to \mathbb{R}^4$ be a linear transformation which acts in the following way on basis elements:
$L(e_1) = -45f_1 - 35f_2 - 21f_3 - 20f_4$,
$L(e_2) = -10f_1 + 25f_2 + 5f_3 - 2f_4$,
$L(e_3) = 26f_1 - 21f_2 + 22f_3 + 46f_4$.

Given our choice of bases, write a matrix M for the linear transformation L.

$$M = \begin{bmatrix} \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ \end{bmatrix}$$

Suppose that V is a 5-dimensional vector space. Let $L\colon V \to V$ be a linear transformation. Decide whether each of the following statements is true or false. If you do not have enough information to decide whether a statement is true or false, select "Impossible to tell".

1. If $u_1, \ldots, u_5$ is any basis of V, then it is possible to write a matrix for L in terms of this basis. [?]
2. If L has eigenvectors $v_1, \ldots, v_5$ which are linearly independent, then L is diagonalizable. [?]
3. Fix some nonzero vector v. If every eigenvector of L is a constant multiple of v, then L is diagonalizable. [?]
4. If there is some basis $w_1, \ldots, w_5$ with respect to which the matrix of L is a diagonal matrix, then $w_1, \ldots, w_5$ are eigenvectors of L. [?]

Suppose that V is a 5-dimensional vector space. Let $S = \{v_1, \ldots, v_5\}$ be some basis of V, and let $T = \{w_1, \ldots, w_5\}$ be some other basis of V. Let $L\colon V \to V$ be a linear transformation. Let M be the matrix of L in the basis S and let N be the matrix of L in the basis T. Decide whether each of the following statements is true or false. If you do not have enough information to decide whether a statement is true or false, select "Impossible to tell".

1. There is a change of basis matrix which takes us from the basis S to the basis T. [?]
2. If P is a change of basis matrix, then $\det P = 0$. [?]
3. The matrices M and N are similar. [?]
4. If M is a diagonal matrix, then N is a diagonalizable matrix. [?]

WeBWorK ReadingHomework21 is due : 11/19/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2\wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e\wedge(ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5))\wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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The set $S=\left\{\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}, \begin{pmatrix}\frac{1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}, \begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}\right\}$
is an orthonormal basis of $\mathbb{R}^3$.

What are the dot products of the vectors in S with each other?

$\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}\frac{1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}=$ ____

$\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}=$ ____

$\begin{pmatrix}\frac{+1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}=$ ____

What are the dot products of the vectors in S with themselves?

$\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}=$ ____

$\begin{pmatrix}\frac{+1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}\frac{+1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}=$ ____

$\begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}\cdot\begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}=$ ____

Express the standard basis vector e_3 in terms of the basis S:

$\begin{pmatrix}0\\0\\1\end{pmatrix}=$ ____ $\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}$ + ____ $\begin{pmatrix}\frac{1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}$ + ____ $\begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}$.

The set $S=\left\{\begin{pmatrix}\frac{-1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}, \begin{pmatrix}\frac{1}{\sqrt2}\\ \frac{1}{\sqrt3}\\ \frac{1}{\sqrt6}\end{pmatrix}, \begin{pmatrix}0\\ \frac{-1}{\sqrt3}\\ \frac{2}{\sqrt6}\end{pmatrix}\right\}$
is an orthonormal basis of $\mathbb{R}^3$.

Write the matrix P for the change of basis from S to the standard basis $\{e_1,e_2,e_3\}$ of $\mathbb{R}^3$.

$P=\begin{bmatrix}\_\_\_\_ & \_\_\_\_ & \_\_\_\_\\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_\\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_\end{bmatrix}$

Write the matrix P^{-1} for the change of basis from the standard basis to S. $P^{-1}=\begin{bmatrix}\_\_\_\_ & \_\_\_\_ & \_\_\_\_\\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_\\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_\end{bmatrix}$

WeBWorK ReadingHomework22 is due : 11/24/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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The matrix A is a real symmetric 5×5 matrix with eigenvalues $3, 7, 11, 16$, and 20. The vector x_1 is an eigenvector of A with eigenvalue 3, the vector x_2 is an eigenvector of A with eigenvalue 7, the vector x_3 is an eigenvector of A with eigenvalue 11, the vector x_4 is an eigenvector of A with eigenvalue 16, and the vector x_5 is an eigenvector of A with eigenvalue 20.

Compute the dot products of the eigenvectors x_i with each other.

$x_1 \cdot x_2 =$ _____
$x_1 \cdot x_3 =$ _____
$x_1 \cdot x_4 =$ _____
$x_1 \cdot x_5 =$ _____
$x_2 \cdot x_3 =$ _____
$x_2 \cdot x_4 =$ _____
$x_2 \cdot x_5 =$ _____
$x_3 \cdot x_4 =$ _____
$x_3 \cdot x_5 =$ _____
$x_4 \cdot x_5 =$ _____

We are going to follow the idea of the proof of Theorem 22.2 in order to show that a particular real 3×3 symmetric matrix is similar to a diagonal matrix of its eigenvalues.

Let M be the matrix given by $M = \begin{pmatrix} 14 & 14 & 0 \\ 14 & 0 & 14 \\ 0 & 14 & 14 \end{pmatrix}$.

Compute the eigenvalues of M. Call the largest eigenvalue λ_1, the middle eigenvalue λ_2, and the smallest eigenvalue λ_3.

$\lambda_1 =$ _____
$\lambda_2 =$ _____
$\lambda_3 =$ _____

Find an eigenvector x_1 of M so that x_1 has eigenvalue λ_1 and length 1. Choose x_1 so that its first nonzero entry is positive.

$x_1 = \begin{bmatrix} \_\_\_ \\ \_\_\_ \\ \_\_\_ \end{bmatrix}$

Let the vector x_2 be given by $x_2 = \begin{pmatrix} 0 \\ \frac{\sqrt{2}}{2} \\ -\frac{\sqrt{2}}{2} \end{pmatrix}$. You can check for yourself that x_1 and x_2 are orthonormal. Find a third vector x_3 so that $\{x_1, x_2, x_3\}$ is an orthonormal basis for $\mathbb{R}^3$. Choose x_3 so that its first nonzero entry is positive.

$x_3 = \begin{bmatrix} \_\_\_ \\ \_\_\_ \\ \_\_\_ \end{bmatrix}$

Let the matrix P be given by $P = (x_1 \quad x_2 \quad x_3)$. Notice that P is orthogonal, so $P^{-1} = P^T$. Compute the matrix $P^T MP$.

$P^T MP = \begin{bmatrix} \_\_\_ & \_\_\_ & \_\_\_ \\ \_\_\_ & \_\_\_ & \_\_\_ \\ \_\_\_ & \_\_\_ & \_\_\_ \end{bmatrix}$

Now we repeat this process to finish diagonalizing M. Let $\hat{M}$ be the two-by-two block in the lower-right corner of the matrix $P^T MP$ which you computed above. You can check for yourself that the eigenvalues of $\hat{M}$ are the eigenvalues λ_2, λ_3 which you computed earlier. Find an eigenvector y_2 of $\hat{M}$ so that y_2 has eigenvalue λ_2 and length 1. Choose y_2 so that its first nonzero entry is positive.

$y_2 = \begin{bmatrix} \_\_\_ \\ \_\_\_ \end{bmatrix}$

Find a second vector y_3 so that $\{y_2, y_3\}$ is an orthonormal basis for $\mathbb{R}^2$. Choose y_3 so that its first nonzero entry is positive.

$y_3 = \begin{bmatrix} \_\_\_ \\ \_\_\_ \end{bmatrix}$

Let the matrix Q be given by $Q = (y_2 \quad y_3)$. Notice that Q is orthogonal, so $Q^{-1} = Q^T$. Compute the matrix $Q^T \hat{M} Q$.

$Q^T \hat{M} Q = \begin{bmatrix} \_\_\_ & \_\_\_ \\ \_\_\_ & \_\_\_ \end{bmatrix}$

You should have ended up with a diagonal matrix. This shows that the matrix M is similar to the diagonal matrix $\begin{pmatrix} \lambda_1 & 0 & 0 \\ 0 & \lambda_2 & 0 \\ 0 & 0 & \lambda_3 \end{pmatrix}$.

WeBWorK ReadingHomework23 is due : 11/29/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

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Decide whether each of the following linear transformations is injective but not surjective, surjective but not injective, bijective, or neither injective nor surjective. Remember that "injective" means one-to-one, "surjective" means onto, and "bijective" means both one-to-one and onto.

1. $L\colon \mathbb{R}^3 \to \mathbb{R}^3$ given by $L(x,y,z) = (x,y,z)$ [?]
2. $L\colon \mathbb{R}^3 \to \mathbb{R}^2$ given by $L(x,y,z) = (x,y)$ [?]
3. $L\colon \mathbb{R}^3 \to \mathbb{R}^3$ given by $L(x,y,z) = (0,0,0)$ [?]
4. $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ given by $L(x,y) = (x,y,0)$ [?]

Decide whether each of the following statements is true or false. If the statement could be true and could be false, i.e., if you need more information to decide, choose "Impossible to tell".

1. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is an injective (one-to-one) linear transformation, then $\operatorname{null} L = 0$. [?]
2. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is an injective (one-to-one) linear transformation, then $\operatorname{rank} L = 3$. [?]
3. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is a linear transformation, then $\operatorname{rank} L = 3$. [?]
4. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is a linear transformation, then $\ker L$ must be a vector space. [?]
5. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is a linear transformation, then $\operatorname{Im} L$ must be a vector space. [?]
6. If $L\colon \mathbb{R}^2 \to \mathbb{R}^3$ is a linear transformation whose kernel is a one-dimensional vector space, then L is injective (one-to-one). [?]

WeBWorK ReadingHomework24 is due : 12/03/2010 at 03:00pm PST.

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Decide whether each of the following statements is true or false. If the statement could be true and could be false, i.e., if you need more information to decide, choose "Impossible to tell".

1. Let U be the subspace of $\mathbb{R}^3$ consisting of the x-axis, and let V be the subspace of $\mathbb{R}^3$ consisting of the xy-plane. Then $U \oplus V = \text{span}(U \cup V)$. [?]

2. Let U be the subspace of $\mathbb{R}^3$ consisting of the z-axis, and let V be the subspace of $\mathbb{R}^3$ consisting of the xy-plane. Then $U \oplus V = \text{span}(U \cup V)$. [?]

3. Let U and V be subspaces of W, and suppose that there exist vectors $u \in U, v \in V, w \in U \oplus V$ such that $u+v=w$. Then it is possible to find vectors $u' \in U, v' \in V$ with $u' \neq u, v' \neq v$, such that $u'+v'=w$. [?]

4. Let $\mathbb{R}^2$ be equal to $U \oplus V$, where U is the span of the vector (a,b) and V is the span of the vector (c,d). Certainly it is true that $(0,0)$ is in both U and V, and that $(0,0)+(0,0)=(0,0)$. There are no nonzero vectors $u \in U, v \in V$ such that $u+v=(0,0)$. [?]

5. Let U and V be subspaces of W with $U \cap V = \{0_W\}$ and let $u \in U$ and $v \in V$ be vectors. Then for any constants $a,b \in \mathbb{R}$, we have that $au+bv \in U \oplus V$. [?]

6. Let U and V be subspaces of W. Then $U \oplus V = V \oplus U$. [?]

Decide whether each of the following statements is true or false. If the statement could be true and could be false, i.e., if you need more information to decide, choose "Impossible to tell". (Assume all vector spaces are finite-dimensional.)

1. Let U be the subspace of $\mathbb{R}^3$ consisting of the z-axis. Then $U^\perp$ is the xy-plane. [?]

2. Let U be a subspace of W. Then given any vector $w \in W$, there exist vectors $u \in U, v \in U^\perp$ such that $u+v=w$. [?]

3. Let U be a subspace of W. Then there exist vectors $u \neq u' \in U, v \neq v' \in U^\perp$ such that $u+v=u'+v'$. [?]

4. Let U be a subspace of W equal to all of W. That is, let $U=W$ and consider it as a subspace of itself. Then $U^\perp$ is empty, that is, there are no vectors at all inside $U^\perp$. [?]

5. Let U and V be subspaces of W with $U^\perp = V$. Then $V^\perp = U$. [?]

WeBWorK ReadingHomework25 is due : 12/05/2010 at 03:00pm PST.

Visit **http://www.math.ucdavis.edu/ wally/teaching/22A/22A.html** for the syllabus, grading policy and other information.

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Let M be an $m \times n$ matrix and let V be a vector in $\mathbb{R}^m$.

Decide whether each of the following statements is true or false.

1. The matrix $M^T M$ must be a square matrix. [?]

2. The equation $MX = V$ must have a solution. That is, there must be some vector X such that $MX = V$. [?]

3. If X_0 is some vector in $\mathbb{R}^n$ such that $MX_0 = V$, then $X = X_0$ must be a least-squares solution to $MX = V$. [?]

4. If X_0 is some vector in $\mathbb{R}^n$ so that $X = X_0$ is a least-squares solution to $MX = V$, then it must also be true that $MX_0 = V$. [?]