This print-out should have 12 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

MatrixVecProd04
001 10.0 points

Determine $\mathbf{v}\mathbf{u}^T$ when

$$\mathbf{u} = \begin{bmatrix} -3 \\ 2 \\ -5 \end{bmatrix}, \qquad \mathbf{v} = \begin{bmatrix} a \\ b \\ c \end{bmatrix}.$$

1. $\mathbf{v}\mathbf{u}^T = \begin{bmatrix} -3a & 2a & -5a \\ -3b & 2b & -5b \\ -3c & 2c & -5c \end{bmatrix}$

2. $\mathbf{v}\mathbf{u}^T = -5a + 2b - 3c$

3. $\mathbf{v}\mathbf{u}^T = \begin{bmatrix} -3a & -3b & -3c \\ 2a & 2b & 2c \\ -5a & -5b & -5c \end{bmatrix}$

4. $\mathbf{v}\mathbf{u}^T = -3a + 2b - 5c$

InverseMatrix01a
002 10.0 points

Solve for X when $AX + B = C$,

$$A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}, \quad B = \begin{bmatrix} 2 & 2 \\ -1 & 3 \end{bmatrix},$$

and

$$C = \begin{bmatrix} 4 & 2 \\ 1 & 2 \end{bmatrix}.$$

LUDecomp06h
003 10.0 points

Find L in an LU decomposition of

$$A = \begin{bmatrix} 4 & -2 & 2 & -2 \\ 16 & -8 & 11 & -7 \\ -12 & 6 & -3 & 4 \end{bmatrix}.$$

1. $L = \begin{bmatrix} 2 & 0 & 0 \\ 4 & 2 & 0 \\ -3 & 1 & 2 \end{bmatrix}$

2. $L = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ -3 & 1 & 1 \end{bmatrix}$

3. $L = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 3 & -1 & 1 \end{bmatrix}$

4. $L = \begin{bmatrix} -1 & 0 & 0 \\ 4 & -1 & 0 \\ -3 & 1 & -1 \end{bmatrix}$

5. $L = \begin{bmatrix} 1 & 0 & 0 \\ -4 & 1 & 0 \\ 3 & 1 & 1 \end{bmatrix}$

6. $L = \begin{bmatrix} 1 & 0 & 0 \\ -4 & 1 & 0 \\ -3 & -1 & 1 \end{bmatrix}$

Subspace05a
004 10.0 points

Let H be the set of all vectors

$$\begin{bmatrix} a-2b \\ ab+3a \\ b \end{bmatrix}$$

where a and b are real. Determine if H is a subspace of $\mathbb{R}^3$, and then check the correct answer below.

1. *H is a subspace of $\mathbb{R}^3$ because it can be written as Span$\{\mathbf{v}_1, \mathbf{v}_2\}$ with $\mathbf{v}_1$, $\mathbf{v}_2$ in $\mathbb{R}^3$.*

2. *H is not a subspace of $\mathbb{R}^3$ because it is not closed under vector addition.*

3. *H is not a subspace of $\mathbb{R}^3$ because it does not contain $\mathbf{0}$.*

4. *H is a subspace of $\mathbb{R}^3$ because it can be written as Nul(A) for some matrix A.*

Invertible01/02
005 10.0 points

A is an $n \times n$ matrix. Which of the following statements are equivalent to A being invertible?

(i) *The equation $A\mathbf{x} = \mathbf{0}$ has infinitely many solutions.*

(ii) *A is row equivalent to the $n \times n$ identity matrix.*

(iii) *The columns of A do not form a basis of $\mathbb{R}^n$.*

1. ii

2. i

3. i and iii

4. iii

5. All of these

6. ii and iii

Rank02c
006 10.0 points

Determine the rank of the matrix

$$A = \begin{bmatrix} 1 & -1 & -1 \\ -2 & 2 & -1 \\ -1 & 1 & -1 \end{bmatrix}.$$

1. $\text{rank}(A) = 5$
2. $\text{rank}(A) = 3$
3. $\text{rank}(A) = 2$
4. $\text{rank}(A) = 1$
5. $\text{rank}(A) = 4$

DetVolume01a
007 10.0 points

Compute the volume of the parallelepiped with adjacent edges $\overline{OP}$, $\overline{OQ}$, and $\overline{OR}$ determined by vertices

$$P(4, -2, -4), \quad Q(2, -1, -3), \quad R(2, 2, -3),$$

where O is the origin in 3-space.

1. volume $= 13$
2. volume $= 14$
3. volume $= 12$
4. volume $= 11$
5. volume $= 10$

BasisNul01a
008 10.0 points

Find a basis for the Null space of the matrix

$$A = \begin{bmatrix} 3 & -3 & 6 & -3 \\ -1 & 1 & 0 & 7 \\ -3 & 3 & -9 & -3 \end{bmatrix}.$$

is a basis for $\mathrm{Nul}(A)$.

Basis03a
009 10.0 points

In the vector space V of all real-valued functions, find a basis for the subspace

$$H = \mathrm{Span}\{\sin t,\ \sin 2t,\ \sin t \cos t\}.$$

1. $\{\sin t,\ \sin 2t,\ \sin t \cos t\}$

2. $\{\cos t,\ \sin 2t\}$

3. $\{\cos t,\ \sin 2t,\ \sin t \cos t\}$

4. $\{\sin 2t,\ \sin t \cos t\}$

5. $\{\sin t,\ \sin 2t\}$

PolyCoordVec01a
010 10.0 points

Find the coordinate vector $[\mathbf{p}]_{\mathcal{B}}$ in $\mathbb{R}^3$ for the polynomial

$$\mathbf{p}(t) = 1 + 4t + 7t^2$$

with respect to the basis

$$\mathcal{B} = \left\{1 + t^2,\ t + t^2,\ 1 + 2t + t^2\right\}$$

for $\mathbb{P}_2$.

1. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} -2 \\ -6 \\ 1 \end{bmatrix}$

2. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} 2 \\ 6 \\ -1 \end{bmatrix}$

3. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} -1 \\ 2 \\ 6 \end{bmatrix}$

4. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} 1 \\ 2 \\ -6 \end{bmatrix}$

5. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} -6 \\ 1 \\ 2 \end{bmatrix}$

6. $[\mathbf{p}]_{\mathcal{B}} = \begin{bmatrix} 6 \\ -1 \\ -2 \end{bmatrix}$

ChangeBasis01b

011 **10.0 points**

Determine the change of coordinates matrix $P_{\mathcal{C}\leftarrow\mathcal{B}}$ from basis $\mathcal{B} = \{\mathbf{b}_1, \mathbf{b}_2\}$ to $\mathcal{C} = \{\mathbf{c}_1, \mathbf{c}_2\}$ of a vector space V when

$$\mathbf{b}_1 = 6\mathbf{c}_1 - 2\mathbf{c}_2, \qquad \mathbf{b}_2 = 9\mathbf{c}_1 - 4c_2 .$$