

Gaussian Elimination plays a big role in the first chapters...

Gaussian Elimination

Maybe already seen

plus

important why it linear algebra works

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1.10	Linear Models in Business, Science, and Engineering	Supplementary Exercises 89

Chapter 2 Matrix Algebra 93

INTRODUCTORY EXAMPLE: Computer Models in Aircraft I

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2.9	Dimension and Rank	155

Spiral method of teaching mathematics...keep switching back and forth between topics to give people a chance to catch up...

linear works

2.8	Subspaces of \mathbb{R}^n	148
2.9	Dimension and Rank	Supplementary Exercise

We take a break discussing dimension and rank

Chapter 3 Determinants 165

INTRODUCTORY EXAMPLE: Rai

3.1	Introduction to Determinants
3.2	Properties of Determinants
3.3	Cramer's Rule, Volume
	Supplementary Exercise

Catch up with dimension and rank while learning determinant so everyone can continue together in chapter 4...

Learning more about dimension and rank...

intents

Chapter 4 Vector Spaces 191

INTRODUCTORY EXAMPLE: Space F

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through more in strange

Chapter 5 Eigenvalues and Eigenvectors

Gaussian Elimination

Theory of Determinants

INTRODUCTORY EXAMPLE: Dynamical Systems 2

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Same thing happens here...

Take a break from the eigenvalue eigenvector problem to discuss Gram-Schmidt and least squares...

Chapter 6 Orthogonality and Least Squares

New algorithm

Started engineers

INTRODUCTORY EXAMPLE: The North American and GPS Navigation 331

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Chapter 7 Symmetric Matrices and Quadratic Forms

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Finish line

generalization of eigenvector eigenvalue problem

INTRODUCTORY EXAMPLE: Multivariable Calculus 399

7.1	Diagonalization of Symmetric Matrices	
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7.3	Constrained Optimization	
7.4	The Singular Value Decomposition	
7.5	Applications to Image Processing	
	Supplementary Exercises	

This gives people time to catch up with the eigenvalue and eigenvectors before Chapter 7 which generalizes the eigenvalue eigenvector problem...to create the singular value decomposition...

Chapter 8 The Geometry of Vector Spaces

INTRODUCTORY EXAMPLE: The Plane 435

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While the spiral method at first looks like someone threw the pages for the book down the stairs and then put them back together in a random order...

The advertising claims that it allows those who fall behind time to catch up while other topics are being discussed while at the same time providing something new each time for people who keep pace with the course...

I'd prefer to cover one topic in depth before going on to the next topic... In either case, the thing to remember is that techniques get used again and again once learned, so it's never useful to forget a topic once the chapter is done...

THEOREM 5

If A is an $m \times n$ matrix, \mathbf{u} and \mathbf{v} are vectors in \mathbb{R}^n , and c is a scalar, then:

- a. $A(\mathbf{u} + \mathbf{v}) = A\mathbf{u} + A\mathbf{v}$;
- b. $A(c\mathbf{u}) = c(A\mathbf{u})$.

PROOF For simplicity, take $n = 3$, $A = [\mathbf{a}_1 \ \mathbf{a}_2 \ \mathbf{a}_3]$, and \mathbf{u}, \mathbf{v} in \mathbb{R}^3 . (The proof of the general case is similar.) For $i = 1, 2, 3$, let u_i and v_i be the i th entries in \mathbf{u} and \mathbf{v} , respectively. To prove statement (a), compute $A(\mathbf{u} + \mathbf{v})$ as a linear combination of the columns of A using the entries in $\mathbf{u} + \mathbf{v}$ as weights.

$$[u_1 + v_1]$$

lin. comb of vectors with free vbls as the parameters...

$$X = \begin{bmatrix} 0 \\ -24/7 \\ 0 \\ 17/7 \\ 2/7 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} x_1 + \begin{bmatrix} 0 \\ -2 \\ 1 \\ 0 \\ 0 \end{bmatrix} x_3$$

$x = s\mathbf{u} + t\mathbf{v}$

$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$	$\begin{matrix} F \\ P \end{matrix}$	$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$	$\begin{matrix} F \\ P \end{matrix}$	$\begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}$	$\begin{matrix} P \\ P \end{matrix}$	$\begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$	$\begin{matrix} P \\ P \end{matrix}$	$\begin{bmatrix} -24/7 \\ 17/7 \\ 2/7 \end{bmatrix}$
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since in the homogeneous case +0 the right-hand side starts zero then there is no const. vec. in the soln.

$x = s\mathbf{u} + t\mathbf{v} \quad (s, t \text{ in } \mathbb{R})$

to emphasize that the parameters vary over all real numbers. In Example 1, the equation

The set all vectors x of this form as s and t range over all real #'s is called a subspace ...

DEFINITION

An indexed set of vectors $\{v_1, \dots, v_p\}$ in \mathbb{R}^n is said to be **linearly independent** if the vector equation

$$x_1 v_1 + x_2 v_2 + \dots + x_p v_p = 0 \quad Ax = 0 \quad (1)$$

has only the trivial solution. The set $\{v_1, \dots, v_p\}$ is said to be **linearly dependent** if there exist weights c_1, \dots, c_p , not all zero, such that

$$c_1 v_1 + c_2 v_2 + \dots + c_p v_p = 0 \quad Ac = 0 \quad (2)$$

non zero solution

put coef. in the matrix

Understands using matrix-vector mult...

$$A = \begin{bmatrix} | & | & & | \\ v_1 & v_2 & \dots & v_p \\ | & | & & | \end{bmatrix}$$

then the eq. (1) is $Ax = 0$

Use G. Elim. to find the (reduced) row echelon form of A .

$$A = \begin{bmatrix} \boxed{1} & * & * & * & * & * \\ 0 & \boxed{1} & * & * & * & * \\ 0 & 0 & 0 & \boxed{1} & * & * \\ 0 & 0 & 0 & 0 & 0 & \boxed{1} \end{bmatrix}$$

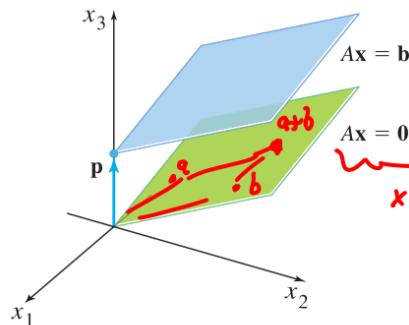
(P, P, F, P, F, P)

Ask question: are there any free variables? Two free vbls...

If only one soln. no free vbls...

If free vbls then many solns.

Lin. Dependent...



*$x = su + tv$
for s, t all real $\neq 0$
ie. $s, t \in \mathbb{R}$.*

Subspaces are sets of points that form a plane or hyperplane which passes through the origin.

FIGURE 6 Parallel solution sets of $Ax = b$ and $Ax = 0$.