Linear algebra with applications solution manual

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 7th Edition Keith Nicholson 2 Comments 0 Like Statistics Notes Be the first to like this 1. Foreword This solutions manual is designed to accompany the eighth edition of Linear Algebra with Applications by Steven J. Leon. The answers in this guide are those listed in the key to the textbook. In addition, this manual contains the complete solutions to all the non-routinian exercises in the book. At the end of each chapter of the textbook there are two chapter tests (A and B) and part of computer exercises to be solved using MATLAB. The questions in each Chapter Test A must be answered as either true or false. Although the true-false answers are given in the answer section of the textbook, students are required to explain or prove their answers. This guide contains explanations, reviews and counter-tests for all chapter test A questions. The chapter tests marked B contain problems similar to those in the chapter. The answers to these problems are not provided in the Answers to Selected Exercises section of the textbook, but they are available in this guide. Complete solutions are given for all the non-Routinian Chapter Test B exercises. In MATLAB exercises most of the calculations are straightforward. They are not included in this solution manual. On the other hand, the text also contains questions relating to the calculations. The purpose of the questions is to emphasise the importance of the calculations. The solutions human-ual provide answers to most of these questions. There are some questions to which it is not possible to give a single answer. For example, some exercises involve randomly generated matrices. In these cases, the answers may depend on the specific random matrices that were generated. Steven J. Leon sleon@umassd.edu Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. Solutions Manual for Linear Algebra with Applications 8th Edition by Leon Full Download: Full download all chapters immediately go to Solutions Manual, Test Bank site: TestBankLive.com 2. Content 1 1 Matrices and Systems of Equations 1 1 Systems of Linear Equations 1 2 Row Echelon Form 3 3 Matrix Arithmetic 4 4 Matrix Algebra 7 5 Elementary Matrices 13 6 Partitioned Matrices 19 MATLAB Exercises Ne 23 Chapter Test A 25 Chapter Test B 28 2 Determinants 31 1 Determinant of a Matrix 31 2 Determinants 34 3 Additional Subjects and Applications 38 MATLAB Exercises 40 Chapter Test A 40 Chapter Test B 42 3 Vector Spaces 44 1 Definition and Examples 44 2 Subspaces 49 3 Linear Independence 53 4 Basis and Dimension 57 5 Change of base 60 6 Row space and column Space 60 MATLAB Exercises 69 Chapter Test A 70 Chapter Test B 72 iii Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 3rd 4 Linear Transformations 76 1 Definition and Examples 76 2 Matrix Representations of Linear Transformations 80 3 Equality 82 MATLAB Exercises 84 Chapter Test A 84 Chapter Test B 86 5 Orthogonality 88 1 Skalar product in Rn 88 2 Orthogonal Subspaces 91 3 Minimum Squares Problems 94 4 Inner Product Spaces 98 5 Orthopaintermal Set 104 6 Gram-Schmidt Process 113 7 Orthogonal Polynomials 115 MATLAB Exercises 119 Chapter Test A 120 Chapter Test B 122 6 Revalues 126 1 Eigenvalues and Eigenvectors 126 2 Systems of Linear Differential Equations 132 3 Diagonalisation 133 4 Hermitian Matrices 142 5 Singular Value Degradation 150 6 Square Shapes 153 7 Positive Determined Matrices 156 8 Non-G MatativeRices 159 MATLAB Exercises 16 1 Chapter Test A 165 Chapter Test B 167 7 Numerical Linear Algebra 171 1 Floating-Point Numbers 171 2 Gaussian Elimination 171 3 Pivoting Strategies 173 4 Matrix Norms and State Numbers 174 5 Orthogontic Transformations 186 6 Eigenvalue Problem 188 7 Least Squares Problems 192 MATLAB Exercises 195 Chapter Test A 197 Chapter Test B 198 Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 4. Chapter1 Matrices and systems of equations 1 systems of linear equations 2. (d) ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 1 1 1 1 1 0 2 1 −2 1 0 0 4 1 −2 0 0 0 1 −3 0 0 0 0 2 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 5. (a) 3x1 + 2x2 = 8 x1 + 5x2 = 7 1 Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 5. 2 Chapter 1 • Matrices and systems of equations (b) 5x1 − 2x2 + x3 = 3 2x1 + 3x2 − 4x3 = 0 (c) 2x1 + x2 + 4x3 = −1 4x1 − 2x2 + 3x3 = 4 5x1 + 2x1 + 2x1 + 2x1 + 2x12x1 + 2x3 2 + 6x2 = −1 (d) 4x1 − 3x2 + x3 + 2x4 = 4 3x1 + x2 − 5x3 + 6x4 = 5 x1 + x2 + 2x3 + 4x4 = 8 5x1 + x2 + 3x3 − 2x4 = 7 9. Considering the system −m1x1 + x2 = b1 −m2x1 + x2 = b2, you can eliminate the variable x2 by dragging the first row from the second. The corresponding system −m1x1 + x2 = b1 (m1 − m2)x1 = b2 − b1 (a) If m1 = m2 can be solved, then the second equation for x1 x1 = b2 b1 m1 − m2 You can then put this value of x1 in the first equation and solve for x2. So if m1 = m2, there will be a unique ordered pair (x1, x2) that meets the two equations. (b) If m1 = m2, the x1 expression falls into the second equation 0 = b2 − b1 This is possible if and only if b1 = b2. c) If m1 = m2, the two equations represent lines of the aircraft with different slopes. Two non-in-the-like lines intersect in a point. This point will be the unique solution to the system. If m1 = m2 and b1 = b2, both equations represent the same line, and therefore each point on that line will satisfy both equations. If m1 = m2 and b1 = b2, the equations represent parallel lines. Because parallel lines do not intersect, there is no point on both lines and thus no solution to the system. 10. The system must be consistent as (0,0) is a solution. 11. A linear equation in 3 unknowns represents a plane in three rooms. The solution set to a 3 × 3 linear system would be the set of all points that lie on all three planes. If the planes are parallel or a plane is parallel to the intersection of the other two, the resolution set will be empty. The three equations can represent the same plan, or the three planes can all cross each other in a line. In both cases, the solution set will contain infinitely many points. If the three planes intersect in a point, the solution set will contain only that point. Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 6. Section 2 • Row Echelon Form 3 2 ROW Echelon FORM 2. b) The system is consistent with a unique solution (4, −1). 4. (b) x1 and x3 are lead variables and x2 is a free variable. (d) x1 and x3 are lead variables, and x2 and x4 are free variables. (f) x2 and x3 are lead variables and x1 is a free variable. 5. (l) The solution is (0, −1,5, −3,5). 6. (c) The action set consists of all ordered triples of the form (0, −α, α). 7. A homogeneous linear equation in 3 unknowns corresponds to a plane passing through the origin of 3-space. Two such equations would correspond to two planes through the origin. If one equation is a multiple of the other, both represent the same plan through the origin, and each point at that level will be a solution to the system. If one equation is not a multiple of the other, then we have two different planes that cut into a line through the origin. Each point on the line intersection will be a solution to the linear system. So in both cases the system must have infinitely many solutions. In the case of a non-accumulative 2 × 3 linear system, the equations respond to plans that do not both pass through the origin. If one equation is a multiple of the other, then both represent the same plan, and there are infinitely many solutions. If the equations represent plans that are parallel, does not intersect and thus the system will have no solutions. If the equations represent different planes that are not parallel, then they must cross each other in a line, and thus there will be infinitely many solutions. So the only options for a nonhomogen 2 × 3 linear system are 0 or infinitely many solutions. 9. (a) As the system is homogeneous, it must be uniform. 13. A homogeneous system is always consistent as it has the trivial solution (0, . ., 0). If the reduced range of echelon form of coefficient matrix involves free variables, then there will be infinitely many solutions. If there are no free variables, then the trivial solution will be the only soltion. 14. A non-homogenic system may be inconsistent, in which case there would be no solutions. If the system is consistent and underdetermined, then there will be free variables, and that would mean that we will have infinitely many solutions. 16. At each junction, the number of vehicles entering shall correspond to the number of vehicles leaving for the flow of traffic. This condition leads to the following system of equations x1 + a1 = x2 + b1 x2 + a2 = x3 + b2 x3 + a3 = x4 + b3 x4 + a4 = x1 + b4 If we add all four equations we get x1 + x2 + x3 + x4 + a1 + a2 + a3 + a4 = x1 + x2 + x3 + x4 + b1 + b2 + b3 + b4 Copyright © 2010 Pearson Education, Inc. Release as Prentice Hall. 7. 4 Chapter 1 • Matrices and equation systems and thus a1 + a2 + a3 + a4 = b1 + b2 + b3 + b4 17. If (c1, c2) is a solution, then a11c1 + a12c2 = 0 a21c1 + a22c2 = 0 Multiplying of both equations through α, you get a11(αc1) + a12(αc2) = α · 0 = 0 a21(αc1) + a22(αc2) = α · 0 = 0 Thus (αc1, αc2) is also a solution. 18. (a) If x4 = 0 then x1, x2 and x3 will all be 0. So if no glucose is produced then there is no reaction. (0,0, 0, 0) is the trivial solution in the sense that if there are no molecules of carbon dioxide and water, then there will be no reaction. (b) If we choose a different value of x4, say x4 = 2, then we end up with resolution x1 = 12, x2 = 12, x3 = 12, x4 = 2. Note that ratios are still 6:6:6:1. 3 MATRIX ARITHMETIC 1. (e) ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 8 −15 11 0 −4 −3 −1 −6 6 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ (g) ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 5 −10 15 5 -1 4 8 -9 6 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 2. (d) ⎛ ⎜ ⎜ ⎝ 36 10 56 10 3 16 ⎞ ⎟ ⎟ ⎠ 5. (a) 5A = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 15 20 5 10 35 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 2A + 3A = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 6 8 2 2 4 14 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 9 12 3 6 21 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 15 20 5 10 35 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ (b) 6A = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 18 24 6 6 12 42 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 3(2A) = 3 ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 6 8 2 2 4 14 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 18 24 6 6 12 42 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ (c) AT= ⎛ ⎜ ⎜ ⎝ 3 1 2 4 1 7 ⎞ ⎟ ⎟ ⎠ Copyright © Pearson Education, Inc. Publishing som Prentice Hall. 8. Afsnit 3 • Matrix Aritmetiske 5 (AT)T = ⎛ ⎜ ⎜ ⎝ 3 1 2 4 1 7 ⎞ ⎟ ⎟ ⎠ T = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 3 4 1 1 2 7 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = A 6. a) A + B = ⎛ ⎜ ⎜ ⎝ 5 4 6 0 5 1 ⎞ ⎟ ⎟ ⎠ = B + A (b) 3(A + B) = 3 ⎛ ⎜ ⎜ ⎝ 5 4 6 0 5 1 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 15 12 18 0 15 3 ⎞ ⎟ ⎟ ⎠ 3A + 3B = ⎛ ⎜ ⎜ ⎝ 12 3 18 6 9 15 ⎞ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎝ 3 9 0 −6 −12 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 15 12 18 0 15 3 ⎞ ⎟ ⎟ ⎠ (c) (A + B)T = ⎛ ⎜ ⎜ ⎝ 5 4 6 0 5 1 ⎞ ⎟ ⎟ ⎠ T = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 5 0 4 6 1 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ AT + BT = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 4 2 1 3 6 5 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 1 −2 3 2 0 −4 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 5 0 4 5 6 1 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ 7. a) 3(AB) = 3 ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 5 14 15 42 0 16 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 15 42 45 126 0 48 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ (3A)B = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 6 3 18 9 −6 12 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 2 4 1 6 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 15 42 45 126 0 48 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ A(3B) = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 2 1 6 3 −2 4 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 6 12 3 18 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 15 42 45 126 0 48 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ (b) (AB)T = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 5 14 15 42 0 16 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ T = ⎛ ⎜ ⎜ ⎝ 5 15 0 14 42 16 ⎞ ⎟ ⎟ ⎠ AT = ⎛ ⎜ ⎜ ⎝ 2 1 4 6 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 2 6 −2 1 3 4 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 5 15 0 14 42 16 ⎞ ⎟ ⎟ ⎠ 8. a) (A + B) + C = ⎛ ⎜ ⎜ ⎝ 0 5 1 7 ⎞ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎝ 3 1 2 1 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 3 6 3 8 ⎞ ⎟ ⎟ ⎠ A + (B + C) = ⎛ ⎜ ⎜ ⎝ 2 4 1 3 ⎞ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎝ 1 2 2 5 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 3 6 3 8 ⎞ ⎟ ⎟ ⎠ (b) (AB)C = ⎛ ⎜ ⎜ ⎝ −4 18 −2 13 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 3 1 2 1 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 24 14 20 11 ⎞ ⎟ ⎟ ⎠ A(F.KR) = ⎛ ⎜ ⎜ ⎝ 2 4 1 3 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ −4 −1 8 4 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 24 14 20 11 ⎞ ⎟ ⎟ ⎠ (c) A(B + C)) = ⎛ ⎜ ⎜ ⎝ 2 4 1 3 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 1 2 2 5 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 10 24 7 17 ⎞ ⎟ ⎟ ⎠ Copyright © 2010 Pearson Education , Inc. Udgivelse som Prentice Hall. 9. 6 Kapitel 1 • Matricer og ligningssystemer AB + AC = ⎛ ⎜ ⎜ ⎝ −4 18 −2 13 ⎞ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎝ 14 6 9 4 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 10 24 7 17 ⎞ ⎟ ⎟ ⎠ (d) (A + B)C = ⎛ ⎜ ⎜ ⎝ 0 5 1 7 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ 3 1 2 1 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 10 5 17 8 ⎞ ⎟ ⎟ ⎠ AC + BC = ⎛ ⎜ ⎜ ⎝ 14 6 9 4 ⎞ ⎟ ⎟ ⎠ + ⎛ ⎜ ⎜ ⎝ −4 −1 8 4 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 10 5 17 8 ⎞ ⎟ ⎟ ⎠ 9. b) x = (2, 1)T er en opløsning, da b = 2a1 +a2. Der er ingen andre løsninger, da echelon form af A er strengt trekantet. c) Opløsningen på Ax = x = (−5 2 , −1 4)T . Therefore c = −5 2 a1 − 1 4 a2. 11. The information provided implies that x1 = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 1 1 0 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ and x2 = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 0 1 1 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ are both solutions to the system. So the system is consistent and since there is more than one solution the range echelon form of A must involve a free variable. A uniform system with a free variable has endless solutions. 12. The system is uniform because x = (1, 1, 1, 1)T is a solution. The system can have no more than 3 lead variables, as A has only 3 rows. Therefore, there must be at least one free variable. A uniform system with a free variable has endless solutions. 13. (a) The reduced range of echelon form indicates that the free variables are x2, x4, x5. If we put x2 = a, x4 = b, x5 = c, then x1 = −2 − 2a − 3b − c x3 = 5 − 2b − 4c and thus the resolution of all vectors of the form x = (−2 − 2a − 3b − c, a, 5 − 2b − 4c, b, c)T (b) If we set the free variables to 0, then x0 = (−2, 0, 5, 0, 0)T is a resolution of Ax = b and thus b = Ax0 = −2a1 + 5a3 = (8, −7, −1, 7)T 14. AT is a n × m matrix. Since AT has m columns and A has m rows, multiplication AT A is possible. Multiplication AT is possible because A has n columns and AT has n rows. 15. If A is skewed symmetrical, then MUST AT = −A. Since (j, j) entering AT is ajj and (j, j) entry of −A is −ajj, follows what is ajj = −ajj for each j and thus diagonal inputs of A must all be 0. 16. The search vector is x = (1, 0, 1, 0, 1, 0)T . The search result is given by the vector y = AT x = (1, 2, 2, 1, 1, 2, 1)T The ith entry of y equals the number of keywords in the title of the ith book. Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 10th Section 4 • Matrix Algebra 7 17. If α = a21/a11, ⎛ ⎜ ⎜ ⎝ 1 0 α 1 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ a11 a12 0 b ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ a11 a12 αa11 + b ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ a11 a12 a21 αa12 + b ⎞ ⎟ ⎟ ⎠ The product is equal to A with αa12 + b = a22 Thus we must choose b = a22 − αa12 = a22 − a21a12 a11 4 MATRIX ALGEBRA 1. (a) (A+B)2 = (A+B)(A+B) = (A+B)A+(A+B)B = A2 +BA+AB+B2 For real numbers ab + ba = 2ab with matrices, AB + BA is generally not equal to 2AB. (b) (A + B)(A − B) = (A + B)(A − B) = (A + B)A − (A + B)B = A2 + BA − AB − B2 In the case of real numbers ab−ba = 0, with matrices, AB−BA is generally not equal to O. 2. If we replace one with A and B with the identity matrix, I, then both rules will work, en (A + I)2 = A2 + IA + AI + B2 = A2 + AI + AI + B2 = A2 + 2 + B2 and (A + I)(A− I) = A2 + IA − AI − I 2 = A2 + A − A − A − I2 = I2 − I2 − I2 − I2 − A2 − I2 − I2 − I2 − I2 − I2 − I2 − I2 − I2 − I2 − I2 3. There are many possible choices for A and B. Select A = ⎛ 0 1 0 0 ⎞ ⎟ ⎟ ⎠ and B = ⎛ ⎜ ⎜ ⎝ 1 1 0 0 ⎞ ⎟ ⎟ ⎠ More generally if A = ⎛ ⎜ ⎜ ⎝ a b ca cb ⎞ ⎟ ⎟ ⎠ B = ⎛ ⎜ ⎜ ⎝ db eb −da −ea ⎞ ⎟ ⎟ ⎠ then AB = O for any choice of scales a, b, c, d, e. 4. To construct nonzero matrices A, B, C with the desired properties, first find nonzero matrices C and D such that DC = O (see Exercise 3). Next, for any non-zero matrix A, set B = A + D. It follows that BC = (A + D)C = AC + DC = AC + O = AC Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 11. 8 Chapter 1 • Matrices and equation systems 5. A 2 × 2 symmetrical matrix is one of the form A = ⎛ ⎜ ⎜ ⎝ a b b c ⎞ ⎟ ⎟ ⎠ Thus A2 = ⎛ ⎜ ⎜ ⎝ a2 + b2 ab + bc ab + bc b2 + c2 ⎞ ⎟ ⎟ ⎠ If A2 = O, its diagonal inputs shall be 0. a2 + b2 = 0 and b2 + c2 = 0 Thus a = b = c = 0 and thus A = O. 6. Let D = (AB)C = ⎛ ⎜ ⎜ ⎝ a11b11 + a12b21 a11b12 + a12b22 a21b11 + a22b21 a21b12 + a22b22 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ c11 c12 c21 c22 ⎞ ⎟ ⎟ ⎠ It follows, at d11 = (a11b11 + a12b21)c11 + (a11b12 + a12b22)c21 = a11b11c11 + a12b21c11 + a11b12c21 + a12b22c21 d12 = (a12b21c12 = (a12b22c21 d12 = (a12b21c12 a11b11 + a12b21)c12 + (a11b12 + a12b22)c22 = a11b11c12 + a12b21c12 + a11b12c22 + a12b22c22 d21 = (a21b11 + a22b21)c11 + (a21b12 + a22b22)c21 = a21b11c11 + a22b21c11 + a21b12c2122b22c21 d22 = (a21b11 + a22b 21)c12 + (a21b12 + a22b22)c22 = a21b11c12 + a22b21c12 + a21b12c22 + a22b22c22 If we put E = A(BC) = ⎛ ⎜ ⎜ ⎝ a11 a12 a21 a22 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ b11c11 + b12c21 b11c12 + b12c22 b21c11 + b22c21 b21c12 + b22c22 ⎞ ⎟ ⎟ ⎠ then it follows that e11 = a11(b11c11 + b12c21) + a12(b21c11 + b22c21) = a11b11c11 + a11b12c21 + a12b21c11 + a12b22c21 e12 = a11(b11c12 + b12c22) + a12(b21c12 + b22c22) = a11b11c12 + a11b12c22 + a12b21c12 + a12b22c22 e21 = a21(b11c11 + b12c21) + a22(b21c11 + b22c21) = a21b11c11 + a21b12c21 + a22b21c11 + a22b22c21 e22 = a21(b11c12 + b12c22) + a22(b21c12 + b22c22) = a21b11c12 + a21b12c22 + a22b21c12 + a22b22c22 Thus d11 = e11 d12 = e12 d21 = e21 d22 = e22 and hence (AB)C = D = E = A (BC) Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 12. Section 4 • Matrix Algebra 9 9. A2 = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 0 0 0 1 0 0 0 0 0 0 0 0 0 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ A3 = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠0 If n > 4 , then an = An−4 A4 = An−4 O = O 10. a) Matrix C is symmetrical, since CT = (A + B)T = AT + BT = A + B = C (b) Matrix D is symmetrical, since DT = (AA)T = AT = A2 = D (c) Matrix E = AB is not symmetrical, as ET = (AB)T = BT AT = BA and GENERAL AB = BA. d) Matrix F is symmetrical, since F T = (ABA)T = AT BT AT = ABA = F (e) Matrix G is symmetrical then GT = (AB+BA)T = (AB)T +(BA)T = BT AT +AT BT = BA+AB = G (f) Matrix H is not symmetrical, as HT = = (AB)T −(BA)T = BT VED BT = BA−AB = −H 11. a) Matrix A is symmetrical since AT = (C + CT)T = CT + (CT)T = CT + C = A (b) Matrix B is not symmetrical, as BT = (C CT) T = CT − (CT)T = CT − C = C = −B (c) matrix D is symmetrical, da AT = (CT C)T = CT (CT)T = CT C = D (d) Matrix E is symmetrical since ET = (CT C − CCT)T = (CT C)T − (CCT)T = CT (CT)T − (CT)T CT = CT C − CCT = E(e) Matrix F is symmetrical, then F T = ((I +C)(I +CT))T = (I +CT)T (I +C)T = (I +C)(I +CT) = F Copyright © 2010 Pearson Education Inc. Publishing as Prentice Hall. 13. 10 Chapter 1 • Matrices and equation systems (s) Matrix G is not symmetrical. F = (I + C)(I − CT) = I + C − CT − CCT F T = ((I + C)(I − CT))T = (I − CT)T (I + C)T = (I − C)(I + CT) = I − C + CT − CCT F and F T are not one's. The two middle udtryk C −CT and −C +CT do not agree. 12. Hvis d = a11a22 − a21a12 = 0 derefter 1 d ⎛ ⎜ ⎜ ⎝ a22 −a12 −a21 a11 ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ a11 a12 a21 a22 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ a11a22 − a12a21 d 0 0 a11a22 − a12a21 d ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = Jeg ⎛ ⎜ ⎜ ⎝ a11 a12 a21 a22 ⎞ ⎟ ⎟ ⎠ 1 d ⎛ ⎜ ⎜ ⎝ a22 −a12 −a21 a11 ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ a11a22 − a12a21 d 0 0 a11a22 − a12a21 d ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ = Jeg derfor 1 d ⎛ ⎜ ⎜ ⎝ a222 −a12 −a21 a11 ⎞ ⎟ ⎟ ⎠ = A−1 13. b) ⎛ ⎜ ⎜ ⎝ −3 5 2 −3 ⎞ ⎟ ⎟ ⎠ 14. If A was nonsingular and AB = A, then it would follow, that A−1 AB = A−1 A and thus that B = I. So if B = I, then A should be ental. 15. Then A−1 A = AA−1 = In the following af definition, that A−1 is nonsingular and its inverse is A. 16. Then AT (A−1)T = (A−1 A)T = I (A−1)T AT = (AA−1)T = I follow it, that (A-1)T = (AT)−1 17. If Ax = Ay and x = y, then A should be ental, for if A was nonsingular then we could walk with A−1 and get A−1 Ax = A−1 Ay x = y Copyright © 2010 Pearson Education, Inc. Publishing as Prentice Hall. 14. Afsnit 4 • Matrix Algebra 11 18. For sts = 1 (A1)−1 = A−1 = (A−1)1 Antag, that the result holds in the added m = k, it will squeak, (Ak)−1 = (A−1)k It follows heraf, at (A−1)k+1 Ak+1 = A−1 (A−1)k Ak A = A−1 A = I and Ak+1 (A− 1)k+1 = AAk (A−1)k A−1 = AA−1 = I Therefore (A−1)k+1 = (Ak+1)−1, and the result follows after mathematical inductive. 19. If A2 = O, then (I + A)(I − A) = I + A − A + A2 = I and (I − A) (I + A) = I − A + A + A2 = I Therefore I − A is nonsingular and (I − A)−1 = I + A. 20. If Ak+1 = O so (I + A + · · · · · · · · ·] Acc)(I − A) = (I + A + · · · + · · · + Ak) = (I + A + · · · · · · / Ak) − (A + A2 + · · · + Ak+1) = I − Ak+1 = Therefore, I am − A is nonsingular and (I − A)−1 = I + A + A2 · · · + Alas . 21. Da RT R = ⎛ ⎜ ⎜ ⎝ cos ς its ς − its ə cos cos cos ς ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ cos ς − its ω sin ς cos cos ς cos ς ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 1 0 0 1 ⎞ ⎟ ⎟ ⎠ ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ cos ς − its ə cos ς cos ς ⎞ ⎟ ⎟ ⎠ ⎛ ⎜ ⎜ ⎝ cos ς its ω − its ω cos ς ⎞ ⎟ ⎟ ⎠ = ⎛ ⎜ ⎜ ⎝ 1 0 0 1 ⎞ ⎟ ⎟ ⎠ it follows, R is nonsingular and R−1 = RT 22. G2 = ⎛ ⎜ ⎜ ⎝ cos2 ω + sin2 ω 0 0 cos2 ω + sin2 ω ⎞ ⎟ ⎟ ⎠ = I 23. H2 = (I − 2uuT)2 = I − 4uuT + 4uuT = I − 4uuT + 4uT + 4uT + 4u(uT u)uT = I − 4uuT + 4uuT = I (da uT u = 1) Copyright © 2010 Education, Inc. Release as Prentice Hall. 15. 12 Chapter 1 • Matrices and equation systems 24. In each case, if you square the given matrix you will end up with the same matrix. 25. (a) If A2 = A thereafter (I − A)2 = I − 2A + A2 = I − 2A + A = I − A (b) If A2 = A then (I − 1 2 A)(I + A) = I − 1 2 A + A − 1 2 A2 = I − 1 2 A + A − 1 2 A = I and (I + A)(I − 1 2 A) = I + A − 1 2 A − 1 2 A = I − 1 2 A = I Therefore I + A is non-vascular and (I + A)−1 = I − 1 2 A. 26. (a) D2 = ⎛ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎜ ⎝ d2 11 0 · · · 0 0 d2 22 · · 0 ... 0 0 · · · d2 nn ⎞ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎟ ⎠ Since each diagonal input in D is equal to either 0 or 1, It follows that d2 jj = djj, for j = 1, . . ., n and thus D2 = D. (b) If A = XDX−1 , then A2 = (XDX−1)(XDX−1) = XD(X−1 X)DX−1 = XDX−1 = A 27. If A is an involution then A2 = I and it follows that B2 = 1 4 (I + A)2 = 1 4 (I + 2A + A2) = 1 4 (2I + 2A) = 1 2 (I + A) = B C2 = 1 4 (I − A)2 = 1 4 (I − 2A + A2) = 1 4 (2I − 2A) = 1 2 (I − A) = C So B and C are both idempotent. BC = 1 4 (I + A)(I − A) = 1 4 (I + A − A − A − A2) = 1 4 (I + A − A − I) = O 28. (I A) T = AT (AT)T = AT A (AAT)T = (AT)T AT = AAT 29. Let A and B be symmetrical n × n matrices. If (AB)T = AB then BA = BT AT = (AB)T = AB Reverse if BA = AB then (AB)T = BT AT = BA = AB 30. (a) BT = (A + AT)T = AT + (AT)T = AT + A = B CT = (A − AT)T = AT − (AT)T = AT − A = −C (b) A = 1 2 (A + AT) + 1 2 (A − AT) Copyright © 2010 Pearson Education, Inc. Release by Prentice Hall. Solutions Manual for Linear Algebra With Applications 8th Edition by Leon Full Download: Full download all chapters immediately go to Solutions Manual, Test Bank site: TestBankLive.com TestBankLive.com