Gaussian elimination rules pdf

Introduction We will now explore a more versatile way for method determinants to determine whether a system of equations has a solution. Indeed, we will be able to use the results of this method to find a real solution to the system (if any). It should be noted that this method can be used for equation systems with an unequal number of equations and unknowns. However, we will only discuss systems with the same number of equations and unknowns. It is easiest to illustrate this method with an example. Consider the equation system to solve for x, y, and from we need to remove some unknowns from some equations. Consider adding -2 times the first equation to the second equation, and also adding 6 times the first equation to the third equation. As a result, we have now removed the x term from the last two equations. Now simplify the last two equations by splitting 2 and 3: To delete an expression y in the last equation, multiply the second equation to -5 and add it to the third equation: The third equation says z=-2. Replacing into the second equation yields y=-1. Using both of these results in the first equation gives x =3. The process of a step-by-step solution for unknowns is called back-substitution. That's the nature of Gauss' elimination. However, we can clean up notations in our work using matrices. Convert equation system above to extended matrix: This matrix contains all the information in the equation system without x, y, and z labels to be transferred. Now perform the process above. The notation to the right of each matrix describes the line operations that were performed to obtain the matrix on this line. For example 2R_1 + R_2 -> R_2 means to replace row 2 with the sum of 2 times row 1 and row 2. If we now reverse the conversion process and turn the extended matrix into an equation system that we have now we can easily solve for x, y and from reverse substitution. Remember: For an equation system with a 3x3 coefficient matrix, the goal of the Gauss elimination process is to create (at least) a triangle of núls in the lower left corner of the matrix at a diagonal. Note that you can switch the row order at any time in an attempt to access this form. Example Let's solve the following system of equations: In the form of an extended matrix we have we now use the Gauss elimination method: We could proceed to try to replace the first element of line 2 with zero, but we can act. To find out why, convert back to equation system: Note the last equation: 0=5. That's not possible. So the system has no solutions; x, y, and z values that meet all three equations at the same time cannot be found. Example Resolve in Matrix Form: Use Gauss Elimination: Convert back to equation system: Note the last 0=0 (this resulted in equation 3 being a linear combination of the other two equations). That's always true. And we can solve the first two equations to get x and y as functions from itself. The solution to the second equation we get A for the first equation variable from in this issue is called a parameter because there are no limits to what values from can it have on. Thus, there are an infinite number of solutions - one for each value of. Examples of solutions are (-11/8,13/8,0) and (-17/8,23/8,1) that come from settings z=0 and z=1. We can briefly write all solutions as three times the form where t is some real number. [Vector Calculus Home] [Mathematics 254 Home] [Mathematics 255 Home] [Notation] [References] Copyright © 1996 Department of Mathematics, Oregon State University If you have questions or comments, do not hestitate us to contact us. The system of equations can be represented in several different matrix forms. One way is to implement the system as a matrix multiplication of coefficients in the system and a column vector of its variables. A square matrix is called a coefficient matrix because it consists of coefficients of variables in a system of equations: Matrix sums: 2x +4y+7z=43x+3y+2z=85x+6y+3z=0⟶[247332563][xyz]=[480]. \text{Product of matrices: }\quad \begin{array}{c c c c} 2x & + & 4y & + & 7z & = & 4\\ 3x & + + 3y & + & 2z & = & 8\\ 5x & + + 6y & + & 3z & = & 0 \end{array} \longrightarrow \left[\\ begin{array}{c} 2 & 4 & 7\\ 3 & 3 & 2\\ 5 & 6 & 3 \end{array} \right] \left[\begin{array }{c} x \\ y \\ from \end{array} \right] = \left[\begin{array}{c} 4 \\ 8 \\ 0 \end{} array \right]. Matrix product: 2x3x5x +++ 4y3y6y +++ 7z2z3z === 480 ⟶⌊⌈ 235 436 723 ⌋⌉ ⌊⌈ xyz ⌋⌉ =⌊⌈ 480 ⌋⌉ . An alternative representation called an extended matrix is created by sewing columns of matrices together and divided by a vertical bar. The coefficient matrix is located on the left side of this vertical bar, while the constants on the right side of each equation are located to the right of the vertical bar: Extended Matrix: 2x+4y+7z=43x+3y+2z=85x+6y+3z=0⟶[247433285630]. \text{Advanced Matrix: } \quad \quad \begin{array}{c c c c} 2x & + & 4y & + & 7z & = & 4 \\ 3x & + & 3y & + & 2z & = & 8 \\ 5x & + & 6y & + & 3z & = & 0 \\ \end{array} \longrightarrow \left[\begin{array}{c c | c} 2 & 4 & amp; 7 & 4 \\ 3 & 3 & 2 & 8 \\ 5 & 6 & 3 & 0 \end{array}\right]. Extended Matrix: 2x3x5x +++ 4y3y6y +++ 7z2z3z === 480 ⟶⌊⌈ 235 436 723 480 ⌋⌉ . The nuts representing these systems may be manipulated in such a way as to provide easy-to-read solutions. This manipulation is called line reduction. Line reduction techniques turn the nut into a reduced in-line echelon form without changing the solutions to The scaled row of the Echelon form of the AAA matrix (\big((marked rref(A)) \text{rref}(A)\big)rref(A)) is a matrix of the same dimensions that meets the following: the leftmovest non-zero element in each row is 1 1 1 1. This element is known as pivot. Each column may have a maximum of 1 1 1 pin. If the column has a rotating column, the rest of the elements in the column will be 0 0 0. For all two columns C1C_{1} C1 and C2C_{2}C2, which have rotated in rows R1 R_{1} R1 and R2, R_{2}, R2 , if the rotation in C1 C_{1} C1 on the left side of the rotation in C2 C_{2}C2 , then R1 R_{1} R1 is above R2 R_{2} R2 . In other words , for all two pins P1 P_{1}P1 and P2P_{2}P2 , if P2 P_{2} P2 is to the right of P1 P_{1} P1 , then P2 P_{2} P2 is below P1 P_{1}P1 . Rows that consist only of eduings are at the bottom of the matrix. To convert any nut to its reduced line of echelon form, Gauss-Jordan's removal is done. There are three basic line operations used to achieve a reduced row echelon form: Switch two rows. Multiply the row with any non-zero constant. Add any multiple of one row to any other row. Find rref(A) \text{rref}(A)rref(A) using Gaussian-Jordanian elimination, where A=[26−216−4−149]. A = \left[\begin{array}{c} 2 & 6 & -2\\ 1 & 6 & -4 \\ -1 & 4 & 9 \\ \end{array}\right]. A=⌊⌈ 21-1 664 −2−49 ⌋⌉ . The leftmost element in the first row must be 1, so the first row is divided by 2: [26−216−4−149]→Distributing the first row 2. [13−116−4−149]. \left[\begin{array}{c} 2 & 6 & -2\\ 1 & 6 & -4 \\ -1 & 4 & 9 \\ \\ \end{array}\right] \ce{->[\large \text{Divide the first row by 2.}]} \left[\begin{array}{c} 1 & 3 & -1\\ 1 & 6 & -4 \\ -1 & 4 & 9 \\ \\ \end{array}\right]. ⌊⌈ 21-1 664 −2−49 ⌋⌉ Divide the first row by 2. ⌊⌈ 11−1 364 −1−49 ⌋⌉ . The upper-left element is rotating, so the rest of the elements in the first column must be 0. You can do this by subtracting the first row from the second row. In addition, you can add the first row to the third row to get the necessary 0s in the first column: [13−116−4−149]→RX2-RX1 and RX3+RX1[13−103−3078]. \left[\begin{array}{c c} 1 & 3 & -1\\ 1 & 6 & -4 \\ -1 & 4 & 9 \\ \\ \end{array}\right] \ce{->[\large R_2 - R_1 text { a } R_3 + R_1]} \left[\begin{array}{c c} 1 & 3 & -1\\ 0 & 3 & -3 \\ 0 & 7 & 8 \\ \\ \end{array}\right]. ⌊⌈ 11-1 364 −1−49 ⌋⌉ RX2 −RX1 and RX3 +RX1 ⌊⌈ 100 337 −1−38 ⌋⌉ . Now that the column is far left [100], \left[\begin{array}{c} 1 \\ 0 \\ 0 \\ \end{array}\right], ⌊⌈ 100 ⌋⌉ , the middle element can be 1 split second row 3: [13−103−3078]→Seal the second row by 3. [13−101−1078]. \left[\begin{array}{c} 1 & 3 & -1\\ 0 & 3 & -3 \\ 0 & 7 & 8 \\ \ce{->[\large \text{Divide the second row by 3.}]} \left[\begin{array}{c} 1 & 3 & -1\\ 0 & 1 & -1 \\ 0 & 7 & 8 \\ \\ \end{array}\right]. ⌊⌈ 100 337 −1−38 ⌋⌉ Divide the second row by 3. ⌊⌈ 100 317 −1−18 ⌋⌉ . The upper and lower elements in the second column may be 0 with the corresponding row operations: [13−101−1078]→RX1-3 RX2 and RX3-7 RX2[10201-10015]. \left[\begin{array}{c c} 1 & 3 & -1\\ 0 & 1 & -1 \\ 0 & 7 & 8 \\ \\ \end{array}\right] \ce{->[\large R_1 - 3R_2 text { a } R_3 - 7R_2]} \left[\begin{array}{c c} 1 & 0 & 2\\ 0 & 1 & -1 \\ 0 & 0 & 15 \\ \\ \end{array}\right]. ⌊⌈ 100 317 −1−18 ⌋⌉ RX1 −3RX2 and RX3 −7RX2 ⌊⌈ 100 010 2−115 ⌋⌉ . With a middle column now [010], \left[\begin{array}{c} 0 \\ 1 \\ 0 \\ \end{array}\right], ⌊⌈ 010 ⌋⌉ , the method continues to the third column divided by the third row 15: [10201−10015]→Seal the third row 15. [10201-1001]. \left[\begin{array}{c} 1 & 0 & 2\\ 0 & 1 & -1 \\ 0 & 0 & 15 \\ \\ \end{array}\right] \ce{->\large \text{Split third row by 15.} \left[\begin{array}{c} 1 & 0 & 2\\ 0 & 1 & -1 \\ 0 & 0 & 1 \\ \\ \end{array}\right]. ⌊⌈ 100 010 2-115 ⌋⌉ Divide the third row by 15 ⌊⌈ 100 010 2–11 ⌋⌉ . In the last step of the process, multiples of the third row are added to the first and second to make the last column [001]: \left[\begin{array}{c} 0 \\ 0 \\ 1 \\ \\ \end{array}\right]: ⌊⌈ 001 ⌋⌉ : [10201-1001]→RX1−2 RX3 and RX2+RX3啦 [100010001]. □ \left[\begin{array}{c} 1 & 0 & 2\\ 0 & 1 & -1 \\ 0 & 0 & 1 \\ \end{array}\right] \ce{->[\large R_1 - 2R_3 \{ and } R_2 + R_3.]} \left[\begin{array}{c} 1 & 0 & 0\\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ \end{array}\right]. \ _\square ⌊⌈ 100 010 2−11 ⌋⌉ RX1 −2RX3 and RX2 +RX3 ⌊⌈ 100 010 001 ⌋⌉ . □ ⌊⌈ 100,010 2-11 ⌋⌉ RX1 -2RX3 and RX2 +RX3 ⌊⌈ 100,010,001 ⌋⌉ . □

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