An Introduction to LaTeX

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Abstract

The goal of this assignment is for me to demonstrate my newfound knowledge about using LaTeX to show how to solve a system of equations by using matrices and Gaussian elimination.

Solving the System of Equations

Introduction

Since LaTeX is a new program to me, this assignment will allow me to learn the program and demonstrate my knowledge of it while writing a scientific paper. Knowledge of the different environments and commands of LaTeX will be shown as a system of three equations is set up and then solved by using an augmented matrix and Gaussian elimination.

Setting up the System

This is the system of three equations that must be solved. It has three equations and three unknowns:

$$\begin{aligned} x + 2y + 3z &= 6 \\ 2x - y + 4z &= 8 \\ -x + 8y + 2z &= 12 \end{aligned} \tag{1}$$

The system is set up in an augmented matrix as follows so that it canbe solved through elimination:

$$A = \begin{bmatrix} 1 & 2 & 3 & 6 \\ 2 & -1 & 4 & 8 \\ -1 & 8 & 2 & 12 \end{bmatrix} \tag{2}$$

Solving the System

Now the system can be solved by changing the matrix into row eschelon form through Gaussian elimination. An upper triangular systen will be produced when the matrix is in row eschelon form.

The first non-zero entry in the first column is chosen as the first pivot number. In this case it is the very first entry, '1'.

$$A = \begin{bmatrix} 1 & 2 & 3 & 6 \\ 2 & -1 & 4 & 8 \\ -1 & 8 & 2 & 12 \end{bmatrix} \tag{3}$$

The goal is to produce zeroes below each pivot number by subtracting muliples of the pivot row from the following rows of the augmented matrix. This can be accomplished by subtracting 2 times row one from row two, and then subtracting -1 times row one from row three as well. By these operations the following new matrix is produced:

$$A = \begin{bmatrix} 1 & 2 & 3 & 6 \\ 0 & -5 & -2 & -4 \\ 0 & 10 & 5 & 18 \end{bmatrix} \tag{4}$$

The first elimination has very nicely produced zeroes beneath the first pivot. Now the second column can be manipulated in the same manner. The entry '-5' in the second column and second row is chosen as the new pivot, and now the goal is to produce a zero beneath that entry. This can be accomplished by subtracting -2 times row two from row three. This operation produces the following matrix:

$$A = \begin{bmatrix} 1 & 2 & 3 & 6 \\ 0 & -5 & -2 & -4 \\ 0 & 0 & 1 & 10 \end{bmatrix} \tag{5}$$

The matrix is now in row eschelon form and can be changed back into a system of equations and solved through back substituiton.

$$x + 2y + 3z = 6 \tag{6}$$
$$-5y - 2z = -4 \tag{7}$$
$$z = 10 \tag{8}$$

Equation (8) clearly shows the solution to the third unknown, $z = 10$. This can be substituted into the previous equation and solved to yield another unknown. This is the 'back-substitution.'

$$-5y - 2(10) = -4 \tag{9}$$

When solved, equation (9) yields the solution to the second unknown.

$$y = -\frac{16}{5} \tag{10}$$

Now that two unknowns have been solved from system equations (7) and (8), these can be plugged into equation (6) to yeild the final unknown.

$$x + 2\left(-\frac{16}{5}\right) + 3(10) = 6 \tag{11}$$

$$x = -\frac{88}{5} \tag{12}$$

System (1) has now been fully solved via Gaussian elimination and back substitution, yielding the values of the three unknowns.

$$\begin{aligned} x &= -\frac{88}{5} \\ y &= -\frac{16}{5} \\ z &= 10 \end{aligned} \tag{13}$$

Conclusion

This assignment allowed me to gain a basic working knowledge of LaTeX while solving the system of equations. I also want to briefly thank my classmate Chris Wilson for helping me learn LaTeX during this assignment.

References

[1] Arnold, David. *Writing Scientific Papers in LaTeX.*