

# Project One Template

## MAT350: Applied Linear Algebra

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### Problem 1

Develop a system of linear equations for the network by writing an equation for each router (A, B, C, D, and E). Make sure to write your final answer as  $Ax=b$  where  $A$  is the  $5 \times 5$  coefficient matrix,  $x$  is the  $5 \times 1$  vector of unknowns, and  $b$  is a  $5 \times 1$  vector of constants.

#### Solution:

For each router we will write an equation for all of the incoming connections on one side, and the outgoing connections on the other side, then rewrite so that all of the variables are on one side and the constants are on the other side.

**Router A** has 100 Mbps incoming, and  $x_1$  and  $x_2$  outgoing.  $x_1 + x_2 = 100$

**Router B** has  $x_1$  and  $x_2$  incoming, and  $x_3$  and  $x_4$  outgoing.  $x_3 + x_4 = x_1 + x_2$ . Simplified for the matrix we get  $-x_1 - x_2 + x_3 + x_4 = 0$

**Router C** has 50 Mbps incoming and  $x_2$  incoming, then  $x_3$  and  $x_5$  outgoing.  $x_3 + x_5 = x_2 + 50$ . Simplified we get  $-x_2 + x_3 + x_5 = 50$

**Router D** has  $x_3$  and  $x_5$  incoming, then  $x_4$  and 120 Mbps outgoing.  $x_4 + 120 = x_3 + x_5$ . Simplified we get  $x_3 - x_4 - x_5 = -120$

**Router E** has  $x_3$ ,  $x_4$ , and  $x_5$  incoming, then  $x_4$  outgoing.  $x_4 = x_3 + x_4 + x_5$ . Simplified we get  $-x_3 - x_5 + x_4 - x_5 = 0$

The matrix can be formed by using  $Ax=b$

$$\begin{bmatrix} 1 & 2 & 0 & 0 & 0 \\ -1 & -1 & 1 & 0 & 1 \\ 0 & -1 & 1 & 0 & 1 \\ 0 & 1 & 0 & -1 & -1 \\ 0 & -1 & -1 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \\ 50 \\ -120 \\ 0 \end{bmatrix}$$

### Problem 2

Use MATLAB to construct the augmented matrix  $[A \ b]$  and then perform row reduction using the `rref()` function. Write out your **reduced matrix** and **identify the free and basic variables of the system**.

#### Solution:

# Applied Linear Algebra And Linear Algebra Labs With Matlab

**Didier Musso**



## **Applied Linear Algebra And Linear Algebra Labs With Matlab:**

**Linear Algebra LABS with MATLAB** David R. Hill, David E. Zitarelli, 1996      Proceedings of the Fifth SIAM Conference on Applied Linear Algebra John Gregg Lewis, 1994-01-01      Exploring Linear Algebra Crista Arangala, 2025-02-26 This text focuses on the primary topics in a first course in Linear Algebra. The author includes additional advanced topics related to data analysis, singular value decomposition, and connections to differential equations. This is a lab text that would lead a class through Linear Algebra using Mathematica demonstrations and Mathematica coding. The book includes interesting examples embedded in the projects. Examples include the discussions of Lights Out, Nim, the Hill Cipher, and a variety of relevant data science projects. The 2nd Edition contains Additional Theorems and Problems for students to prove/disprove; these act as theory exercises at the end of most sections of the text. Additional sections that support Data Analytics techniques such as Kronecker sums and products and LU decomposition of the Vandermonde matrix. Updated and expanded end of chapter projects. Instructors and students alike have enjoyed this popular book as it offers the opportunity to add Mathematica to the Linear Algebra course. I would definitely use the book specifically the projects at the end of each section to motivate undergraduate research. Nick Luke, North Carolina A T State University      *Applied Abstract Algebra with Maple™ and MATLAB* Richard Klima, Neil Sigmon, Ernest Stitzinger, 2015-11-18 Applied Abstract Algebra with Maple™ and MATLAB provides an in-depth introduction to real-world abstract algebraic problems. This popular textbook covers a variety of topics including block designs, coding theory, cryptography, and counting techniques including Polya's and Burnside's theorems. The book also includes a concise review of all prerequisites.      **Linear Algebra With Machine Learning and Data** Crista Arangala, 2023-05-09 This book takes a deep dive into several key linear algebra subjects as they apply to data analytics and data mining. The book offers a case study approach where each case will be grounded in a real-world application. This text is meant to be used for a second course in applications of Linear Algebra to Data Analytics, with a supplemental chapter on Decision Trees and their applications in regression analysis. The text can be considered in two different but overlapping general data analytics categories: clustering and interpolation. Knowledge of mathematical techniques related to data analytics and exposure to interpretation of results within a data analytics context are particularly valuable for students studying undergraduate mathematics. Each chapter of this text takes the reader through several relevant case studies using real-world data. All data sets, as well as Python and R syntax, are provided to the reader through links to Github documentation. Following each chapter is a short exercise set in which students are encouraged to use technology to apply their expanding knowledge of linear algebra as it is applied to data analytics. A basic knowledge of the concepts in a first Linear Algebra course is assumed; however, an overview of key concepts is presented in the Introduction and as needed throughout the text.      Exploring Linear Algebra Crista Arangala, 2019-03-07 Exploring Linear Algebra Labs and Projects with MATLAB is a hands-on lab manual that can be used by students and instructors in classrooms every day to

guide the exploration of the theory and applications of linear algebra For the most part labs discussed in the book can be used individually or in a sequence Each lab consists of an explanation of material with integrated exercises Some labs are split into multiple subsections and thus exercises are separated by those subsections The exercise sections integrate problems using Mathematica demonstrations an online tool that can be used with a browser with Java capabilities and MATLAB coding This allows students to discover the theory and applications of linear algebra in a meaningful and memorable way Features The book s inquiry based approach promotes student interaction Each chapter contains a project set which consists of application driven projects emphasizing the chapter s materials Adds a project component to any Linear Algebra course Explores many applications to a variety of fields that can promote research projects Employs MATLAB to calculate and explore concepts and theories of linear algebra

Handbook of Linear Algebra Leslie Hogben,2006-11-02 The Handbook of Linear Algebra provides comprehensive coverage of linear algebra concepts applications and computational software packages in an easy to use handbook format The esteemed international contributors guide you from the very elementary aspects of the subject to the frontiers of current research The book features an accessibl

Linear Algebra Ward Cheney,David Kincaid,2012 Ward Cheney and David Kincaid have developed Linear Algebra Theory and Applications Second Edition a multi faceted introductory textbook which was motivated by their desire for a single text that meets the various requirements for differing courses within linear algebra For theoretically oriented students the text guides them as they devise proofs and deal with abstractions by focusing on a comprehensive blend between theory and applications For application oriented science and engineering students it contains numerous exercises that help them focus on understanding and learning not only vector spaces matrices and linear transformations but uses of software tools available for use in applied linear algebra Using a flexible design it is an ideal textbook for instructors who wish to make their own choice regarding what material to emphasis and to accentuate those choices with homework assignments from a large variety of exercises both in the text and online

**Linear Algebra with Applications** Gareth Williams,2011-08-24 Revised and edited Linear Algebra with Applications Seventh Edition is designed for the introductory course in linear algebra and is organized into 3 natural parts Part 1 introduces the basics presenting systems of linear equations vectors and subspaces of  $\mathbb{R}^n$  matrices linear transformations determinants and eigenvectors Part 2 builds on this material introducing the concept of general vector spaces discussing properties of bases developing the rank nullity theorem and introducing spaces of matrices and functions Part 3 completes the course with many of the important ideas and methods of numerical linear algebra such as ill conditioning pivoting and LU decomposition Offering 28 core sections the Seventh Edition successfully blends theory important numerical techniques and interesting applications making it ideal for engineers scientists and a variety of other majors

*Advanced Linear Algebra* Hugo Woerdeman,2015-12-23 Advanced Linear Algebra features a student friendly approach to the theory of linear algebra The author s emphasis on vector spaces over general fields with corresponding

current applications sets the book apart He focuses on finite fields and complex numbers and discusses matrix algebra over these fields The text then proceeds to cover vector spaces in depth Also discussed are standard topics in linear algebra including linear transformations Jordan canonical form inner product spaces spectral theory and as supplementary topics dual spaces quotient spaces and tensor products Written in clear and concise language the text sticks to the development of linear algebra without excessively addressing applications A unique chapter on How to Use Linear Algebra is offered after the theory is presented In addition students are given pointers on how to start a research project The proofs are clear and complete and the exercises are well designed In addition full solutions are included for almost all exercises

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In an electronic digital era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Applied Linear Algebra And Linear Algebra Labs With Matlab**," written by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we will delve in to the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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