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# Bernischer Staatskalender

auf das Jahr

1857.

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Mit einem Anhange,

enthaltend

die eidgenössischen Bundesbehörden, den Generalstab,  
die fremden Gesandten in der Schweiz  
und die  
eidgenössischen diplomatischen Agenten im Auslande.



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Bern,

Gedruckt in der Stämpflischen Buchdruckerei.  
(G. Hünerwadel.)

# Chapter 10

## Introduction

The purpose of this chapter is to provide a comprehensive overview of the various methods used to solve linear systems of equations. We will discuss the theoretical foundations of these methods, as well as their practical implementation and convergence properties. The chapter is organized as follows:

## 1. Direct Methods

In this section, we will discuss the direct methods for solving linear systems, which are based on the elimination of variables. The most common direct method is Gaussian elimination, which is a systematic procedure for transforming a linear system into an upper triangular form. Other direct methods include LU decomposition and QR decomposition.

The first part of this section will focus on Gaussian elimination, which is a systematic procedure for transforming a linear system into an upper triangular form. This is achieved by performing row operations on the augmented matrix of the system.

The second part of this section will discuss LU decomposition, which is a method for decomposing a matrix into a lower triangular matrix (L) and an upper triangular matrix (U). This decomposition is useful for solving linear systems, as it allows us to solve the system in two steps: first, solve the system  $Ly = b$ , and then solve the system  $Ux = y$ .

The third part of this section will discuss QR decomposition, which is a method for decomposing a matrix into an orthogonal matrix (Q) and an upper triangular matrix (R). This decomposition is useful for solving linear systems, as it allows us to solve the system in two steps: first, solve the system  $Q^T y = b$ , and then solve the system  $Rx = y$ .

The fourth part of this section will discuss the Cholesky decomposition, which is a method for decomposing a symmetric positive definite matrix into a lower triangular matrix (L) and its transpose (L^T). This decomposition is useful for solving linear systems, as it allows us to solve the system in two steps: first, solve the system  $Lz = b$ , and then solve the system  $L^T x = z$ .

The fifth part of this section will discuss the Householder transformation, which is a method for decomposing a matrix into a product of orthogonal matrices and an upper triangular matrix. This decomposition is useful for solving linear systems, as it allows us to solve the system in two steps: first, solve the system  $Q^T y = b$ , and then solve the system  $Rx = y$ .

The sixth part of this section will discuss the Givens rotation, which is a method for decomposing a matrix into a product of orthogonal matrices and an upper triangular matrix. This decomposition is useful for solving linear systems, as it allows us to solve the system in two steps: first, solve the system  $Q^T y = b$ , and then solve the system  $Rx = y$ .

The seventh part of this section will discuss the Jacobi method, which is an iterative method for solving linear systems. The Jacobi method is based on the idea of solving each equation in the system for one variable, using the values of the other variables from the previous iteration. The Jacobi method is useful for solving linear systems, as it is simple to implement and can be parallelized.