

# Numerische Methoden

## Lösungsvorschläge zur Modulprüfung

### Aufgabe 1 (10 + 10 = 20 Punkte)

Gegeben seien

$$\text{die Matrix } A = \begin{pmatrix} 4 & 0 & 14 \\ 0 & 9 & 27 \\ 14 & 27 & 251 \end{pmatrix} \text{ und der Vektor } b = \begin{pmatrix} 210 \\ 477 \\ 3981 \end{pmatrix}.$$

(a) Bestimmen Sie die Cholesky-Zerlegung der Matrix  $A$ .

(b) Lösen Sie mithilfe der in (a) bestimmten Cholesky-Zerlegung das lineare Gleichungssystem  $Ax = b$ .

#### Lösung von Aufgabe 1

(a) Wir gehen Schrittwiese vor wie in Algorithmus 1.20. Zu berechnen ist die Matrix

$$L = \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix}.$$

**Schritt 1.**  $i = 1$ : Hier haben wir nur

$$l_{11} = \sqrt{a_{11}} = \sqrt{4} = 2.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix}.$$

**Schritt 2.**  $i = 2$ : Hier berechnen wir

$$l_{21} = \frac{a_{21}}{l_{11}} = \frac{0}{2} = 0, \quad l_{22} = \sqrt{a_{22} - |l_{21}|^2} = \sqrt{9 - 0^2} = \sqrt{9 - 0} = \sqrt{9} = 3,$$

$$l_{31} = \frac{a_{31}}{l_{11}} = \frac{14}{2} = 7.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 7 & l_{32} & l_{33} \end{pmatrix}.$$

**Schritt 3.**  $i = 3$ : Hier berechnen wir

$$l_{32} = \frac{1}{l_{22}} (a_{32} - l_{31}l_{21}) = \frac{1}{3} (27 - 7 \cdot 0) = \frac{27 - 7 \cdot 0}{3} = \frac{27 - 0}{3} = \frac{27}{3} = 9,$$

$$l_{33} = \sqrt{a_{33} - |l_{31}|^2 - |l_{32}|^2} = \sqrt{251 - 7^2 - 9^2} = \sqrt{251 - 49 - 81} = \sqrt{121} = 11.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 7 & 9 & 11 \end{pmatrix} \in \mathbb{R}^{3 \times 3}$$

mit

$$A = LL^H = LL^T.$$

# Numerische Methoden 1

**H. Heinrich, G. Schmid**



## **Numerische Methoden 1:**

This book delves into Numerische Methoden 1. Numerische Methoden 1 is a crucial topic that must be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Numerische Methoden 1, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:

- Chapter 1: Introduction to Numerische Methoden 1
- Chapter 2: Essential Elements of Numerische Methoden 1
- Chapter 3: Numerische Methoden 1 in Everyday Life
- Chapter 4: Numerische Methoden 1 in Specific Contexts
- Chapter 5: Conclusion

2. In chapter 1, the author will provide an overview of Numerische Methoden 1. The first chapter will explore what Numerische Methoden 1 is, why Numerische Methoden 1 is vital, and how to effectively learn about Numerische Methoden 1.
3. In chapter 2, the author will delve into the foundational concepts of Numerische Methoden 1. This chapter will elucidate the essential principles that need to be understood to grasp Numerische Methoden 1 in its entirety.
4. In chapter 3, the author will examine the practical applications of Numerische Methoden 1 in daily life. The third chapter will showcase real-world examples of how Numerische Methoden 1 can be effectively utilized in everyday scenarios.
5. In chapter 4, this book will scrutinize the relevance of Numerische Methoden 1 in specific contexts. This chapter will explore how Numerische Methoden 1 is applied in specialized fields, such as education, business, and technology.
6. In chapter 5, the author will draw a conclusion about Numerische Methoden 1. This chapter will summarize the key points that have been discussed throughout the book.

This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. It is highly recommended for anyone seeking to gain a comprehensive understanding of Numerische Methoden 1.

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