Universidade Estadual de Campinas
Instituto de Computação

Laura Viglioni

The Dissertation or Thesis Title in English

Título da Dissertação ou Tese em Português

CAMPINAS
2020

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Dissertação apresentada ao Instituto de Computação da Universidade Estadual de Campinas como parte dos requisitos para a obtenção do título de Mestra em Ciência da Computação.

Dissertation presented to the Institute of Computing of the University of Campinas in partial fulfillment of the requirements for the degree of Master in Computer Science.

Supervisor/Orientador: Prof. Dr. Ricardo Dahab

Este exemplar corresponde à versão da Dissertação entregue à banca antes da defesa.

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Resumo

O resumo deve ter no máximo 500 palavras e deve ocupar uma única página.

Abstract

The abstract must have at most 500 words and must fit in a single page.

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Chapter 1

Introduction

Chapter 2

Mathematical Background

2.1 Groups

Definition 2.1.1 *A **group** is a set G closed under a binary operation $\cdot$ defined on G such that:*

- ***Associativity:*** $\forall a, b, c \in G,\ a \cdot (b \cdot c) = (a \cdot b) \cdot c$
- ***Identity element:*** $\exists e \in G\ ;\ \forall a \in G,\ a \cdot e = e \cdot a = a$
- ***Inverse element:*** $\forall a \in G,\ \exists b \in G\ ;\ a \cdot b = b \cdot a = e$

And it is denoted by $\langle G, \cdot \rangle$, or simply G if the operation is implied.

Definition 2.1.2 *A group is sait to be **commutative** or **abelian** if $\forall a, b \in G,\ a \cdot b = b \cdot a$*

A group is called **additive** or **multiplicative** if its operation is addition or multiplication, respectively.

Definition 2.1.3 *A subset H of G is a **subgroup** of $\langle G, \cdot \rangle$ if it is closed under $\cdot$ induced by $\langle G, \cdot \rangle$.*

Definition 2.1.4 *The **order** of a group $\langle G, \cdot \rangle$ is the cardinality of the set G.*

Definition 2.1.5 *A subgroup H of G can be used to decompose G in uniform sized and disjoints subsets called **cosets**. Given an element $g \in G$:*

- *A **left coset** is defined by $gH := \{g \cdot h\ ;\ h \in H\}$*
- *A **right coset** is defined by $Hg := \{h \cdot g\ ;\ h \in H\}$*

2.2 Rings and Fields

Definition 2.2.1 *A **ring** is a set together with two binary operations, we will note by $+$ and $*$ and call it addition and multiplication, respectively, such that:*

- *$\langle R, + \rangle$ is an abelian group.*
- *$*$ is associative*
- *$*$ is distributive over $+$*

And it is denoted by $\langle R, +, * \rangle$, or simply G if the operations are implied.

Definition 2.2.2 *A ring is said to be **commutative** if its $*$ operation is commutative.*

Definition 2.2.3 *A ring is said to be **with unity** if $*$ has a identity element. We shall note it by 1 and it is called **unity**.*

Definition 2.2.4 *A **division ring** is a ring R where $\forall r \in R$, $\exists s \in R$; $r * s = 1$.*

Definition 2.2.5 *A **field** is a commutative division ring.*

2.3 Lattices

Definition 2.3.1 *A Lattice $\Lambda \subset \mathbb{R}^n$ is a subgroup of the additive group $\mathbb{R}^n$*

In other words, given m linear independent vectors in $\mathbb{R}^n$, the set $\{v_1, v_2, ..., v_m\}$ is called a **basis** for Λ and the Lattice may defined by:

Definition 2.3.2

$$\Lambda := \left\{ x = \sum_{i=1}^{m} \lambda_i v_i \in \mathbb{R}^n \mid \lambda_i \in \mathbb{Z} \right\} \tag{2.1}$$

2.4 Number Fields

Definition 2.4.1 *Let K and L be two fields, L is said to be a **field extension** of K if $L \subseteq K$ and we denote by L/K*

Note that in a field extension L/K, L has a structure of a vector space over K, where vector addition is in L and scalar multiplication $a \in K,\ v \in L \implies av \in L$. The dimention of L as a vector space is called **degree** and it is denoted by $[L : K]$.

Definition 2.4.2 *A field extension is called **number field** when it is over $\mathbb{Q}$.*

Chapter 3

Hypothesis

Chapter 4

Results

Chapter 5

Conclusions