

# Number Theory

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June 12, 2022

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**Part I**

**Algorithms**

# **Chapter 1**

## **Data structures**

**1.1 Linear data structures**

**1.2 Sorting and search**

**1.3 Trees**

**1.4 Graphs**

## **Chapter 2**

# **Computational geometry**

## **Part II**

## **Chapter 3**

# **Information theory**

## **Chapter 4**

# **Coding theory**



## **Chapter 5**

# **Cryptography**

## **Part III**

# **Numerical analysis**

## Chapter 6

# Finite difference methods

### 6.1 Ordinary differential equations

interpolation, differentiation and integration runge-kutta, multi-step

### 6.2 Elliptic equations

6.1 (1D Poisson equation). Consider the following boundary value problem:

$$\begin{cases} -u''(x) = f(x), & \text{in } (0, 1), \\ u(0) = u(1) = 0. \end{cases}$$

We discretize it by  $(u_j)_{j=0}^N$  such that  $hN = 1$  and

$$\begin{cases} -\frac{u_{j+1} - 2u_j + u_{j-1}}{h^2} = f_j, & \text{for } j = 1, \dots, N-1, \\ u_0 = u_N = 0. \end{cases}$$

$$\frac{1}{h^2} \begin{pmatrix} 2 & -1 & & 0 \\ -1 & 2 & \ddots & \\ & \ddots & \ddots & -1 \\ 0 & & -1 & 2 \end{pmatrix} \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_{N-1} \end{pmatrix} = \begin{pmatrix} f_1 \\ f_2 \\ \vdots \\ f_{N-1} \end{pmatrix}$$

### 6.3 Parabolic equations

### 6.4 Hyperbolic equations

### 6.5 Computational fluid dynamics

## **Chapter 7**

# **Finite element methods**

## Chapter 8

# Optimization

### 8.1 Convex optimization

### 8.2 Dynamic programming

optimal control

## **Part IV**

# **Mathematical statistics**

## **Chapter 9**

# **Statistical models**

## **Chapter 10**

# **Statistical inference**

estimation, testing hypothesis, ranking, selection



## Chapter 11