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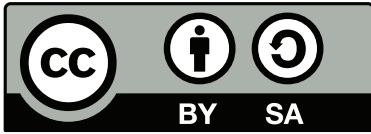
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<sup>1</sup>

$\LaTeX$

The source code of this book is available.

<https://github.com/open-optimization/>

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<sup>1</sup>[https://en.wikipedia.org/wiki/Open\\_educational\\_resources#/media/File:Global\\_Open\\_Educational\\_Resources\\_Logo.svg](https://en.wikipedia.org/wiki/Open_educational_resources#/media/File:Global_Open_Educational_Resources_Logo.svg)

## **Preface**



# **Chapter 1**

## **Preface**



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# Introduction

## 1.1 Notation

- $\mathbb{1}$  - a vector of all ones (the size of the vector depends on context)
- $\forall$  - for all
- $\exists$  - there exists
- $\in$  - in
- $\therefore$  - therefore
- $\Rightarrow$  - implies
- s.t. - such that (or sometimes "subject to".... from context?)
- $\{0,1\}$  - the set of numbers 0 and 1
- $\mathbb{Z}$  - the set of integers (e.g.  $1, 2, 3, -1, -2, -3, \dots$ )
- $\mathbb{Q}$  - the set of rational numbers (numbers that can be written as  $p/q$  for  $p, q \in \mathbb{Z}$  (e.g.  $1, 1/6, 27/2$ )
- $\mathbb{R}$  - the set of all real numbers (e.g.  $1, 1.5, \pi, e, -11/5$ )
- $\setminus$  - setminus, (e.g.  $\{0, 1, 2, 3\} \setminus \{0, 3\} = \{1, 2\}$ )
- $\cup$  - union (e.g.  $\{1, 2\} \cup \{3, 5\} = \{1, 2, 3, 5\}$ )
- $\cap$  - intersection (e.g.  $\{1, 2, 3, 4\} \cap \{3, 4, 5, 6\} = \{3, 4\}$ )
- $\{0,1\}^4$  - the set of 4 dimensional vectors taking values 0 or 1, (e.g.  $[0, 0, 1, 0]$  or  $[1, 1, 1, 1]$ )
- $\mathbb{Z}^4$  - the set of 4 dimensional vectors taking integer values (e.g.,  $[1, -5, 17, 3]$  or  $[6, 2, -3, -11]$ )
- $\mathbb{Q}^4$  - the set of 4 dimensional vectors taking rational values (e.g.  $[1.5, 3.4, -2.4, 2]$ )
- $\mathbb{R}^4$  - the set of 4 dimensional vectors taking real values (e.g.  $[3, \pi, -e, \sqrt{2}]$ )
- $\sum_{i=1}^4 i = 1 + 2 + 3 + 4$
- $\sum_{i=1}^4 i^2 = 1^2 + 2^2 + 3^2 + 4^2$

- $\sum_{i=1}^4 x_i = x_1 + x_2 + x_3 + x_4$
- $\square$  - this is a typical Q.E.D. symbol that you put at the end of a proof meaning "I proved it."
- For  $x, y \in \mathbb{R}^3$ , the following are equivalent (note, in other contexts, these notations can mean different things)
  - $x^\top y$     *matrix multiplication*
  - $x \cdot y$     *dot product*
  - $\langle x, y \rangle$     *inner product*

and evaluate to  $\sum_{i=1}^3 x_i y_i = x_1 y_1 + x_2 y_2 + x_3 y_3$ .

A sample sentence:

$$\forall x \in \mathbb{Q}^n \exists y \in \mathbb{Z}^n \setminus \{0\}^n \text{ s.t. } x^\top y \in \{0, 1\}$$

"For all non-zero rational vectors  $x$  in  $n$ -dimensions, there exists a non-zero  $n$ -dimensional integer vector  $y$  such that the dot product of  $x$  with  $y$  evaluates to either 0 or 1."

## **Part I**

# **Introduction to Optimization**



## **Chapter 2**

# **Mathematical Programming**

Mathematical programming is great...

### **2.1 Liner Programming**

Linear programming is great...

### **2.2 Integer Programming**

Integer programming is great...

### **2.3 Models**



## **Chapter 3**

# **Algorithms and Complexity**

Algorithms are great....