

# Basic computer science

Teo Banica

DEPARTMENT OF MATHEMATICS, UNIVERSITY OF CERGY-PONTOISE, F-95000  
CERGY-PONTOISE, FRANCE. [teo.banica@gmail.com](mailto:teo.banica@gmail.com)

2010 *Mathematics Subject Classification.* 97P70

*Key words and phrases.* Electric computer, Machine learning

ABSTRACT. This is an introduction to computer science, with focus on architecture and hardware, computing power and artificial intelligence, and social implications. We first discuss the various interactions in the physical world, which can be mechanical, electric, chemical, or quantum, and the challenge of converting them into usable computers. Then we provide a standard introduction to the electric computers, first with various architecture and hardware aspects, from early attempts up to the present times, and then with software, information theory, and other mathematical aspects. We end with a discussion regarding the increasing power of computers, and artificial intelligence.

## Preface

Scared about computers, and the future? So am I. Back in the 1980s, I used to have a Commodore 64 as a kid, and useful and lightning quick machine that was. Plug in and instantly works, then type in commands, and that would be instantly executed too. Good and faithful machine and friend, with no bad intentions or whatsoever. I miss it.

Later in the early 1990s, I has the occasion of working on all sorts of machines, old Macs and Unix stations, connected to the internet. And again, lightning fast all that ancient machinery was. Want to consult a website, post on a forum, send an email, or do whatever other type of networking? Lightning fast, simple and reliable, period.

What happens now, and in fact since the early 2000s, is simply frightening. Anything electronic, computer, internet, and even devices like a new car, or a new toaster if I understand well, have not tried those, is spending a considerable and palpable amount of time and energy in judging your input. Which is definitely not reassuring and friendly, and for people from my generation, who were used to a better life, with man in control of the machines, this looks more like the beginning of some sort of apocalypse.

This being said, enough complaining, and time to get into some action. Computers are among us, that is for sure, and we should learn how to fight them back.

In practice, you probably already know how to deactivate artificial intelligence, at least partly, whenever you buy new electronic devices, such as computers, or modern cars, or that damn new coffee machine or toaster. However, such kind of knowledge is not enough, our enemy is particularly strong, and we will surely not get away with just a handful of such simple manipulations. A more in-depth knowledge of who computers are, how exactly they function, and perhaps, what they want too, is certainly needed.

The present book is an introduction to this, general computer science, with focus on architecture and hardware, computing power and artificial intelligence, and social implications. The book is organized in 4 parts, the plan being as follows:

I. We will first discuss the various interactions in the physical world, which can be of many types, and the challenge of converting them into usable computers.

II. Then we will discuss the usual, electric computers, with various architecture and hardware aspects, from the early attempts, up to the present times.

III. We will go then on a more technical discussion, regarding software, and what computers do, with a look into information theory, and other mathematical aspects.

IV. We will end with a discussion on the increasing power of computers, and artificial intelligence, with the main aim of understanding what modern computers want.

In the hope that you will find this book useful. Young reader, all eyes are on you, with the hope that you will find a solution to all these modern problems, that people from my generation never saw coming, or rather, to be honest, plainly created.

Thanks to my old Mac, for making this book possible, and in the hope that the tex file, or even pdf, will not self-transform over the time. Many thanks as well to my cats. They say that modern computers are like birds - free to fly, but can be caught.

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Part I

Computer types

*Seven deadly sins  
Seven ways to win  
Seven holy paths to hell  
And your trip begins*

## CHAPTER 1

### Nature computes

1a.

1b.

1c.

1d.

#### 1e. Exercises

Exercises:

EXERCISE 1.1.

EXERCISE 1.2.

EXERCISE 1.3.

EXERCISE 1.4.

EXERCISE 1.5.

EXERCISE 1.6.

EXERCISE 1.7.

EXERCISE 1.8.

Bonus exercise.



## CHAPTER 2

### Mechanical computers

2a.

2b.

2c.

2d.

#### 2e. Exercises

Exercises:

EXERCISE 2.1.

EXERCISE 2.2.

EXERCISE 2.3.

EXERCISE 2.4.

EXERCISE 2.5.

EXERCISE 2.6.

EXERCISE 2.7.

EXERCISE 2.8.

Bonus exercise.



## CHAPTER 3

### Electric computers

**3a.**

**3b.**

**3c.**

**3d.**

#### **3e. Exercises**

Exercises:

EXERCISE 3.1.

EXERCISE 3.2.

EXERCISE 3.3.

EXERCISE 3.4.

EXERCISE 3.5.

EXERCISE 3.6.

EXERCISE 3.7.

EXERCISE 3.8.

Bonus exercise.





CHAPTER 4

**Chemistry and quantum**

4a.

4b.

4c.

4d.

4e. Exercises

Exercises:

EXERCISE 4.1.

EXERCISE 4.2.

EXERCISE 4.3.

EXERCISE 4.4.

EXERCISE 4.5.

EXERCISE 4.6.

EXERCISE 4.7.

EXERCISE 4.8.

Bonus exercise.



## Part II

# Electric computers

*Enola Gay*  
*Is mother proud of little boy today*  
*Ah-ha, this kiss you give*  
*It's never ever going to fade away*

## CHAPTER 5

### Early history

5a.

5b.

5c.

5d.

#### 5e. Exercises

Exercises:

EXERCISE 5.1.

EXERCISE 5.2.

EXERCISE 5.3.

EXERCISE 5.4.

EXERCISE 5.5.

EXERCISE 5.6.

EXERCISE 5.7.

EXERCISE 5.8.

Bonus exercise.



## CHAPTER 6

### Basic functioning

6a.

6b.

6c.

6d.

6e. Exercises

Exercises:

EXERCISE 6.1.

EXERCISE 6.2.

EXERCISE 6.3.

EXERCISE 6.4.

EXERCISE 6.5.

EXERCISE 6.6.

EXERCISE 6.7.

EXERCISE 6.8.

Bonus exercise.





## CHAPTER 7

### Input and output

7a.

7b.

7c.

7d.

#### 7e. Exercises

Exercises:

EXERCISE 7.1.

EXERCISE 7.2.

EXERCISE 7.3.

EXERCISE 7.4.

EXERCISE 7.5.

EXERCISE 7.6.

EXERCISE 7.7.

EXERCISE 7.8.

Bonus exercise.



## CHAPTER 8

### Microchips, memory

8a.

8b.

8c.

8d.

#### 8e. Exercises

Exercises:

EXERCISE 8.1.

EXERCISE 8.2.

EXERCISE 8.3.

EXERCISE 8.4.

EXERCISE 8.5.

EXERCISE 8.6.

EXERCISE 8.7.

EXERCISE 8.8.

Bonus exercise.



## Part III

# Math, algorithms

*Tropical the island breeze  
All of nature wild and free  
This is where I long to be  
La Isla Bonita*

CHAPTER 9

**Information theory**

**9a.**

**9b.**

**9c.**

**9d.**

**9e. Exercises**

Exercises:

EXERCISE 9.1.

EXERCISE 9.2.

EXERCISE 9.3.

EXERCISE 9.4.

EXERCISE 9.5.

EXERCISE 9.6.

EXERCISE 9.7.

EXERCISE 9.8.

Bonus exercise.





## CHAPTER 10

### Basic algorithms

10a.

10b.

10c.

10d.

10e. Exercises

Exercises:

EXERCISE 10.1.

EXERCISE 10.2.

EXERCISE 10.3.

EXERCISE 10.4.

EXERCISE 10.5.

EXERCISE 10.6.

EXERCISE 10.7.

EXERCISE 10.8.

Bonus exercise.



CHAPTER 11

**Languages, coding**

**11a.**

**11b.**

**11c.**

**11d.**

**11e. Exercises**

Exercises:

EXERCISE 11.1.

EXERCISE 11.2.

EXERCISE 11.3.

EXERCISE 11.4.

EXERCISE 11.5.

EXERCISE 11.6.

EXERCISE 11.7.

EXERCISE 11.8.

Bonus exercise.



CHAPTER 12

**Codes, cryptography**

**12a.**

**12b.**

**12c.**

**12d.**

**12e. Exercises**

Exercises:

EXERCISE 12.1.

EXERCISE 12.2.

EXERCISE 12.3.

EXERCISE 12.4.

EXERCISE 12.5.

EXERCISE 12.6.

EXERCISE 12.7.

EXERCISE 12.8.

Bonus exercise.



**Part IV**

**Machine learning**

*And it's a hard  
It's a hard  
It's a hard  
It's a hard rain's a-gonna fall*



## CHAPTER 13

### Playing chess

**13a.**

**13b.**

**13c.**

**13d.**

**13e. Exercises**

Exercises:

EXERCISE 13.1.

EXERCISE 13.2.

EXERCISE 13.3.

EXERCISE 13.4.

EXERCISE 13.5.

EXERCISE 13.6.

EXERCISE 13.7.

EXERCISE 13.8.

Bonus exercise.



CHAPTER 14

**Neural networks**

**14a.**

**14b.**

**14c.**

**14d.**

**14e. Exercises**

Exercises:

EXERCISE 14.1.

EXERCISE 14.2.

EXERCISE 14.3.

EXERCISE 14.4.

EXERCISE 14.5.

EXERCISE 14.6.

EXERCISE 14.7.

EXERCISE 14.8.

Bonus exercise.



CHAPTER 15

**Artificial intelligence**

**15a.**

**15b.**

**15c.**

**15d.**

**15e. Exercises**

Exercises:

EXERCISE 15.1.

EXERCISE 15.2.

EXERCISE 15.3.

EXERCISE 15.4.

EXERCISE 15.5.

EXERCISE 15.6.

EXERCISE 15.7.

EXERCISE 15.8.

Bonus exercise.



## CHAPTER 16

### The apocalypse

**16a.**

**16b.**

**16c.**

**16d.**

**16e. Exercises**

Congratulations for having read this book, and no exercises for this final chapter.





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