Complex Systems
Course Notes

Ernesto Costa

Version 0.01
Monday 15th February, 2016

Contents

1 Complex Systems **11**
1.1 Introduction 11

2 Basic Concepts **13**
2.1 Introduction 13

3 Dynamical Systems **15**
3.1 Introduction 15

List of Tables

List of Figures

Preface

> I think the next century will be the century of complexity
>
> Stephen W. Hawking

It is a truism to say that we live in a world of increasing complexity. If we look around us we see different types of systems (physical, biological, cognitive, social) whose structure and behavior are hard to formalize and understand. For example,

three body problem
immune system
mind
city

We need a new way of thinking, a new kind of science. That is the goal of the new Complex Systems Science.

In this text we compile some notes concerning the course on Complex Systems given at the Department of Informatics Engineering of the University of Coimbra. There are some recent books on the subject (see [2], [1]) and these notes do not intent to replace them. The course started in 2015 and we decided to start writing these notes because when you write your are forced to make clear your understanding, and in this process you faced your own difficulties in the subject.

Organization

Acknowledgments

Chapter 1

Complex Systems

1.1 Introduction

Chapter 2

Basic Concepts

2.1 Introduction

Chapter 3

Dynamical Systems

3.1 Introduction

Bibliography

[1] Albert-Laszlo Barabasi. *Network Science*. Creative Commons, 2015.

[2] Hiroki Sayama. *Introduction to the modeling and analysis of complex systems*. Open SUNY Textbooks, 2015.