Branching processes in discrete time. A first approach

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Abstract. The probabilistic theory of branching models began in the second part of the 19th century, with the objective of giving a complete answer, from a scientific viewpoint, to the problem of determining the extinction of family lines of the European bourgeoisie and aristocracy, according to forerunners F. Galton and H. Watson. This branching model, commonly called the Galton-Watson process, has been extensively studied and used to describe the behaviour of systems whose components (cells, particles, individuals in general) reproduce, transform, and die, in fields as diverse as Biology, Epidemiology, Genetics, Medicine, Nuclear Physics, Demography, Financial Mathematics, Algorithms, etc.

To describe practical and complex situations in a more precise manner, because the basic model of Galton-Watson did not provide an acceptable explanation, in the second half of the 20th century, new models of branching processes were developed both in discrete and continuous time. For discrete time, one can cite, among others, the Controlled Branching Process, the Multitype Branching Process, the Branching Process with Immigration, the Population Size Dependent Branching Process, the Branching Process in a Varying Environment, or the Branching Process in Random Environments.

In this course, we will introduce the classical Galton-Walton Branching Processes and some of its modifications from a theoretical and practical point of view. We will also simulate some examples using the statistical program R.