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COMPLEX SYSTEMS AND ARTIFICIAL COGNITIVE PROCESSES IN PLANT GENETICS

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Linear models and distributive assumptions are the basis of the traditional dissection of complex phenotypes in Genetics: a sound example is the Fisher's infinitesimal model in the analysis and interpretation of quantitative traits. This simple but effective approach is based on a *black box strategy* in which unspecified natural functions associate the input (unknown) variables, the genes, to the output ones, the phenotypes. Decades of theoretical and experimental results support the effectiveness of the black box approach.

Nowadays the increasing knowledge on genomics, gene expression and metabolic networks strongly suggests the opportunity to open the black box and to fill it of sound interpretation of the relevant paths between genes and phenotype or its components. The number of available data at different level from DNA sequence to phenotypic expression is growing faster and faster and simple stochastic models are inadequate to efficiently manage them, even at a first approximation.

New analytical approaches are, for these reasons, required to mine the huge amount of genetic and phenotypic trait and to find the relevant core of information.

The class of artificial cognitive processes can be an appealing solution. More particularly, some procedures, based on computer simulations and Montecarlo methods, are available. They reach solutions by means of an iterative self-learning process based on the principles, for instance, of natural selection and evolution.

In particular the basics and the applications of two of these dynamical rule based systems, the *Genetic Algorithms* and the *Random Forests,* will be presented with examples based on experimental results in forest genetics.

The possibility of a joint analysis of traits with different distributive characteristics and the related information about the ranking of single trait on the basis of its relative importance in problem solving will be discussed in the frame of varietal identification in Poplar.