08/01/02

## Summer Lecture Series 2002

# "Global" Analyses

## Overview and References

This lecture is devoted to the analyses of evolutionary algorithms which are "global in time": The analysis concentrates on a complete run of an evolutionary algorithm, not on a small number of steps. We concentrate on evolutionary algorithms used as optimization tools.

The first important question to ask about a general optimization algorithm is whether or not it actually optimizes. Thus, historically, the main interest was in the limit behavior of evolutionary algorithms running for an infinite number of generations. The main question is whether an evolutionary algorithm that is used as an optimization algorithm "converges" to an optimal solution almost surely. We briefly discuss some aspects of this discussion and try to understand the meanings of "convergence" in the context of evolutionary algorithms. We distinguish between "gene convergence" and "convergence to a function value" leading to the notion of "premature convergence".

Of greater practical interest is the question of how long an evolutionary algorithm (again used as an optimization algorithm) needs to find a global optimum. We study the analysis of this "first hitting time" or "expected optimization time" and discuss a number of different methods to derive asymptotically tight results.

One drawback of "global" analyses is the increased difficulty of the analysis. Concentrating on a small number of generations (or even on one single generation) is much simpler. The schema theory (as discussed in the previous lecture) is an example of an approach that is concerned with describing behaviors in one single generation. Since often such "local" analyses come with the promise of valid predictions for longer periods of time via iteration, we discuss an example case where local performance measures yield misleading results. This motivates us to discuss the difficulties in the use of local performance measures and "local analysis methods".

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The following list of references gives an overview of some papers that are relevant to the lecture. The papers are meant to be a good starting point for study and contain references to other relevant papers. There are countless other papers that are relevant for "global analysis" and are not mentioned here.

## References


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