Applications of Markov Chain Methodology in Evolutionary Computation

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It is well-known that the majority of heuristic search algorithms including EAs are naturally modeled as discrete-time stochastic processes. Furthermore, these stochastic processes are most frequently Markov processes. In this tutorial, We intend to explain the notions of stochastic processes and Markov processes and how they model EAs. Next, we intend to explain the fundamentals of the theory of Markov chains that is sufficiently powerful on its own to shed some light onto the asymptotic behavior of EAs. This part of the tutorial should take approximately 40 mins since we intend to provide a very detailed explanation assuming that not all audience members may be familiar with these important notions. A number of basic illustrative examples will be provided. I intend to end this portion of the tutorial with a 5 mins interactive discussion that includes answering questions.

Absorbing Markov chains may be used to model elitist-EAs. The expected time to absorbtion is then given in terms of the entries of the fundamental matrix of such a Markov chain and it is directly related to the expected run-time complexity of the elitist EA in question. This is a particularly elegant and simple classical methodology that I intend to explain in detail. A relationship with drift analysis and expected runtime (i.e. time to absorbtion) will be discussed in detail and illustrated by examples. This part of the tutorial should occupy approximately another 40mins. We intend to present the topic in a way that's suitable to an audience with diverse backgrounds. We would then like to end with a 5mins break.

The remaining 30mins of the tutorial would then be devoted to other important, more advanced topics. These may include lumping quotients of Markov chains, convergence rates of the fundamental matrices of absorbing Markov chains and how these notions have been applied in evolutionary computing.