Announcing the Final Examination of Gautham Anil for the degree of Doctor of Philosophy

Time & Location: June 29, 2012 at 9:00 AM in Partnership 2 141
Title: A Fitness Function Elimination Theory for Blackbox Optimization and Problem Class Learning

The modern view of optimization is that optimization algorithms are not designed in a vacuum, but can make use of information regarding the broad class of objective functions from which a problem instance is drawn. Using this knowledge, we want to design optimization algorithms that execute quickly (efficiency), solve the objective function with minimal samples (performance), and are applicable over a wide range of problems (abstraction). However, we present a new theory for blackbox optimization from which, we conclude that of these three desired characteristics, only two can be maximized by any algorithm.

We put forward an alternate view of optimization where we use knowledge about the problem class and samples from the problem instance to identify which problem instances from the class are being solved. From this Elimination of Fitness Functions approach, an idealized optimization algorithm that minimizes sample counts over any problem class, given complete knowledge about the class, is designed. This theory allows us to learn more about the difficulty of various problems, and we are able to use it to develop problem complexity bounds.

We present general methods to model this algorithm over a particular problem class and gain efficiency at the cost of specifically targeting that class. This is demonstrated over the Generalized Leading-Ones problem, and our algorithm obtains optimal performance and very good efficiency for that class. Additionally, we present a probabilistic framework based on our Elimination of Fitness Functions approach that clarifies how one can ideally learn about the problem class we face from the objective functions. This problem learning increases the performance of an optimization algorithm at the cost of abstraction.

In the context of this theory, we re-examine the blackbox framework as a problem design framework and suggest several improvements to existing methods, including incorporating problem learning, not being restricted to blackbox framework and building parameterized algorithms. We feel that this theory and our recommendations will help a practitioner make substantially better use of all that is available in typical practical optimization algorithm design scenarios.

Major: Computer Science

Educational Career:
- Bachelor's of Computer Science and Engineering, BS, 2003, Calicut University, India
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- Dr. Annie Wu, Chair, Electrical Engineering and Computer Science
- Dr. Paul Wiegand, Co-Chair, Institute of Simulation and Training
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- Thomas Jansen, Department of Computer Science, University College, Cork, Ireland

Approved for distribution by Dr. Annie Wu, Committee Chair, on January 1, 2014.

The public is welcome to attend.