Evolutionary Algorithms for Industrial Optimization Problems: Challenges and Lessons Learned

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Abstract:

Evolutionary algorithms are popular population-based iterative problem solvers taking inspiration from biological evolution and genetics. Several properties make them suitable for solving hard optimization problems. Consequently, they have soon found their way from academic environments to real-world applications in engineering design, manufacturing, transportation and numerous other fields. Nowadays they represent a state-of-the-art optimization methodology and are widely deployed in science, engineering and business.

However, despite the general-purpose nature and robustness of evolutionary algorithms, providing a solution to an industrial optimization problem using this methodology can face a number of obstacles. The unbridged gap between solution providers and customers, the time-consuming process of gradually refining the optimization problem definition, and the potential application failure due to non-technical reasons are just a few issues that are rarely, if at all, addressed in the literature.

The goal of this tutorial is to discuss the challenges faced and lessons learned in designing evolutionary algorithms for industrial optimization problems that go beyond the textbook knowledge on optimization and evolutionary computation. It starts with defining the scope of the presentation and providing motivating examples of industrial applications with diverse characteristics. The core of the tutorial is a systematic analysis of the potential challenges illustrated with practical situations, followed by an overview of the lessons learned in dealing with these challenges in order to overcome the obstacles for successful deployment of evolutionary algorithms. The analysis addresses the differences between the worlds of solution providers and customers, the sources of difficulties in industrial optimization, the iterative nature of real-world problem solving, and non-technical issues critical to the success of evolutionary algorithm applications. The tutorial concludes with a summary and discussion.

Expected enrollment:

- Students, researchers and engineers interested in designing evolutionary algorithms for industrial optimization problems
- End-users from various industries interested in applying evolutionary algorithms to their optimization problems

The length of the tutorial: two hours