APPROXIMATE COMPUTING: AN EVOLUTIONARY COMPUTING PERSPECTIVE

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The goal of this tutorial is to introduce the field of approximate computing to a wider evolutionary computing (EC) audience and present evolutionary computing as an ideal tool for solving many problems related to approximate computing. This tutorial is motivated by the fact that a new research field – approximate computing – was established in recent years to investigate how computer systems can be made better – more energy efficient, faster, and less complex – by relaxing the requirement that they are exactly correct. The current interest in approximations in computer science and engineering is primarily caused by the urgent need to reduce power consumption of computer systems ranging from low power IoT nodes, via mobile devices to supercomputers. Approximate computing addresses this challenge by exploiting the fact that some applications are inherently error resilient. Therefore, the error (accuracy of computations) can be used as a design metric and traded for performance or power consumption – creating thus a complex multi-objective optimization problem. The main advantage of the EC-based approach is that the approximation problem can be formulated as a multi-objective optimization/design problem and solved using well established multi-objective EAs, providing much better solutions than commonly used methods such as deterministic ad hoc approximations or simple greedy search algorithms. In particular, this tutorial deals with: (i) Introduction to approximate computing. (ii) Sensitivity analysis and error metrics. (iii) Approximation techniques for SW and HW components. (iv) Evolutionary circuit approximation. (v) Evolutionary software approximation. (vi) Case studies.