Analysis and Optimization of Task Granularity in Concurrent Applications

Task granularity, i.e., the amount of work to be performed by computing tasks, is a key performance attribute of parallel and distributed applications. On the one hand, fine-grained tasks (i.e., short-running tasks carrying on small computations) may introduce considerable parallelization overheads, due to the high number of tasks required by the application and the scheduling costs. On the other hand, coarse-grained tasks (i.e., long-running tasks performing substantial computations) may result in missed parallelization opportunities, as tasks might be further split to speed up computations. To optimize performance and scalability of concurrent applications, developers need to find the best tradeoff between fine and coarse task granularity. Despite being a key feature of concurrent applications, related work has paid little attention to parallel task granularity. As a result, detailed analysis on this topic as well as tools that aid developers in finding the optimal granularity tradeoff are, to the best of our knowledge, missing to date.

This project aims at filling this gap by providing a thorough analysis of task granularity in real-world concurrent applications. The student will be involved in a number of activities:

1. Identification of quantitative metrics suitable for task granularity characterization;
2. Development of profilers for the measurement of those metrics in concurrent applications;
3. Empirical evaluation of the profilers on real-world concurrent applications and identification of scalability bottlenecks;
4. Program optimizations targeting at the removal of the identified bottlenecks.

The project is a unique opportunity for the student to deepen his or her knowledge in the domains of concurrent programming, dynamic program analysis, and empirical evaluation, all being important skills for a software engineer. The student will work side-by-side with the members of the Dynamic Analysis Group at USI, and will receive support in learning about advanced topics that will strengthen his or her abilities as a computer scientist. Applicants interested in this project should have a good knowledge of Java, good programming skills, and deep interest in the field of concurrent programming.

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