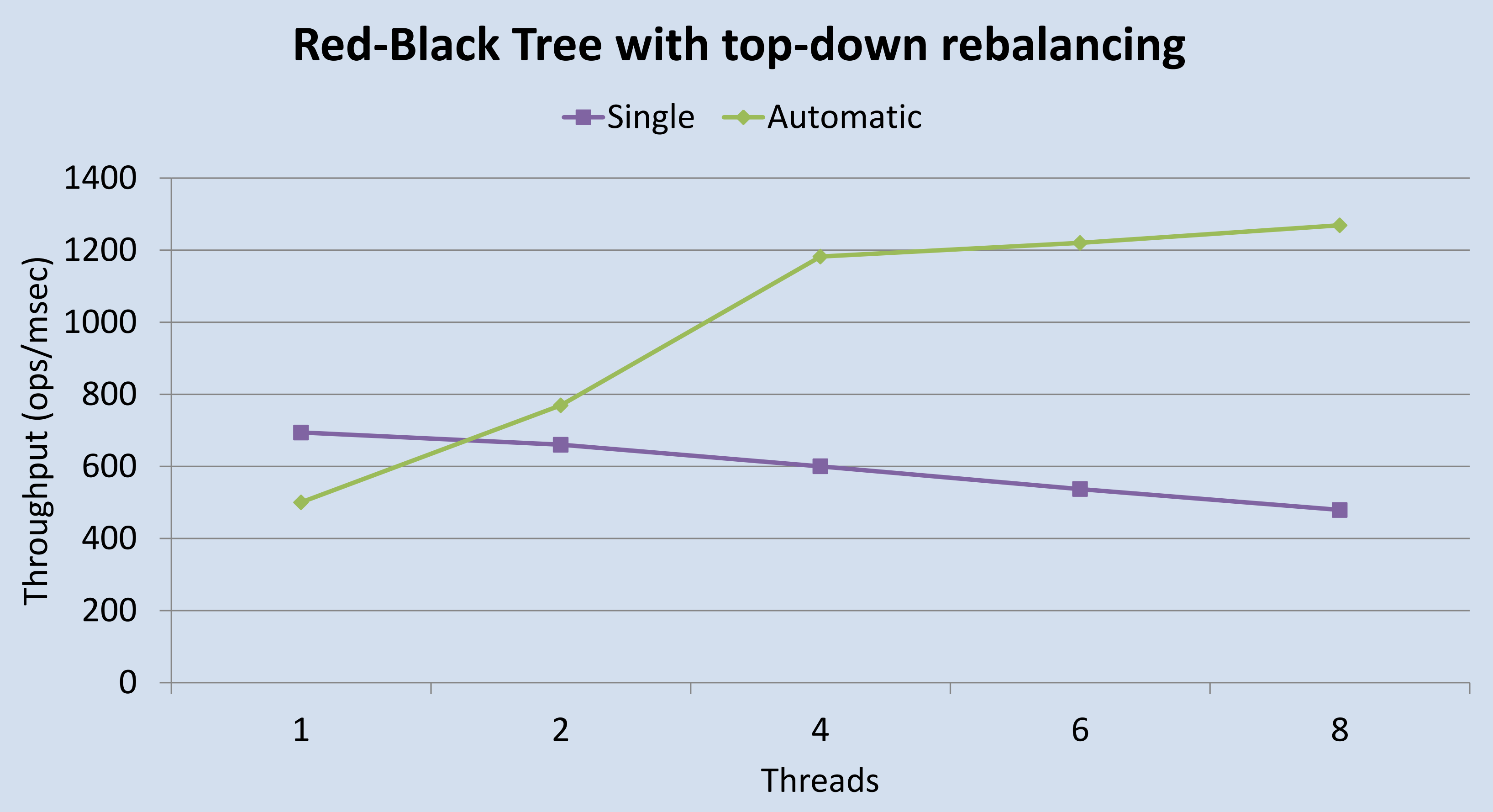
Enforcing Atomicity for Data Structure Manipulations

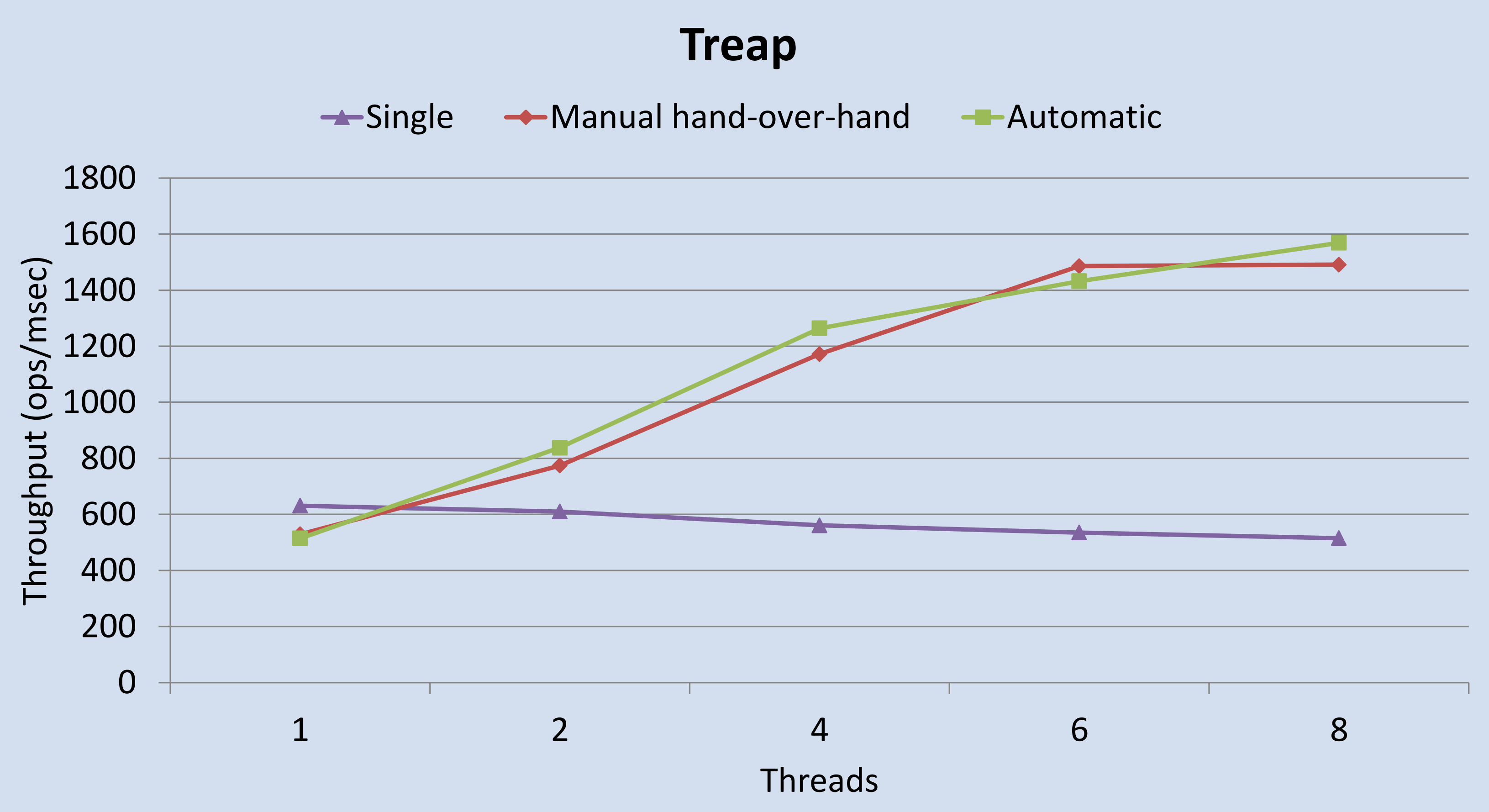
1. Introduction

A key challenge in writing concurrent software is to correctly and efficiently synchronize concurrently executing code. Our goal is to develop synchronization techniques that exploit properties of realistic code in order to automatically synchronize concurrent operations in a correct and efficient way.

2. Synchronization using Shape Properties

We have developed an automatic technique that adds fine grain locking to data structure implementations. This technique is applicable to data structures where the shape of shared memory is a forest; it allows the shared shape to change dynamically as long as the shared shape is a forest between invocations of the data structure operations (This enables handling, for example, operations with tree rotations and operations that move items between different trees).



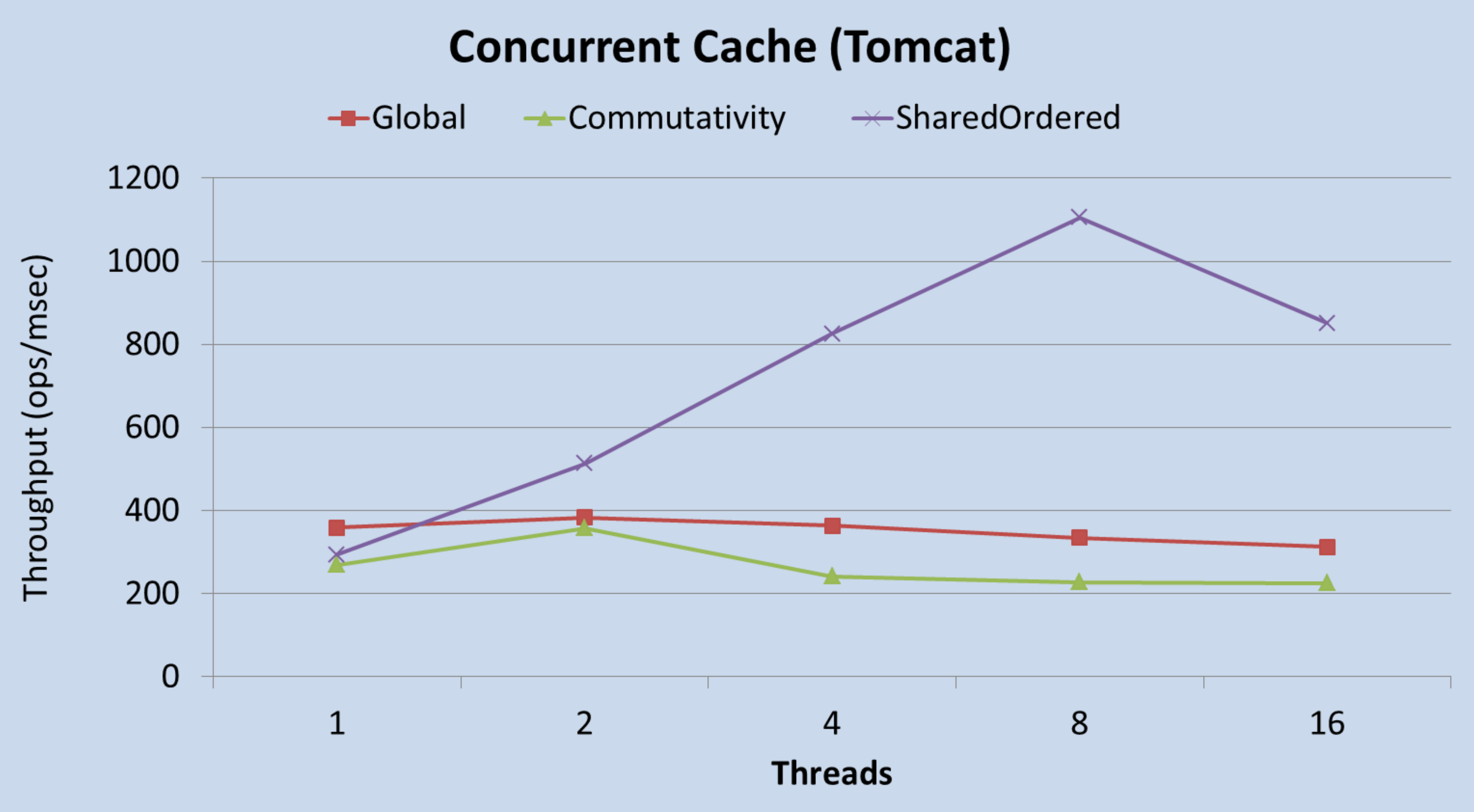


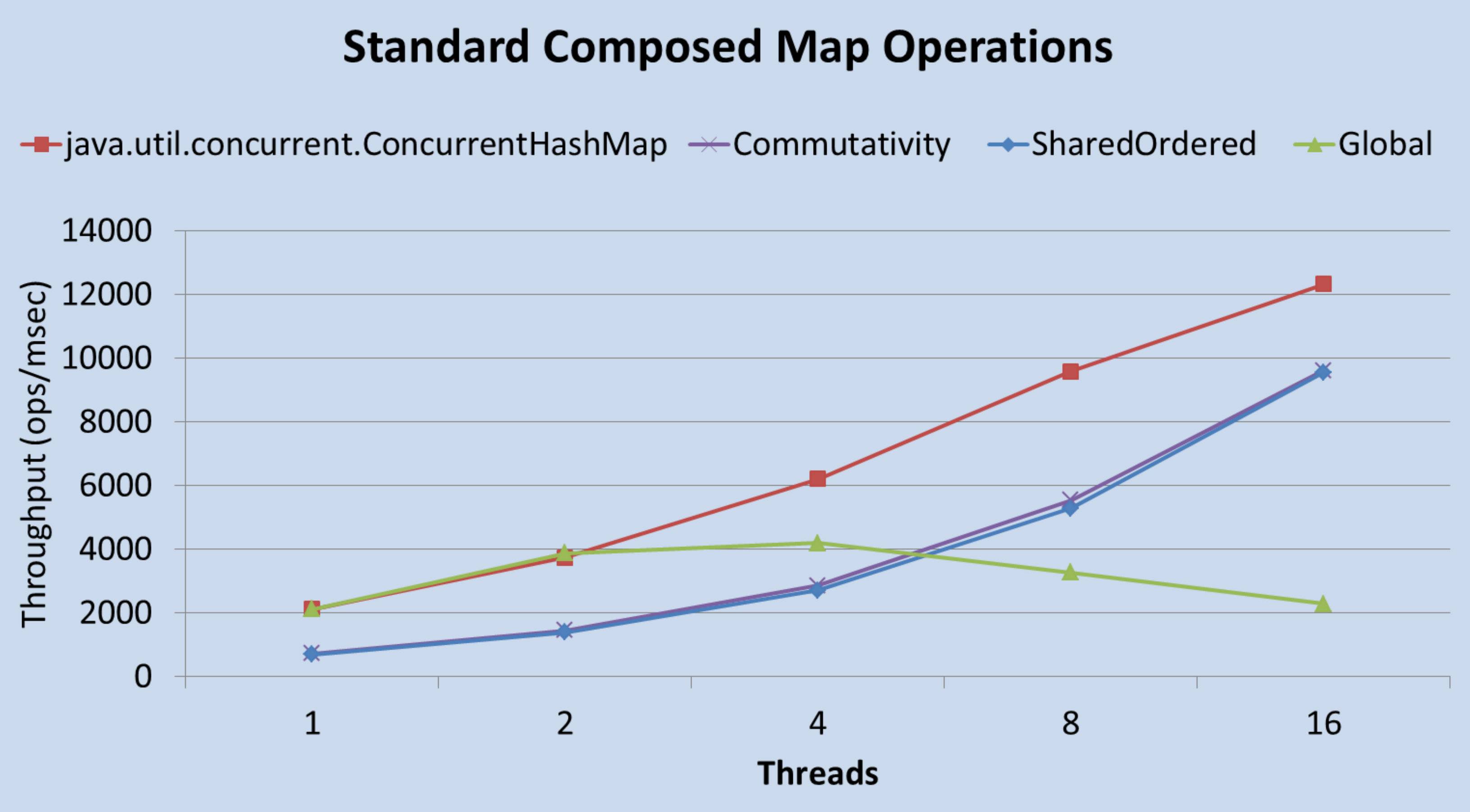
Domination Locking: The technique is based on Domination Locking, a novel locking protocol which is a strict generalization of existing locking protocols for dynamically changing graphs. This protocol capitalizes on the inability of programs in modern programming languages (such as Java) to access shared memory without following pointers from a designated set of roots.

3. Collaborative Synchronization

We are currently working on a methodology for collaboration between data structure synchronization and their clients' synchronization.
The main idea is to create data structures that enable their clients to dynamically give information about their future behavior (e.g., what operations will not be used starting from a specific situation). This information can be utilized by a data structure for its synchronization, and for helping synchronizing the client code.

We are currently developing data structures that are able to utilize such information, and static algorithms that compute this information. Preliminary results show that such data structures enable to automatically create effective synchronization for composed clients operations.





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