# CLoF: A Compositional Lock Framework for Multi-level NUMA Systems

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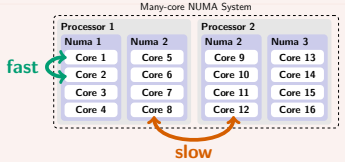
## Motivation



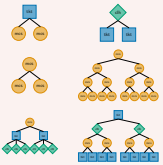

- Large servers have a deep NUMA hierarchy.
- Core distance affects performance.
- We need correct & scalable lock implementations.
- Hierarchical locks can map the platform hierarchy to maximize performance benefits.

## CLoF opens new opportunities to improve lock performance

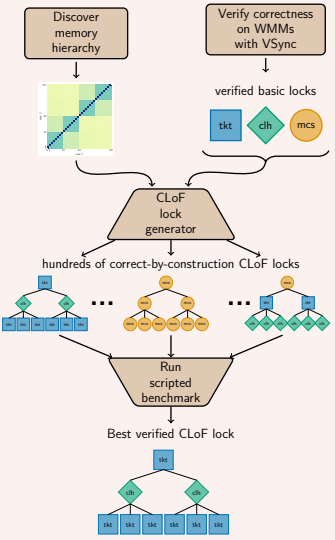
lock cohorting
- **heterogeneous**
- only 2 levels

HMCS
- homogeneous
- **multi-level**

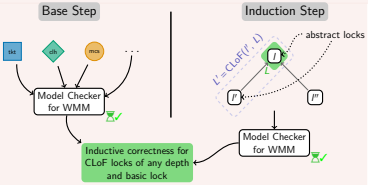
CLoF
- **heterogeneous**
- **multi-level**
- **correct-by-construction**



## Our approach: the CLoF workflow



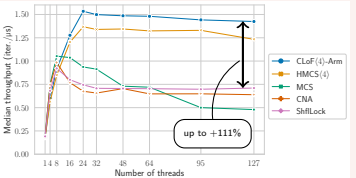

## Correctness argument




- Model checking the full hierarchy is not feasible.
- In CLoF, we combine **model checking** with an **inductive argument**.

## CLoF outperforms existing locks

LevelDB readrandom benchmark, Armv8




The best CLoF lock yields twice the throughput achieved with CNA lock and ShflLock.

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