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Tarjan Algorithm

Performance Analysis

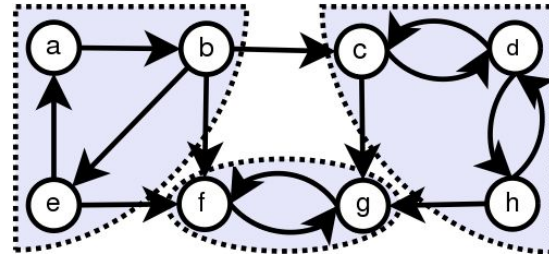
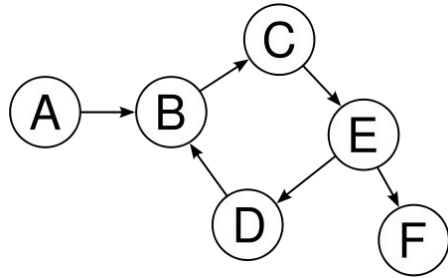
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Problems Tarjan's algorithms solve

Tarjan's Algorithms solve three related problems relevant to model checking.
Given a state graph;

- Find its Strongly Connected Components (SCCs)
- Identify which nodes are in a loop
- Locate which nodes are in a lasso



Setup

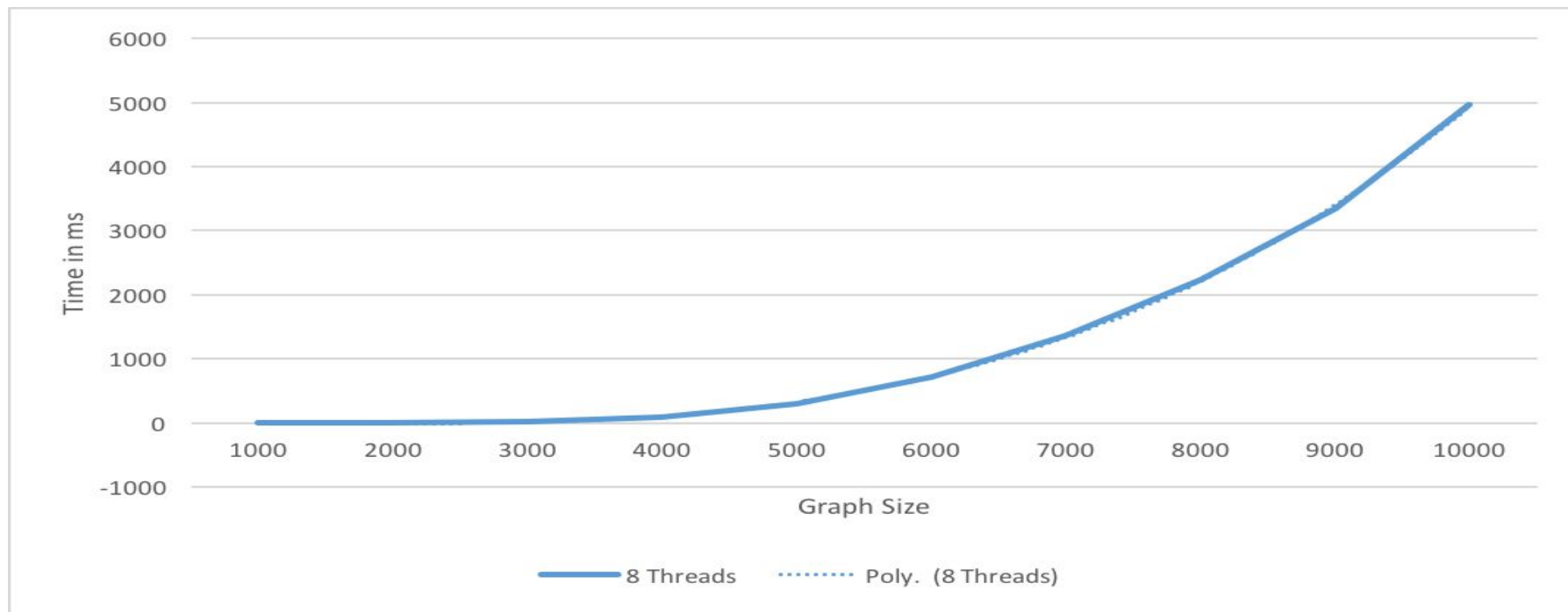
- Intel's Manycore Testing Lab (MTL).
- Each node: 4 × Intel(R) Xeon(R) CPU E7- 4860 CPU.
- Java:
 - Java version "1.7.0_01".
 - Java HotSpot(TM) 64-Bit Server VM.
- Memory:
 - 1 GB most test cases.
 - Some test cases had up to 5 GB.
- Runs: 12 runs, skip first 4.

Response Time & Throughput

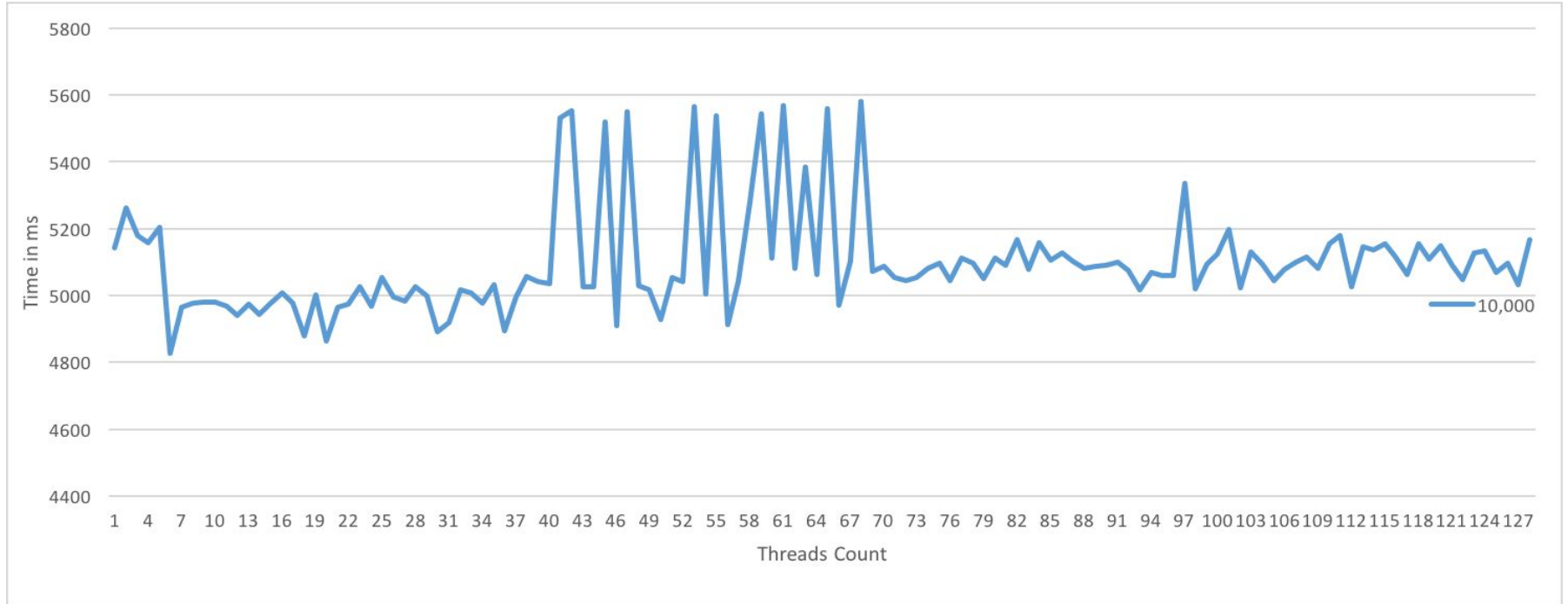
- Response time is defined as the time to process a single request to categorize all nodes in a given state graph.
- An operation for the throughput is defined as a single loop in calculate method in TarjanWorker class.

```
private void calculate(final ManagementStack<T> stackManager,
    final Set<Set<Node<T>>> results) {
    while (!stackManager.isControlStackEmpty()) {
        ++mIterations;
        final Node<T> node = stackManager.controlStackTop();
        final Node<T> nextChild = node.getUnvisitedChild();
        if (nextChild != null) {
            checkAndUpdateChild(stackManager, node, nextChild);
        } else {
            assert(node.isCurrentThread());
            backtrack(stackManager, node);
            identifyGraphProperties(stackManager, node, results);
        }
    }
}
```

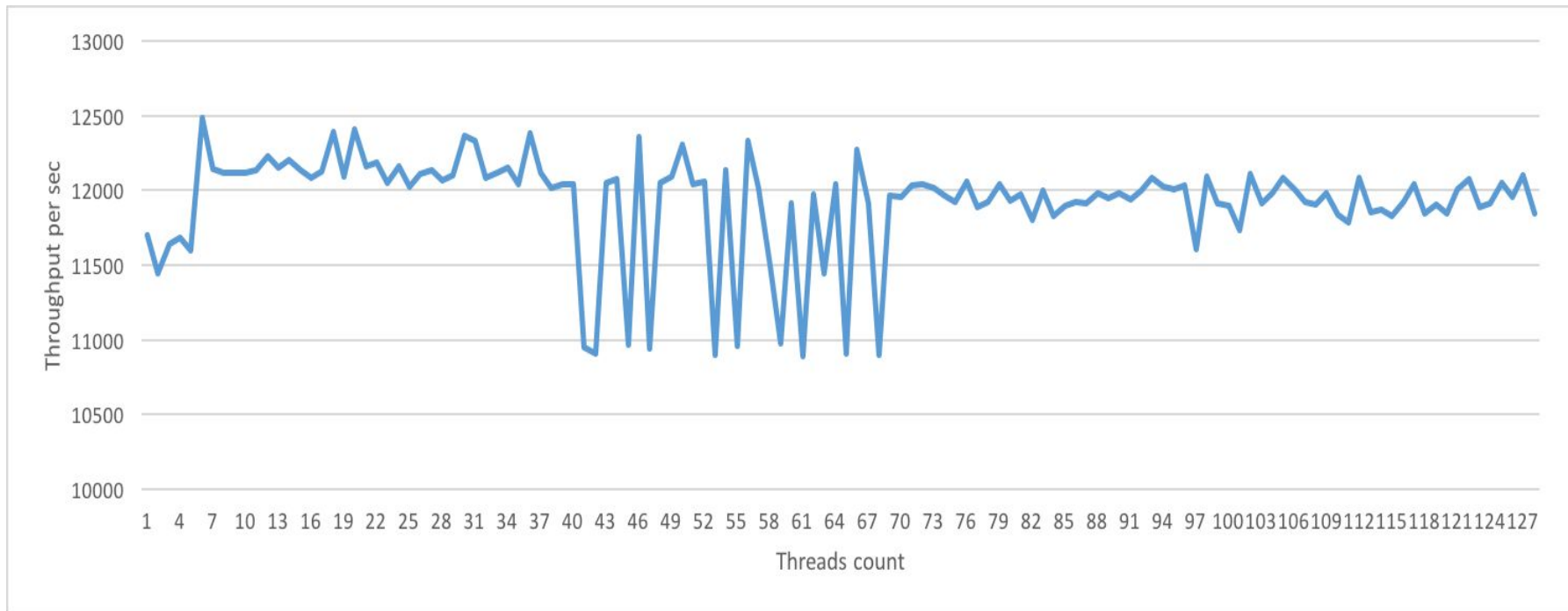
Time versus Size



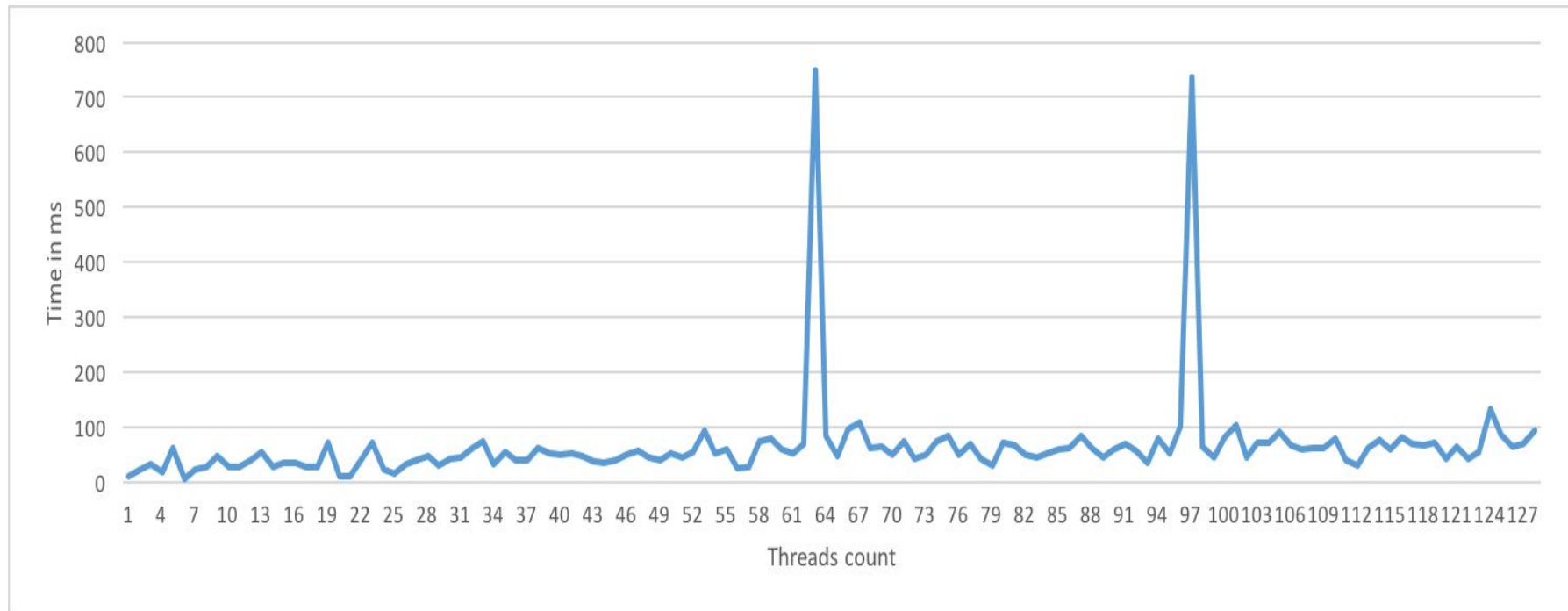
Time versus Threads



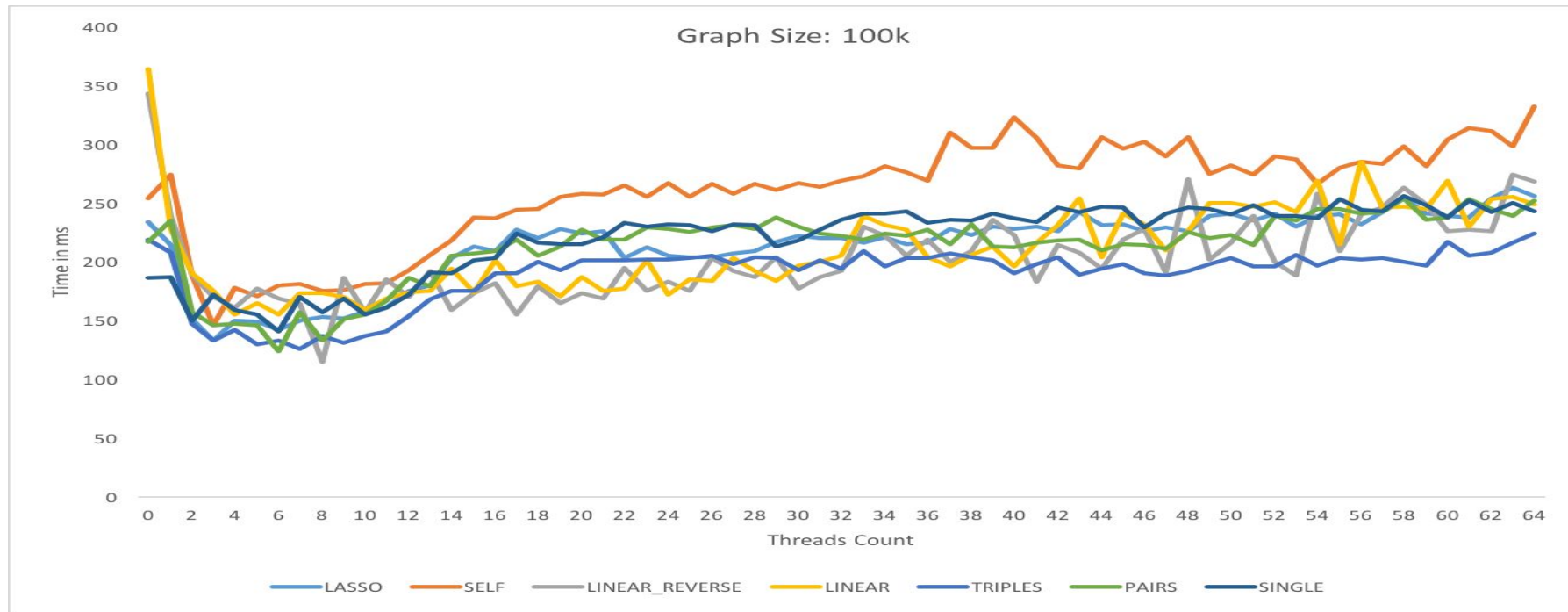
Throughput vs Threads



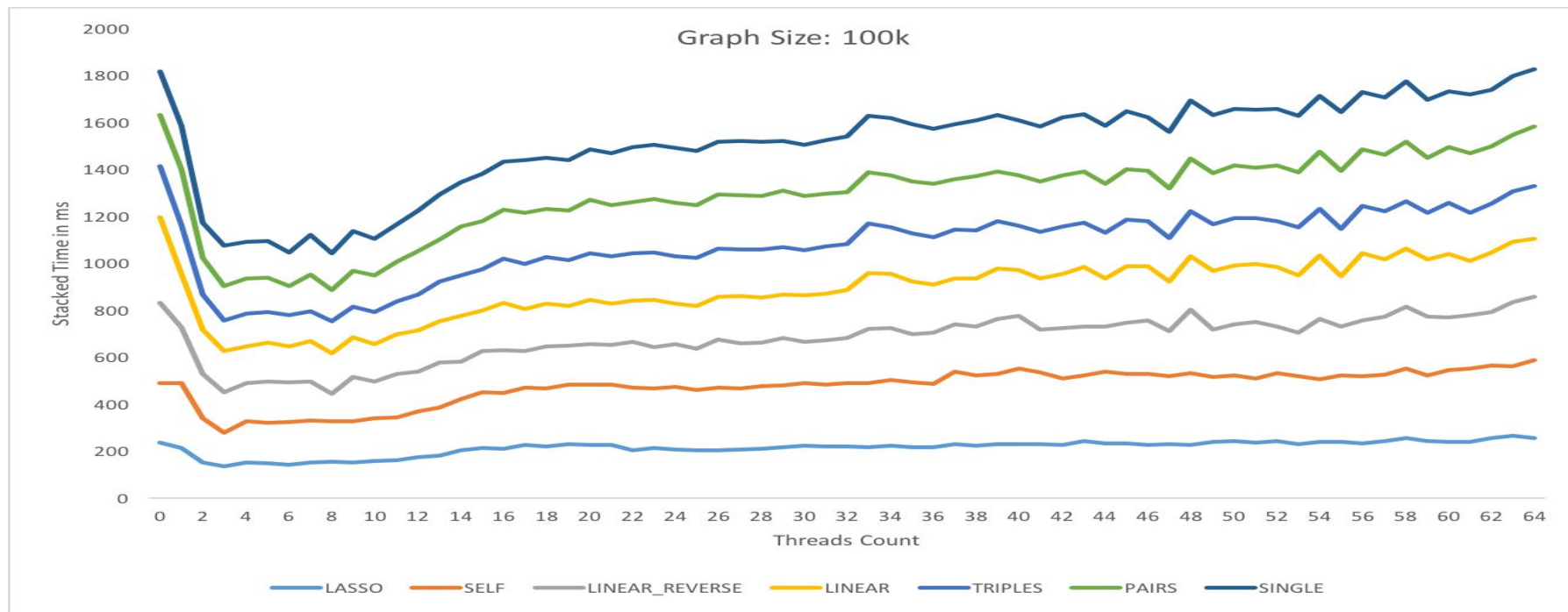
Standard deviation



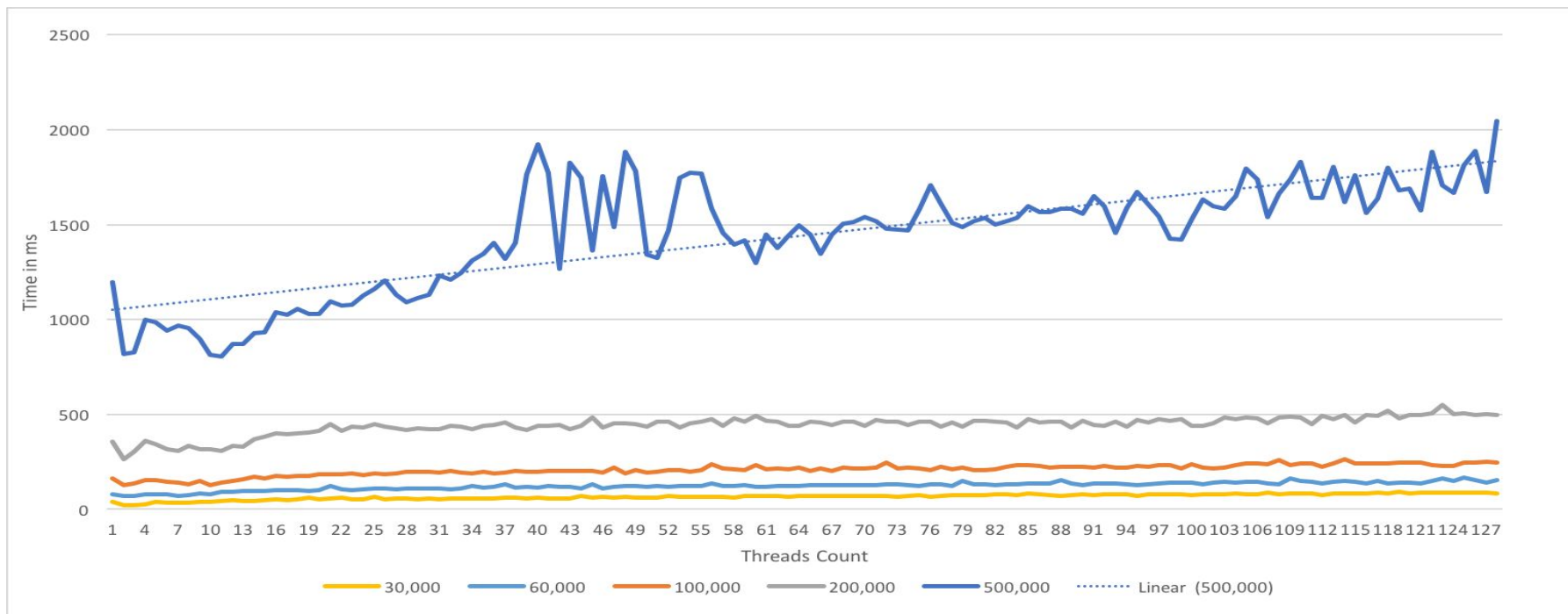
Predefined Graph Types (1)



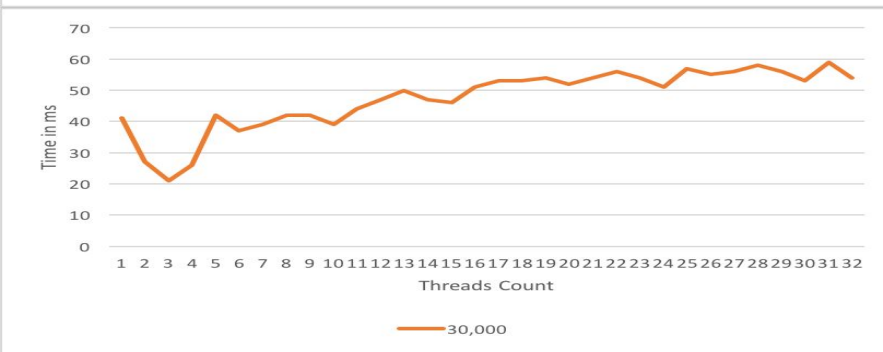
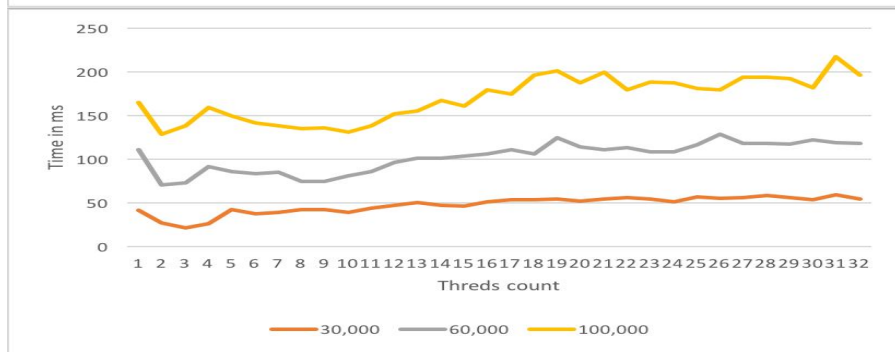
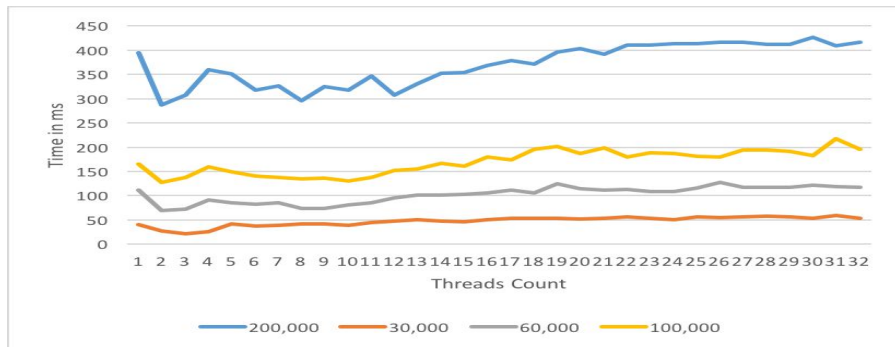
Predefined Graph Types (2)



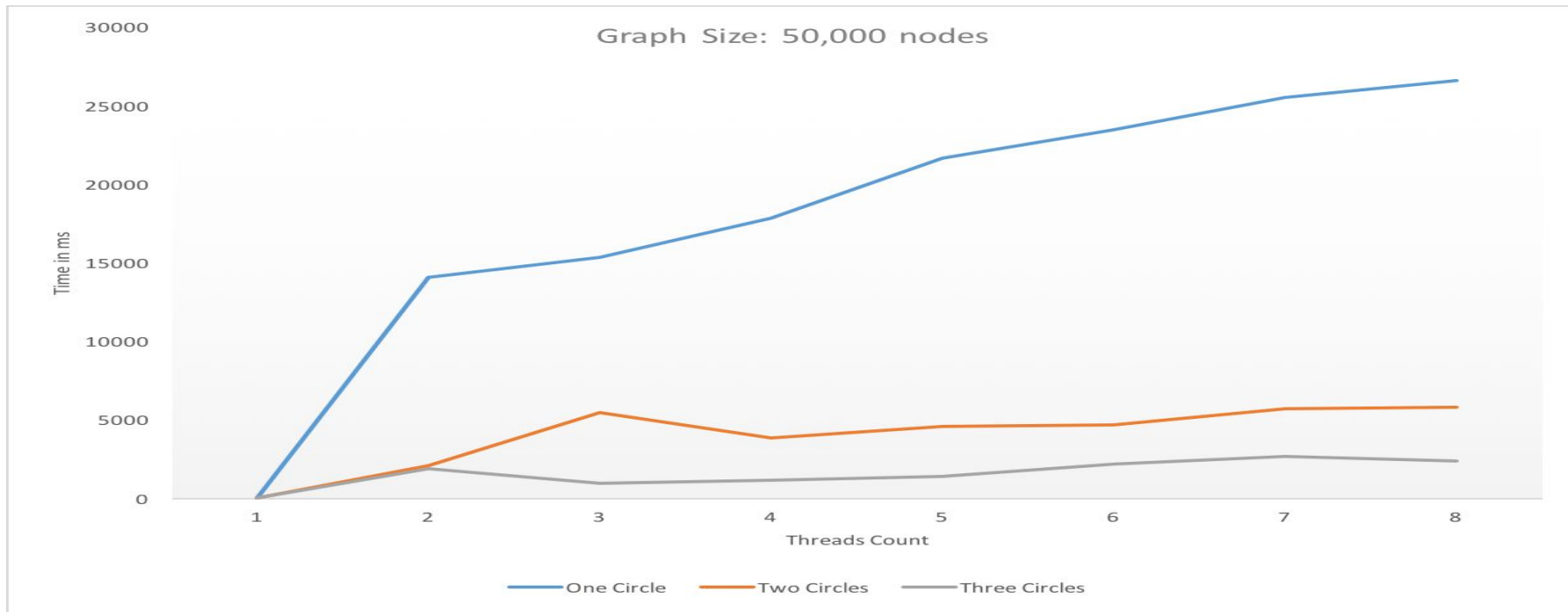
Single Graph Type (1)



Single Graph Type (2)



Circles



Recap with random graphs

- Time increases linearly with threads.
- Time increases linearly with connectivity.
- Time increases polynomially with size.

Next steps?

- Test automation.
- Publish code on github.

Q&A

Thank you