University of Craiova
Faculty of Automation, Computers and Electronics

Dijkstra

Parallel and Distributed Algorithms

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Computers Romanian Language
Study Group CR 3.2
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2 Input data generation

To generate input data, a graph is generated based on a given density.
Input format:
noOfNodes sourceNode
c00 c01 ... c0(noOfNodes -1)
c01 c11 ... c1(noOfNodes -1)
...
c(noOfNodes -1)0 c(noOfNodes -1)1 ... c(noOfNodes -1)(noOfNodes -1)

Where:

- **noOfNodes**: the number of nodes
- **sourceNode**: the source node
- **c**: the adjacency matrix

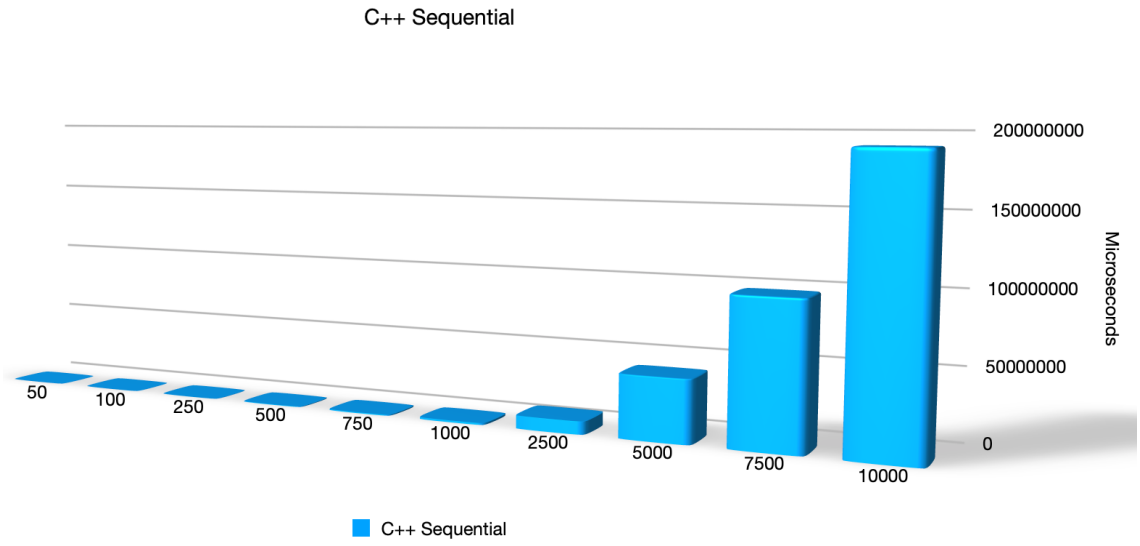
```java
/**
 * Generate a random graph.
 *
 * @param noOfNodes The number of nodes.
 * @param density   The density of graph. If density is @Constants.MIN_DENSITY, no edge will be generated.
 * If density is @Constants.MAX_DENSITY, edges between all nodes will be generated.
 *
 * @return The generated graph.
 */
public static Graph generateGraph(final int noOfNodes, final int density) {
  List<List<Integer>> adjacencyMatrix = new ArrayList<>(noOfNodes);
  for (int i = 0; i < noOfNodes; i++) {
      List<Integer> row = new ArrayList<>();
      for (int j = 0; j < noOfNodes; j++) {
          final int grade = RandomUtil.generateNumber(Constants.MIN_DENSITY, Constants.MAX_DENSITY);
          if (i == j) {
              row.add(j,  element: 0);
          } else {
            row.add(j, grade > density ? Constants.INFINITE :
              RandomUtil.generateNumber(Constants.MIN_EDGE_COST, Constants.MAX_EDGE_COST)
            );
          }
      }
      adjacencyMatrix.add(i, row);
  }

  return new Graph(adjacencyMatrix);
}
```

3 Output data

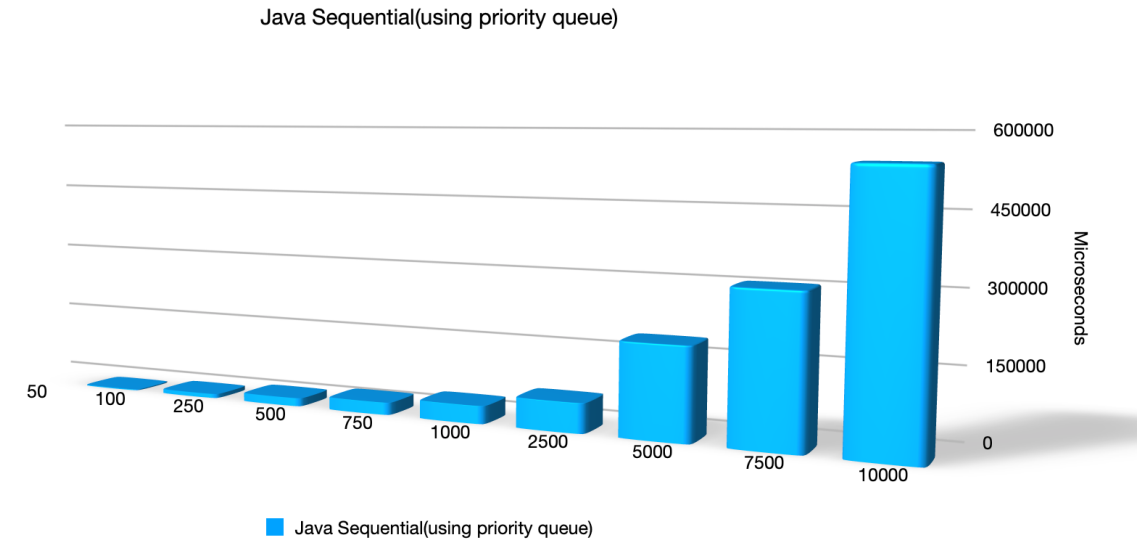
Each algorithm will have the following output format:
Vertex Distance from source(source node)
0 c0
1 c1
...
noOfNodes -1 c(noOfNodes - 1)
Where:
c[i] is the distance between node i and source node.

4 Results

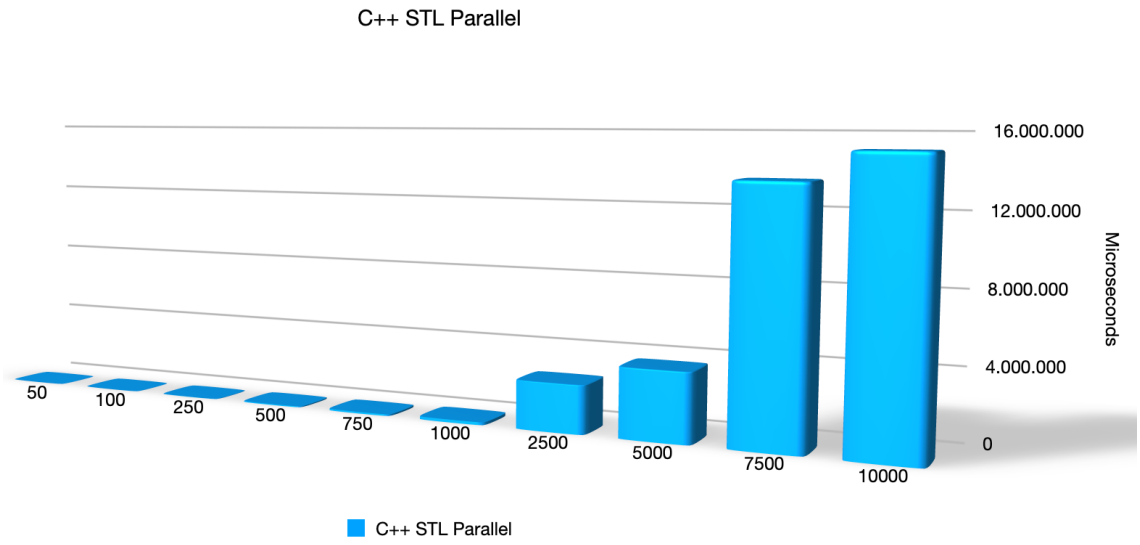
4.1 C++ Sequential



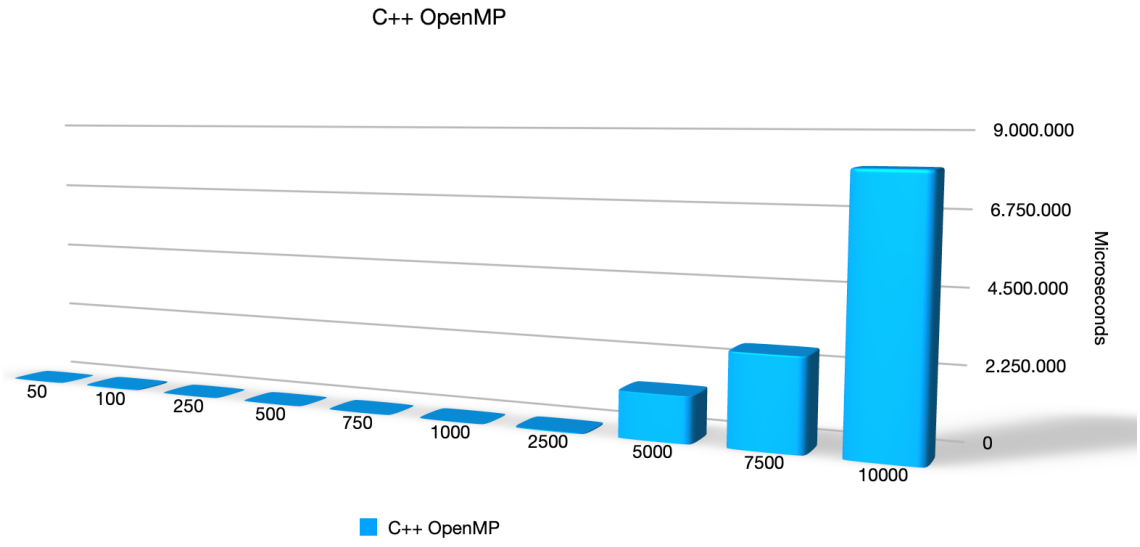
4.2 Java Sequential(using priority queue)



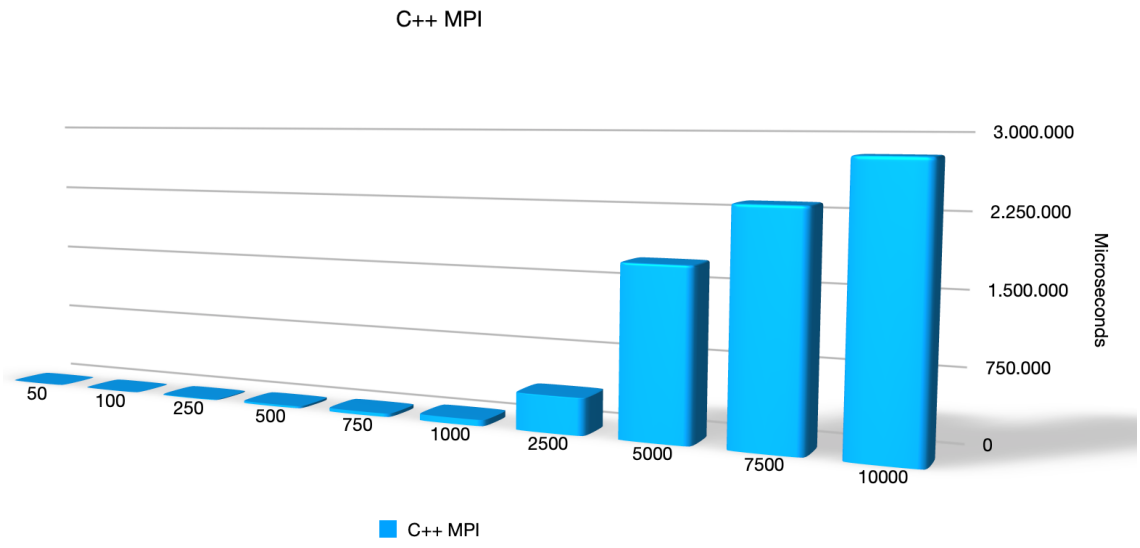
4.3 C++ STL parallel



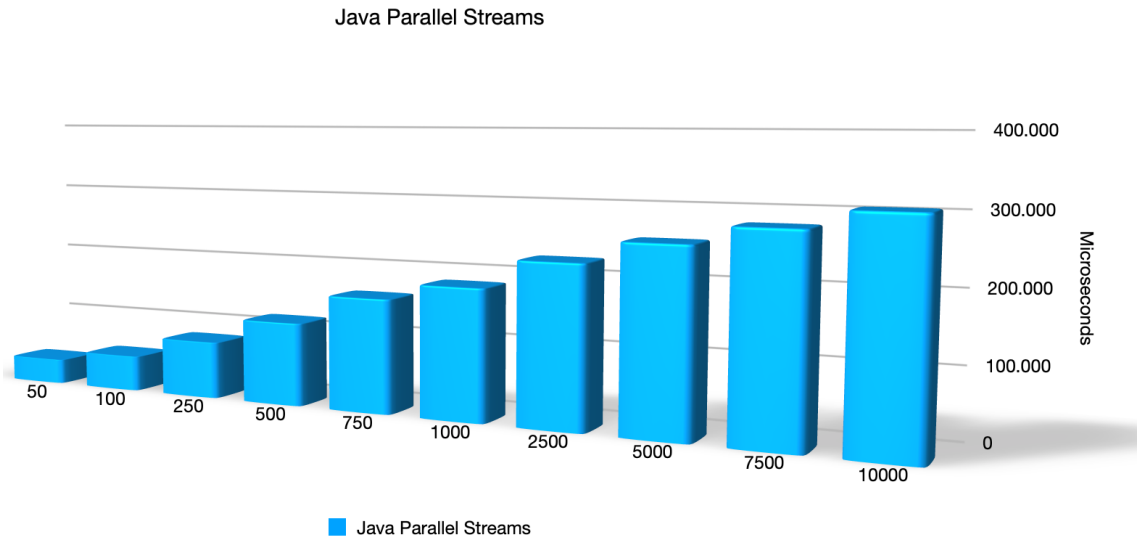
4.4 C++ OpenMP



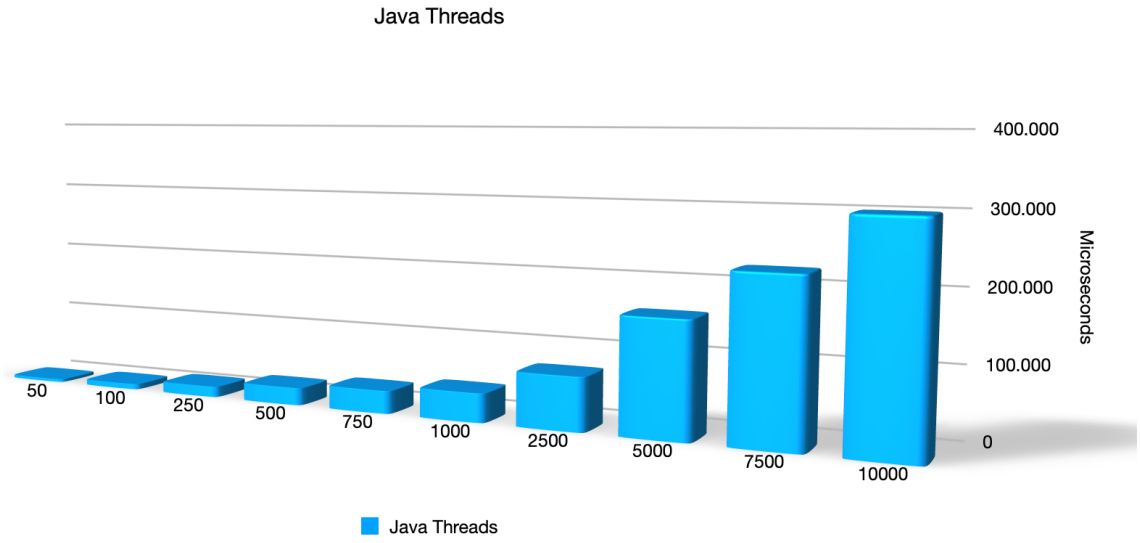
4.5 C++ MPI



4.6 Java Parallel Streams

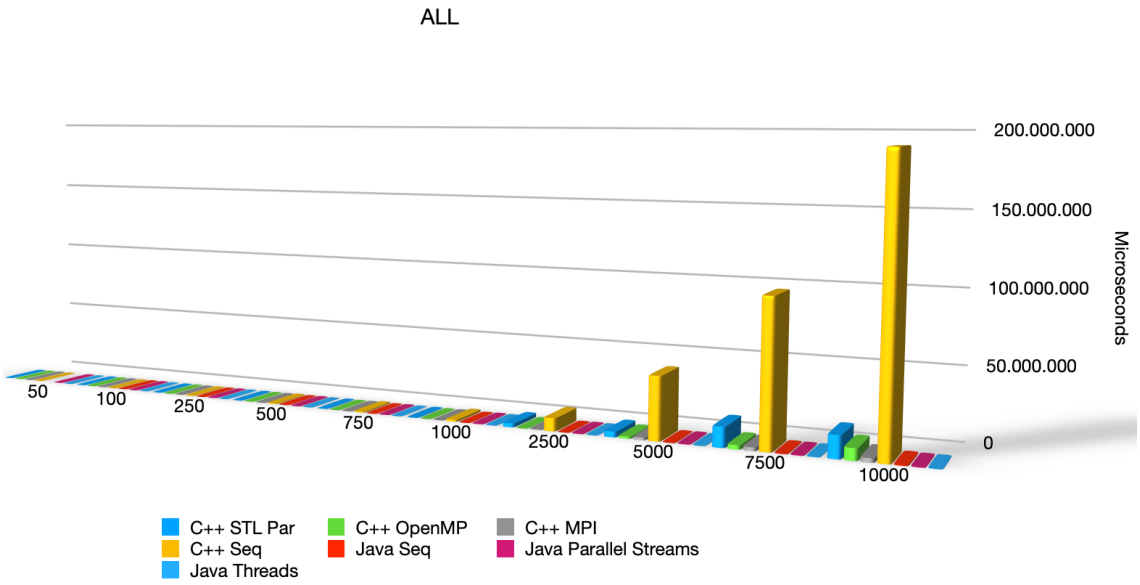


4.7 Java with Threads

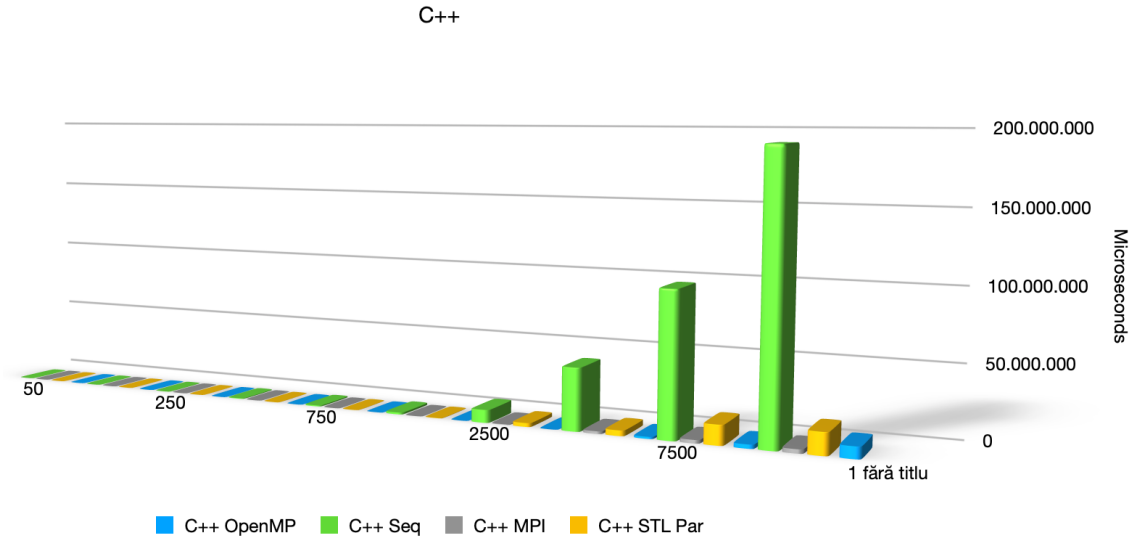


5 Comparasion

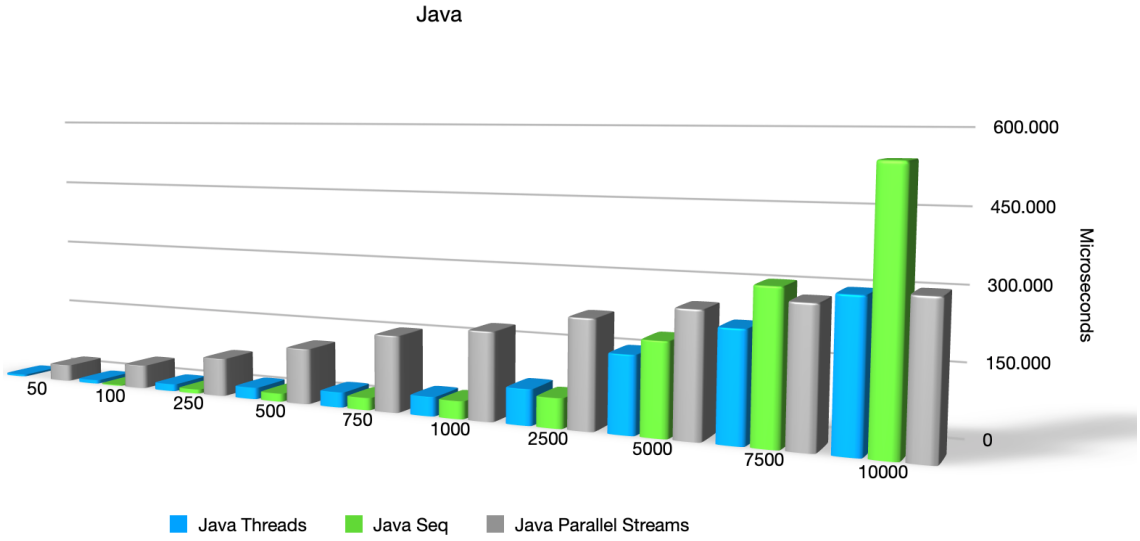
5.1 All implementations



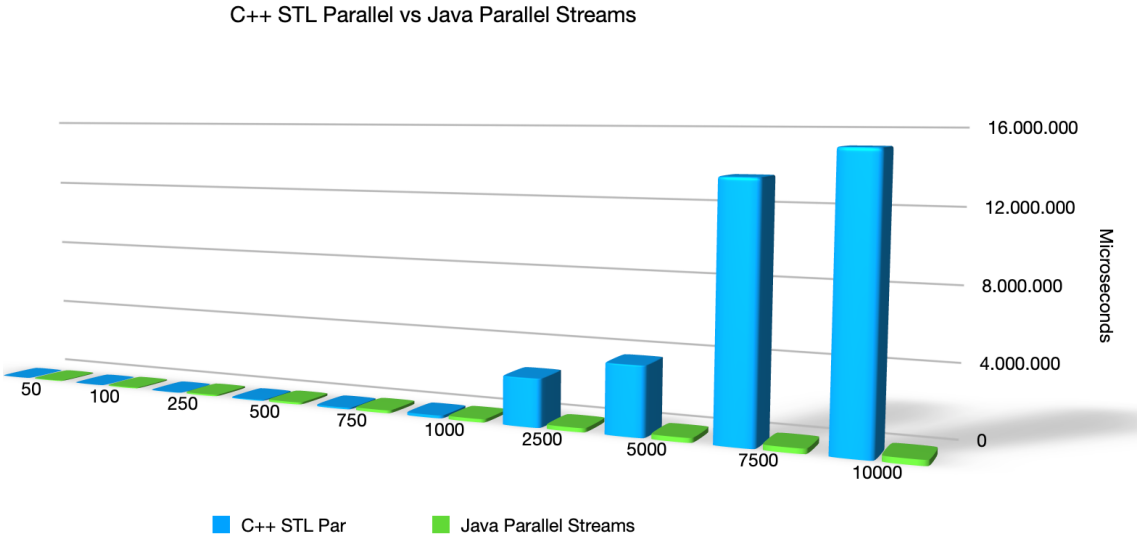
5.2 C++ implementations



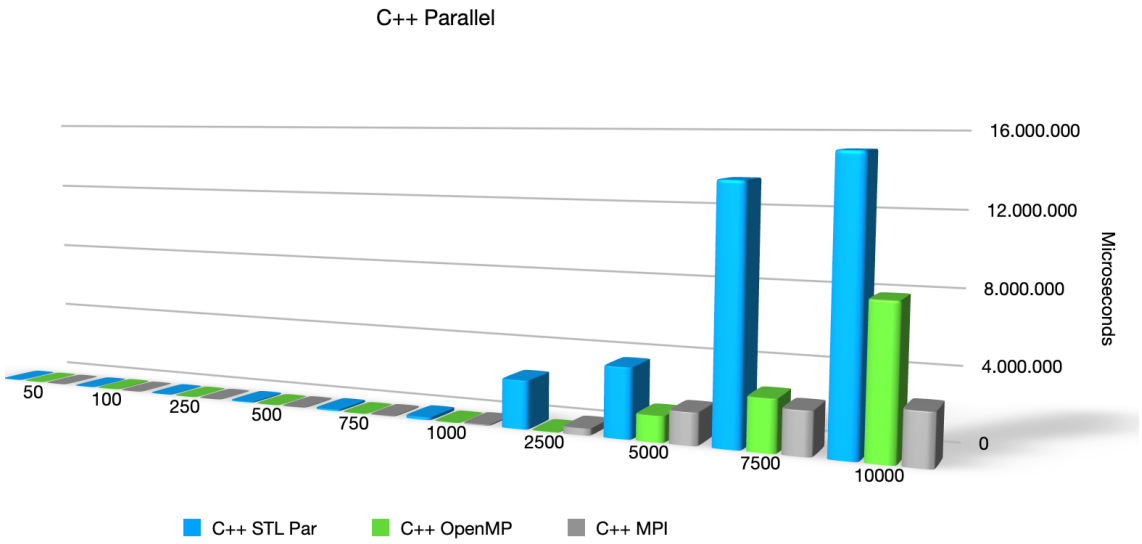
5.3 Java implementations



5.4 C++ STL Parallel vs Java Streams Parallel



5.5 C++ Parallel



Observation
The environment on which I ran the tests is: Windows 10 Home, 16GB Ram, 512GB SSD, Eclipse for Java programs and Visual Studio 2019 for C++.

6 Bibliography

References

[1] repository.stcloudstate.ed,https://repository.stcloudstate.edu/cgi/viewcontent.cgi?article=1044&context=csit_etds, accessed in March 2022.

[2] geeksforgeeks,https://www.geeksforgeeks.org/dijkstras-shortest-path-algorithm-greedy-algo-7/, accessed in March 2022.