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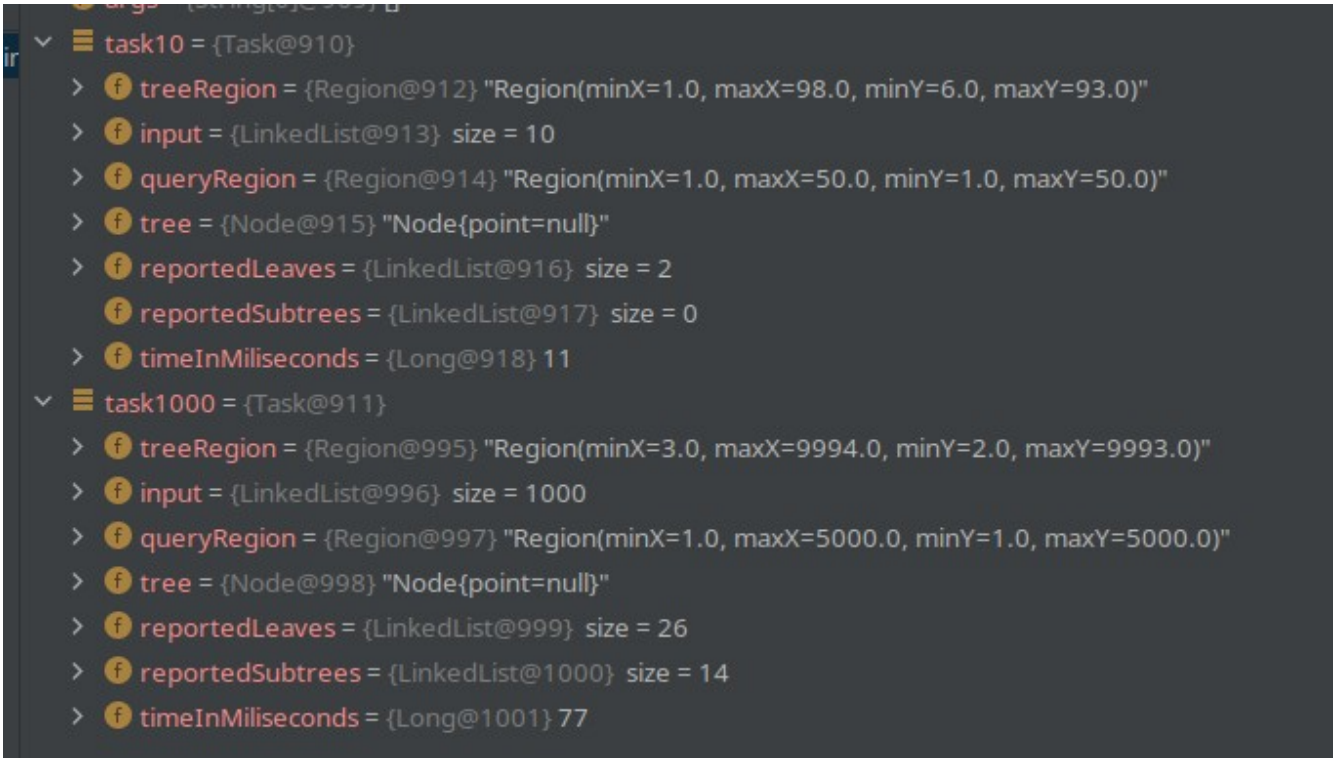
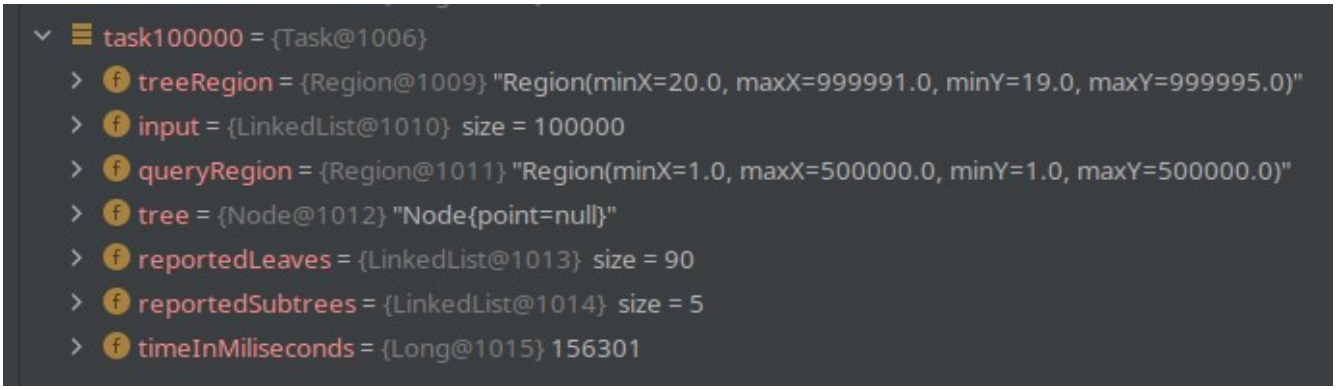
Wyniki z debuggera




Kod:

```
import model.Region;
import model.Task;
import service.InputBuilder;

public class Main {

  public static void main(String[] args) throws Exception {
```

```
    Task task10 = new Task(
        new InputBuilder(10).build(),
        new Region(
            1.0d,
            50.0d,
            1.0d,
            50.0d
        )
    );
    Task task1000 = new Task(
        new InputBuilder(1000).build(),
        new Region(
            1.0d,
            5000.0d,
            1.0d,
            5000.0d
        )
    );
    Task task100000 = new Task(
        new InputBuilder(100000).build(),
        new Region(
            1.0d,
            500000.0d,
            1.0d,
            500000.0d
        )
    );
    Task task10000000 = new Task(
        new InputBuilder(10000000).build(),
        new Region(
            1.0d,
            5000000.0d,
            1.0d,
            5000000.0d
        )
    );
  }

}
```

```
package model;

import com.google.common.collect.Lists;
import java.util.List;
import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;
```

```java
@AllArgsConstructor
@NoArgsConstructor
@Data
public class Input {

  private List<Point> points = Lists.newLinkedList();
  private Region region = new Region();

}
```

```java
package model;

import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;

@AllArgsConstructor
@NoArgsConstructor
@Data
public class Node {

  private Double location;
  private NODE_TYPE type;
  private Point point;
  private Node parent;
  private Node left;
  private Node right;
  private Region region;

  public Node(
      Double location,
      NODE_TYPE type,
      Point point,
      Node left,
      Node right
  ) {
    this.location = location;
    this.type = type;
    this.point = point;
    this.left = left;
    this.right = right;
  }

  public boolean isLeaf() {
    return this.left == null && this.right == null;
  }

  public void setRegion(Region region) {
    this.region = new Region();
```

```
    this.region.of(region);
  }

  public boolean isLeft() {
    return this == this.parent.left;
  }

  public boolean isRight() {
    return this == this.parent.right;
  }

  @Override
  public String toString() {
    return "Node{" + "point=" + this.point + '}';
  }

  public enum NODE_TYPE {
    LEAF,
    VERTICAL_LINE,
    HORIZONTAL_LINE;
  }

}

package model;

import model.Node.NODE_TYPE;

public class NodeBuilder {

  /**
   * Stworzenie node'a na podstawie argumentów.
   *
   * @param location
   * @param type
   * @param point
   * @param left
   * @param right
   */
  public Node build(
      Double location,
      NODE_TYPE type,
      Point point,
      Node left,
      Node right
  ) {

    Node node = new Node(
        location,
```

```
        type,
        point,
        left,
        right
    );
    if (left != null) {
      left.setParent(node);
      node.setLeft(left);
    }
    if (right != null) {
      right.setParent(node);
      node.setRight(right);
    }
    return node;
  }

}
```

```
package model;

import com.google.common.collect.Lists;
import java.util.Collections;
import java.util.List;
import model.Node.NODE_TYPE;
import service.RegionComparator;

public class Task {

  public Region treeRegion = new Region(
      0.0,
      0.0,
      0.0,
      0.0
  );
  private List<Point> input = Lists.newArrayList();
  private Region queryRegion;
  private Node tree;
  private List<Point> reportedLeaves = Lists.newLinkedList();
  private List<Node> reportedSubtrees = Lists.newLinkedList();
  private Long timeInMiliseconds = 0L;

  public Task(
      Input input,
      Region queryRegion
  ) {
    this.input = input.getPoints();
    this.treeRegion = input.getRegion();
    this.queryRegion = queryRegion;
    this.run();
```

```
}

/**
 * Metoda fasadowa. Uruchamia poszczegolne etapy algorytmu.
 */
public void run() {

  try {
    long start = System.currentTimeMillis();
    this.validate();
    this.tree = this.buildKdTree(
        this.input,
        0
    );
    this.tree.setRegion(this.treeRegion);
    this.defineRegion(this.tree);
    this.checkAffiliationToQueryRegion(this.tree);
    this.timeInMiliseconds = System.currentTimeMillis() - start;
  } catch (Exception exception) {
    System.out.println(exception.getMessage());
  }
}

/**
 * Walidacja danych wejsciowych. Złożoność O(n^2)
 *
 * @throws Exception
 */
public void validate() throws Exception {

  this.validateAmountOfPoints();
  this.validateQueryRegion();
  for (Point leftPoint : this.input) {
    for (Point rightPoint : this.input) {
      if (!leftPoint.equals(rightPoint)) {
        this.validateDifferenceOfX(
            leftPoint,
            rightPoint
        );
        this.validateDifferenceOfY(
            leftPoint,
            rightPoint
        );
      }
    }
  }
}

/**
```

```
 * Walidacja obszaru zapytania
 *
 * @throws Exception
 */
public void validateQueryRegion() throws Exception {

  if (this.queryRegion != null) {
    if (this.queryRegion.getMinX() > this.queryRegion.getMaxX()
        || this.queryRegion.getMinY() > this.queryRegion.getMaxY()) {
      throw new Exception("Nieprawidłowy obszar zapytania");
    }
  }
}

/**
 * Walidacja danych wejsciowych
 *
 * @throws Exception
 */
public void validateAmountOfPoints() throws Exception {

  if (this.input.size() == 0) {
    throw new Exception("Nie podano punktów.");
  }
}

/**
 * Walidacja danych wejsciowych
 *
 * @throws Exception
 */
public void validateDifferenceOfX(
    Point left,
    Point right
) throws Exception {

  if (left.getX() == right.getX()) {
    throw new Exception("Współrzędne x są takie same w punktach");
  }
}

/**
 * Walidacja danych wejsciowych
 *
 * @throws Exception
 */
public void validateDifferenceOfY(
    Point left,
    Point right
```

```
) throws Exception {

  if (left.getY() == right.getY()) {
    throw new Exception("Współrzędne y są takie same w punktach");
  }
}

/**
 * Budowanie kd drzewa na podstawie punktow z argumentu metody. Złozoność O(n).
 *
 * @param points
 * @param d
 */
public Node buildKdTree(
    List<Point> points,
    Integer d
) {

  if (points.size() == 1) {
    return new NodeBuilder().build(
        0d,
        NODE_TYPE.LEAF,
        points.get(0),
        null,
        null
    );
  } else if (points.size() == 0) {
    return null;
  }
  Integer axis = d % 2;
  NODE_TYPE type = axis == 0 ? NODE_TYPE.VERTICAL_LINE : NODE_TYPE.HORIZONTAL_LINE;
  double median = this.calculateMedian(
      axis,
      points
  );
  List<Point> leftPoints = Lists.newLinkedList();
  List<Point> rightPoints = Lists.newLinkedList();
  for (Point temporary : points) {
    double value = axis == 0 ? temporary.getX() : temporary.getY();
    if (value <= median) {
      leftPoints.add(temporary);
    } else {
      rightPoints.add(temporary);
    }
  }
  Node leftSubtree = this.buildKdTree(
      leftPoints,
      d + 1
  );
```

```
  Node rightSubtree = this.buildKdTree(
      rightPoints,
      d + 1
  );
  Node newNode = new NodeBuilder().build(
      median,
      type,
      null,
      leftSubtree,
      rightSubtree
  );

  return newNode;
}

/**
 * Liczenie mediany z punktow wzgledem osi x lub y z argumentu
 *
 * @param axis
 * @param points
 */
public Double calculateMedian(
    Integer axis,
    List<Point> points
) {

  Double median = axis == 0 ? this.calculateMedianByX(points) : this.calculateMedianByY(points);

  return median;
}

/**
 * Liczenie mediany punktow wzgledem osi x
 *
 * @param points
 */
public Double calculateMedianByX(
    List<Point> points
) {

  this.sortByX(points);
  Integer half = points.size() / 2;
  Double median = (points.size() % 2 == 0) ?
      ((points.get(half).getX() + points.get(half - 1).getX()) / 2)
      : points.get(half).getX();

  return median;
}
```

```java
/**
 * Liczenie mediany punktow wzgledem osi y
 *
 * @param points
 */
public Double calculateMedianByY(
    List<Point> points
) {

  this.sortByY(points);
  Integer half = points.size() / 2;
  Double median = (points.size() % 2 == 0) ?
      ((points.get(half).getY() + points.get(half - 1).getY()) / 2)
      : points.get(half).getY();

  return median;
}

/**
 * Sortowanie po osi x
 *
 * @param points
 */
public void sortByX(List<Point> points) {

  points.sort((p1, p2) -> {
    if ((p1.getX() < p2.getX()) || (p1.getX() == p2.getX() && p1.getY() < p2.getY())) {
      return -1;
    } else if (p1.getX() > p2.getX()) {
      return 1;
    } else {
      return 0;
    }
  });
}

/**
 * Sortowanie po osi y
 *
 * @param points
 */
public void sortByY(List<Point> points) {

  Collections.sort(points, (p1, p2) -> {
    if ((p1.getY() < p2.getY()) || (p1.getY() == p2.getY() && p1.getX() < p2.getX())) {
      return -1;
    } else if (p1.getY() > p2.getY()) {
      return 1;
    } else {
```

```
      return 0;
    }
  });
}

/**
 * Zdefiniowanie rejonu punktow node'a z argumentu metody. Rekurencyjnie sprawdza rejony dla
 * dzieci.
 *
 * @param node
 */
public void defineRegion(Node node) {

  if (!node.isLeaf()) {
    if (node.getParent() != null) {
      node.setRegion(
          node.getParent().getRegion()
      );
      Region nodeRegion = node.getRegion();
      Double location = node.getParent().getLocation();
      if (nodeRegion != null && location != null) {
        if (NODE_TYPE.HORIZONTAL_LINE.equals(node.getType())) {
          if (node.isLeft()) {
            nodeRegion.setMaxX(location);
          } else {
            nodeRegion.setMinX(location);
          }
        } else {
          if (node.isLeft()) {
            nodeRegion.setMaxY(location);
          } else {
            nodeRegion.setMinY(location);
          }
        }
        node.setRegion(nodeRegion);
      }
    }
    if (node.getLeft() != null) {
      this.defineRegion(
          node.getLeft()
      );
    }
    if (node.getRight() != null) {
      this.defineRegion(
          node.getRight()
      );
    }
  }
}
```

```
/**
 * Sprawdza czy node znajduje sie w obszarze zapytania i dodaje go do zgloszonych elementow
 *
 * @param node
 */
public void checkAffiliationToQueryRegion(Node node) {

  if (node.isLeaf()) {
    this.checkLeafAffiliationToQueryRegion(node);
  } else {
    if (node.getLeft().isLeaf()) {
      this.checkLeafAffiliationToQueryRegion(node.getLeft());
    } else {
      this.checkSubtreeAffiliationToQueryRegion(node.getLeft());
    }
    if (node.getRight().isLeaf()) {
      this.checkLeafAffiliationToQueryRegion(node.getRight());
    } else {
      this.checkSubtreeAffiliationToQueryRegion(node.getRight());
    }
  }
}

/**
 * Sprawdza czy lisc przynalezy do obszaru zapytania
 *
 * @param node
 */
public void checkLeafAffiliationToQueryRegion(Node node) {

  Boolean contained = this.containedInRegion(
      this.queryRegion,
      node.getPoint()
  );
  if (contained) {
    this.reportedLeaves.add(
        node.getPoint()
    );
  }
}

/**
 * Sprawdza czy poddrzewo znajduje sie w obszarze zapytania
 *
 * @param node
 */
public void checkSubtreeAffiliationToQueryRegion(Node node) {
```

```
    if (
        node != null
            && this.queryRegion != null
            && new RegionComparator(
            node.getRegion(),
            this.queryRegion).isNodeRegionContainedInQueryRegion()
    ) {
      this.reportedSubtrees.add(node);
    } else if (
        node != null
            && this.queryRegion != null
            && new RegionComparator(
            node.getRegion(),
            this.queryRegion).isNodeRegionIntersectionOfQueryRegion()
    ) {
      this.checkAffiliationToQueryRegion(node);
    } else {
      if (node.isLeaf()) {
        this.checkLeafAffiliationToQueryRegion(node);
      }
    }
  }

  /**
   * Sprawdza czy punkt z argumentu znajduje sie danym rejonie z argumentu
   *
   * @param region
   * @param point
   */
  public Boolean containedInRegion(
      Region region,
      Point point
  ) {

    Boolean pointInRegion = point.getX() >= region.getMinX() && point.getX() <= region.getMaxX()
        && point.getY() >= region.getMinY() && point.getY() <= region.getMaxY();

    return pointInRegion;
  }

}

package model;

import java.util.Objects;
import java.util.UUID;
import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;
```

```java
@AllArgsConstructor
@NoArgsConstructor
@Data
public class Point {

  private UUID id = UUID.randomUUID();

  private double x;

  private double y;

  public Point(
      Double x,
      Double y
  ) {
    this.x = x;
    this.y = y;
  }

  @Override
  public boolean equals(Object o) {

    if (this == o) {
      return true;
    }
    if (o == null || getClass() != o.getClass()) {
      return false;
    }
    Point point = (Point) o;
    return Double.compare(point.x, x) == 0 && Double.compare(point.y, y) == 0;
  }

  @Override
  public int hashCode() {

    return Objects.hash(x, y);
  }

}
```

```java
package model;

import lombok.Data;
import lombok.NoArgsConstructor;

@NoArgsConstructor
@Data
public class Region {
```

```java
private Double minX;
private Double maxX;
private Double minY;
private Double maxY;

/**
 * Stworzenie rejonu z prawodilowy przypisaniem wartosci minimalnych/maksymlanych
 *
 * @param minX
 * @param maxX
 * @param minY
 * @param maxY
 */
public Region(
    Double minX,
    Double maxX,
    Double minY,
    Double maxY
) {

  double temporary;
  if (minX > maxX) {
    temporary = minX;
    minX = maxX;
    maxX = temporary;
  }
  if (minY > maxY) {
    temporary = minY;
    minY = maxY;
    maxY = temporary;
  }
  this.minX = minX;
  this.maxX = maxX;
  this.minY = minY;
  this.maxY = maxY;
}

/**
 * Skopiowanie wartosci z danego rejonu do instacji
 *
 * @param region
 */
public void of(Region region) {

  this.minX = region.getMinX();
  this.maxX = region.getMaxX();
  this.minY = region.getMinY();
  this.maxY = region.getMaxY();
```

```
  }

}
```

```
package service;

import com.google.common.collect.Lists;
import com.google.common.collect.Sets;
import java.util.List;
import java.util.Random;
import java.util.Set;
import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;
import model.Input;
import model.Point;
import model.Region;

@AllArgsConstructor
@NoArgsConstructor
@Data
public class InputBuilder {

  private Integer amount;

  /**
   * Tworzy liste z losowymi wartosciami oraz rejon w obrebie ktorego znajduja sie te wartosci
   */
  public Input build() {

    List<Point> points = Lists.newLinkedList();
    List<Double> xPoints = this.buildListOfRandomDouble();
    List<Double> yPoints = this.buildListOfRandomDouble();
    Double minX = xPoints.get(0);
    Double maxX = xPoints.get(0);
    Double minY = yPoints.get(0);
    Double maxY = yPoints.get(0);
    for (int i = 0; i < this.amount; i++) {
      Point point = new Point(
          xPoints.get(i),
          yPoints.get(i)
      );
      points.add(point);
      if (point.getX() < minX) {
        minX = point.getX();
      }
      if (point.getX() > maxX) {
        maxX = point.getX();
      }
```

```
      if (point.getY() < minY) {
        minY = point.getY();
      }
      if (point.getY() > maxY) {
        maxY = point.getY();
      }
    }
    Region region = new Region(
        minX,
        maxX,
        minY,
        maxY
    );
    Input input = new Input(
        points,
        region
    );

    return input;
  }

  /**
   * Tworzy liste z losowymi wartosciami
   */
  public List<Double> buildListOfRandomDouble() {

    Set<Double> doubles = Sets.newLinkedHashSet();
    double randomDouble;
    int randomInt;
    Random random = new Random();
    while (doubles.size() != this.amount) {
      randomInt = random.nextInt(this.amount * 10);
      randomInt = randomInt < 0 ? randomInt * -1 : randomInt;
      randomDouble = randomInt;
      doubles.add(randomDouble);
    }
    List<Double> result = doubles.stream().toList();

    return result;
  }

}

package service;

import lombok.AllArgsConstructor;
import lombok.Data;
import lombok.NoArgsConstructor;
import model.Point;
```

```java
import model.Region;

@AllArgsConstructor
@NoArgsConstructor
@Data
public class RegionComparator {

 private Point topRightQueryPoint;
 private Point bottomLeftQueryPoint;
 private Point topRightNodePoint;
 private Point bottomLeftNodePoint;

 public RegionComparator(
    Region node,
    Region query
 ) {
  this.topRightQueryPoint = new Point(
     query.getMaxX(),
     query.getMaxY()
  );
  this.bottomLeftQueryPoint = new Point(
     query.getMinX(),
     query.getMinY()
  );
  this.topRightNodePoint = new Point(
     node.getMaxX(),
     node.getMaxY()
  );
  this.bottomLeftNodePoint = new Point(
     node.getMinX(),
     node.getMinY()
  );
 }

 /**
  * Sprawdza czy node znajduje sie w obszarze zapytania
  */
 public Boolean isNodeRegionContainedInQueryRegion() {

  boolean condition1 = this.topRightNodePoint.getX() <= this.topRightQueryPoint.getX();
  boolean condition2 = this.topRightNodePoint.getY() <= this.topRightQueryPoint.getY();
  boolean condition3 = this.bottomLeftNodePoint.getX() >= this.bottomLeftQueryPoint.getX();
  boolean condition4 = this.bottomLeftNodePoint.getY() >= this.bottomLeftQueryPoint.getY();
  boolean result = condition1 && condition2 && condition3 && condition4;

  return result;
 }

 /**
```

```
   * Sprawdza czy node przecina obszarz zapytania
   */
  public Boolean isNodeRegionIntersectionOfQueryRegion() {

    boolean condition1 = this.topRightQueryPoint.getX() < this.bottomLeftNodePoint.getX();
    boolean condition2 = this.bottomLeftQueryPoint.getX() > this.topRightNodePoint.getX();
    boolean condition3 = this.topRightQueryPoint.getY() < this.bottomLeftNodePoint.getY();
    boolean condition4 = this.bottomLeftQueryPoint.getY() > this.topRightNodePoint.getY();
    boolean result = condition1 || condition2 || condition3 || condition4 ? false : true;

    return result;
  }

}
```