

## Disjoint Sets Data Structures and Union Find Algorithm

Last updated @ 29 October 2017

First published @ 23 September 2017

### What are Disjoint Sets?

Disjoint sets are sets whose intersection is the empty set. For example,  $\{0, 1, 2\}$  and  $\{3\}$  are disjoint sets, while  $\{0, 1, 2\}$  and  $\{2, 3\}$  are not.

### Problem

Given some separated elements grouped in disjoint sets. **Find** whether 2 elements are in the same set or not.

### Approach

- **How to determine if 2 elements are in the same set?** Check if they have the same set root/representative.
- **How to determine the root/representative of a set?** Choose the biggest index of a set or by rank.

### Implementation

**Find with compress path and Union by biggest index**

[src/com/hellokoding/core/disjoinset/DisjoinSetUnionByBiggestIndex.java](https://github.com/hellokoding/core/blob/master/disjoinset/DisjoinSetUnionByBiggestIndex.java)

```
package com.hellokoding.core.disjoinset;
```

```

public class DisjoinSetUnionByBiggestIndex {

    int[] parents;
    int N;

    DisjoinSetUnionByBiggestIndex(int N) {
        this.N = N;
        parents = new int[N];
        initDisjoinSet();
    }

    void initDisjoinSet() {
        for (int i = 0; i < N; i++) {
            parents[i] = i;
        }
    }

    int findRoot(int x) {
        if (parents[x] != x) {
            parents[x] = findRoot(parents[x]);
        }

        return parents[x];
    }

    void union(int x, int y) {
        int rootOfX = findRoot(x);
        int rootOfY = findRoot(y);

        if (rootOfX == rootOfY) {
            return;
        }

        parents[rootOfX] = rootOfY;
    }

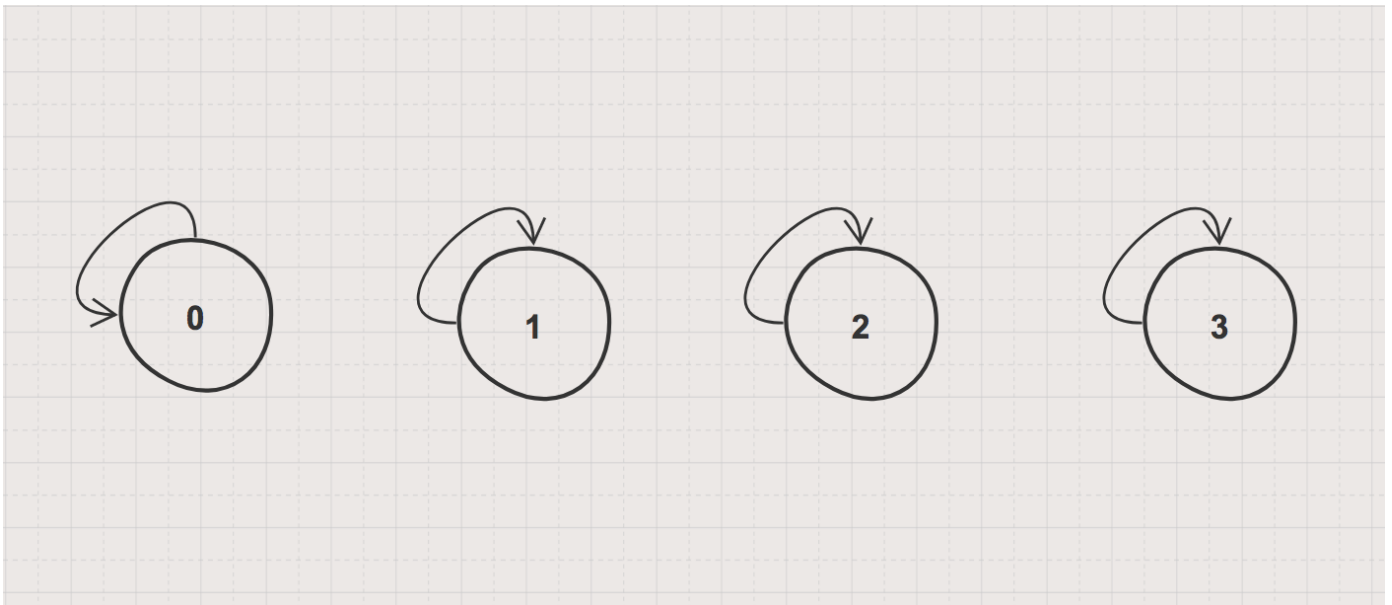
    public static void main(String[] args) {
        int N = 4;
        DisjoinSetUnionByBiggestIndex disjoinSet = new DisjoinSetUnionByBiggestIndex(N);
        disjoinSet.union(0, 1);
    }
}

```

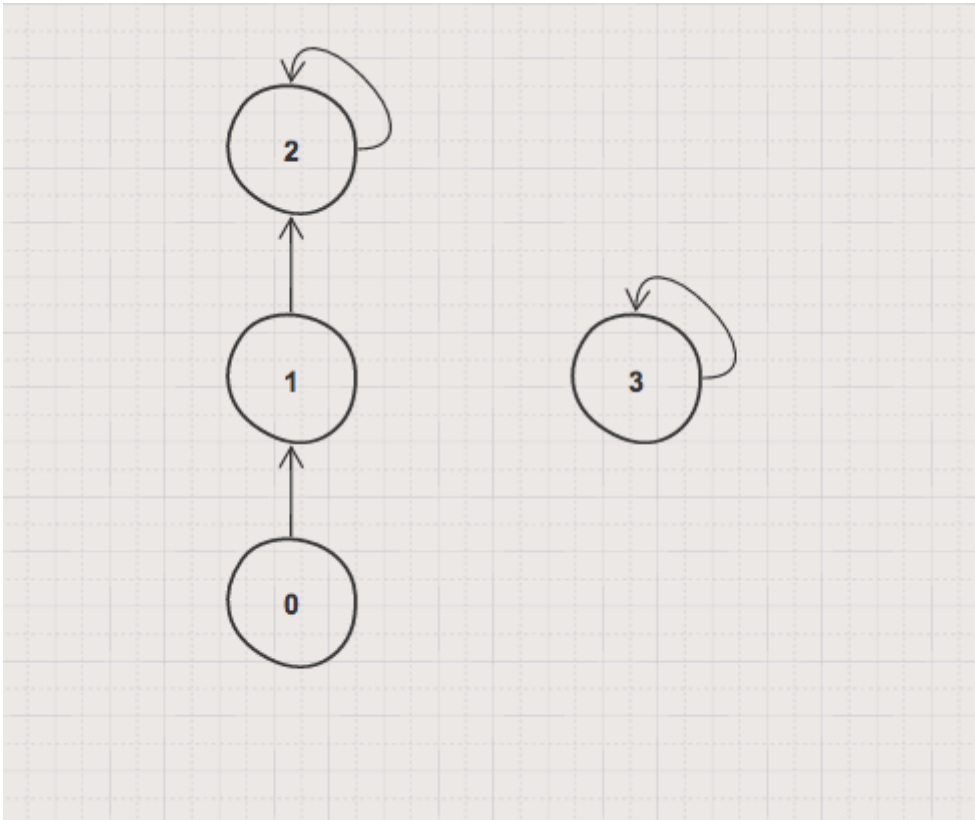
```
disjoinSet.union(0, 1);  
disjoinSet.union(1, 2);
```

```
// Check if 1 is in the same set with 2  
if (disjoinSet.findRoot(1) == disjoinSet.findRoot(2)) {  
    System.out.println("1 is in the same set with 2");  
} else {  
    System.out.println("1 is not in the same set with 2");  
}  
  
// Check if 1 is in the same set with 3  
if (disjoinSet.findRoot(1) == disjoinSet.findRoot(3)) {  
    System.out.println("1 is in the same set with 3");  
} else {  
    System.out.println("1 is not in the same set with 3");  
}  
}  
}
```

Initial state of parents



Final state of parents



**Find with compress path and Union by rank**

[src/com/hellokoding/core/disjoinset/DisjoinSetUnionByRank.java](https://src.com/hellokoding/core/disjoinset/DisjoinSetUnionByRank.java)

```
package com.hellokoding.core.disjoinset;
```

```
public class DisjoinSetUnionByRank {  
    int[] parents, ranks;  
    int N;
```

```
    DisjoinSetUnionByRank(int N) {  
        this.N = N;  
        parents = new int[N];  
        ranks = new int[N];  
        initDisjoinSet();  
    }
```

```
    void initDisjoinSet() {  
        for (int i = 0; i < N; i++) {
```

```

        parents[i] = i;
    }
}

int findRoot(int x) {
    if (parents[x] != x) {
        parents[x] = findRoot(parents[x]);
    }

    return parents[x];
}

void union(int x, int y) {
    int rootOfX = findRoot(x);
    int rootOfY = findRoot(y);

    if (rootOfX == rootOfY) {
        return;
    }

    if (ranks[rootOfX] < ranks[rootOfY]) {
        parents[rootOfX] = rootOfY;
    } else if (ranks[rootOfX] > ranks[rootOfY]) {
        parents[rootOfY] = rootOfX;
    } else {
        parents[rootOfX] = rootOfY;
        ranks[rootOfY] = ranks[rootOfY] + 1;
    }
}

public static void main(String[] args) {
    int N = 4;
    DisjoinSetUnionByRank disjoinSet = new DisjoinSetUnionByRank(N);
    disjoinSet.union(0, 1);
    disjoinSet.union(1, 2);

    // Check if 1 is in the same set with 2
    if (disjoinSet.findRoot(1) == disjoinSet.findRoot(2)) {
        System.out.println("1 is in the same set with 2");
    } else {

```

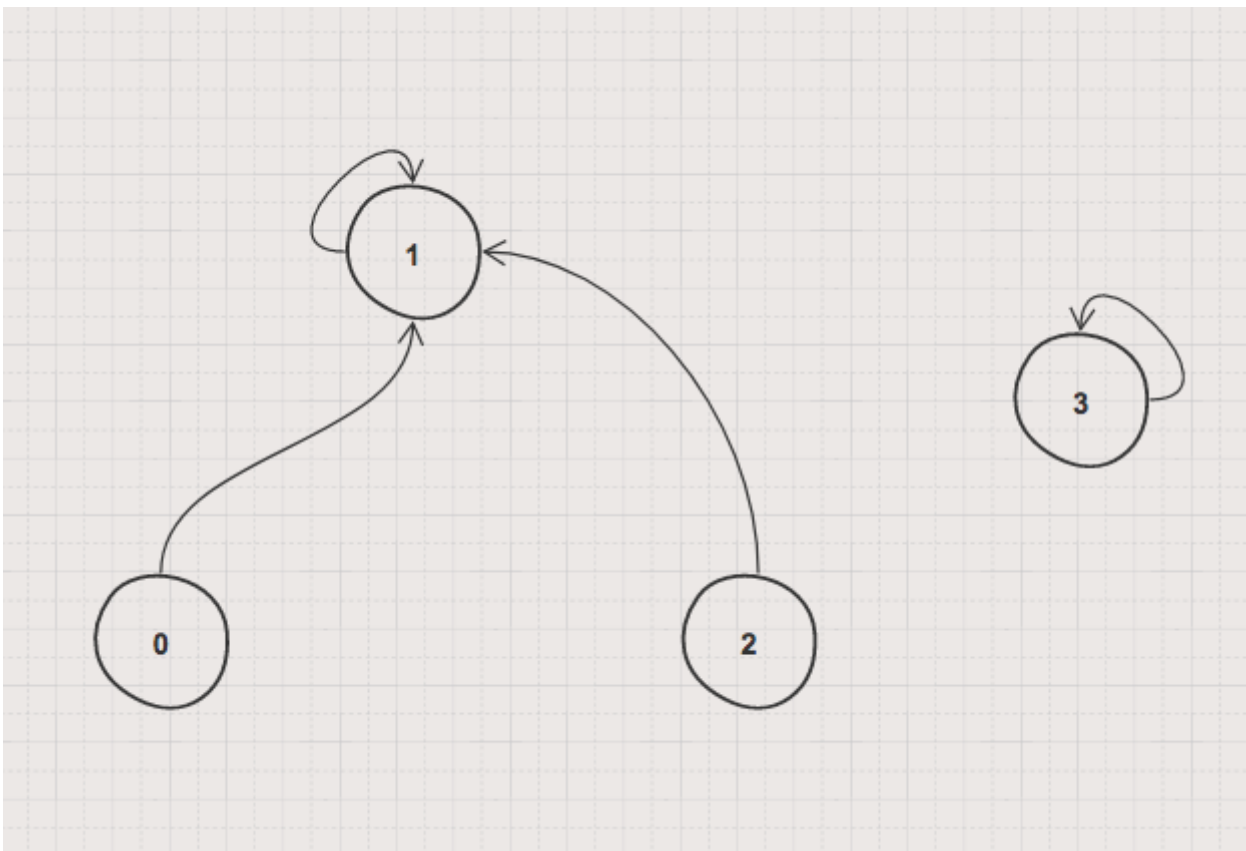
```

    } else {
        System.out.println("1 is not in the same set with 2");
    }

    // Check if 1 is in the same set with 3
    if (disjoinSet.findRoot(1) == disjoinSet.findRoot(3)) {
        System.out.println("1 is in the same set with 3");
    } else {
        System.out.println("1 is not in the same set with 3");
    }
}
}

```

Final state of parents



## References

[Disjoin-set Data Structures\(topcoder.com\)](https://www.topcoder.com/tutorials/data-structures/disjoint-set)

# Core

# Data Structure

# DisjoinSet

# Algorithm

# UnionFind

# Java

## Giau Ngo

Giau Ngo is a software engineer, creator of Hello Koding. He is interested in making simple code examples and tutorials. Follow him on GitHub/Twitter or drop a message [hellokoding \[at\] gmail \[dot\] com](mailto:hellokoding[at]gmail[dot]com)



Previous Story

Giau Ngo - 13 August 2017

## RESTful API Example with Spring Boot, Spring Data REST, Spring Data JPA Many To Many Extra Columns Relationship and MySQL

# Arch

# RESTful

# Spring Data REST

# Spring Data JPA

# Spring Boot

# Java

# MySQL

# cURL

Giau Ngo - 10 October 2017

## Longest Increasing Subsequence

# Core

# Algorithm

# Dynamic Programming

# Java

### Comments

---



0 Comments

hellokoding.com

 Arefe ▾

 Recommend

 Share

Sort by Best ▾



Start the discussion...

Be the first to comment.

ALSO ON HELLOKODING.COM

## Todo App with React Native, Realm

5 comments • 2 years ago



**Chandrajyoti Das** — Hi, You have used "let repository = new Realm({...}" in ToDoService.js. According to Realm ...

## JPA One-To-One Foreign Key Relationship Mapping Example with Spring Boot, HSQL

2 comments • 2 years ago



**Giau Ngo** — Thanks Wiktor :)  
Avatar

## RESTful API Example with Spring Boot, Spring Data REST One To Many ...

3 comments • a year ago



**teshan prasanga** — I am getting error  
java.lang.StackOverflowError: nullat ...

## JPA Many-To-Many Extra Columns Relationship Mapping Example with ...

2 comments • 2 years ago



**Jie** — I tried your approach, the problem is even  
Avatar I clear the set of bookpublisher in a book, I still  
get same bookpublisher.

 Subscribe

 Add Disqus to your siteAdd DisqusAdd

 Disqus' Privacy PolicyPrivacy PolicyPrivacy

Recent Stories

Streaming Data from Kafka to Postgres with Kafka Connect, AVRO, Schema Registry and Python

---

RESTful APIs Example with Spring Boot, Integration Test with MockMVC, UI Integration with VueJS

---

## Email Verification Example with Spring Boot, MySQL, Docker Compose, Amazon SES

---

## Docker Compose with Spring Boot, MySQL, NGINX

### Follow Us



Hello Koding

Like Page

139 likes

Be the first of your friends to like this

### Related Posts

---

Giau Ngo - 10 October 2017

## Longest Increasing Subsequence

---

Giau Ngo - 10 January 2018

## Email Verification Example with Spring Boot, MySQL, Docker Compose, Amazon SES

---

Giau Ngo - 09 January 2018

## Docker Compose with Spring Boot, MySQL, NGINX

---

### Hello Koding

Auth

Persistence

REST



GitHub



Facebook



Twitter



Google Plus