

Harshal Jaiswal (1097734)

Program Structures & Algorithms

Fall 2021

Assignment 3

Weighted Quick Union with Path Compression (WQUPC).

- **Task**

1. Implemented method doPathCompression by changing the parent of the node by its parent's parent.
2. Implemented method mergeComponents by first checking if they are not connected and if they aren't then comparing their parent's height and assigning the smaller height value one to the new parent of the bigger one also updating their height as well and vice versa.
3. Implemented method find which finds the parent of any given node.

- **Relationship Conclusion**

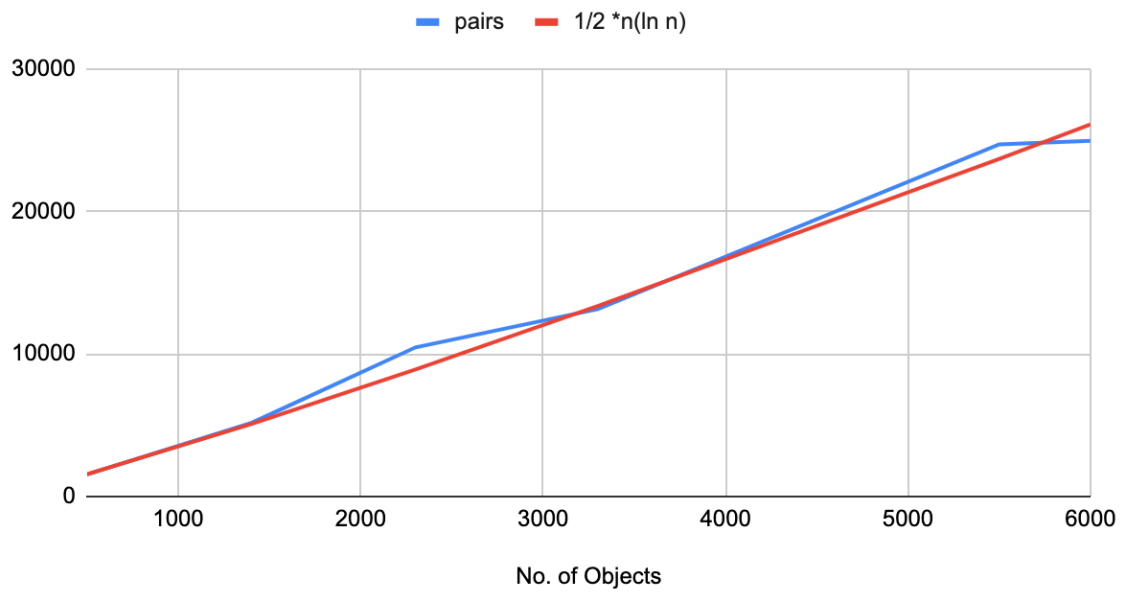
While running the program for various values of no of samples we form the following observation on the number of objects(N) and number of pairs(M).

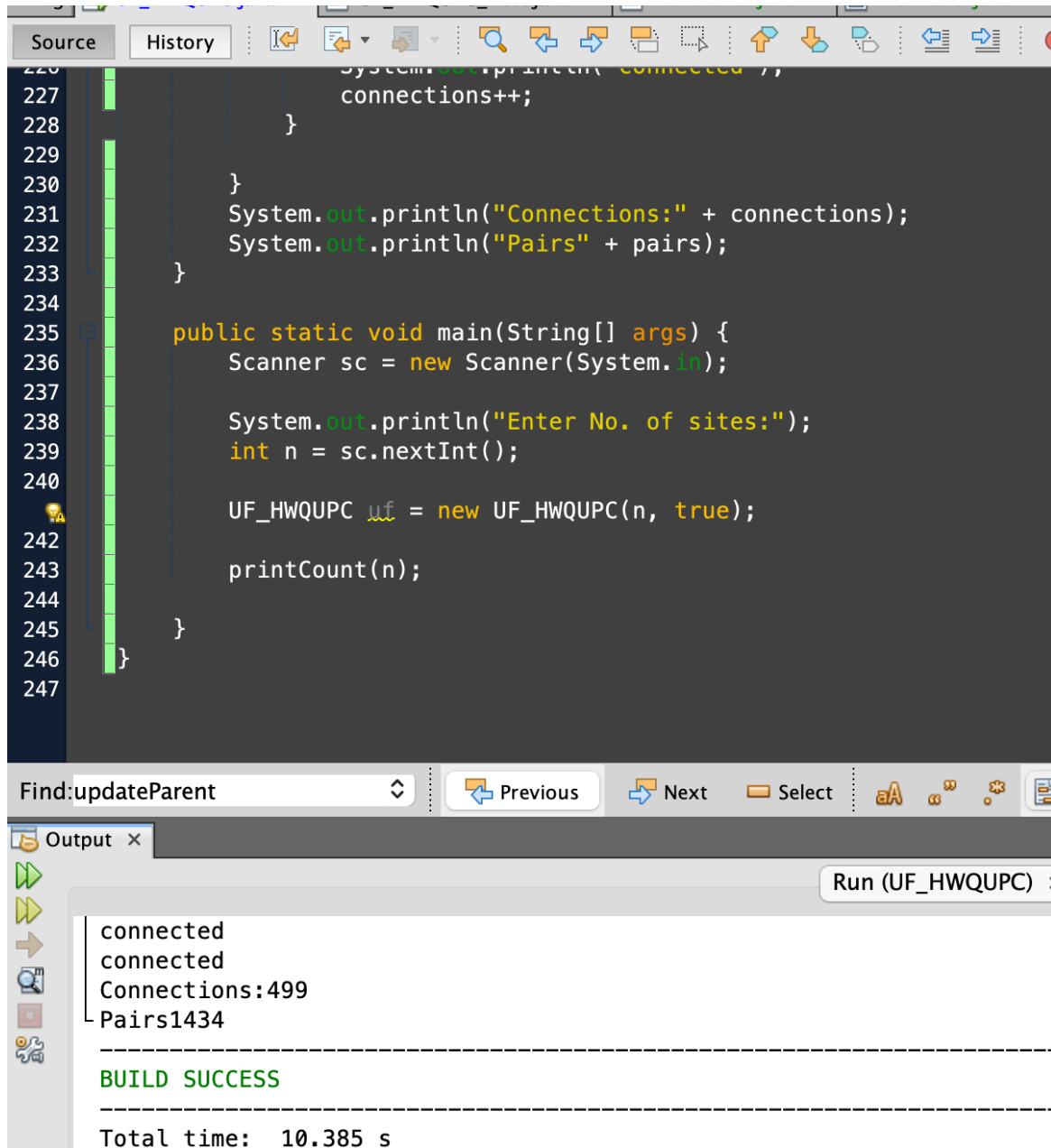
$$M = 1/2 * N (\ln N)$$

Following graph helps in supporting the relation

No. of Objects	pairs	1/2 *n(ln n)
500	1547	1,554
1400	5150	5,071
2300	10459	8,902
3300	13140	13,368
5500	24695	23,684
6000	24953	26,099

pairs and $n(\log n)$





The screenshot shows an IDE with a Java source file. The code defines a class with a `main` method that uses a `Scanner` to read an integer `n` and creates a `UF_HWQUPC` object. It then prints the number of connections and pairs. The output window shows the execution results, including the printed values and a success message.

```
226         System.out.println("connected");
227         connections++;
228     }
229
230 }
231 System.out.println("Connections:" + connections);
232 System.out.println("Pairs" + pairs);
233 }
234
235 public static void main(String[] args) {
236     Scanner sc = new Scanner(System.in);
237
238     System.out.println("Enter No. of sites:");
239     int n = sc.nextInt();
240
241     UF_HWQUPC uf = new UF_HWQUPC(n, true);
242
243     printCount(n);
244
245 }
246 }
247
```

Find: updateParent

Previous Next Select

Output x

Run (UF_HWQUPC) >

```
connected
connected
Connections:499
Pairs1434
-----
BUILD SUCCESS
-----
Total time: 10.385 s
```

...age UF_HWQUPC.java x UF_HWQUPC_Test.java x VehicleList.java x ViewPanel.java x

Source History

```
226      System.out.println("connected");
227      connections++;
228  }
229
230  }
231  System.out.println("Connections:" + connections);
232  System.out.println("Pairs" + pairs);
233  }
234
235  public static void main(String[] args) {
236      Scanner sc = new Scanner(System.in);
237
238      System.out.println("Enter No. of sites:");
239      int n = sc.nextInt();
240
241      UF_HWQUPC uf = new UF_HWQUPC(n, true);
242
243      printCount(n);
244
245  }
246  }
247
```

Find:updateParent

Previous Next Select

Output x

Run (UF_HWQUPC) x

```
connected
Connections:1399
Pairs4784

BUILD SUCCESS

Total time: 2.409 s
```

SourceHistory

226

227

228

229

230

231

232

233

234

235

236

237

238

239

240

242

243

244

245

246

247

```
                System.out.println("connected");
                connections++;
            }
        }
        System.out.println("Connections:" + connections);
        System.out.println("Pairs" + pairs);
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.println("Enter No. of sites:");
        int n = sc.nextInt();

        UF_HWQUPC uf = new UF_HWQUPC(n, true);

        printCount(n);
    }
}
```

Find:updateParent

PreviousNextSelect

aA

Output x

Run (UF_HW

connected

Connections:2299

Pairs9088

BUILD SUCCESS

Total time: 2.996 s

```
Source History
226      System.out.println("connected",
227      connections++;
228      }
229
230      }
231      System.out.println("Connections:" + connections);
232      System.out.println("Pairs" + pairs);
233      }
234
235      public static void main(String[] args) {
236          Scanner sc = new Scanner(System.in);
237
238          System.out.println("Enter No. of sites:");
239          int n = sc.nextInt();
240
241          UF_HWQUPC uf = new UF_HWQUPC(n, true);
242
243          printCount(n);
244
245      }
246  }
247
```

Find:updateParent

Previous

Next

Select



Output x



Run (UF

```
connected
Connections:3299
Pairs11481
```

BUILD SUCCESS

Total time: 5.578 s

```
Source History
226      System.out.println("Connections: " + connections);
227      connections++;
228  }
229
230  }
231  System.out.println("Connections:" + connections);
232  System.out.println("Pairs" + pairs);
233  }
234
235  public static void main(String[] args) {
236      Scanner sc = new Scanner(System.in);
237
238      System.out.println("Enter No. of sites:");
239      int n = sc.nextInt();
240
241      UF_HWQUPC uf = new UF_HWQUPC(n, true);
242
243      printCount(n);
244  }
245  }
246  }
```

Find: updateParent Previous Next Select

Output x

Run (UF

```
Connections:5499
Pairs20666
-----
BUILD SUCCESS
-----
Total time: 14.943 s
```

```
227         connections++;
228     }
229
230 }
231 System.out.println("Connections:" + connections);
232 System.out.println("Pairs" + pairs);
233 }
234
235 public static void main(String[] args) {
236     Scanner sc = new Scanner(System.in);
237
238     System.out.println("Enter No. of sites:");
239     int n = sc.nextInt();
240
241     UF_HWQUPC uf = new UF_HWQUPC(n, true);
242
243     printCount(n);
244
245 }
246 }
247
```

Find:updateParent

Previous Next Select

Output x

Run (UF_HWQUPC) x

971
connected
Connections:5999
Pairs24953

BUILD SUCCESS

Total time: 4.776 s

- Unit tests result

The screenshot displays an IDE interface. The top pane shows a Java source file with a unit test method `testFind1()` at line 85. The method creates a `UF_HWQUPC` object, connects it, and asserts the results of `find()` calls. The bottom pane shows the 'Test Results' window, which reports that all 13 tests passed in 0.017 seconds. The test suite is `edu.neu.coe.info6205.union_find.UF_HWQUPC_Test`. The individual tests and their durations are listed below:

Test Name	Result	Duration
<code>edu.neu.coe.info6205.union_find.UF_HWQUPC_Test</code>	passed	0.017 s
<code>testIsConnected01</code>	passed	0.011 s
<code>testIsConnected02</code>	passed	0.0 s
<code>testIsConnected03</code>	passed	0.003 s
<code>testFind0</code>	passed	0.0 s
<code>testFind1</code>	passed	0.001 s
<code>testFind2</code>	passed	0.0 s
<code>testFind3</code>	passed	0.0 s
<code>testFind4</code>	passed	0.001 s
<code>testFind5</code>	passed	0.0 s
<code>testToString</code>	passed	0.0 s
<code>testConnect01</code>	passed	0.001 s
<code>testConnect02</code>	passed	0.0 s
<code>testConnected01</code>	passed	0.0 s