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Program Structures & Algorithms
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Union-find-Alternative

Code has been pushed to github.com

Link: https://github.com/Sunil-Y/INFO6205/tree/union-find-alternative

- ## Task
  Code and benchmark the Union-find alternatives

- ## Relationship conclusion

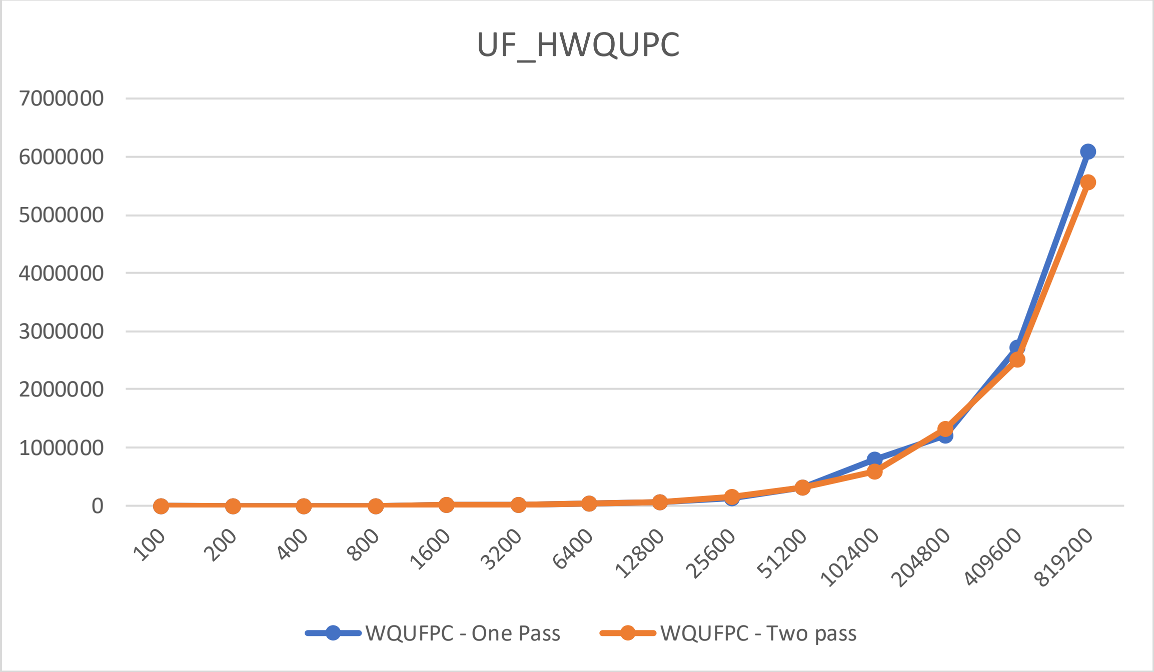
1. **Grand-parent Fix**
   Runtime of find():
   - Maximum depth of any node will logN with the previous implementation.
   - After grand-parent fix it will be (depth of p) / 2 since we are skipping one node.
   - Since we don't constants while considering time complexity, the overall time complexity will remain the same as logN with average depth of 2.
   - Grand-parent fix will improve the performance slightly.

2. **Weighted quick union with path compression – Two pass**

n	WQUFPC – One pass	WQUFPC –two pass
100	242	290
200	566	439
400	1221	1052
800	2756	2877
1600	6100	6690
3200	11788	12464
6400	30329	27808
12800	60098	68693

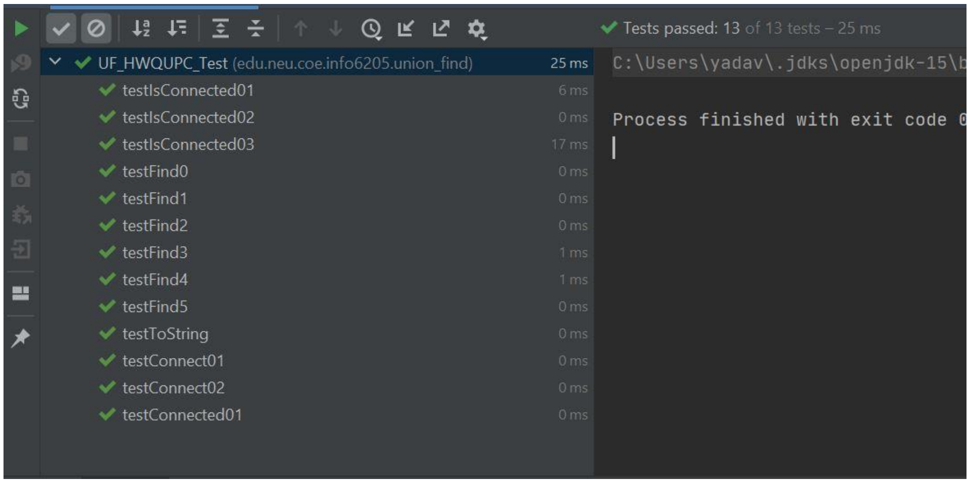
25600	129211	146821
51200	311613	319749
102400	796135	593782
204800	1205909	1325226
409600	2719466	2511119
819200	6087243	5560684

Evidence to support relationship



The blue line is one-pass, the orange line is two-pass.
From the above chart, we can conclude that they are very close and similar.
So, we can draw a conclusion that the relationship that time performance of two pass is slightly better that one-pass

- **Screenshot of Unit test passing**

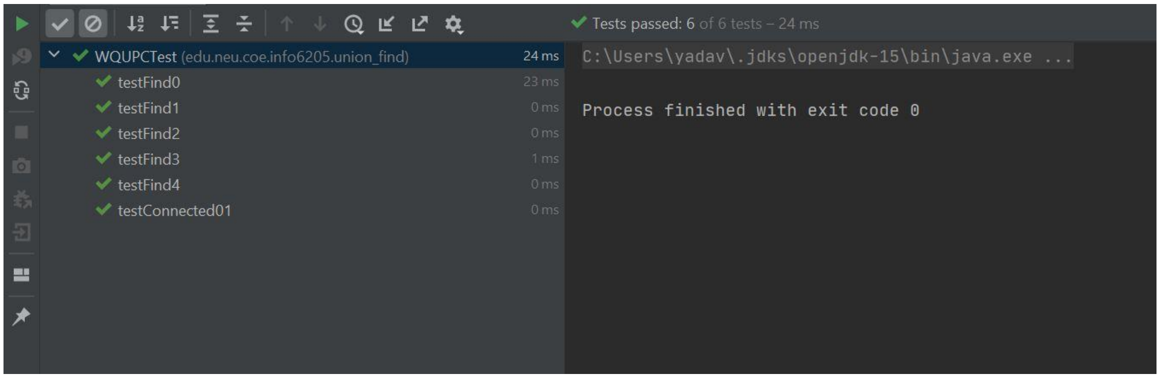


Tests passed: 13 of 13 tests – 25 ms

```
UF_HWQUPC_Test (edu.neu.coe.info6205.union_find)   25 ms
    testIsConnected01                               6 ms
    testIsConnected02                               0 ms
    testIsConnected03                              17 ms
    testFind0                                       0 ms
    testFind1                                       0 ms
    testFind2                                       0 ms
    testFind3                                       1 ms
    testFind4                                       1 ms
    testFind5                                       0 ms
    testToString                                    0 ms
    testConnect01                                   0 ms
    testConnect02                                   0 ms
    testConnected01                                 0 ms
```

```
C:\Users\yadav\.jdks\openjdk-15\b

Process finished with exit code 0
```



Tests passed: 6 of 6 tests – 24 ms

```
WQUPCTest (edu.neu.coe.info6205.union_find)   24 ms
    testFind0                                 23 ms
    testFind1                                  0 ms
    testFind2                                  0 ms
    testFind3                                  1 ms
    testFind4                                  0 ms
    testConnected01                            0 ms
```

```
C:\Users\yadav\.jdks\openjdk-15\bin\java.exe ...

Process finished with exit code 0
```