Program Structures and Algorithms
Spring 2023(Section - 1)

Name: Mani Charan Reddy Loka
NUID: 002727403

Task:
Step 1) Implement height-weighted Quick Union with Path Compression

find method:

```
81    public int find(int p) {
82        validate(p);
83        int root = p;
84        // FIXME
85        while(root!=parent[root]) {
86             root=parent[root];
87        }
88        if(pathCompression) {
89        while(p!=root) {
90            //int newp = parent[p];
91            doPathCompression(p);
92            p=parent[p];
93        }
94        }
95        // END
96        return root;
97    }
```

mergeComponents method:

```
180
181    private void mergeComponents(int i, int j) {
182        int rootI=find(i);
183        int rootJ=find(j);
184        if(rootI==rootJ) return;
185        if(height[rootI]<height[rootJ]) {
186            parent[rootI]=rootJ;
187            height[rootJ]+=height[rootI];
188        }
189        else {
190            parent[rootJ]=rootI;
191            height[rootI]+=height[rootJ];
192
193        }
194        //count--;
195        // FIXME make shorter root point to taller one
196        // END
197    }
```

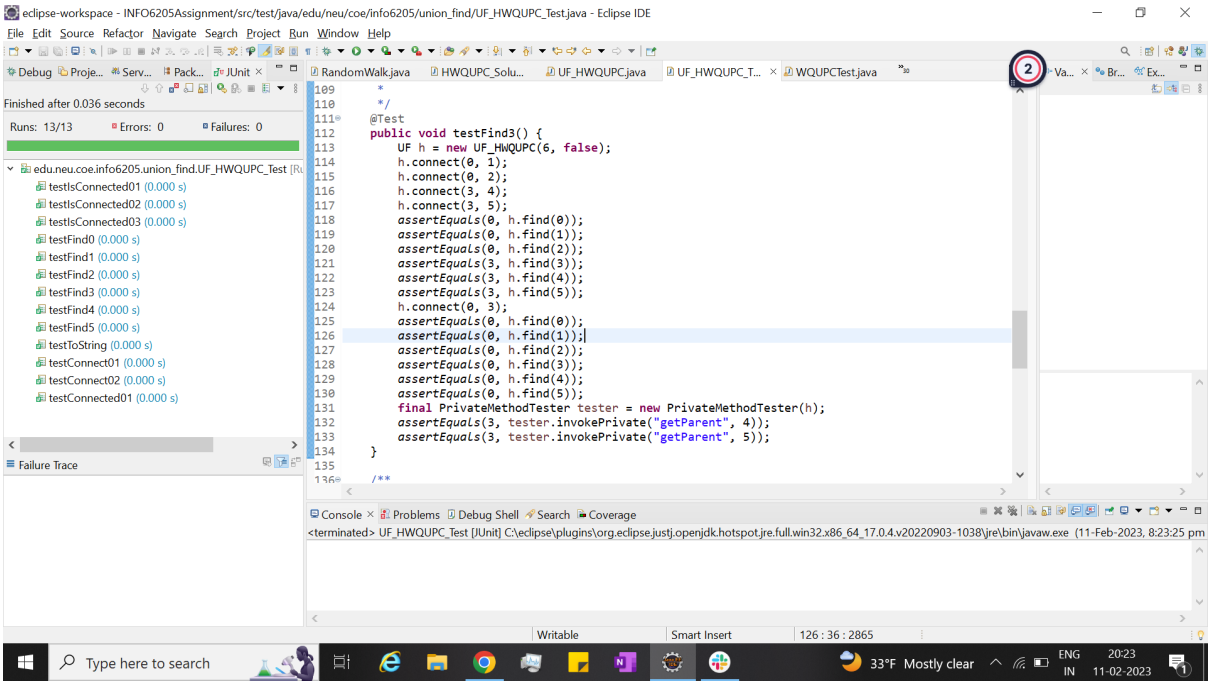
doPathCompression method:

```
    private void doPathCompression(int i) {
        // FIXME update parent to value of grandparent
        //parent[i]=parent[parent[i]];
        parent[i]=getParent(getParent(i));
        // END
    }
}
```

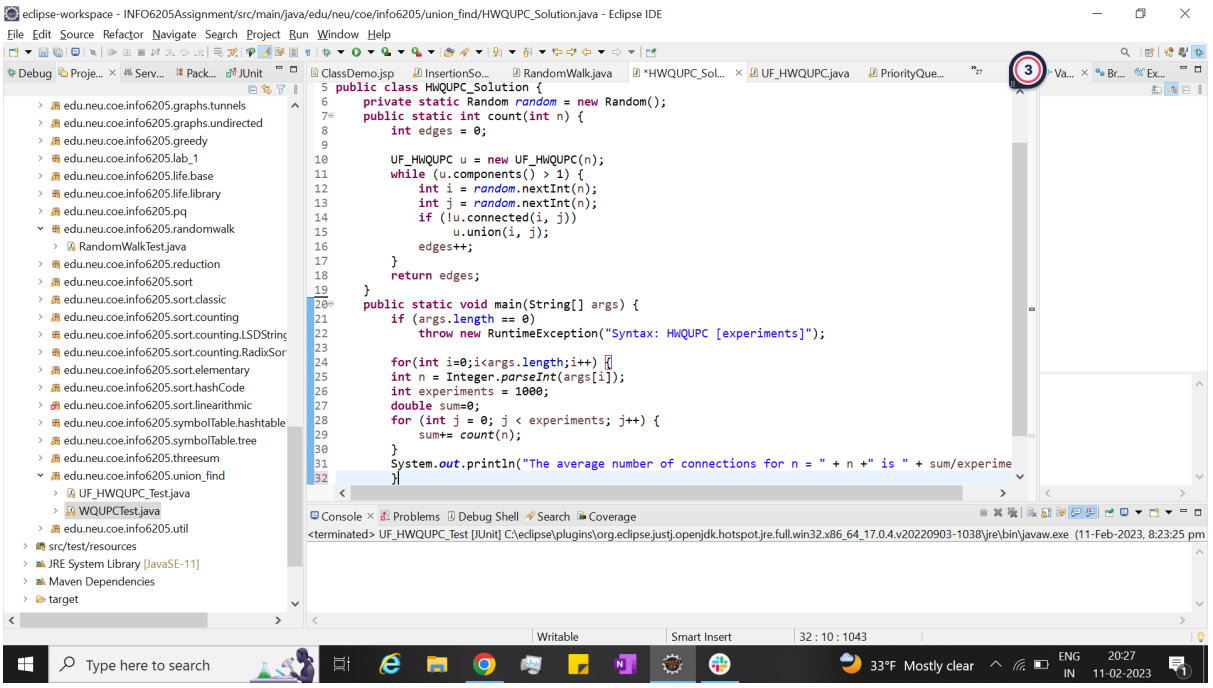
Program Structures and Algorithms
Spring 2023(Section - 1)

Unit Test Screenshots:

1)UF_HWQUPC_Test.java



Step 2)Using your implementation of UF_HWQUPC, develop a UF ("union-find") client



Program Structures and Algorithms
Spring 2023(Section - 1)

Output:

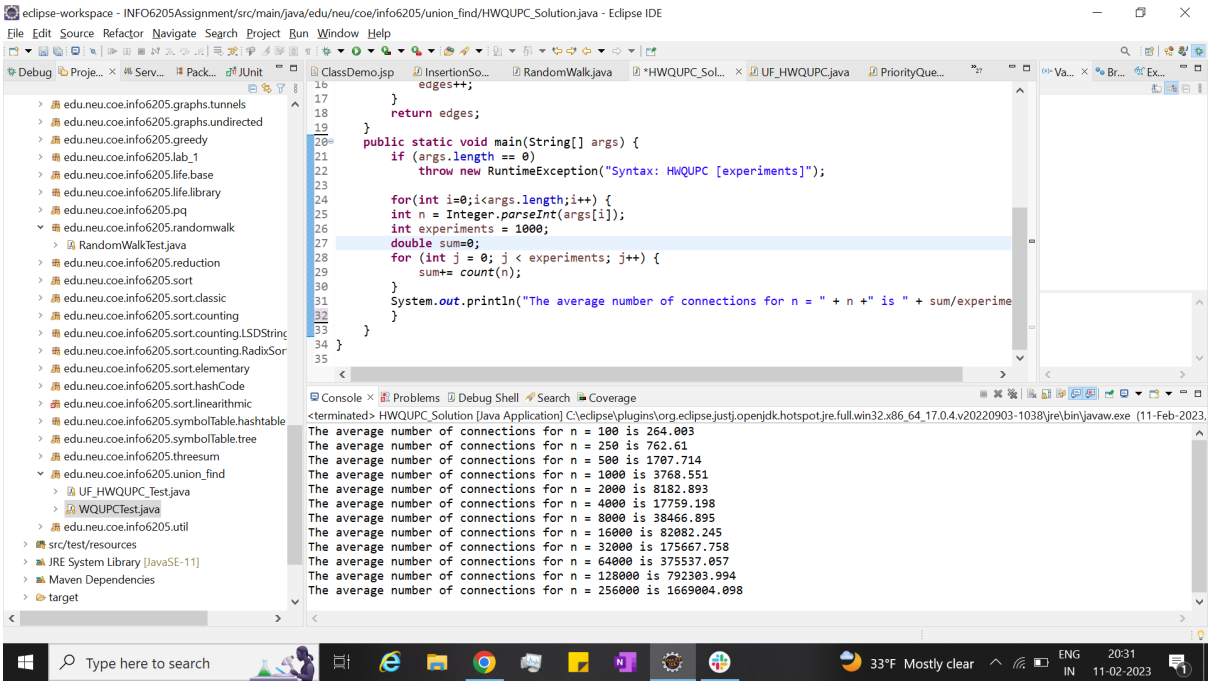


Table showing no.of times connected method being called as against the input n

Objects(n)	Pairs(m)
100	263.03
250	760.7
500	1701.71
1000	3728.77
2000	8230.46
4000	17694.12
8000	38430.47
16000	82193.73
32000	175634.79
64000	374728.17
128000	790186.53
256000	1659293.67

Program Structures and Algorithms
Spring 2023(Section - 1)

Relationship Conclusion:

The number of pairs generated to connect all the sites is linearly proportional to the log scale of no. of sites. I.e., m is proportional to nlogn.
By averaging out the constant factor, it is found that the average constant factor is 0.37

Objects(n)	Pairs(m)	n*log(n,2)	Average		0.37*n*logn
100	263.03	664.385619	0.3958995988		245.822679
250	760.7	1991.446071	0.3819837308		736.8350463
500	1701.71	4482.892142	0.3796009241		1658.670093
1000	3728.77	9965.784285	0.3741572056		3687.340185
2000	8230.46	21931.56857	0.3752791313		8114.680371
4000	17694.12	47863.13714	0.3696815766		17709.36074
8000	38430.47	103726.2743	0.370498895		38378.72148
16000	82193.73	223452.5486	0.3678352766		82677.44297
32000	175634.79	478905.0971	0.3667423693		177194.8859
64000	374728.17	1021810.194	0.3667297235		378069.7719
128000	790186.53	2171620.388	0.3638695484	Average factor	803499.5437
256000	1659293.67	4599240.777	0.3607755607	0.3727544617	1701719.087

Graph of 0.37nlogn and m, as against n.