Varun Venkatesh Gowda (002126161)

Program Structures & Algorithms

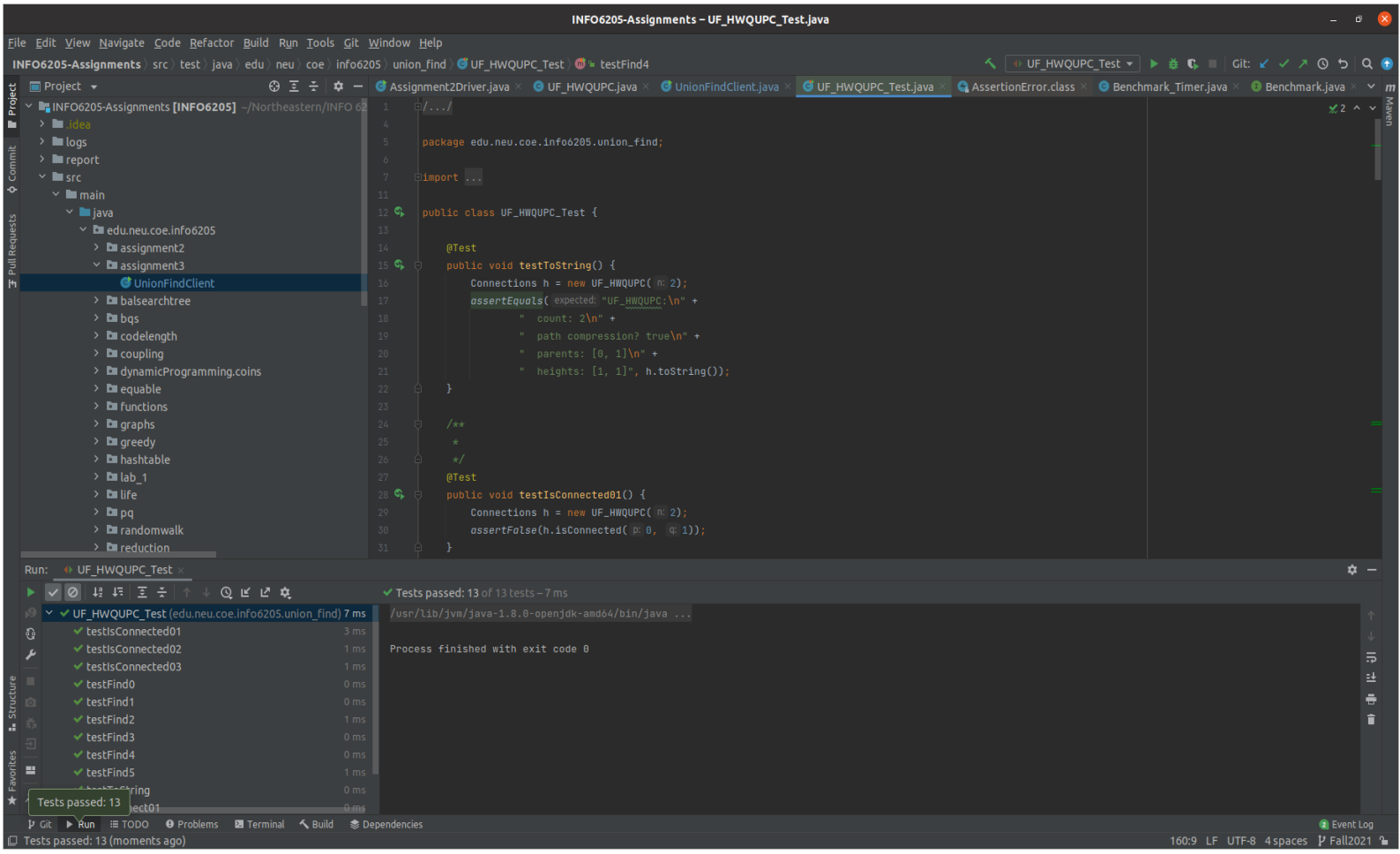
Fall 2021

Assignment No. 3

Tasks:

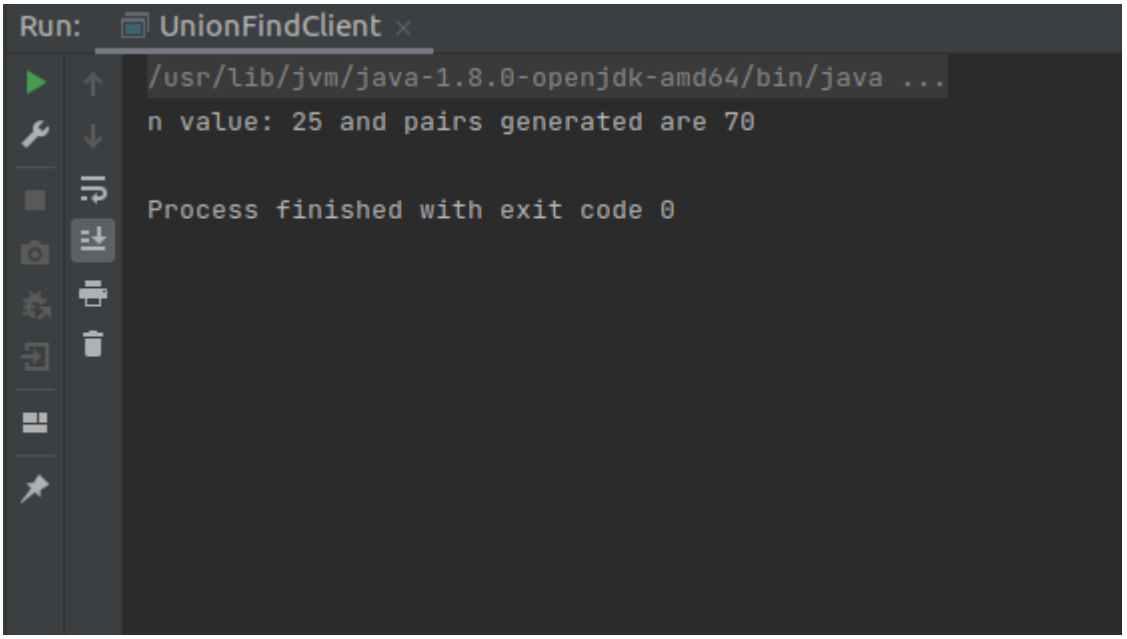
1. Implemented find(int p) method in UF_HWQUPC.java
2. Implemented mergeComponents(int i, int j) in UF_HWQUPC.java
3. Implemented doPathCompression(int i) in UF_HWQUPC.java
4. Ran test cases from UF_HWQUPC_Test.java (all passed)
5. Coded UnionFindClient.java in **edu.neu.coe.info6205.assignment3** package to run the experiments
6. Implemented a main() method to run the experiments for defined values of n
7. Implemented count() method calculate and return the pairs generated to reduce the components to 1
8. Ran the experiments for multiple values of “n” and 3 runs for each value of “n”
9. Tabulated the readings in excel and generated a graph to observe the trend

Tests passing screenshot:

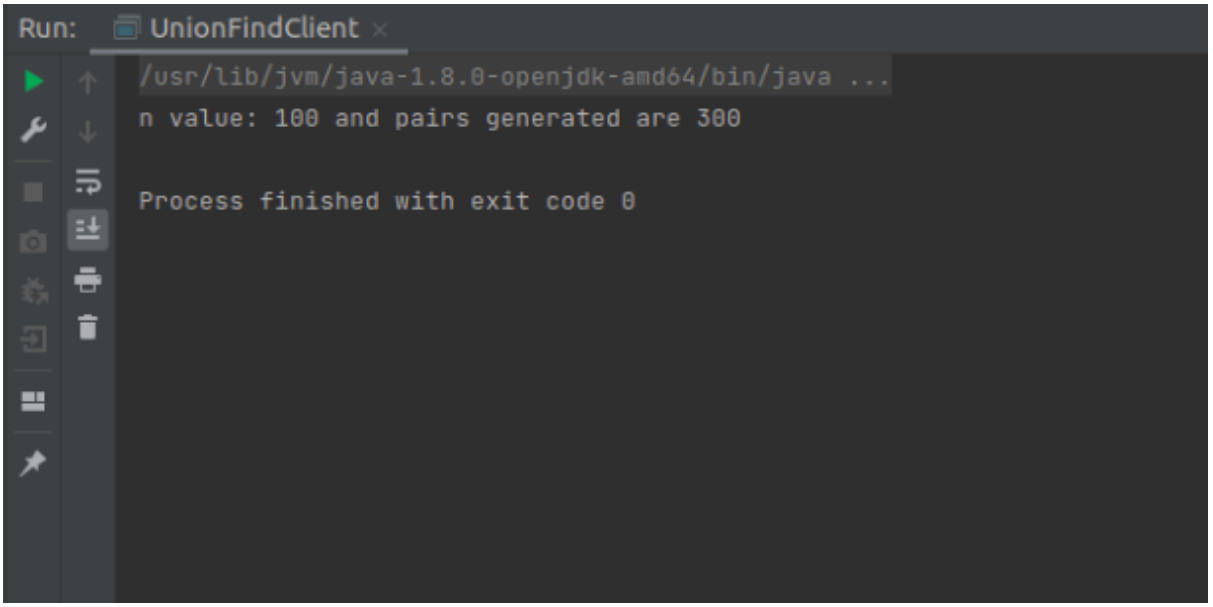


Outputs:

For n = 25

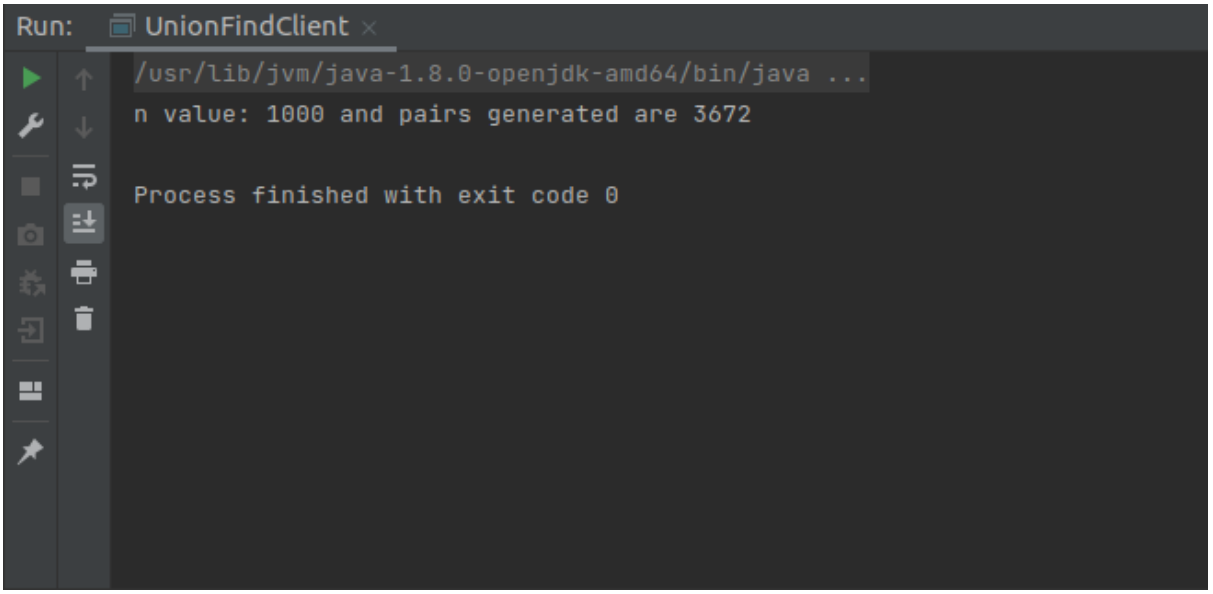


For n = 100

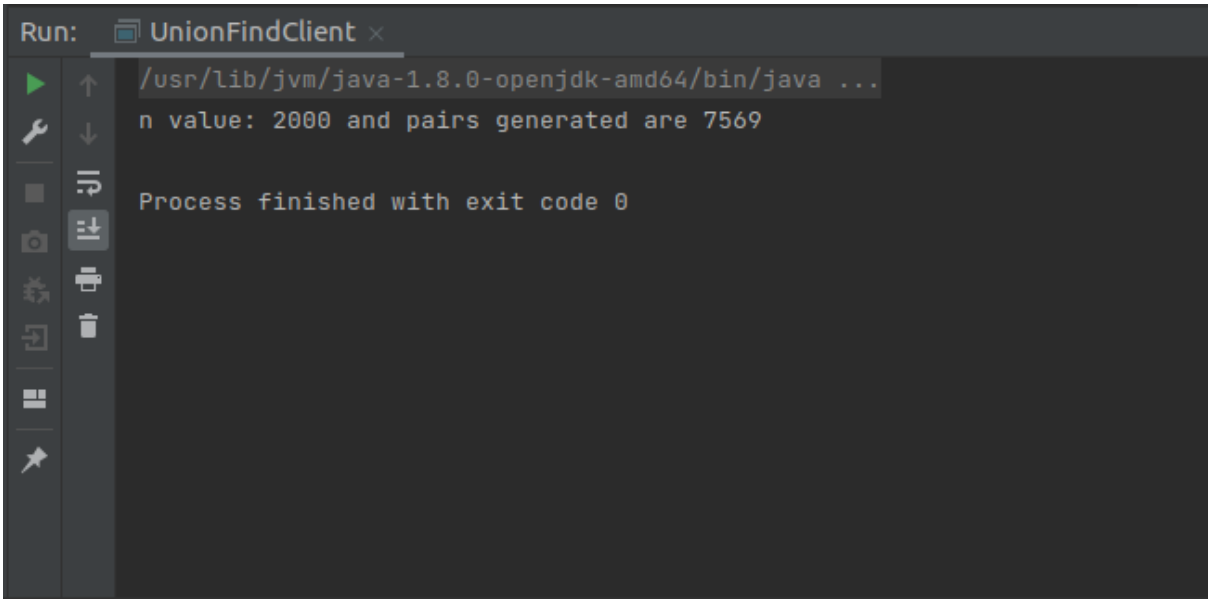


For n = 500

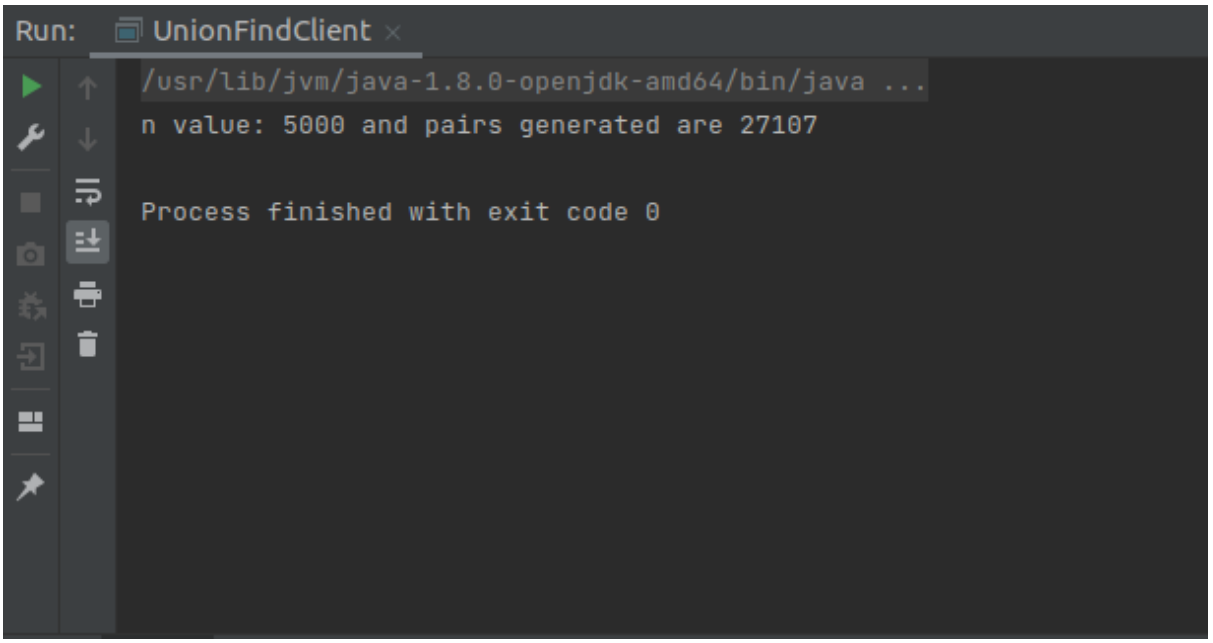
For n = 1000



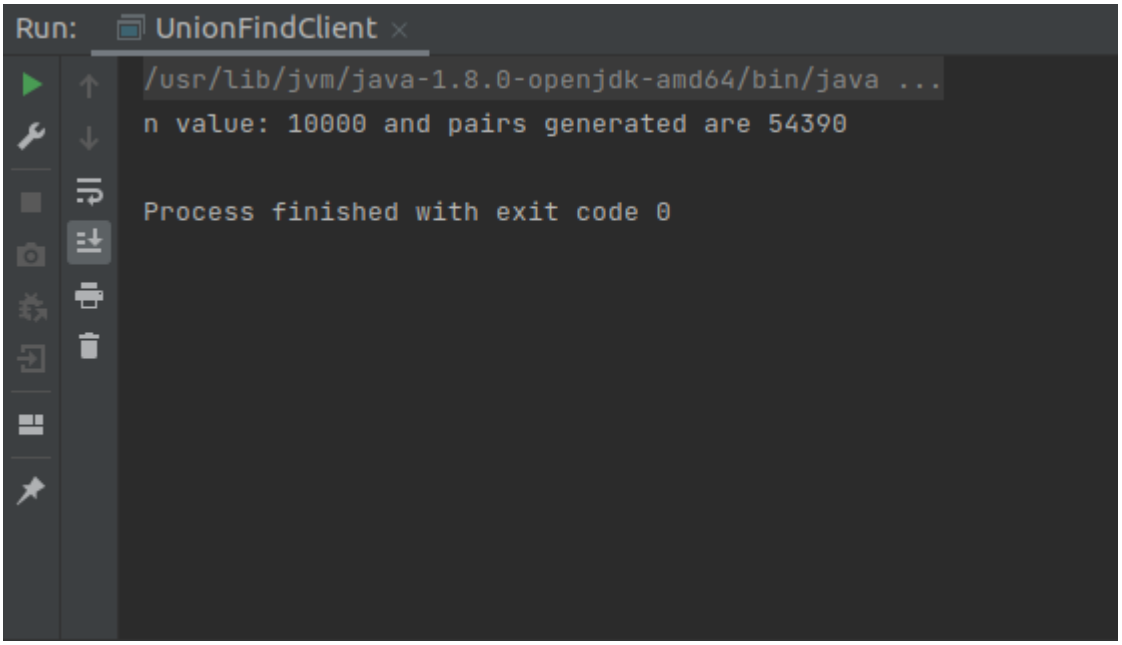
For n = 2000



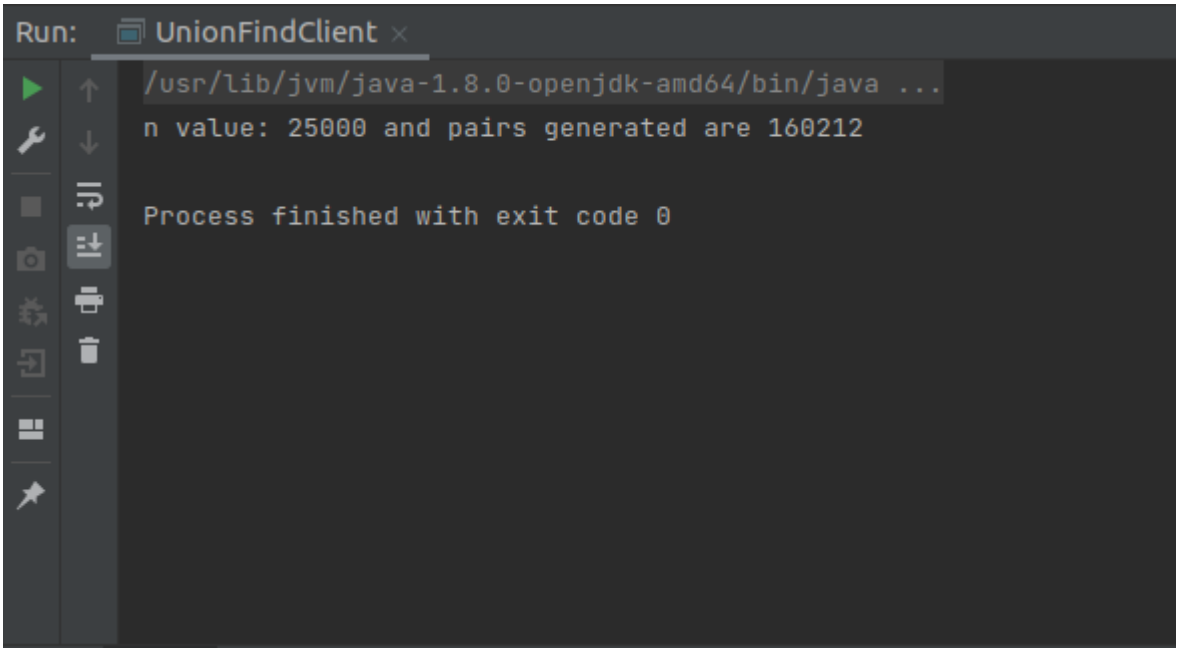
For n = 5000



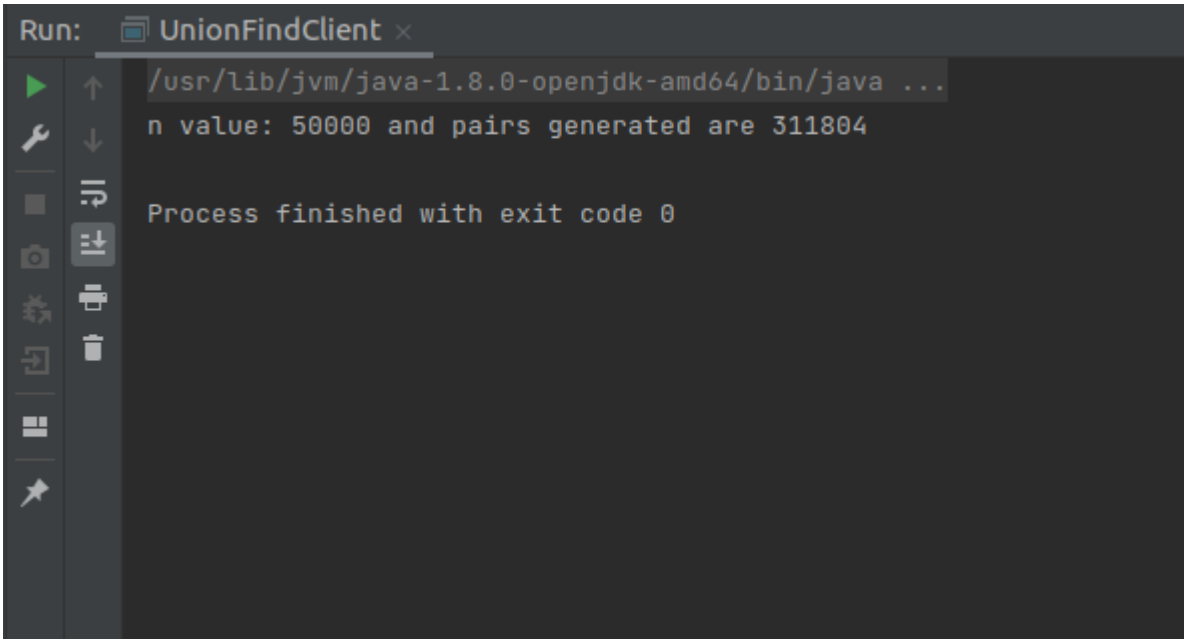
For n = 10000



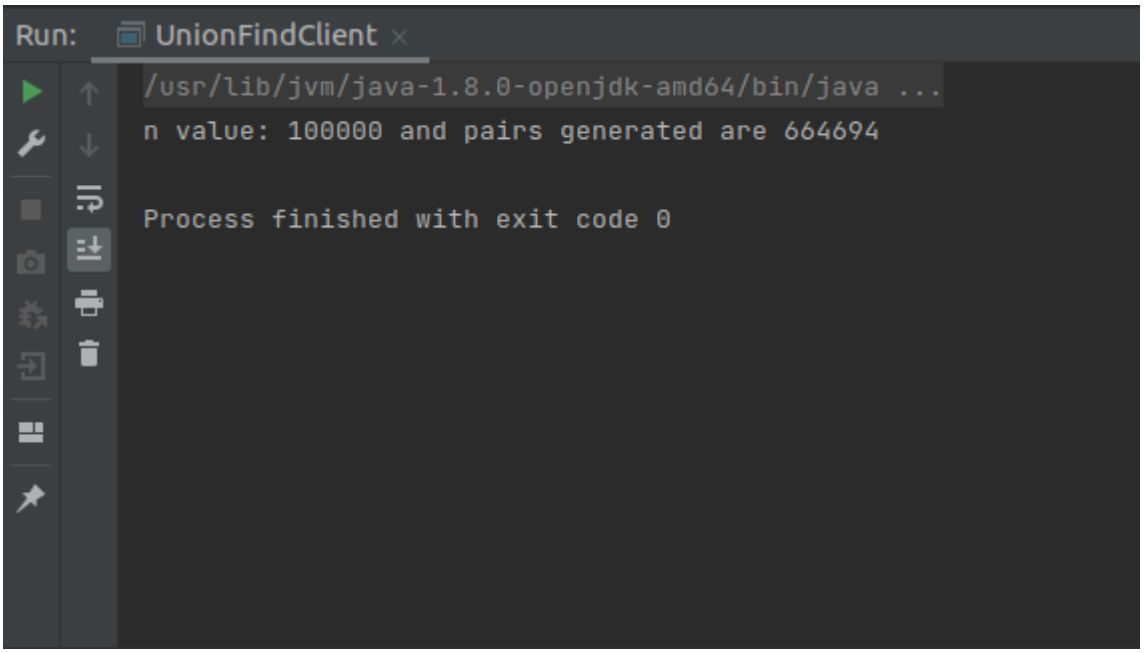
For n = 25000



For n = 50000



For n = 100000



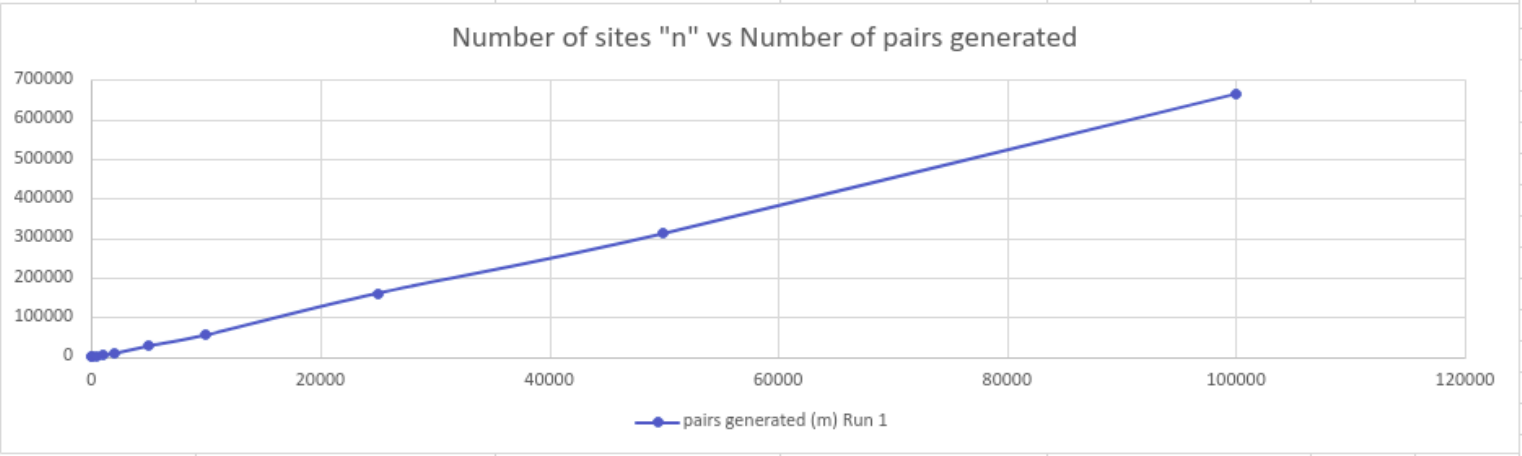
Consolidated Output:

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 25 and pairs generated are 56
n value: 100 and pairs generated are 296
n value: 500 and pairs generated are 1608
n value: 1000 and pairs generated are 4095
n value: 2000 and pairs generated are 7529
n value: 5000 and pairs generated are 24625
n value: 10000 and pairs generated are 60179
n value: 25000 and pairs generated are 125735
n value: 50000 and pairs generated are 310464
n value: 100000 and pairs generated are 719788

Process finished with exit code 0
```

Tabulation/ Graph:

number of sites (n)	pairs generated (m) Run 1	pairs generated (m) Run 2	pairs generated (m) Run 3	pairs generated (m) Run 4
25	70	103	51	56
100	300	233	311	296
500	1658	1616	1580	1608
1000	3672	2764	4641	4095
2000	7569	8043	8033	7529
5000	27107	22879	25462	24625
10000	54390	51030	39773	60179
25000	160212	138885	122170	125735
50000	311804	244769	261728	310464
100000	664694	562899	702448	719788



Conclusion:

From the readings obtained, it is seen that as the number of sites (n) increases, the number of pairs generated (m) also increases (Exponentially large in the case of larger values of n) and generates a linear graph. so I believe that “n” and “m” are directly proportional.

$$n \propto m$$