

Program Structures & Algorithms

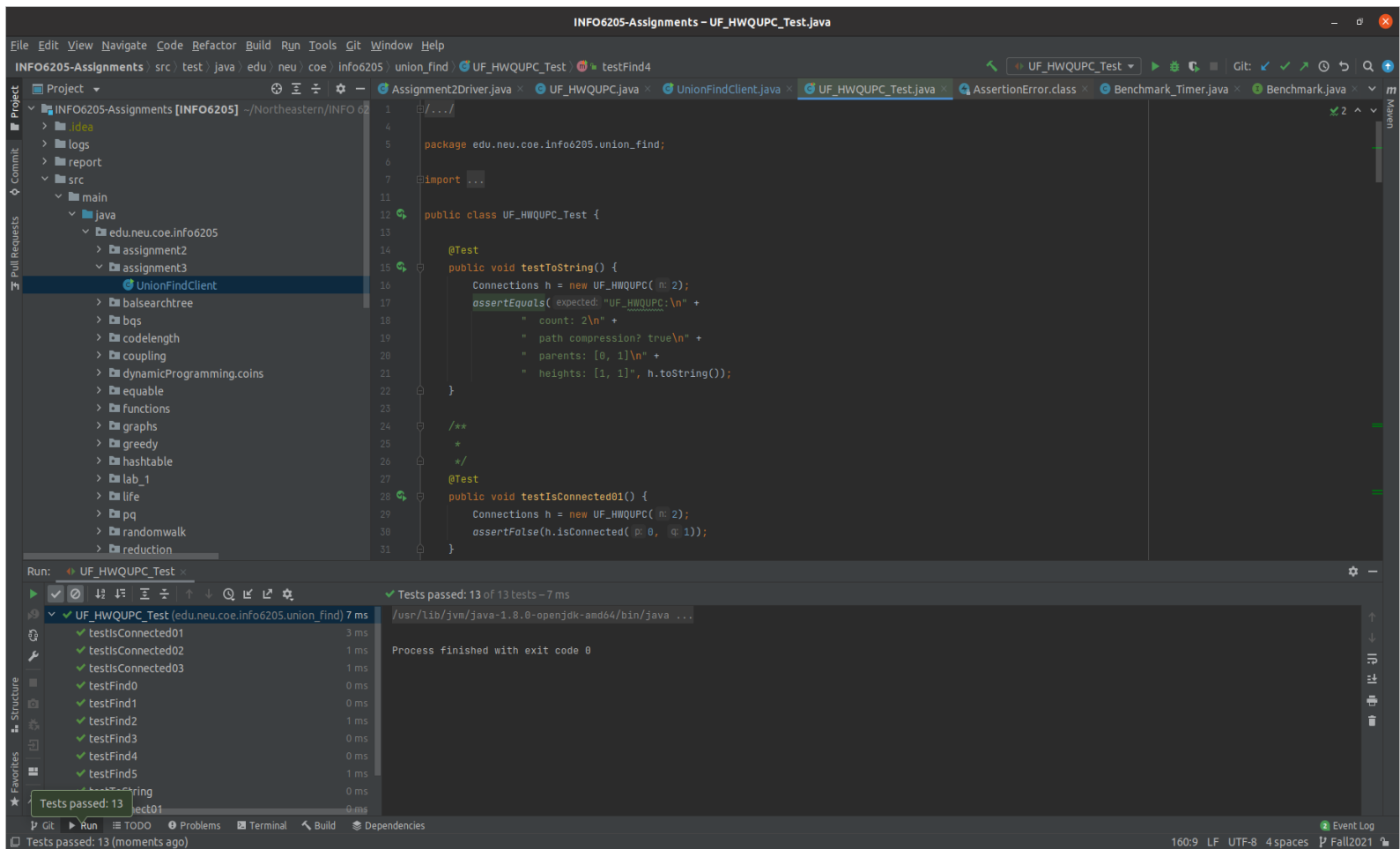
Fall 2021

Assignment No. 3

Tasks:

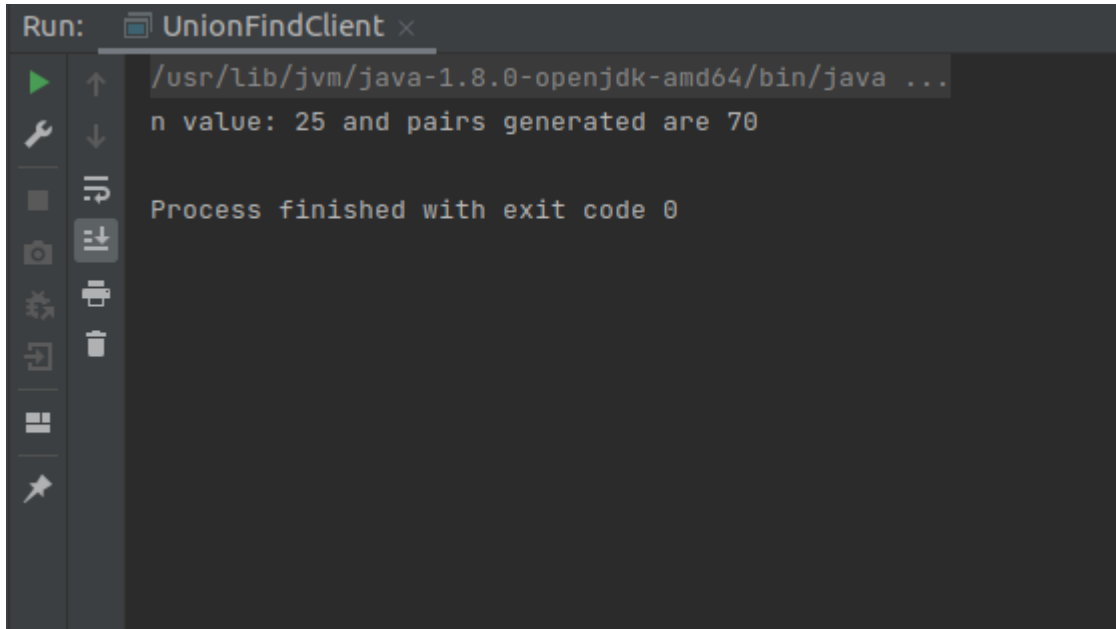
1. Implemented find(int p) method in UF_HWQUPC.java
2. Implemented mergeComponents(int i, int j) in UF_HWQUPC.java
3. Implemented doPathCompression(int i) in UF_HWQUPC.java
4. Ran test cases from UF_HWQUPC_Test.java (all passed)
5. Coded UnionFindClient.java in **edu.neu.coe.info6205.assignment3** package 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:

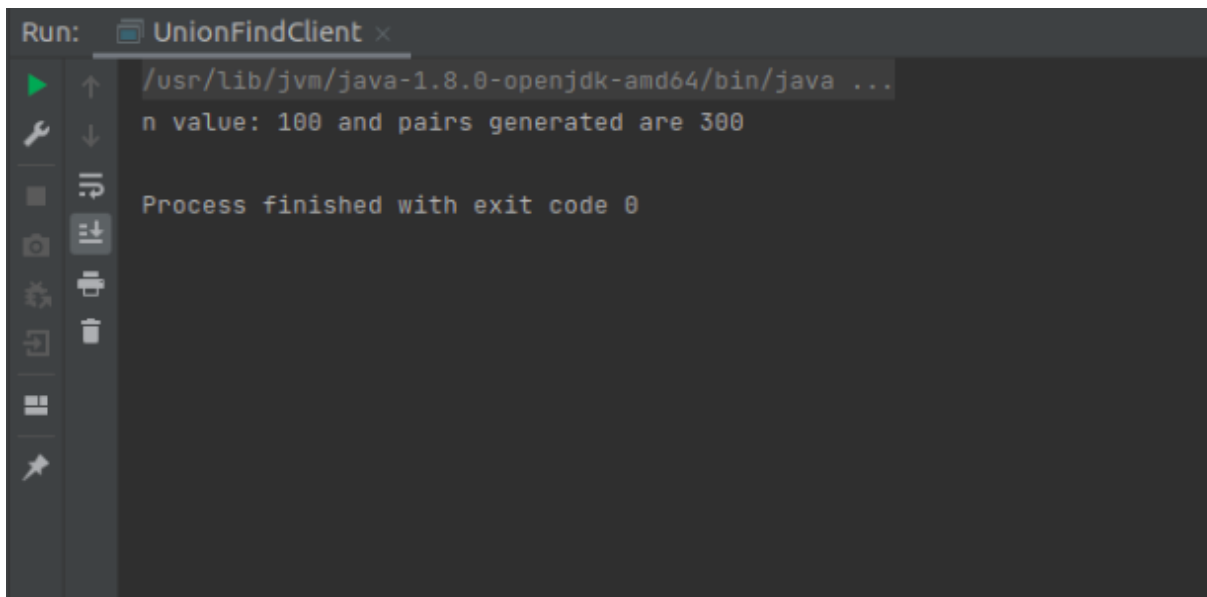
For $n = 25$

A screenshot of an IDE's Run console window. The title bar says "Run: UnionFindClient x". The console output shows the Java command path, the input value n=25, the number of pairs generated (70), and the successful exit of the process.

```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 25 and pairs generated are 70

Process finished with exit code 0
```

For $n = 100$

A screenshot of an IDE's Run console window. The title bar says "Run: UnionFindClient x". The console output shows the Java command path, the input value n=100, the number of pairs generated (300), and the successful exit of the process.

```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 100 and pairs generated are 300

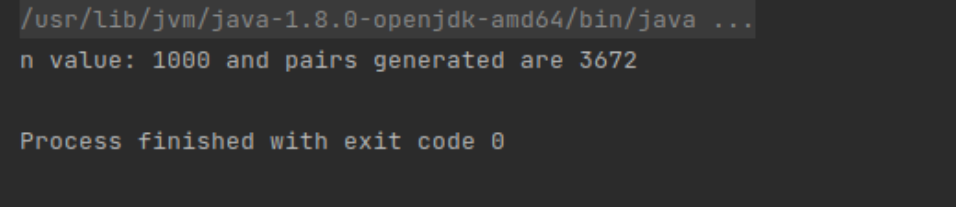
Process finished with exit code 0
```

For $n = 500$

```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 500 and pairs generated are 1616

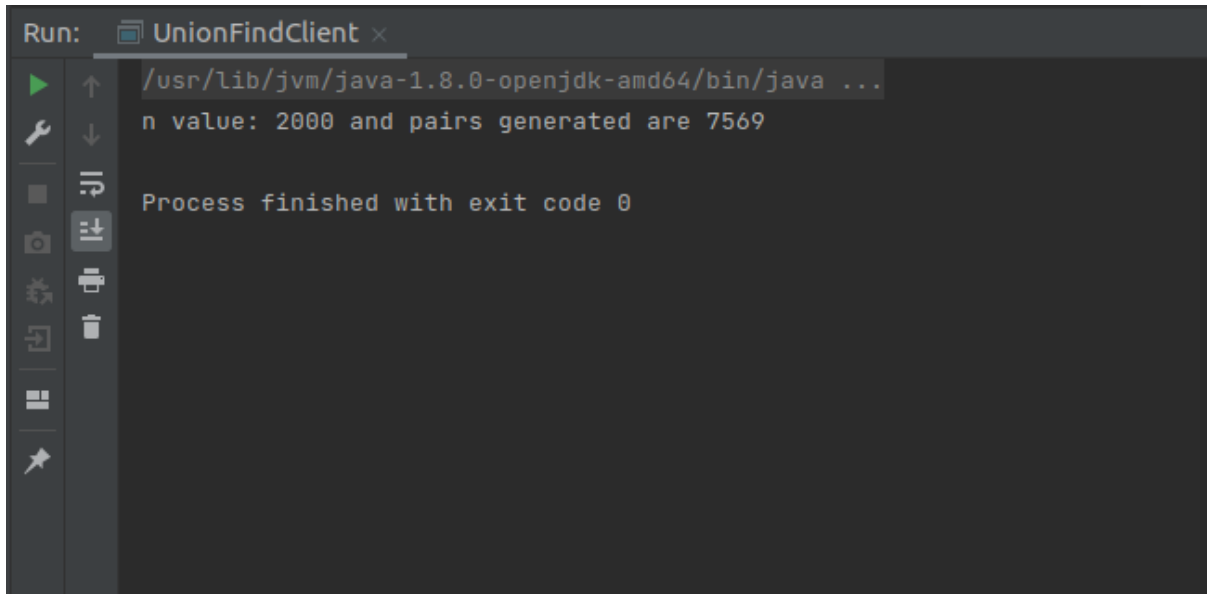
Process finished with exit code 0
```

For $n = 1000$



```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 1000 and pairs generated are 3672
Process finished with exit code 0
```

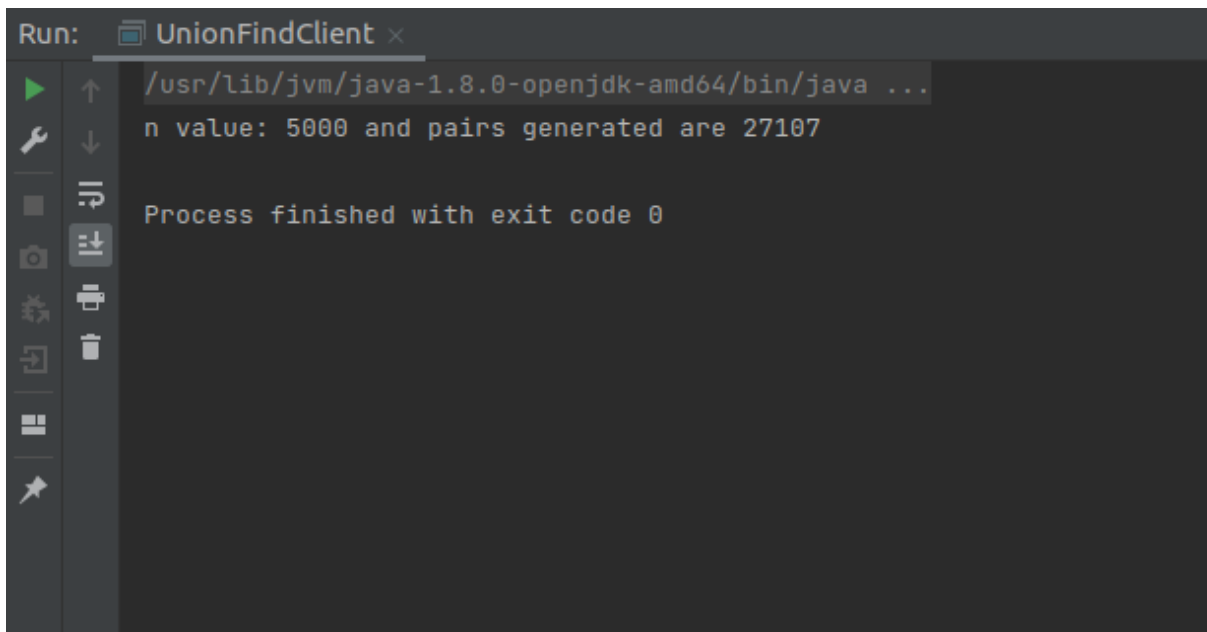
For n = 2000



The screenshot shows a terminal window titled "Run: UnionFindClient x". The command executed is `/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...`. The output is `n value: 2000 and pairs generated are 7569`. Below the output, it states "Process finished with exit code 0". The left sidebar of the IDE contains various icons for debugging and development.

```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 2000 and pairs generated are 7569
Process finished with exit code 0
```

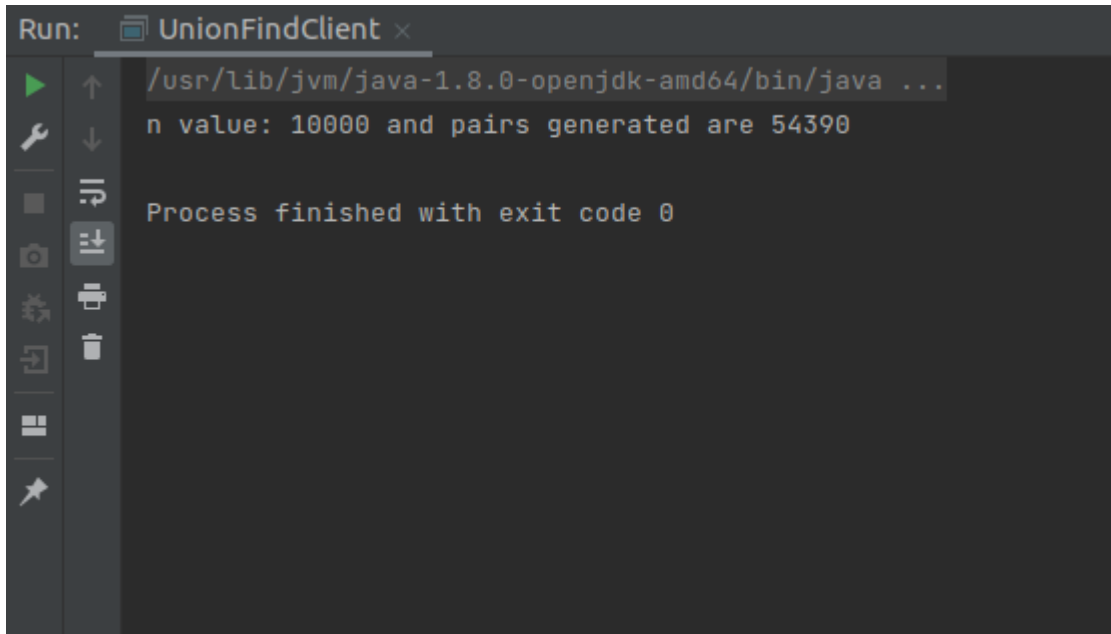
For n = 5000



The screenshot shows a terminal window titled "Run: UnionFindClient x". The command executed is `/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...`. The output is `n value: 5000 and pairs generated are 27107`. Below the output, it states "Process finished with exit code 0". The left sidebar of the IDE contains various icons for debugging and development.

```
Run: UnionFindClient x
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
n value: 5000 and pairs generated are 27107
Process finished with exit code 0
```

For $n = 10000$

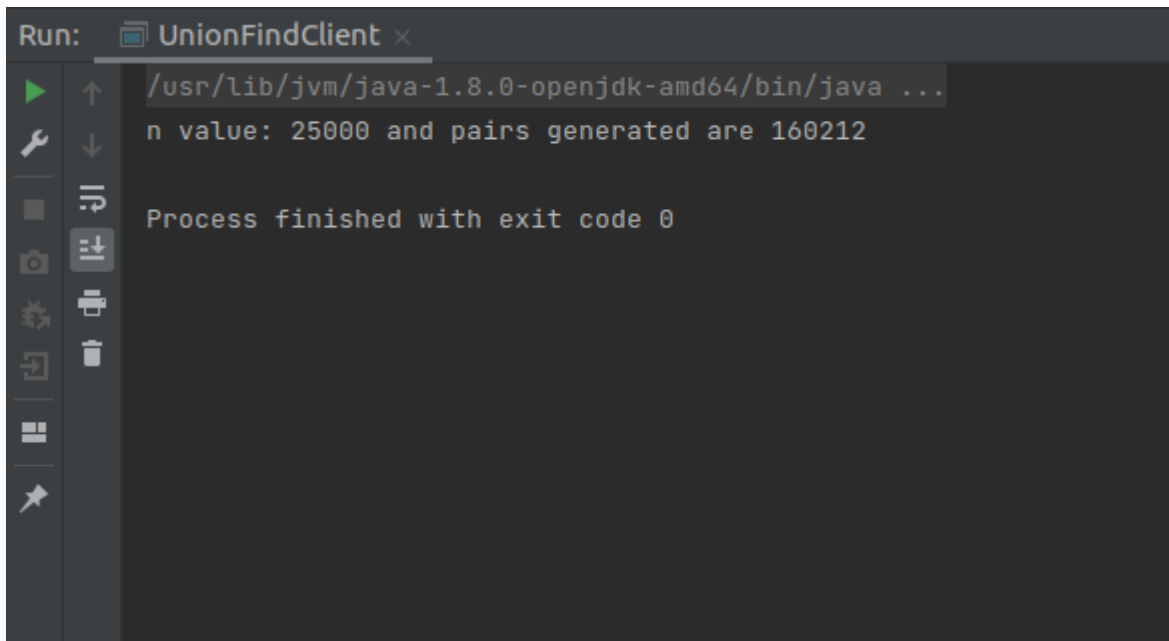


The screenshot shows an IDE console window titled "Run: UnionFindClient x". The console output is as follows:

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...  
n value: 10000 and pairs generated are 54390  
  
Process finished with exit code 0
```

The left sidebar of the IDE contains various icons for running, debugging, and viewing the project structure.

For $n = 25000$

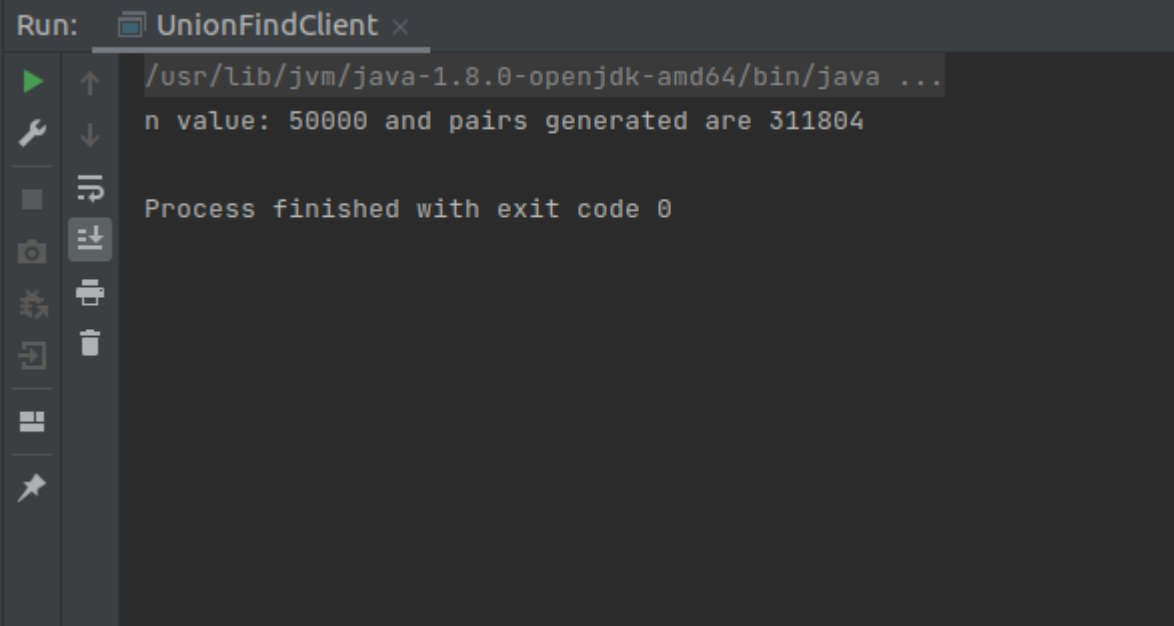


The screenshot shows an IDE console window titled "Run: UnionFindClient x". The console output is as follows:

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...  
n value: 25000 and pairs generated are 160212  
  
Process finished with exit code 0
```

The left sidebar of the IDE contains various icons for running, debugging, and viewing the project structure.

For n = 50000

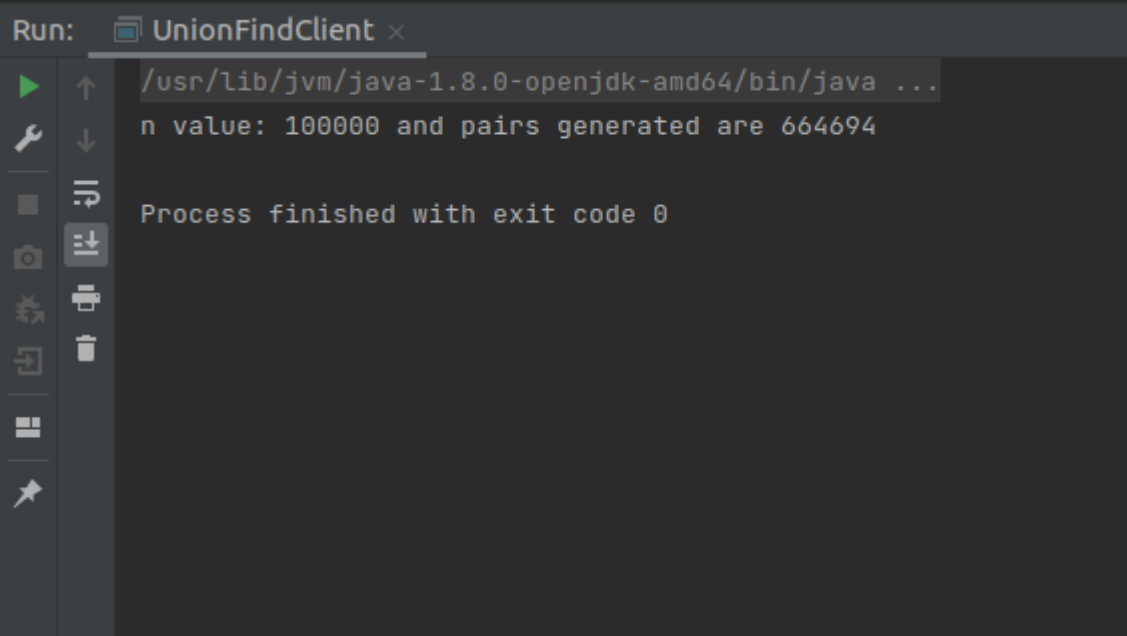


The screenshot shows an IDE console window titled "Run: UnionFindClient x". The console output is as follows:

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...  
n value: 50000 and pairs generated are 311804  
  
Process finished with exit code 0
```

The left sidebar of the IDE contains various icons for running, debugging, and viewing the project structure.

For n = 100000



The screenshot shows an IDE console window titled "Run: UnionFindClient x". The console output is as follows:

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...  
n value: 100000 and pairs generated are 664694  
  
Process finished with exit code 0
```

The left sidebar of the IDE contains various icons for running, debugging, and viewing the project structure.

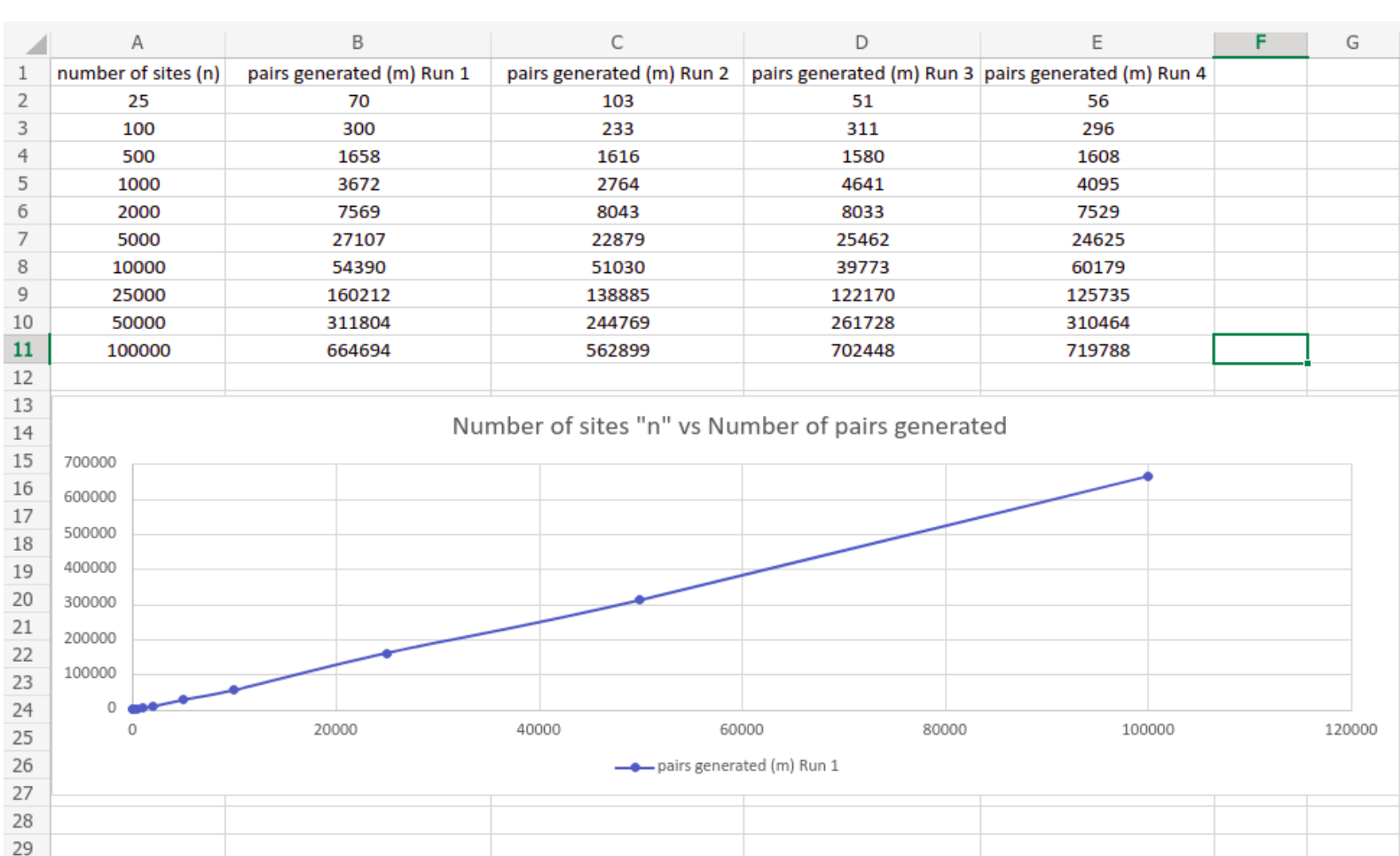
Consolidated Output:

```
/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:



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.

$$n \propto m$$