Program Structures and Algorithms
Assignment-4

Summer-2022

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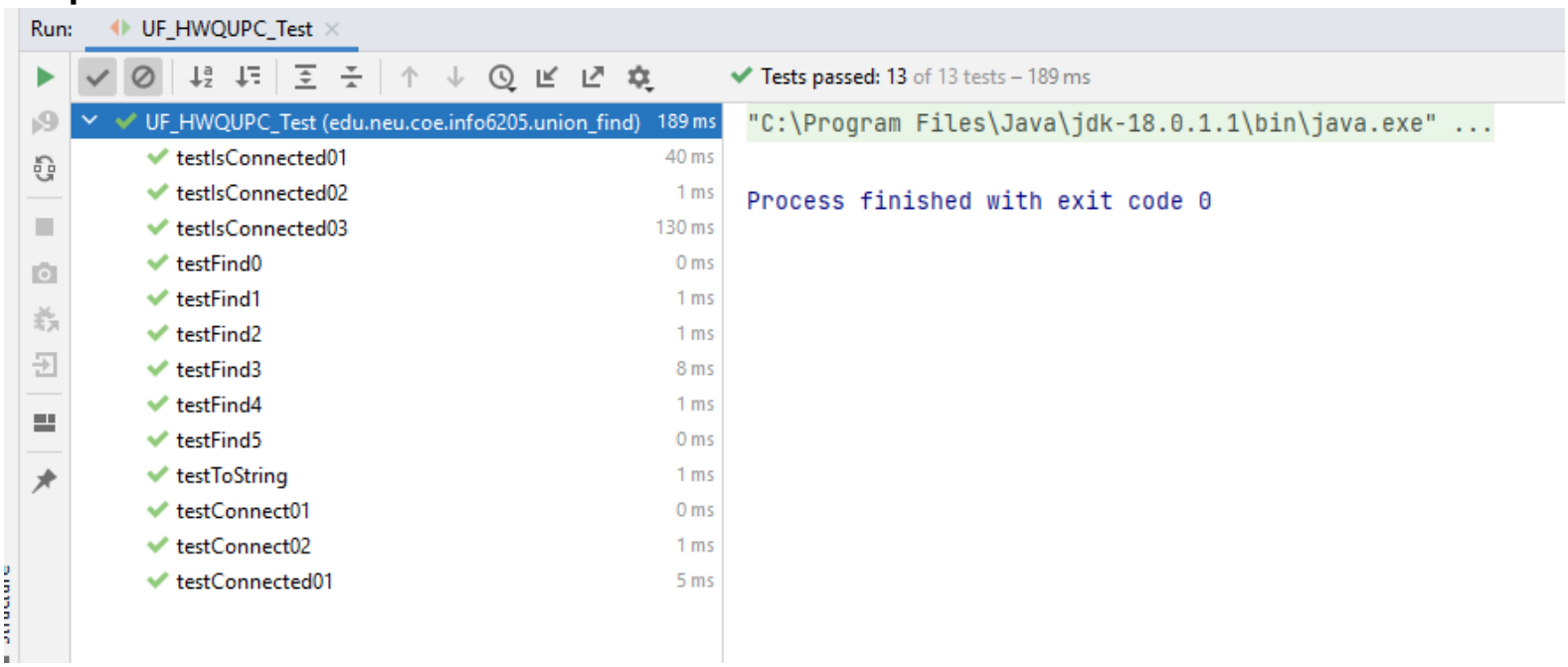
Task-1:

Implement height-weighted Quick Union with Path Compression. For this, you will flesh out the class UF_HWQUPC. All you have to do is to fill in the sections marked with // TO BE IMPLEMENTED ... // ...END IMPLEMENTATION. Check that the unit tests for this class all work. You must show "green" test results in your submission (screenshot is OK).

Output:

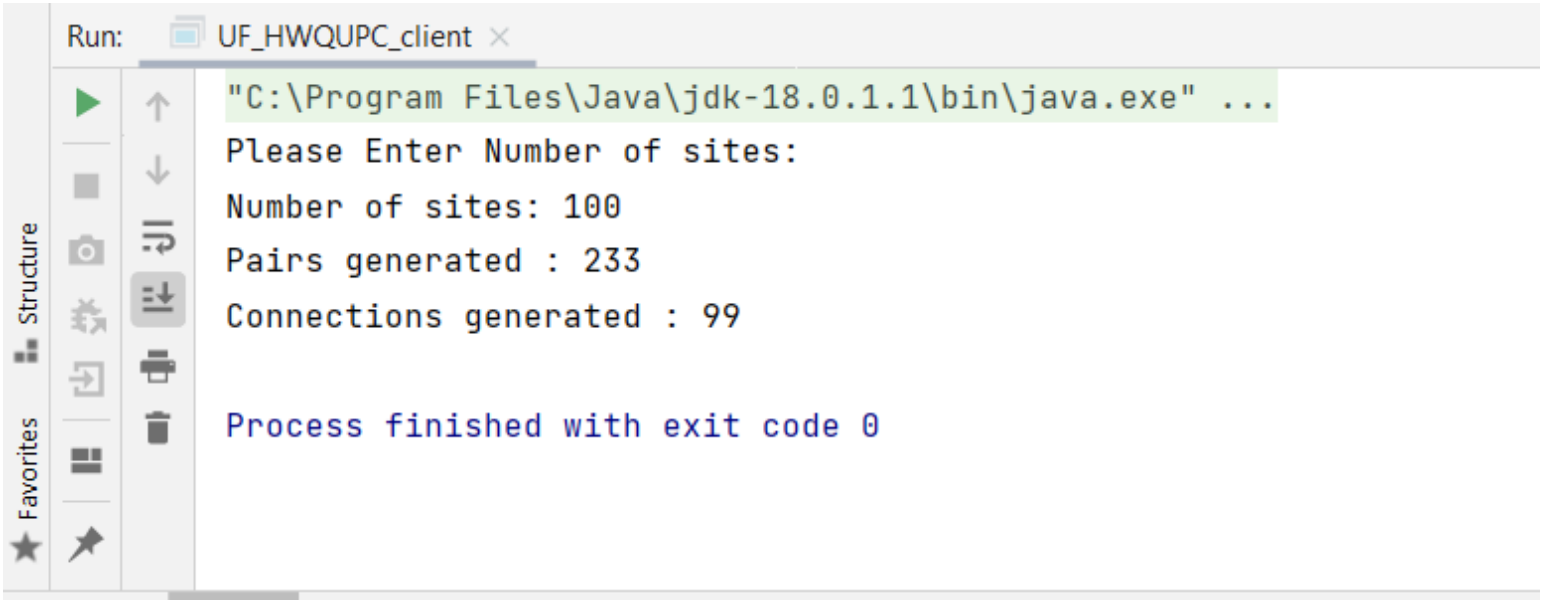


Task-2:

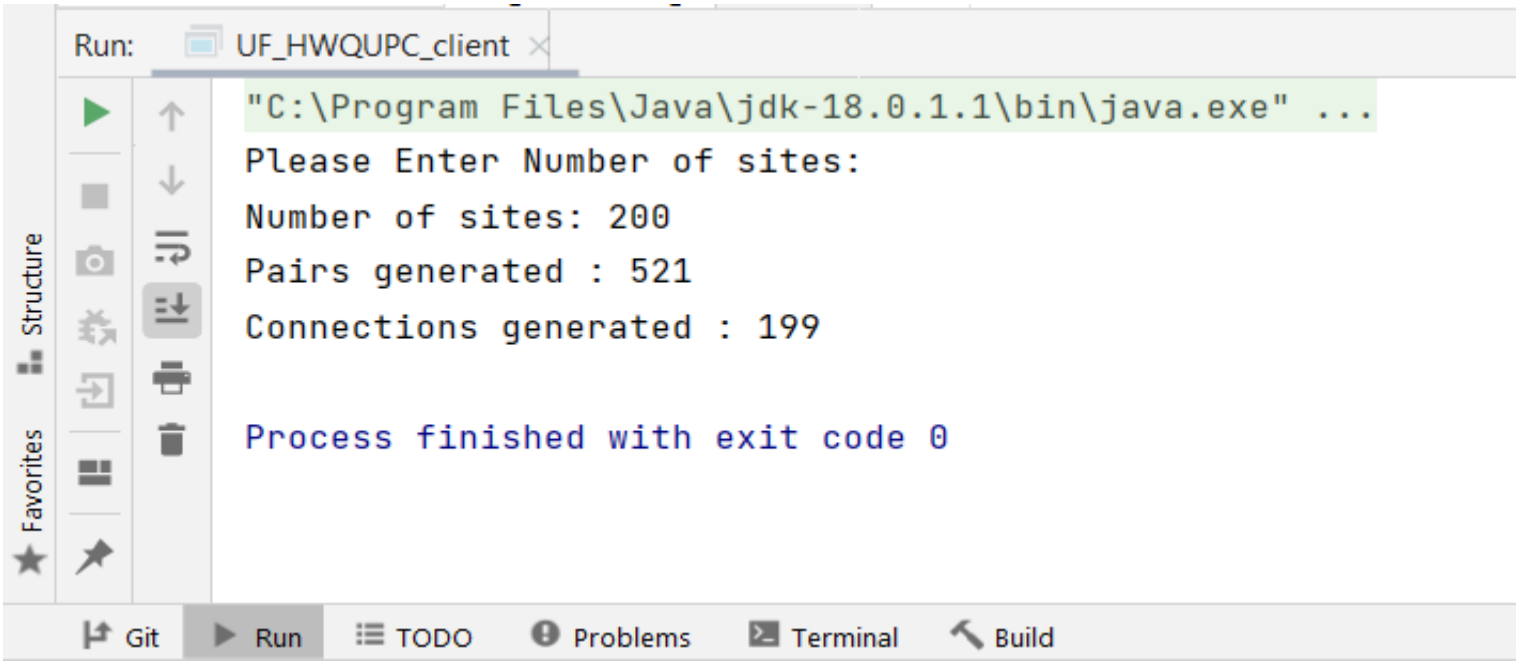
Using your implementation of UF_HWQUPC, develop a UF ("union-find") client that takes an integer value n from the command line to determine the number of "sites." Then generates random pairs of integers between 0 and n-1, calling connected() to determine if they are connected and union() if not. Loop until all sites are connected then print the number of connections generated. Package your program as a static method count() that takes n as the argument and returns the number of connections; and a main() that takes n from the command line, calls count() and prints the returned value. If you prefer, you can create a main program that doesn't require any input and runs the experiment for a fixed set of n values. Show evidence of your run(s).

Output:

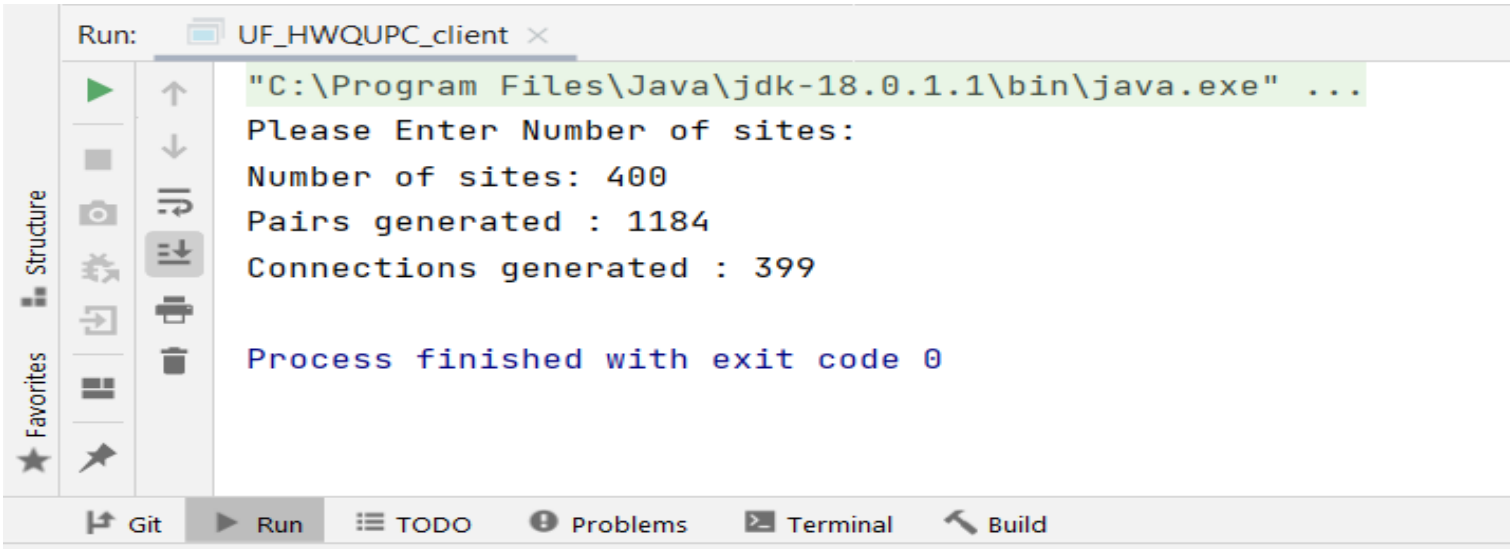
For 100 sites:



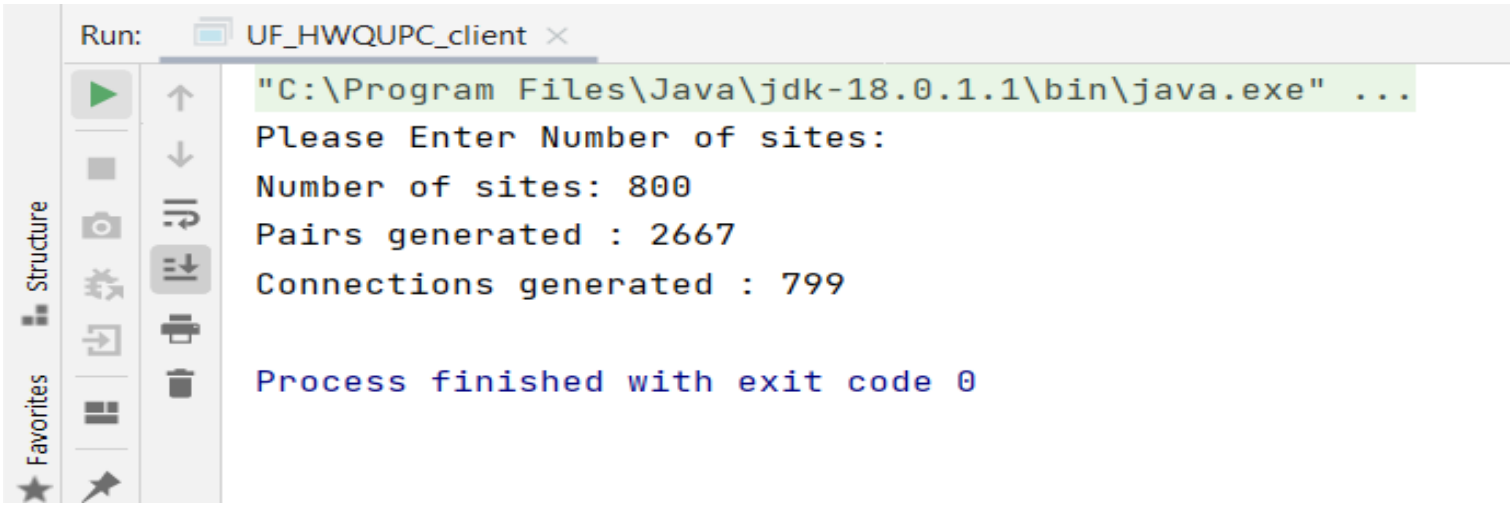
For 200 sites :



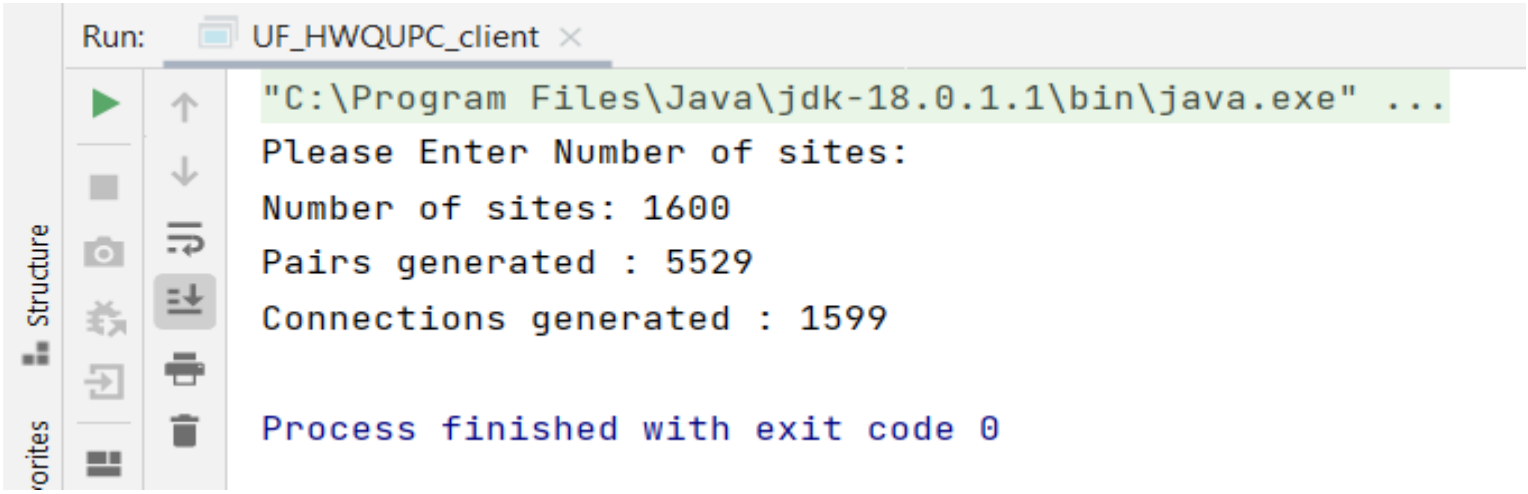
For 400 sites:



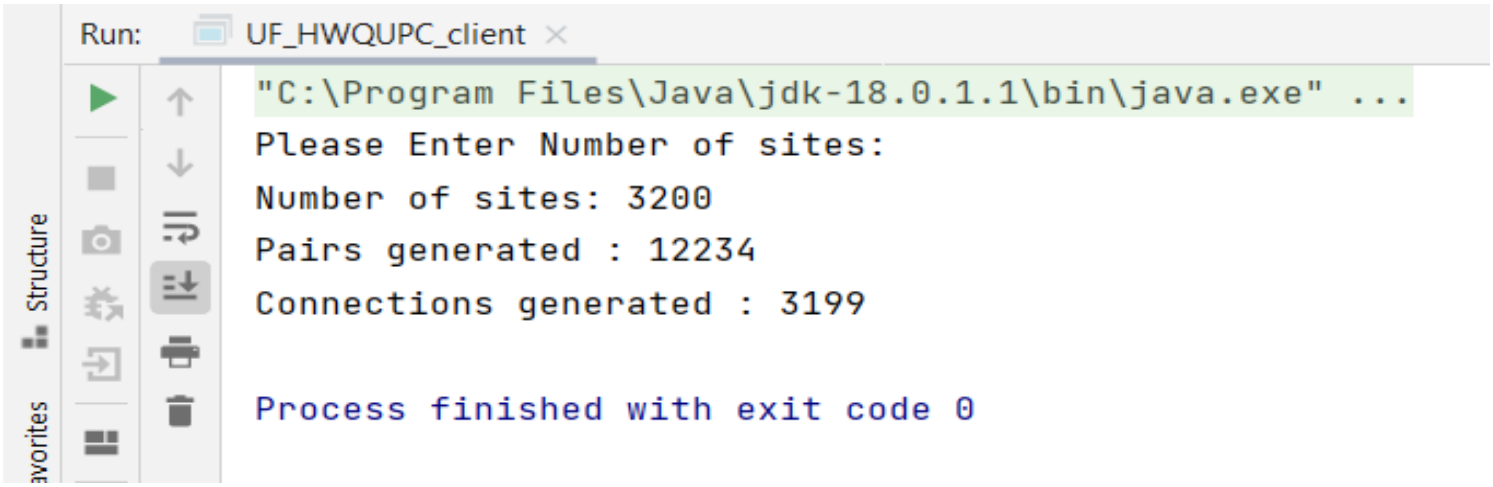
For 800 sites:



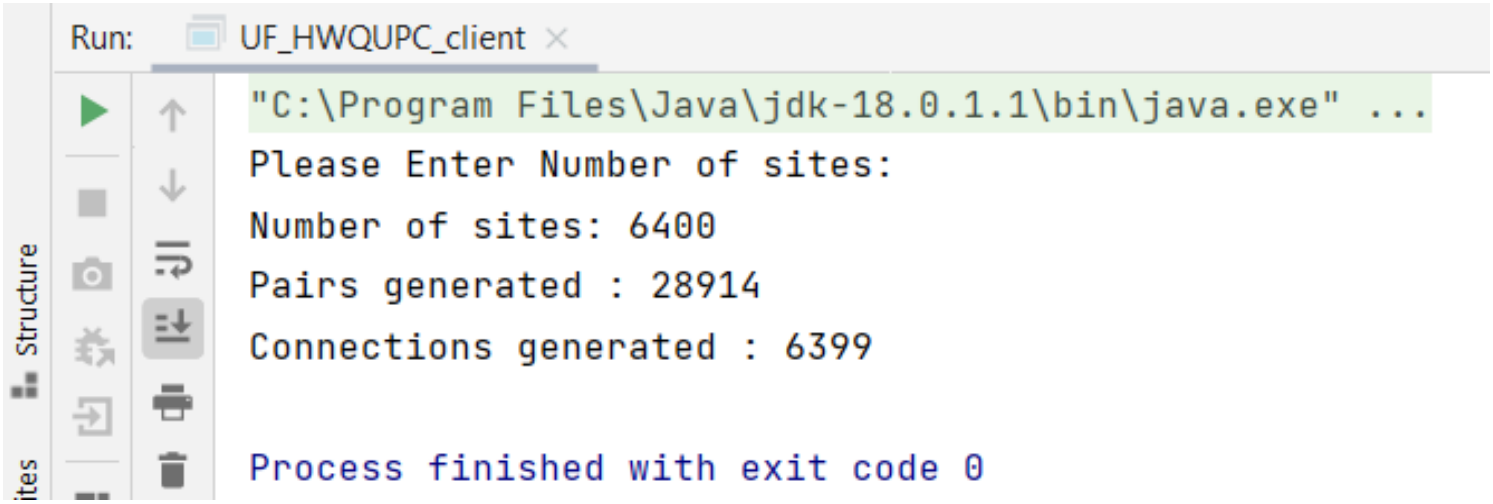
For 1600 sites:



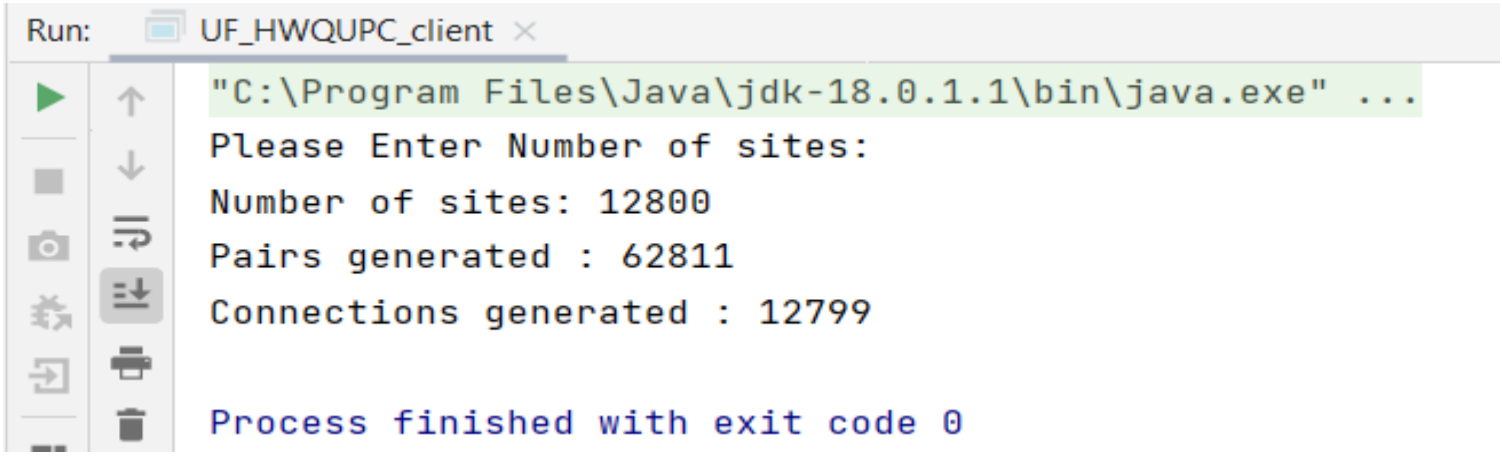
For 3200 sites:



For 6400 sites:



For 12800 Sites:



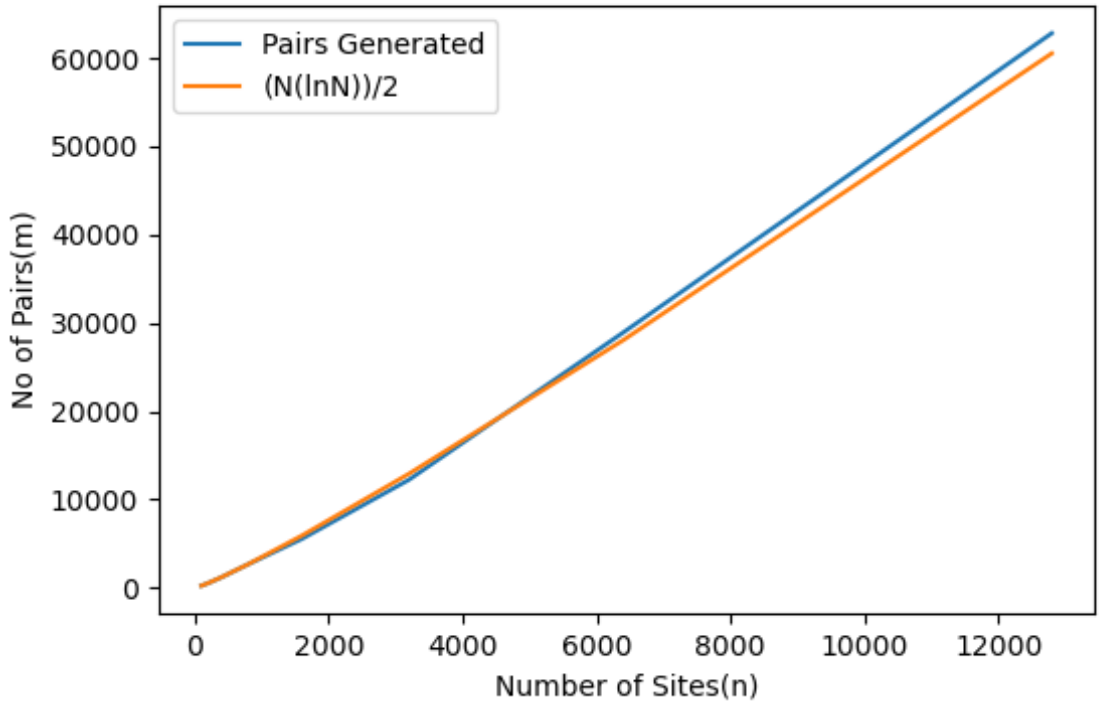
Task-3:

Determine the relationship between the number of objects (*n*) and the number of pairs (*m*) generated to accomplish this (i.e. to reduce the number of components from *n* to 1). Justify your conclusion in terms of your observations and what you think might be going on.

Comparison Table:

N(Sties)	Pairs(m) Generated	½N(lnN)
100	233	230.25
200	521	529.38
400	1184	1198.29
800	2667	2673.84
1600	5529	5902.20
3200	12234	12913.45
6400	28914	28044.97
12800	62811	60526.08

Comparison Graph:



Conclusion :

From the above simulations, it is observed that the relationship between the number of sites/objects(N) and the number of pairs (m) is,

$$m = \frac{Nln(N)}{2}$$