

Program Structures & Algorithms

Spring 2022

Assignment No. N3

Name: Shijie Zhang

(NUID): 001537250

- **Task**
- **Output screenshot**
- **Relationship Conclusion**
- **Evidence / Graph**
- **Unit tests result**

➤ **Task**

STEP ONE:

- Implement height-weighted Quick Union with Path Compression.
- Check that the unit tests for this class all work. You must show "green" test results in your submission

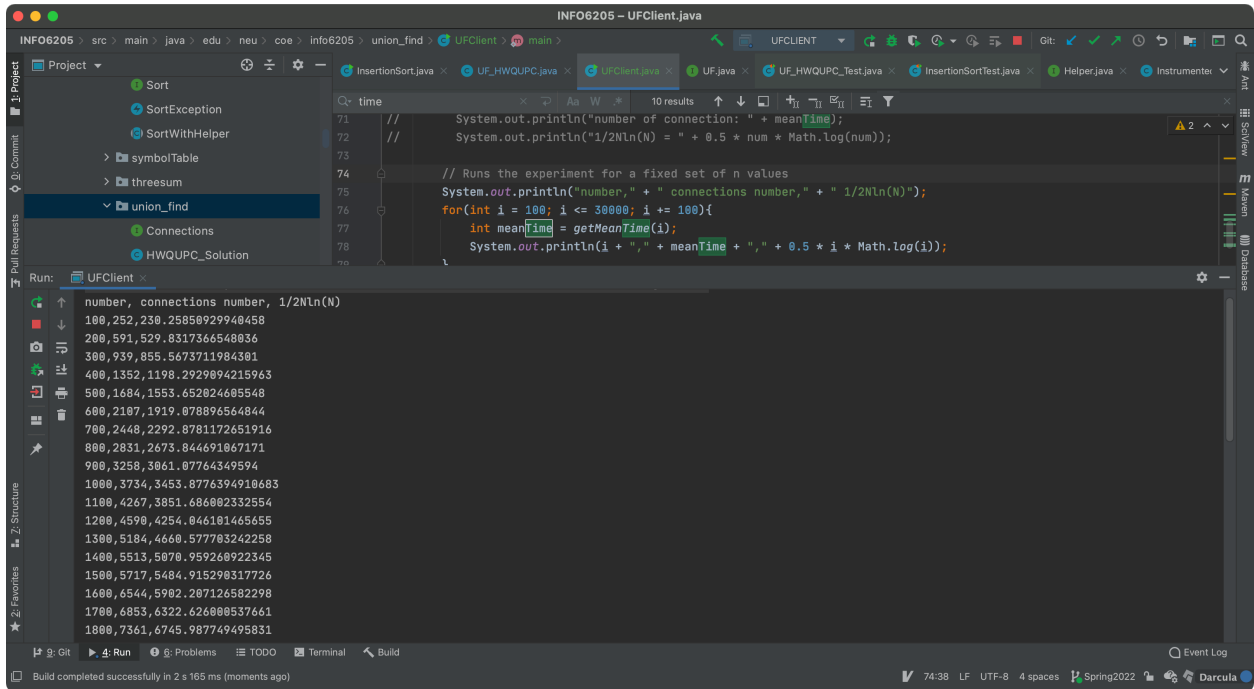
STEP TWO:

- 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.

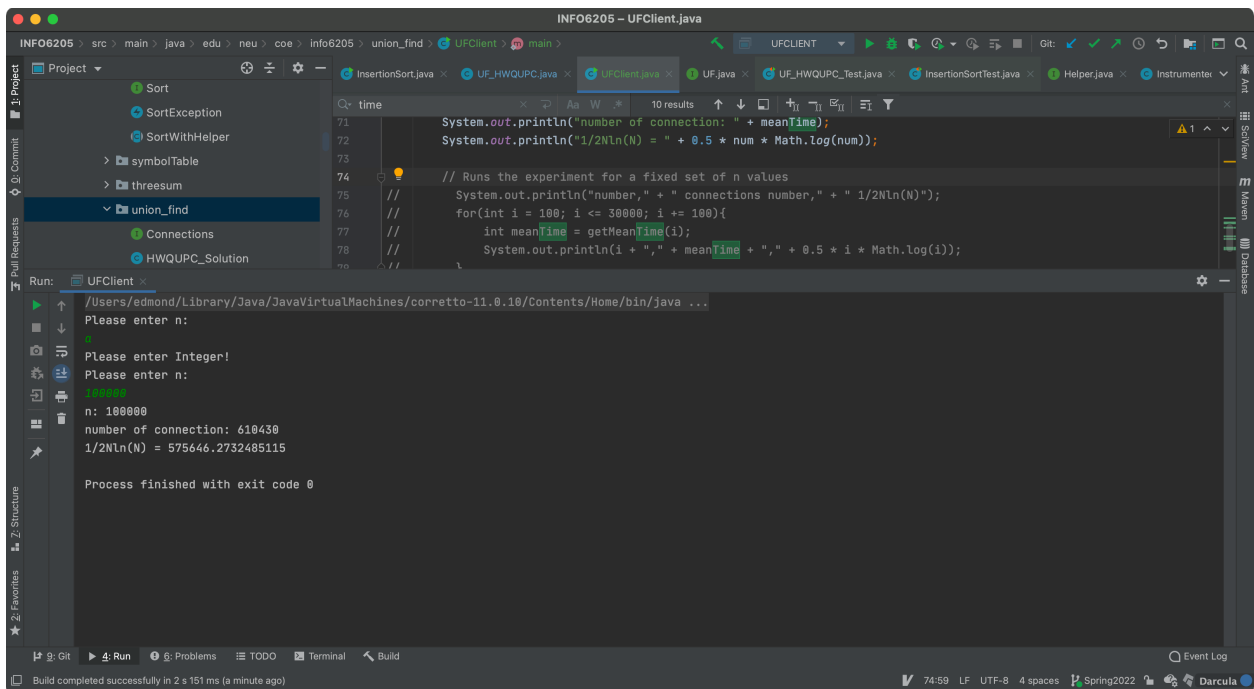
STEP THREE:

- 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.

➤ **Output screenshot**



Picture 1- Runs the experiment for a fixed set of n values



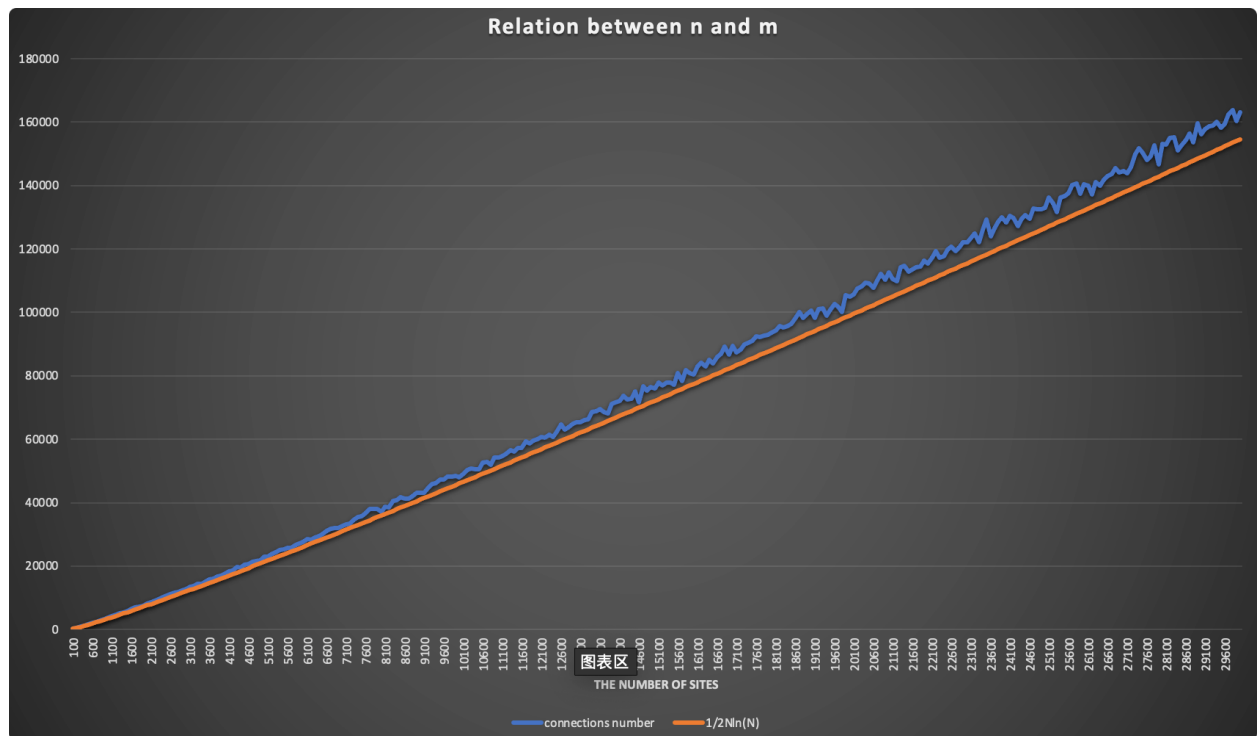
Picture 2- Runs the experiment for n values input in command line

➤ Relationship Conclusion

$$M = \frac{1}{2} N \ln(N)$$

M for number of pairs, and n for number of objects

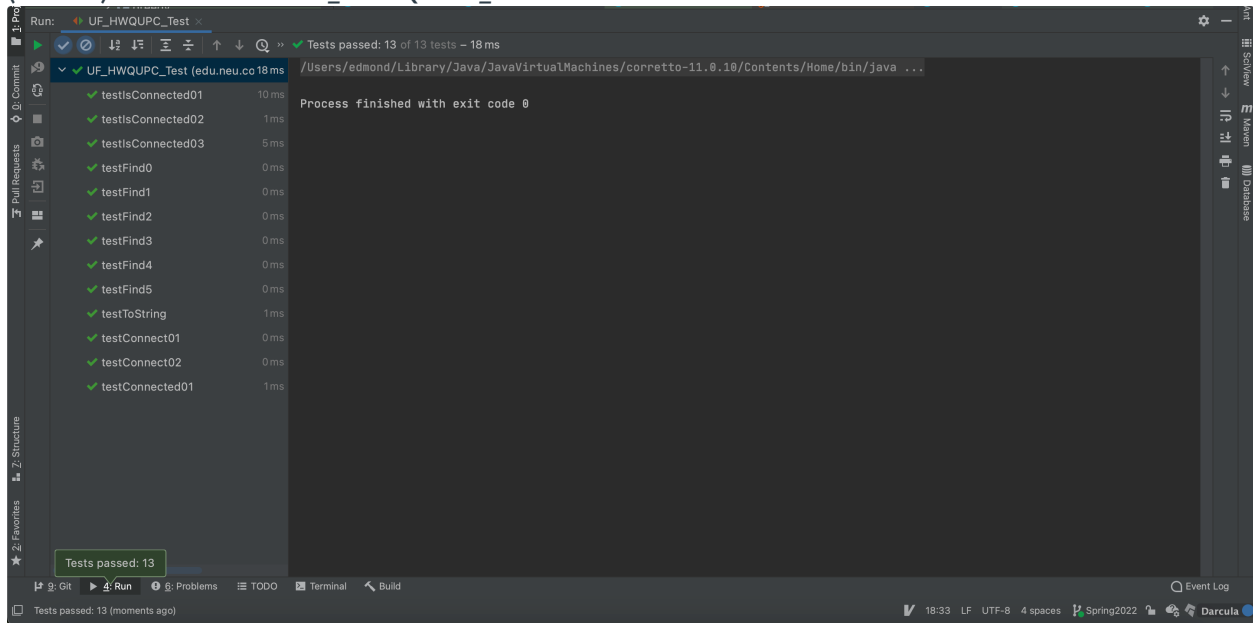
➤ Evidence / Graph



Picture 3- Evidence of Relationship Conclusion

➤ Unit tests result

(Part 1) unit tests in *UF_HWQUPC_Test*.



Picture 4-unit tests in UF_HWQUPC