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ASSIGNMENT-4

TASK:

Step 1: Implement height-weighted Quick Union with Path Compression. Check for all the unit test cases

Step 2: Using the 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." 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 the 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 or create a main program that doesn't require any input and runs the experiment for a fixed set of n values. Show evidence of the run(s).

Step 3: Determine the relationship between the number of objects (n) and the number of pairs (m)

Relationship Conclusion:

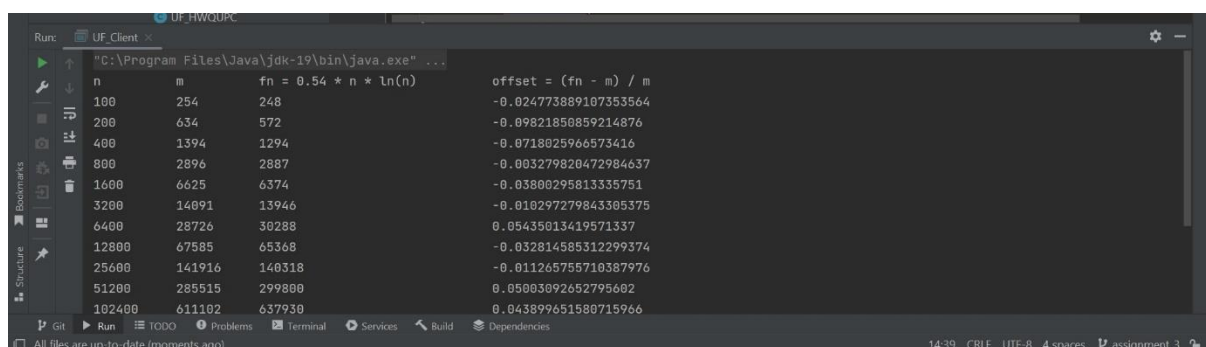
Based on the data produced, it is evident that the number of pairs(m) created is proportional to the number of objects(n) supplied as input:

$$M = c * n * \log n$$

$$M \sim n \log n$$

OUTPUT:

The result below depicts the number of pairs(m), number of objects(n), function and offsetValue.



n	m	fn = 0.54 * n * ln(n)	offset = (fn - m) / m
100	254	248	-0.024773889107353564
200	634	572	-0.09821850859214876
400	1394	1294	-0.0718025966573416
800	2896	2887	-0.003279820472984637
1600	6625	6374	-0.03800295813335751
3200	14091	13946	-0.010297279843305375
6400	28726	30288	0.05435013419571337
12800	67585	65368	-0.032814585312299374
25600	141916	140318	-0.011265755710387976
51200	285515	299800	0.05003092652795602
102400	611102	637930	0.043899651580715966

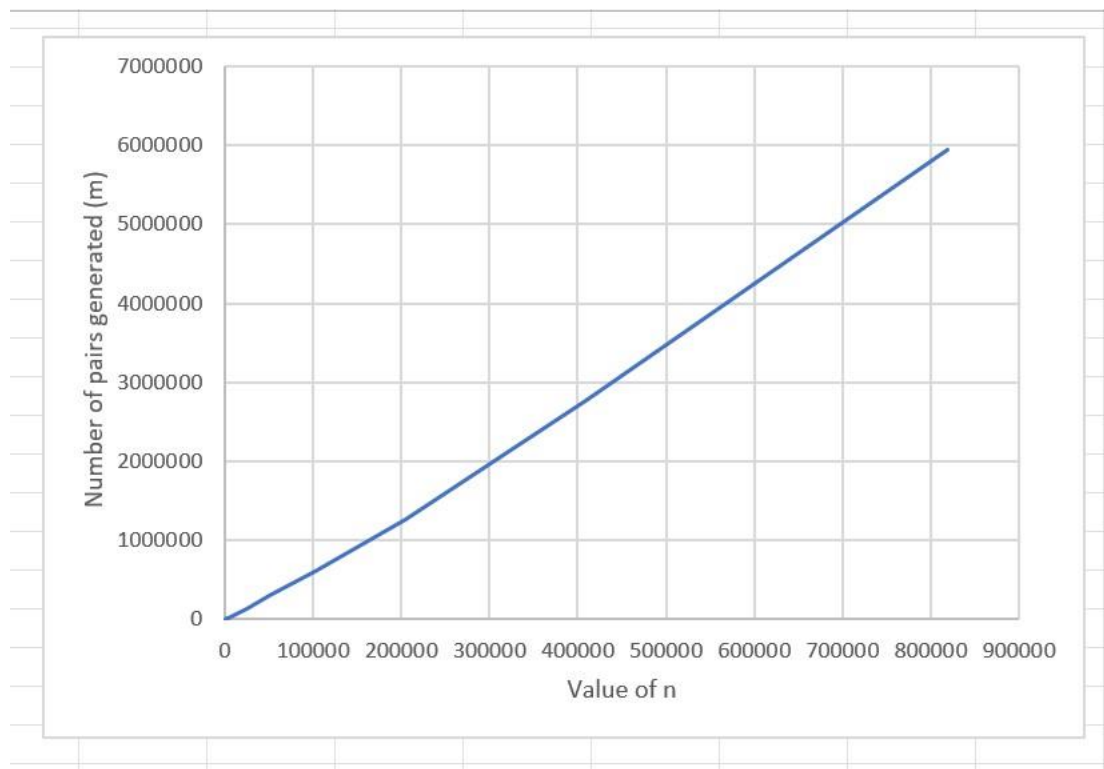
```
Run: UF_Client x UF_HWQUPC
1600      6625      6374      -0.03800295813335751
3200      14091     13946     -0.010297279843305375
6400      28726     30288     0.05435013419571337
12800     67585     65368     -0.032814585312299374
25600     141916    140318    -0.011265755710387976
51200     285515    299800     0.05003092652795602
102400    611102    637930     0.043899651580715966
204800    1307854    1352516    0.03414883446879362
409600    2679840    2858346    0.06661065337443077
819200    5684344    6023319    0.05963301590241429

Process finished with exit code 0
```

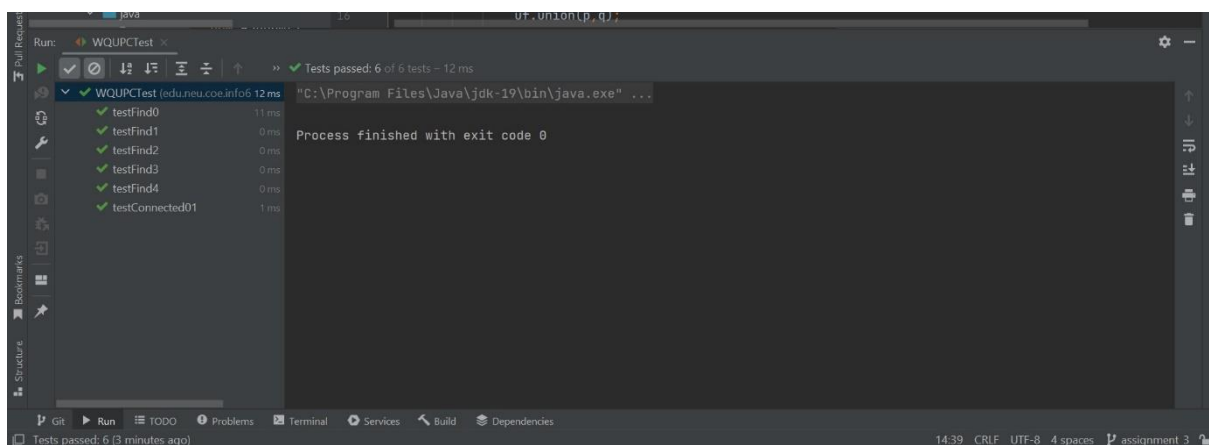
Evidence:

The below table and the graph depicts the relationship between the number of objects(n) and number of pairs(m) for different sets of values for both n and m.

number of objects (n)	Number of pairs generated(m)
100	277
200	534
400	1353
800	3188
1600	6958
3200	13713
6400	30301
12800	65037
25600	132349
51200	296898
102400	601016
204800	1270618
409600	2773753
819200	5940808



Passed Unit Test Cases:





Source code:

The source code for this assignment is available on my repository:
https://github.com/ShreyaBaliga2408/Union_Find/tree/uf