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Program Structures & Algorithms

Fall 2021

Assignment No. 3

- **Task:** Implement height-weighted Quick Union with Path Compression.

  Step 1 a): Fill in the sections // TO BE IMPLEMENTED

  b): Check all the unit tests.

  Step 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."

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

- **Relationship Conclusion:**

$$The\ number\ of\ pairs(m) \approx \frac{1}{2} Nln(N)$$

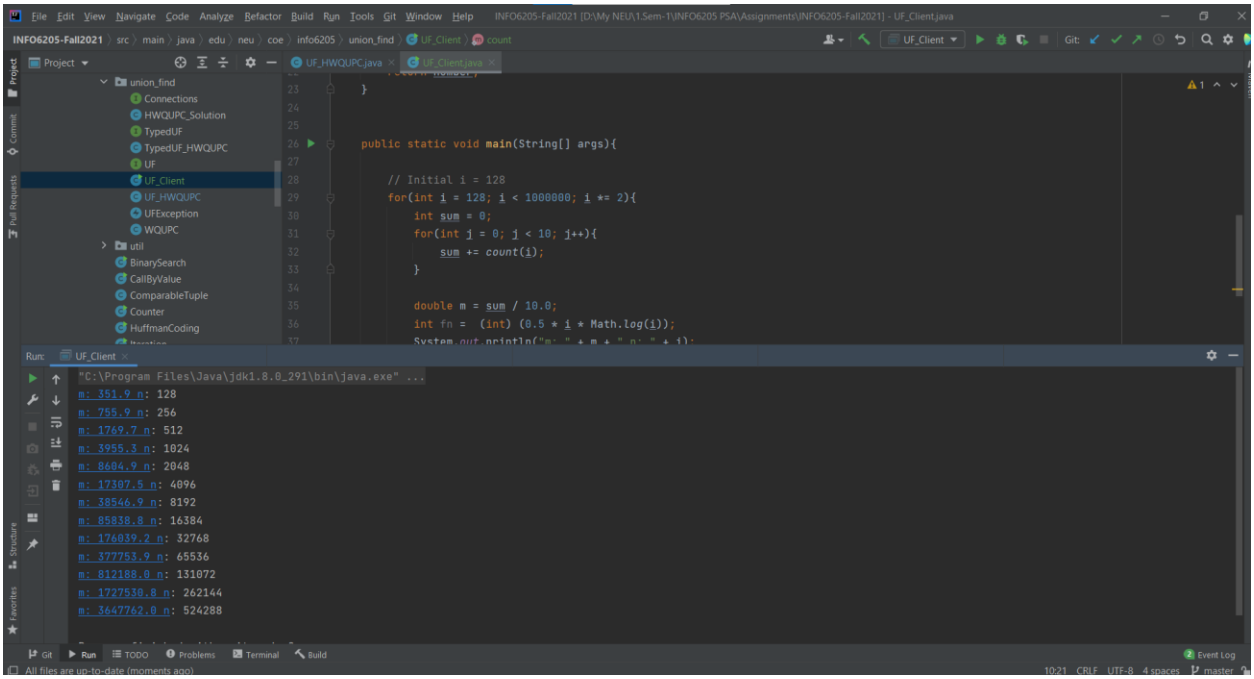
  The relationship between the number of objects(n) and the number of pairs(m) generated is the above relation.

  I pasted the table and line graph to justify the relationship.

  We can observe that the relation between N vs M graph is very similar to N vs NlogN graph even for large values.

- **Evidence to support the conclusion:**

  Output (Snapshot of Code output in the terminal):



Console Output:

m: 351.9 n: 128

m: 755.9 n: 256

m: 1769.7 n: 512

m: 3955.3 n: 1024

m: 8604.9 n: 2048

m: 17307.5 n: 4096

m: 38546.9 n: 8192

m: 85838.8 n: 16384

m: 176039.2 n: 32768

m: 377753.9 n: 65536

m: 812188.0 n: 131072

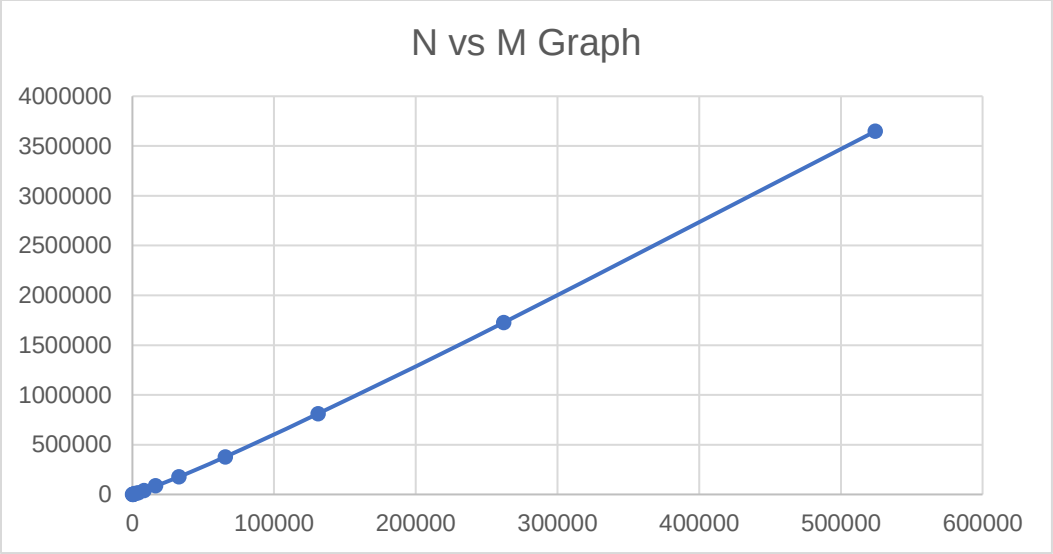
m: 1727530.8 n: 262144

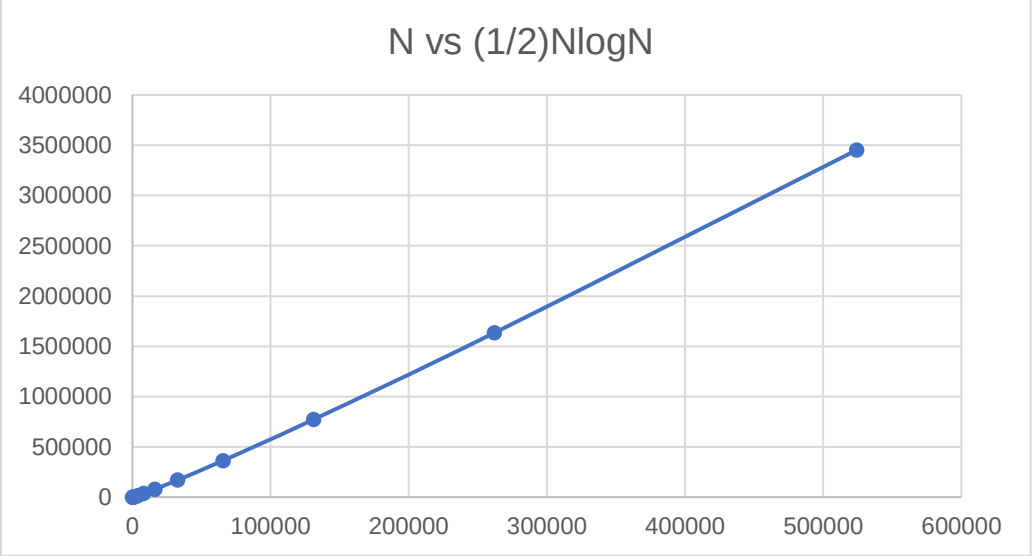
m: 3647762.0 n: 524288

Process finished with exit code 0

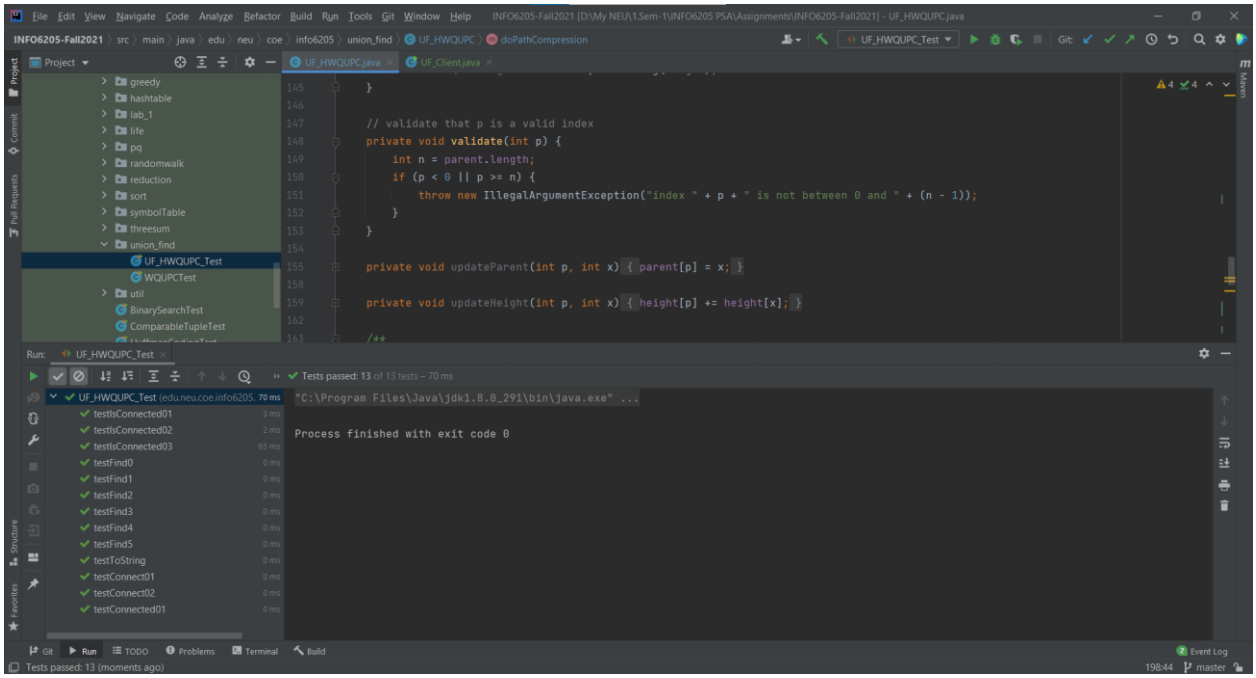
Graphical Representation

Number of Objects (n)	Number of Pairs(m)	(1/2)nlogn
128	351.9	310.5299369
256	755.9	709.7827129
512	1769.7	1597.011104
1024	3955.3	3548.913564
2048	8604.9	7807.609842
4096	17307.5	17034.78511
8192	38546.9	36908.70107
16384	85838.8	79495.66384
32768	176039.2	170347.8511
65536	377753.9	363408.749
131072	812188	772243.5916
262144	1727530.8	1635339.371
524288	3647762	3452383.116





- **Unit tests result:**


File Edit View Navigate Code Analyze Refactor Build Run Tools Git Window Help
INFO6205-Fall2021 [D:\My NEU\1.Sem-1\INFO6205 PSA\Assignments\INFO6205-Fall2021] - UF_HWQUPC.java
INFO6205-Fall2021 › src › main › java › edu › neu › coe › info6205 › union_find › UF_HWQUPC › doPathCompression
UF_HWQUPC_Test
Git:
Project
greedy
hashtable
lab_1
life
pq
randomwalk
reduction
sort
symbolTable
threesum
union_find
UF_HWQUPC_Test
WQUPCTest
util
BinarySearchTest
ComparableTupleTest
UF_HWQUPC.java
UF_Client.java
}
// validate that p is a valid index
private void validate(int p) {
int n = parent.length;
if (p < 0 || p >= n) {
throw new IllegalArgumentException("index " + p + " is not between 0 and " + (n - 1));
}
}
private void updateParent(int p, int x) { parent[p] = x; }
private void updateHeight(int p, int x) { height[p] += height[x]; }
/**
Run: UF_HWQUPC_Test
Tests passed: 13 of 13 tests – 70 ms
UF_HWQUPC_Test (edu.neu.coe.info6205. 70 ms
testIsConnected01 3 ms
testIsConnected02 2 ms
testIsConnected03 65 ms
testFind0 0 ms
testFind1 0 ms
testFind2 0 ms
testFind3 0 ms
testFind4 0 ms
testFind5 0 ms
testToString 0 ms
testConnect01 0 ms
testConnect02 0 ms
testConnected01 0 ms
"C:\Program Files\Java\jdk1.8.0_291\bin\java.exe" ...
Process finished with exit code 0
Git Run TODO Problems Terminal Build
Event Log
Tests passed: 13 (moments ago)
198:44 master