INFO 6205 – Section 01

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Assignment 3: UNION-FIND

1. <u>Task</u>

   Step 1:
   (a) 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.

   (b) Check that the unit tests for this class all work. You must show "green" test results in your submission (screenshot is OK).

   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." 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).

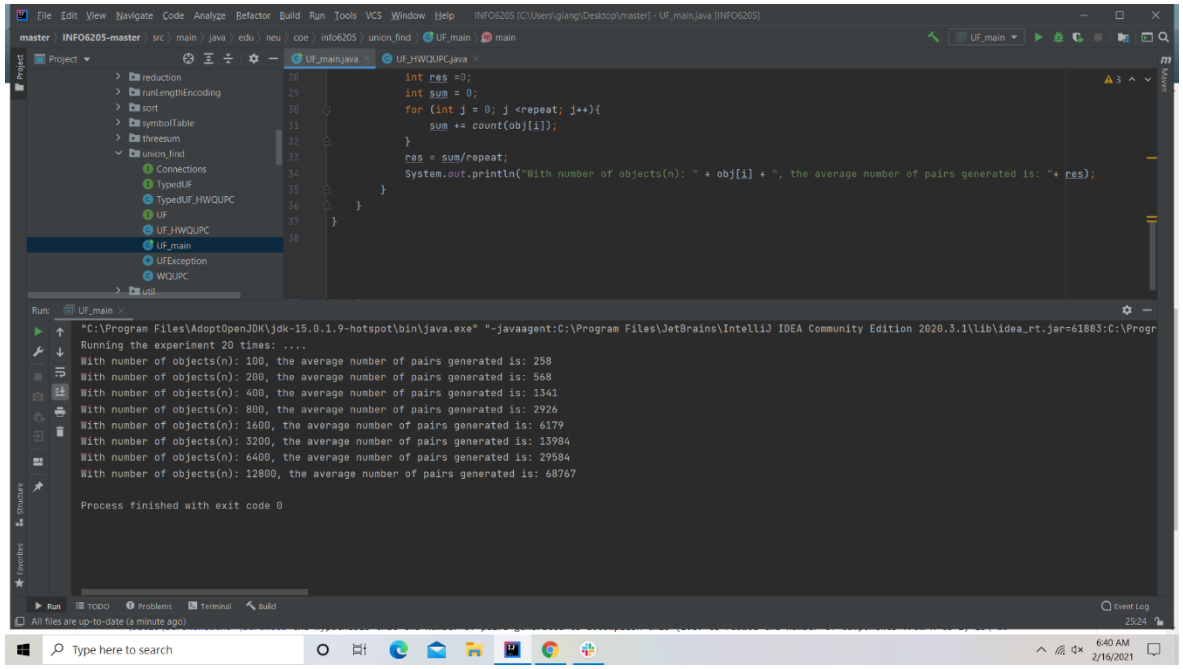
   Step 3:
   Determine the relationship between the number of objects (*n*) and the number of pairs (*m*) generated to accomplish this (i.e. to reduce the number of components from *n* to 1). Justify your conclusion.

2. <u>Conclusion</u>

   - I ran the experiments for each case of objects (n) 20 times to get the average number of pair (m) generated, which I will show in the table result below. I believe the relationship between n and m to reduce components from n to 1 is:

     $m = 0.55 * n * \ln(n) \sim \frac{1}{2} n \ln(n)$
     where ln(n) is natural logarithm of n.

3. <u>Evidence</u>



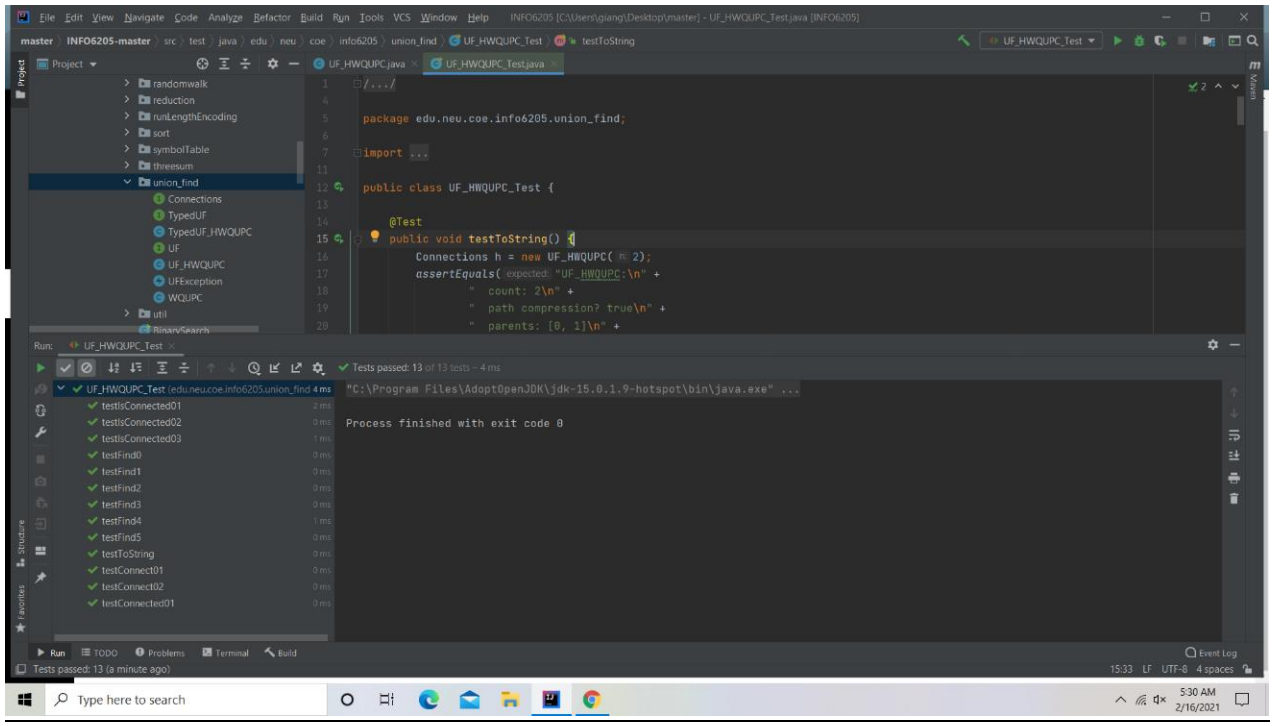
As the result above shown we can have the table:

Objects (n)	Pairs generated (m)	0.55 * n *ln(n)
100	258	253
200	568	582
400	1341	1318
800	2926	2941
1600	6179	6492
3200	13984	14204
6400	29584	30849
12800	68767	66578

4. Code

   File modified including UF_HWQUPC.java and UF_main.java. If you have trouble running it, please download the master folder on github repo for running/testing.

5. Unit Test (passed)


File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
INFO6205 [C:\Users\giang\Desktop\master] - UF_HWQUPC_Test.java [INFO6205]
master 〉 INFO6205-master 〉 src 〉 test 〉 java 〉 edu 〉 neu 〉 coe 〉 info6205 〉 union_find 〉 UF_HWQUPC_Test 〉 testToString
UF_HWQUPC_Test
Project
randomwalk
reduction
runLengthEncoding
sort
symbolTable
threesum
union_find
Connections
TypedUF
TypedUF_HWQUPC
UF
UF_HWQUPC
UFException
WQUPC
util
BinarySearch
UF_HWQUPC.java
UF_HWQUPC_Test.java
/.../
package edu.neu.coe.info6205.union_find;
import ...
public class UF_HWQUPC_Test {
@Test
public void testToString() {
Connections h = new UF_HWQUPC(n: 2);
assertEquals(expected: "UF_HWQUPC:\n" +
" count: 2\n" +
" path compression? true\n" +
" parents: [0, 1]\n" +
Run: UF_HWQUPC_Test
Tests passed: 13 of 13 tests – 4 ms
UF_HWQUPC_Test (edu.neu.coe.info6205.union_find 4 ms
testIsConnected01 2 ms
testIsConnected02 0 ms
testIsConnected03 1 ms
testFind0 0 ms
testFind1 0 ms
testFind2 0 ms
testFind3 0 ms
testFind4 1 ms
testFind5 0 ms
testToString 0 ms
testConnect01 0 ms
testConnect02 0 ms
testConnected01 0 ms
"C:\Program Files\AdoptOpenJDK\jdk-15.0.1.9-hotspot\bin\java.exe" ...
Process finished with exit code 0
Run TODO Problems Terminal Build
Event Log
Tests passed: 13 (a minute ago)
15:33 LF UTF-8 4 spaces
Type here to search
5:30 AM
2/16/2021