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Program Structures and Algorithms
Spring 2021(SEC 05)

Task:

Step 1:
(a) Implement height-weighted Quick Union with Path Compression.

(b) Check that the unit tests for this class all work.

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." 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.

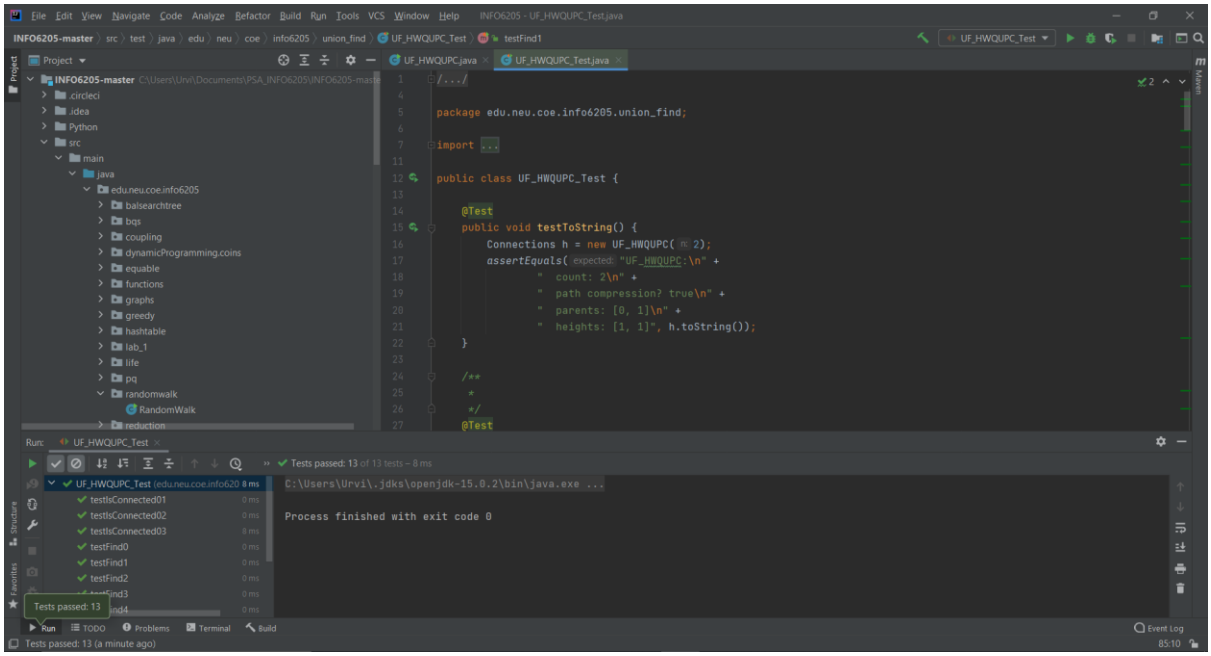
Step 3:
Determine the relationship between the number of objects (*n*) and the number of pairs (*m*) generated to accomplish this (i.e., to reduce the number of components from *n* to 1).

Relationship Conclusion:
$M \approx (n/2) * \ln(n)$
Where,
M = number of pairs generated
N = number of nodes

Evidence to support that conclusion:

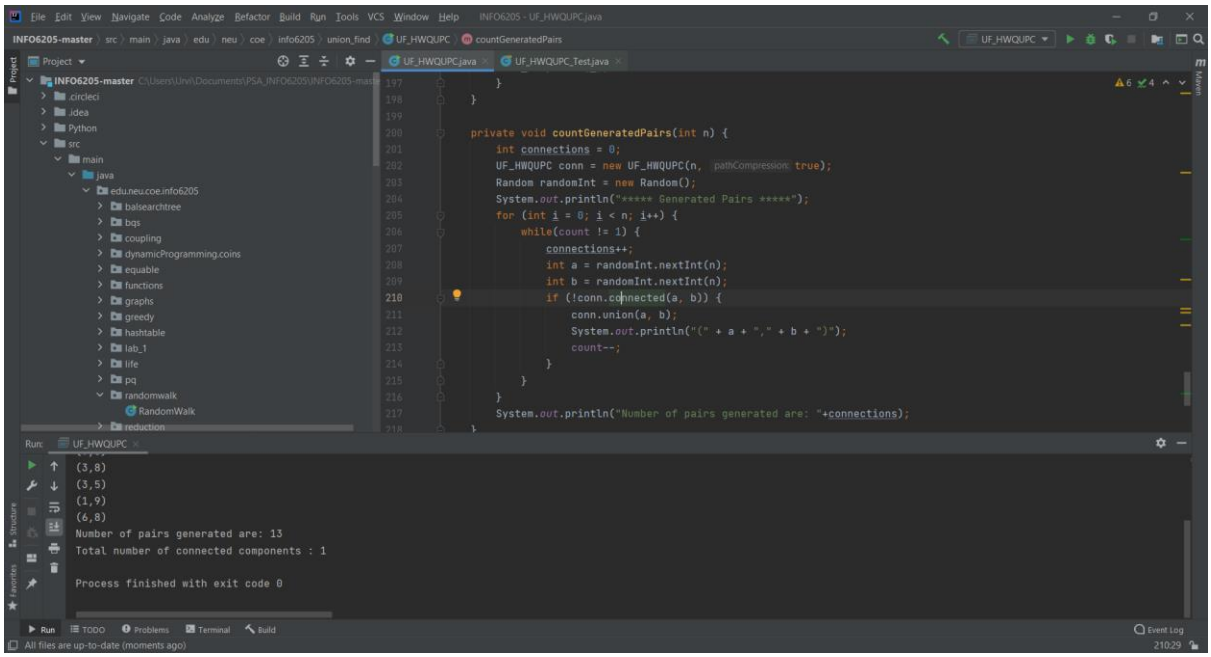
	A	B	C	D
1	**Number of nodes(n)**	**Total pairs generated**	**ln(n)**	**n/2 * ln(n)**
2	10	17	2.3	11.5
3	100	243	4.6	230
4	500	2089	6.21	1552
5	1000	4260	6.9	3450
6	10000	61761	9.2	46000
7	100000	688406	11.5	575000
8	1000000	6801536	13.81	6905000
9				

Unit Test Screenshots

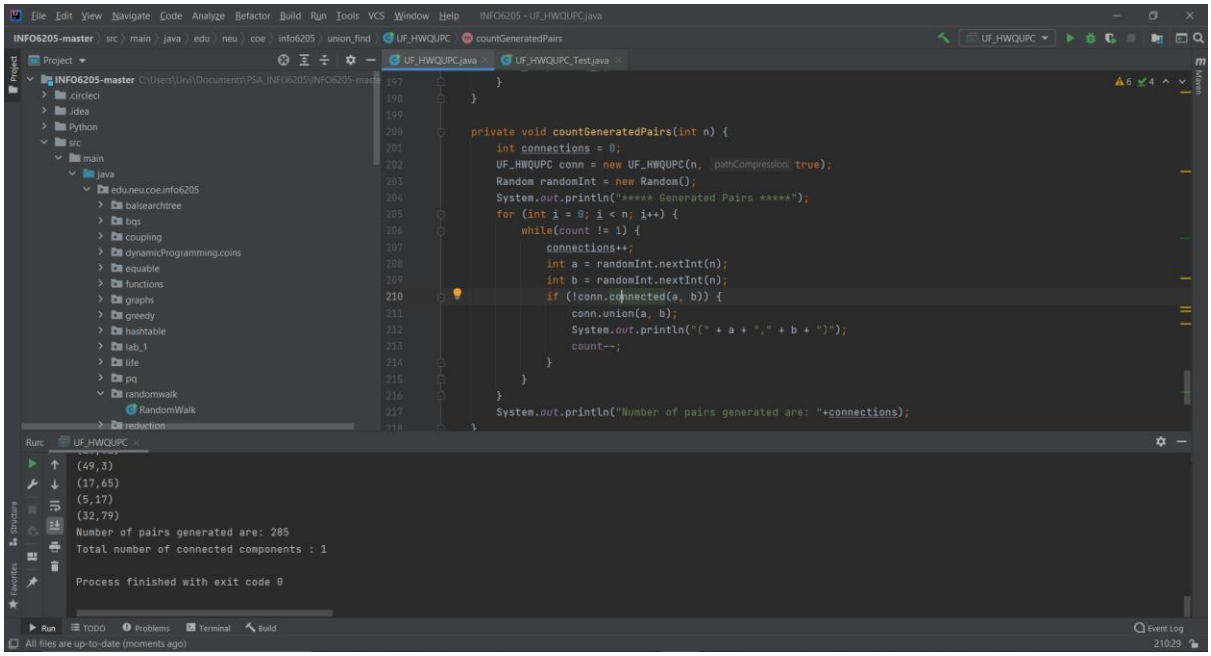


Output Screenshots

For n = 10



For n = 100



For n = 1000