Assignment 3 (WQUPC)

Tasks:

Step 1:
(a) Implement height-weighted Quick Union with Path Compression. For this, you will flesh out the class UF_HWQUPC.

(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.

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

Relationship

Performed experiment for different values of n and calculated the number of pairs. We observed that the relationship between the number of objects (n) and the number of pairs (m) generated to reduce the number of components from n to 1 comes out to be:

$$m = f(n) = 1/2 \times n \times \ln(n)$$

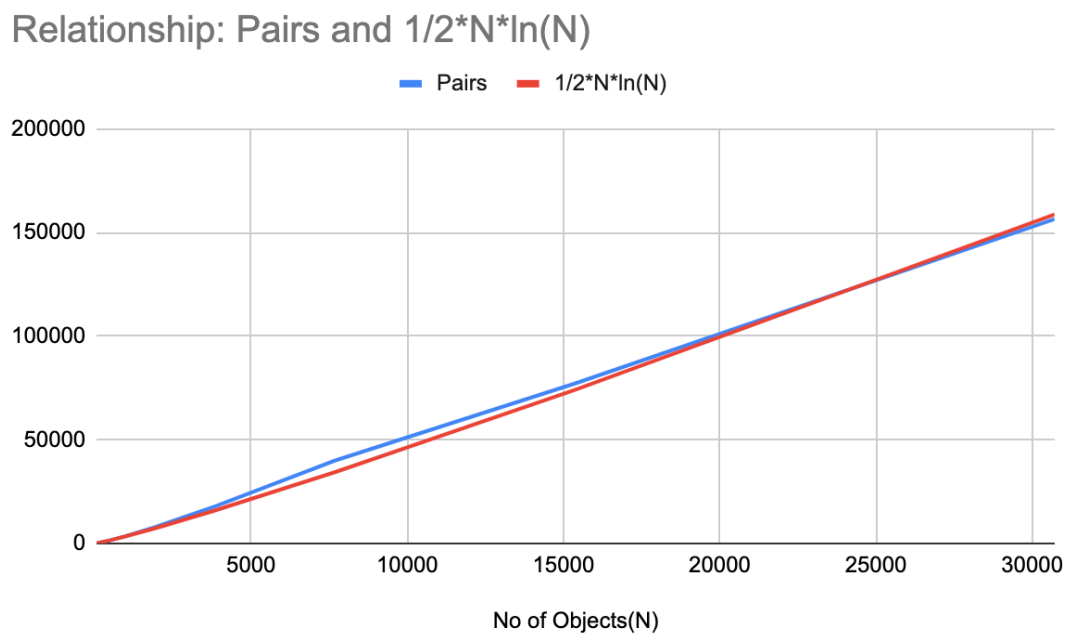
$m = number\ of\ pairs\ generated\ to\ reduce\ the\ number\ of\ components$

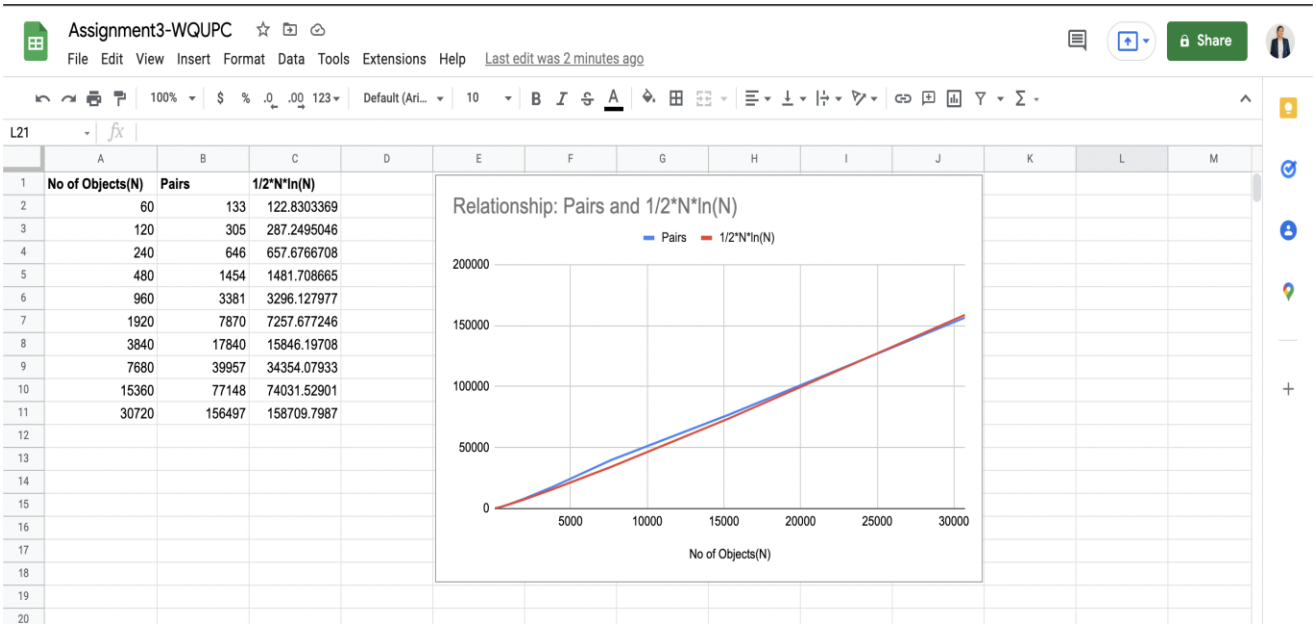
$n = number\ of\ objects$

Evidence:

Have plotted the graph between pairs and 1/2xNxln(N). It is evident from the graph that the number of pairs generated is almost equal to the graph of 1/2xNxln(N).

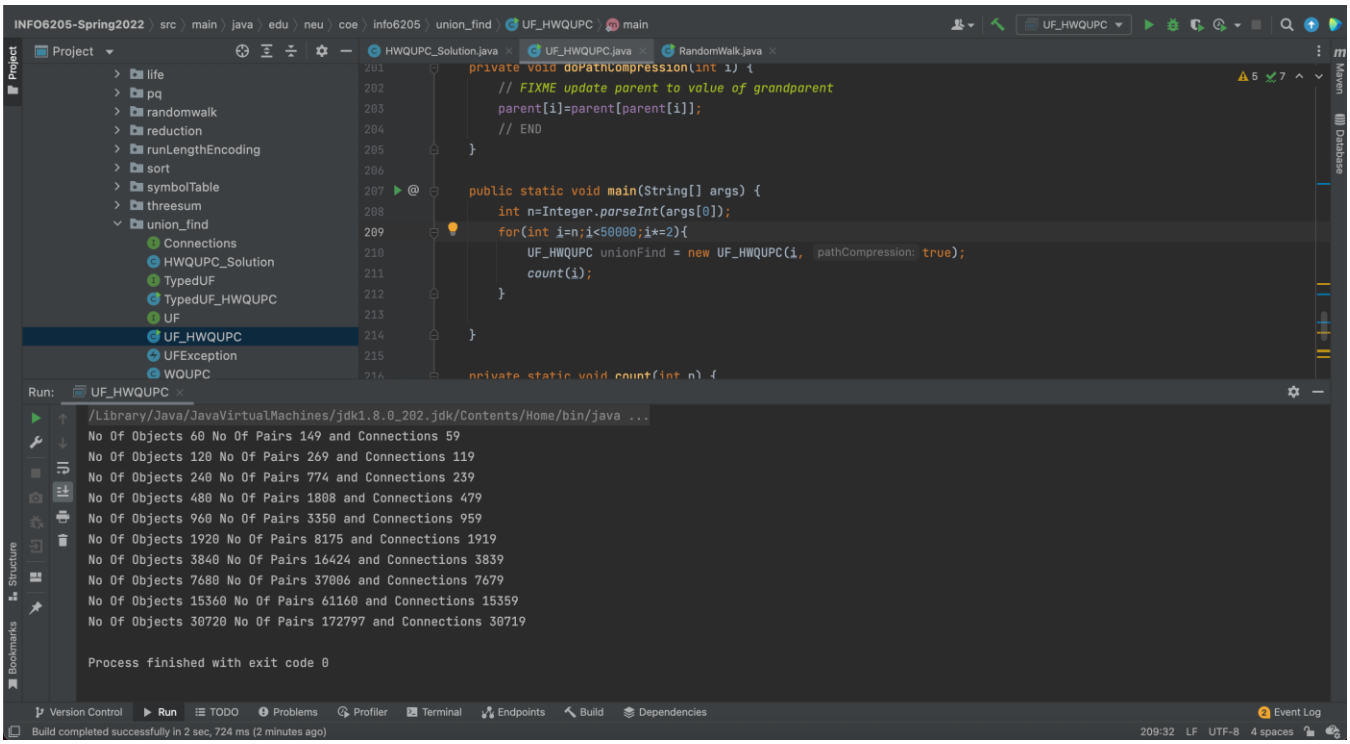
Graph:





No of Objects(N)	Pairs	1/2*N*ln(N)
60	133	122.8303369
120	305	287.2495046
240	646	657.6766708
480	1454	1481.708665
960	3381	3296.127977
1920	7870	7257.677246
3840	17840	15846.19708
7680	39957	34354.07933
15360	77148	74031.52901
30720	156497	158709.7987

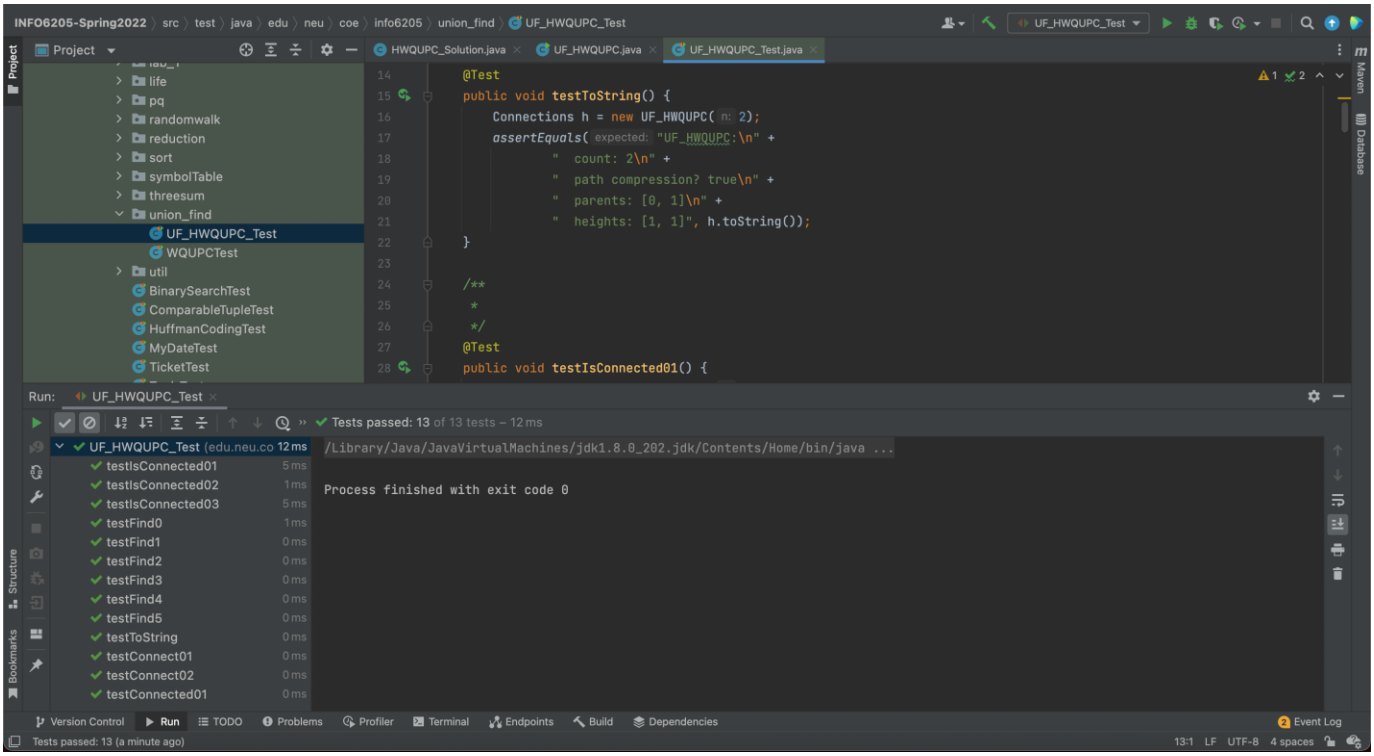
Console Output:



Unit Tests:

Performed unit tests for the union find. All unit tests passed successfully.

- UF_HWQUPC_Test class



- WQUPCTest class