Assignment - 3

PSA

Task:

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 in terms of your observations and what you think might be going on.

Output:

The data generated by the main function:

for n = 5 the number of connected pairs is = 6

for n = 10 the number of connected pairs is = 17

for n = 15 the number of connected pairs is = 28

for n = 20 the number of connected pairs is = 35

for n = 25 the number of connected pairs is = 43

for n = 30 the number of connected pairs is = 61

for n = 35 the number of connected pairs is = 82

for n = 40 the number of connected pairs is = 80

for n = 45 the number of connected pairs is = 115

for n = 50 the number of connected pairs is = 97

for n = 55 the number of connected pairs is = 132

for n = 60 the number of connected pairs is = 148

for n = 65 the number of connected pairs is = 161

for n = 70 the number of connected pairs is = 172

for n = 75 the number of connected pairs is = 184

for n = 80 the number of connected pairs is = 218

for n = 85 the number of connected pairs is = 214

for n = 90 the number of connected pairs is = 215

for n = 95 the number of connected pairs is = 231

for n = 100 the number of connected pairs is = 268

Graphical representation:

Chart, line chart

Description automatically generated

Screenshots of test cases:

Text

Description automatically generated

Explanation:

The graphical data and the data collected can be used to deduce that the relationship between the values of N and the values of the connected pairs is n\*log(n).

Connected pairs = k\*n(log(N))

The value of k determines the variation seen in the data that was obtained. The value of k can be determined for the data that was collected using excel.

k = 0.417

Chart

Description automatically generated