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INFO 6205

Program Structures & Algorithms

Spring 2020

Assignment 3

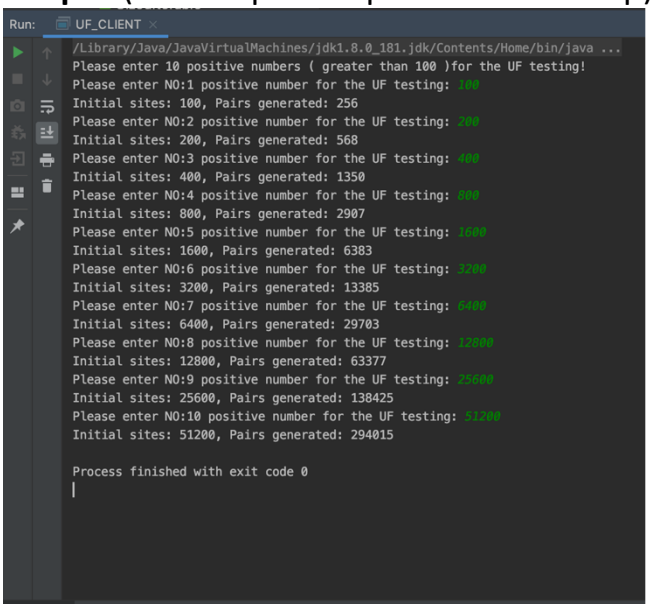
- **Task**

Step 1: 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. Check that the unit tests for this class all work.

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: Confirm the hypothesis that the number of pairs generated to accomplish this (i.e. to reduce the number of components from n to 1) is ~ 1/2 n ln n where ln n is the natural logarithm of n? Justify your conclusion.

- **Output** (few outputs to prove relationship)



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- ## Relationship conclusion

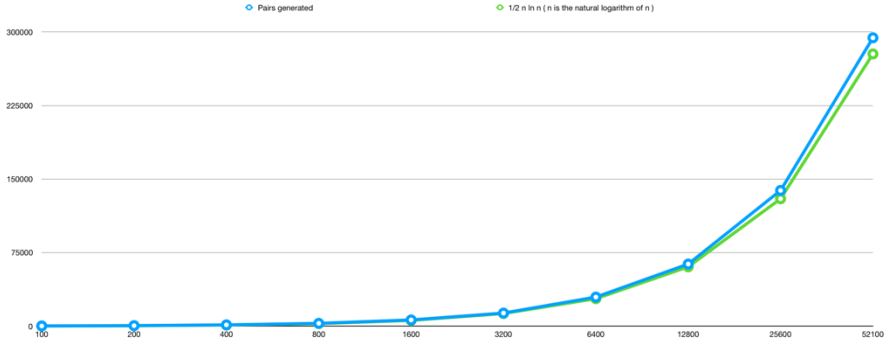
I implemented the above step1 and step2. Each time user enter the number, I will gained the result of how many pairs generated to union all the sites by run the count method 100 times and take the average result.

Based on the data, even though the 1/2 N lnN (where lnN is the natural logarithm of N) is slightly bigger than the actual pairs generated, it's very obviously that the trend of the number of pairs generated is quite similar to the trend of 1/2NlnN (where lnN is the natural logarithm of N), Thus, the hypothesis can be confirmed that given N as original components number, to reduce the number of components from N to 1, ~1/2 N lnN (where lnN is the natural logarithm of N) of connections are needed.

- ## Evidence to support relationship

Result Table

Initial sites	Pairs generated	1/2 n ln n (*n* is the natural logarithm of *n*)
100	256	230.258509299405
200	568	529.831736654804
400	1350	1198.2929094216
800	2907	2673.84469106717
1600	6383	5902.2071265823
3200	13385	12913.4497420605
6400	29703	28044.9704619128
12800	63377	60526.0828794093
25600	138425	129924.449669986
51200	294015	277593.467162307



- ## Screenshot of Unit test passing