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**Program Structures & Algorithms**

**Fall 2021**

**Assignment No. 3**

* **Task (List down the tasks performed in the Assignment)**
* 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.
* NOTE: although I'm not going to tell you in advance what the relationship is, I can assure you that it is a simple relationship.
* Don't forget to follow the submission guidelines. And to use sufficient (and sufficiently large) different values of n.
* **Relationship Conclusion: (For ex : z = a \* b)**

M = 171.87\*N – 77.564

* **Evidence to support the conclusion:**

1. **Output (Snapshot of Code output in the terminal)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 |
| m | 114.12 | 259.61 | 413.1 | 614.97 | 750.39 | 975.97 | 1167.81 | 1283.31 | 1456.79 |

While N = 450, the screenshot is following

The number of sites is: 450

The number of connections is: 1212

The number of sites is: 450

The number of connections is: 1406

The number of sites is: 450

The number of connections is: 1222

The number of sites is: 450

The number of connections is: 1417

The number of sites is: 450

The number of connections is: 1556

The number of sites is: 450

The number of connections is: 1630

The average number of connections is: 1456.79

1. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**

**图表, 折线图

描述已自动生成**

* **Unit tests result:(Snapshot of successful unit test run)**

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