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Program Structures & Algorithms

Fall 2021

Assignment No. 3(WQUPC)

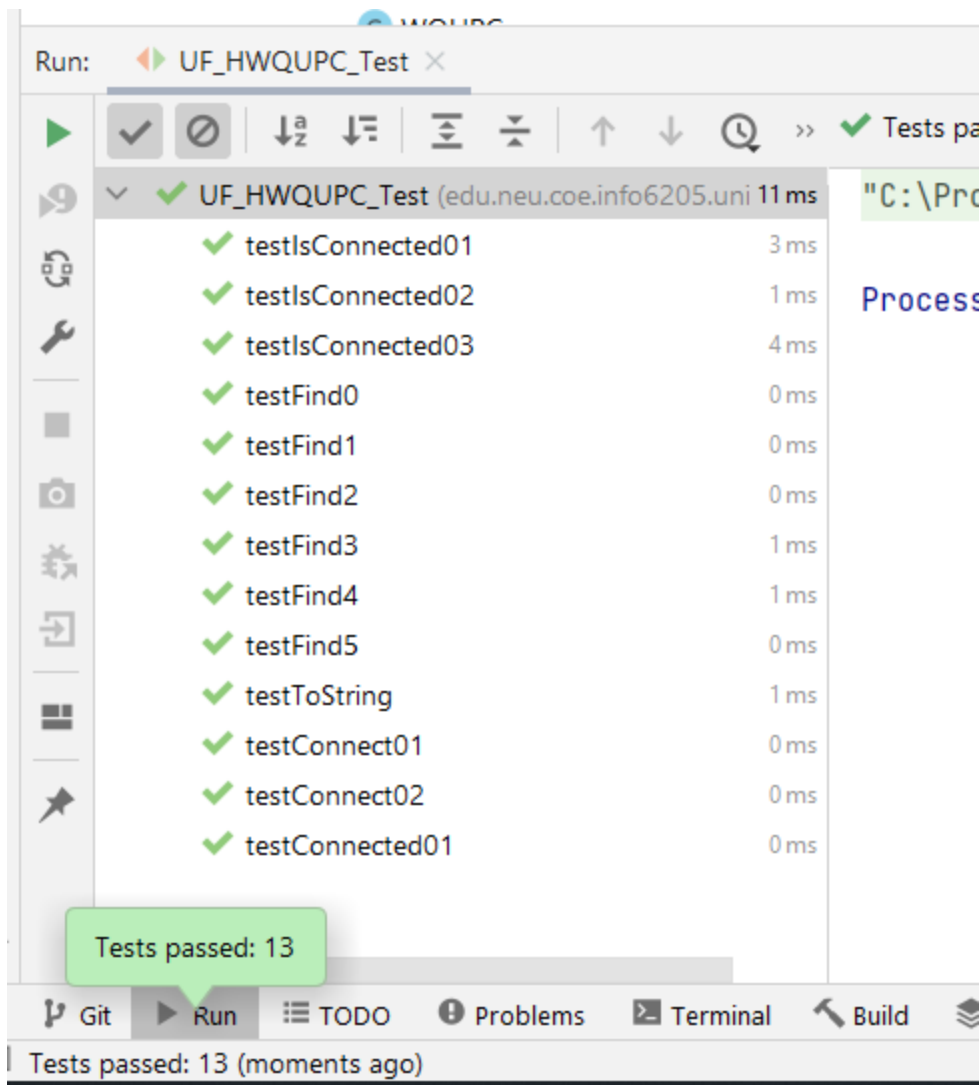
- ◉ **Task (List down the tasks performed in the Assignment)**
- ◉ **Relationship Conclusion: (For ex : $z = a * b$)**
- ◉ **Evidence to support the conclusion:**
 1. **Output (Snapshot of Code output in the terminal)**
 2. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**
- ◉ **Unit tests result:(Snapshot of successful unit test run)**

Implemented height-weighted Quick Union with Path Compression.
Class UF_HWQUPC has been fleshed out.

https://github.com/venkteshgm/INFO6205-Assignments/blob/Fall2021/src/main/java/edu/neu/coe/info6205/union_find/UF_HWQUPC.java

Step 1:

Unit test results:



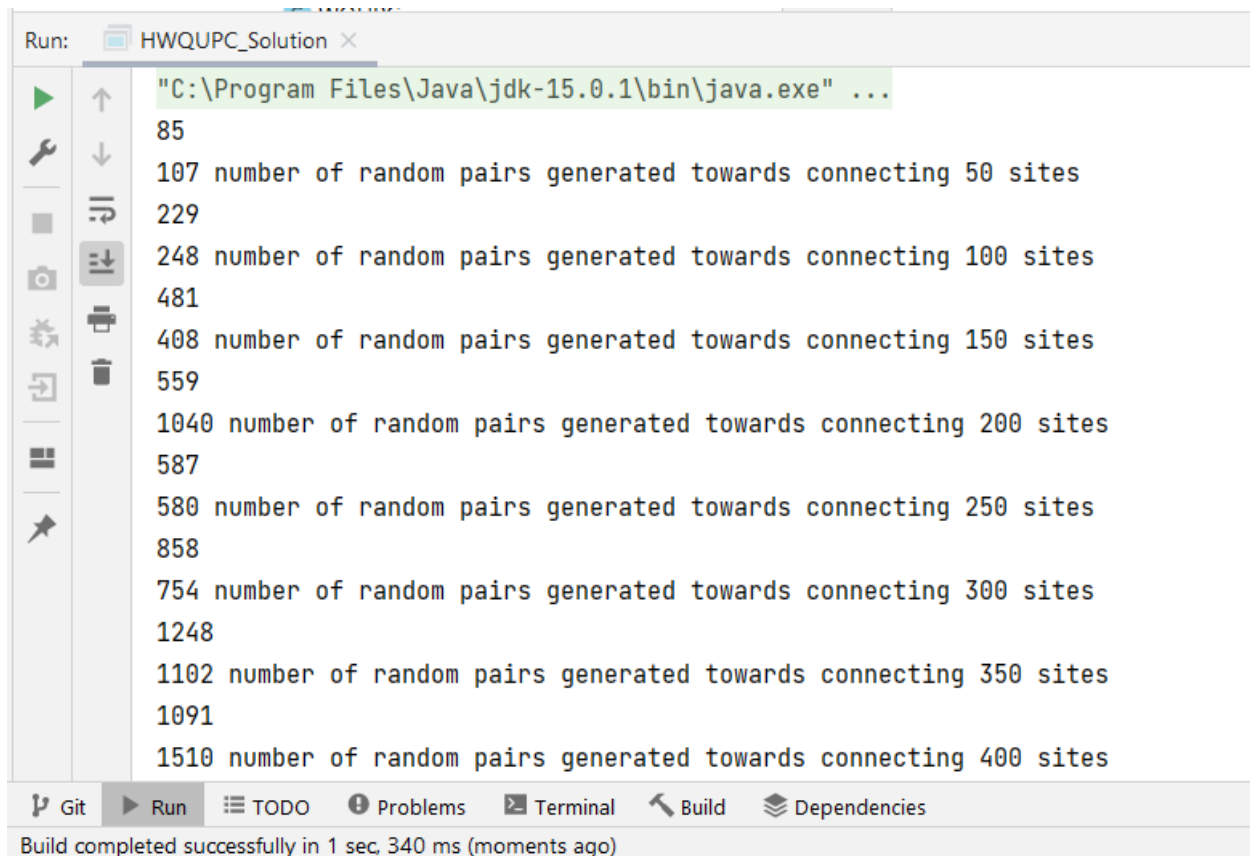
Step 2:

Union find client implemented in HWQUPC_Solution.java file.

https://github.com/venkteshgm/INFO6205-Assignments/blob/Fall2021/src/main/java/edu/neu/coe/info6205/union_find/HWQUPC_Solution.java

Union_find(int n) takes n as the number of sites and returns the number of random pairs of site values generated towards the connecting of all sites.

Screenshot of output:



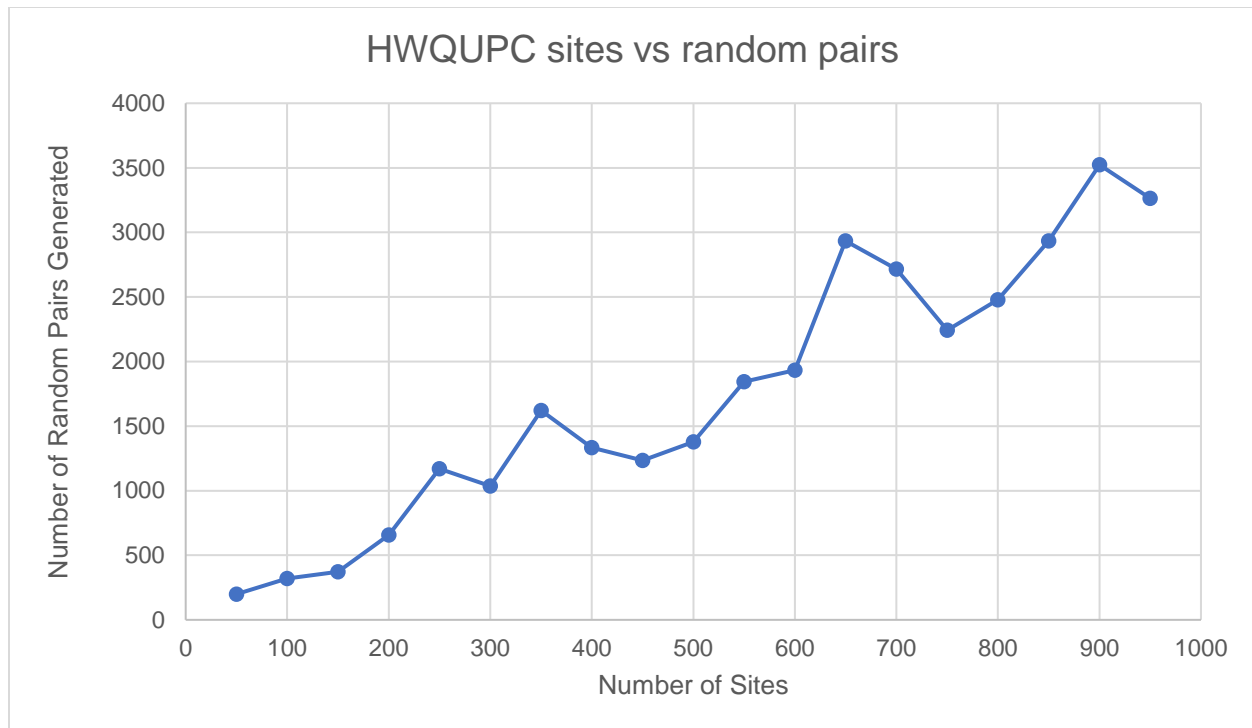
```
Run: HWQUPC_Solution x
"C:\Program Files\Java\jdk-15.0.1\bin\java.exe" ...
85
107 number of random pairs generated towards connecting 50 sites
229
248 number of random pairs generated towards connecting 100 sites
481
408 number of random pairs generated towards connecting 150 sites
559
1040 number of random pairs generated towards connecting 200 sites
587
580 number of random pairs generated towards connecting 250 sites
858
754 number of random pairs generated towards connecting 300 sites
1248
1102 number of random pairs generated towards connecting 350 sites
1091
1510 number of random pairs generated towards connecting 400 sites
```

Build completed successfully in 1 sec, 340 ms (moments ago)

Step 3:

Determine the relationship between pairs generated “k” and number of sites “n”.

The graph plotted with number of sites on X axis and number of pairs generated on Y axis shows a linear relationship between n and k.



Our algorithm results in a connected tree with length 1, which means all other sites are connected to 1 root site.

In such a scenario, the number of connections for n sites would be $n-1$.

If we were to not count the repeated pairs generated by the random pair generator, we'd be left with such a scenario, making the number of pairs $k = n - 1$.

All we're doing right now is adding a random value to the RHS to account for the repeats generated.

Thus, even though we cannot be sure of what that random number can be, the value k increases approximately linearly with increase in n .