

Program Structures & Algorithms

Fall 2021

Assignment No. 3

- **Tasks:**

- Implemented the code for **Height-Weighted Quick Union with Path Compression**.
- Passed all the unit tests for the **Height-Weighted Quick Union with Path Compression** code.
- Wrote and executed the **Client code for Height-Weighted Quick Union**.
- Inferred the relationship between the **number of random pairs generated** to reduce the number of components from **n to 1** for various different values of components n.

- **Relationship Conclusion:**

- 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** is **$N/2 * \log(N)$** . Where $\log(N)$ is natural logarithms.

i.e. if there are **32 components** in the Quick Union, approximately **55 random pairs** are generated to accomplish the singular component condition.

- **Evidence to support the conclusion:**

1. The output of the program:

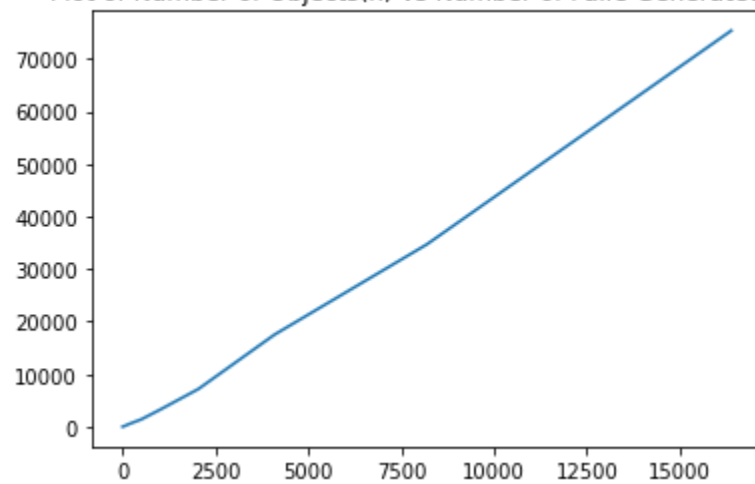
```
/usr/lib/jvm/java-1.11.0-openjdk-amd64/bin/java ...
n:8 Total connections generated: 10
n:16 Total connections generated: 31
n:32 Total connections generated: 83
n:64 Total connections generated: 133
n:128 Total connections generated: 357
n:256 Total connections generated: 716
n:512 Total connections generated: 1407
n:1024 Total connections generated: 3277
n:2048 Total connections generated: 7179
n:4096 Total connections generated: 17524
n:8192 Total connections generated: 34683
n:16384 Total connections generated: 75346

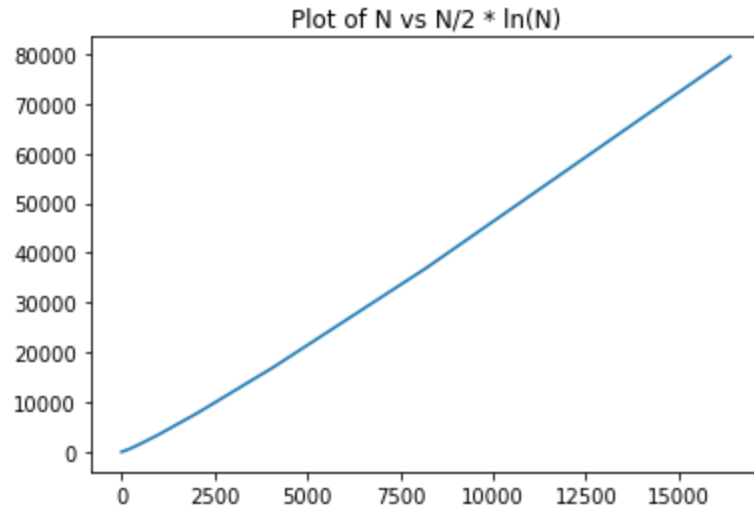
Process finished with exit code 0
```

2. Graphical Representation:

Number of objects (N)	Number of Pairs Generated (m)
8	10
16	31
32	83
64	133
128	357
256	716
512	1407
1024	3277
2048	7179
4096	17524
8192	34683
16384	75346

Plot of Number of Objects(n) vs Number of Pairs Generated(m)





- **Unit Tests Results:**

