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Program Structures & Algorithms

Fall 2021

Assignment No. 3

◉ **Task (List down the tasks performed in the Assignment)**

1. Implement height-weighted Quick Union with Path Compression
2. 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.
3. Determine the relationship between the number of objects (n) and the number of pairs (m)

◉ **Relationship Conclusion:**

$$m = \frac{1}{2}n \ln n$$

◉ **Evidence to support the conclusion:**

1. **Output**

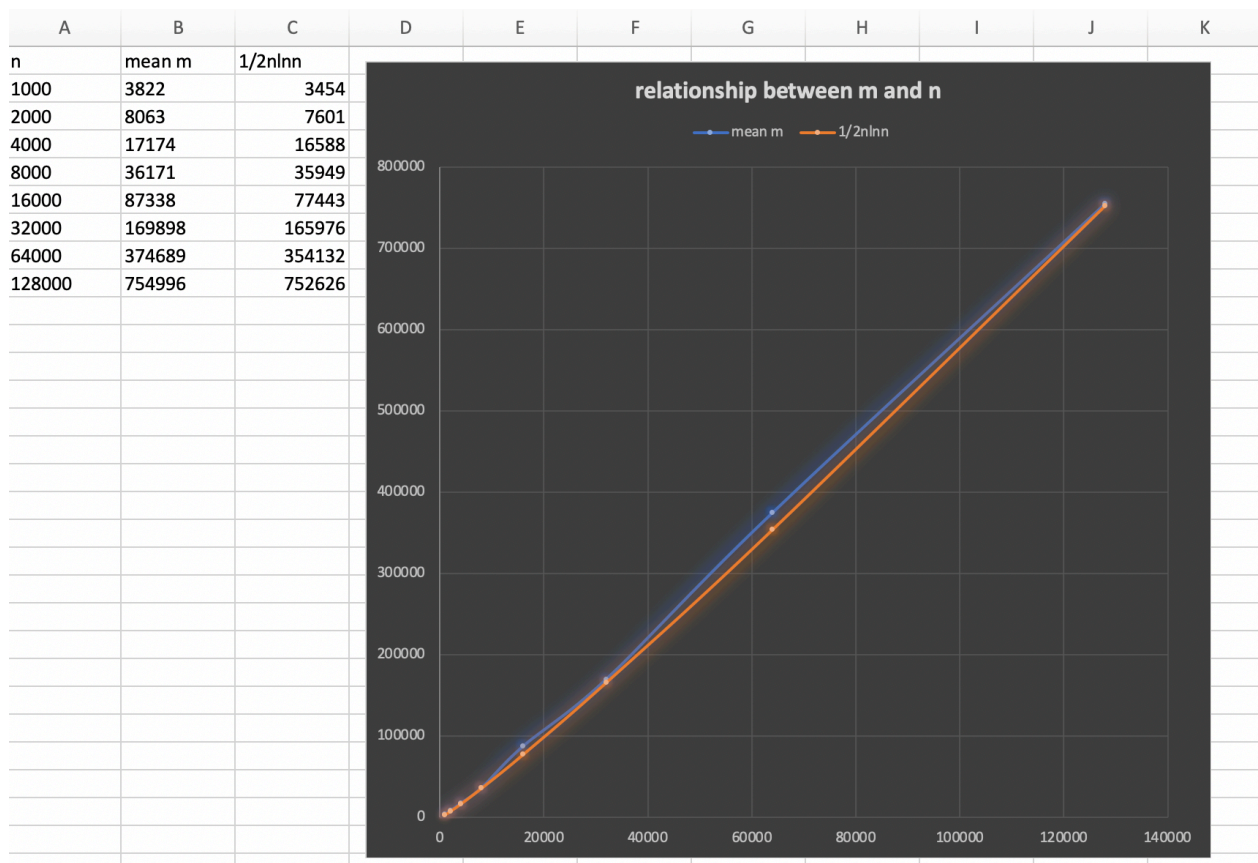
Run main program in `UFClient.java` and. Firstly, we can input a number from the command line to test the `count()` method. Sec-

only, we can run more n values and make their values bigger using doubling method, each with 10 times to test the relationship between m and n.

```
Run: UFCClient x
/Library/Java/JavaVirtualMachines/jdk1.8.0_181.jdk/Contents/Home/bin/java ...
please enter a number from the command line (eg. 100)
100
the number of objects is 100, and the number of connections is 226
part 3, test the relationship between m and n
the number of objects is 1000, and the number of pairs is 3822
the number of objects is 2000, and the number of pairs is 8063
the number of objects is 4000, and the number of pairs is 17174
the number of objects is 8000, and the number of pairs is 36171
the number of objects is 16000, and the number of pairs is 87338
the number of objects is 32000, and the number of pairs is 169898
the number of objects is 64000, and the number of pairs is 374689
the number of objects is 128000, and the number of pairs is 754996

Process finished with exit code 0
```

2. Graphical Representation



x-axis means n (the number of objects), blue line means 10 times mean random pairs of m and orange line means the function I assumed. We can find that two lines are similar, so $m = \frac{1}{2}n \ln n$.

◉ Unit tests result:

