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# Program Structures & Algorithms

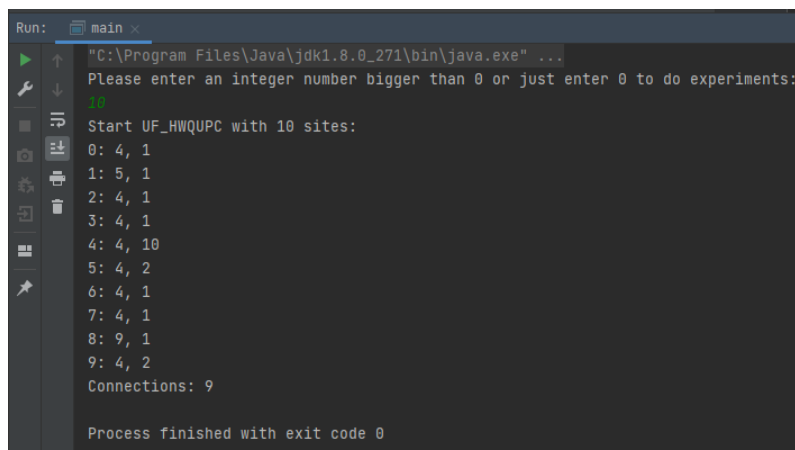
## Assignment NO.3

### 1. Task

- Implement height-weighted Quick Union with Path Compression in the class called UF\_HWQUPC.
- Develop a UF client using UF\_HWQUPC by requirements.
- Determine the relationship between the number of objects (n) and the number of pairs (m) from those experiments.

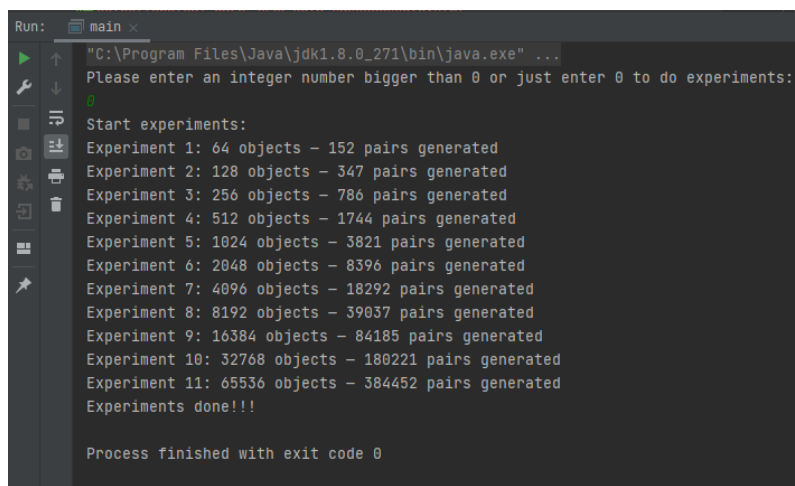
### 2. Output

- Take an integer value from command line to do a UF\_HWQUPC:



```
Run: main x
"C:\Program Files\Java\jdk1.8.0_271\bin\java.exe" ...
Please enter an integer number bigger than 0 or just enter 0 to do experiments:
10
Start UF_HWQUPC with 10 sites:
0: 4, 1
1: 5, 1
2: 4, 1
3: 4, 1
4: 4, 10
5: 4, 2
6: 4, 1
7: 4, 1
8: 9, 1
9: 4, 2
Connections: 9
Process finished with exit code 0
```

- Doing experiments (n from 64 to 65536) and 1000-times running of each n:



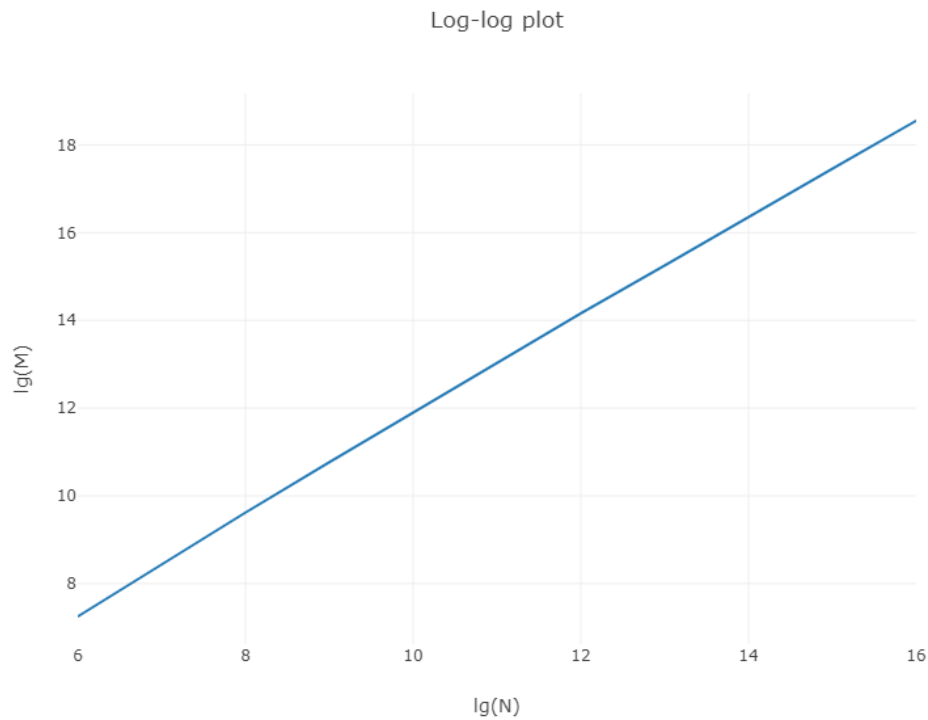
```
Run: main x
"C:\Program Files\Java\jdk1.8.0_271\bin\java.exe" ...
Please enter an integer number bigger than 0 or just enter 0 to do experiments:
0
Start experiments:
Experiment 1: 64 objects - 152 pairs generated
Experiment 2: 128 objects - 347 pairs generated
Experiment 3: 256 objects - 786 pairs generated
Experiment 4: 512 objects - 1744 pairs generated
Experiment 5: 1024 objects - 3821 pairs generated
Experiment 6: 2048 objects - 8396 pairs generated
Experiment 7: 4096 objects - 18292 pairs generated
Experiment 8: 8192 objects - 39837 pairs generated
Experiment 9: 16384 objects - 84185 pairs generated
Experiment 10: 32768 objects - 180221 pairs generated
Experiment 11: 65536 objects - 384452 pairs generated
Experiments done!!!
Process finished with exit code 0
```

### 3. Relationship Conclusion

$$N \propto M$$

### 4. Evidence to support the conclusion:

- Chart



- Table

lg(N)	lg(M)	N	M
6	7.247928	64	152
7	8.438792	128	347
8	9.618386	256	786
9	10.76818	512	1744
10	11.89973	1024	3821
11	13.03549	2048	8396
12	14.15893	4096	18292
13	15.25255	8192	39037
14	16.36128	16384	84185
15	17.45941	32768	180221
16	18.55244	65536	384452

As chart and table shown above, the slope of line in log-log plot and results in table indicate that N has a linear relationship with M.

## 5. Unit test result

