

Program Structures and Algorithms Spring 2024

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GITHUB LINK: <https://github.com/Nangongnuanshan/INFO6205>

Task: Assignment 4

Relationship Conclusion:

The data indicates that as the number of sites n increases, the number of connections m required to connect all sites also increases. This increase is not merely linear; the growth rate of m surpasses linear growth, suggesting a super-linear relationship.

I think $\log m = a * \log n$. a is about 1.1.

Evidence to support that conclusion:

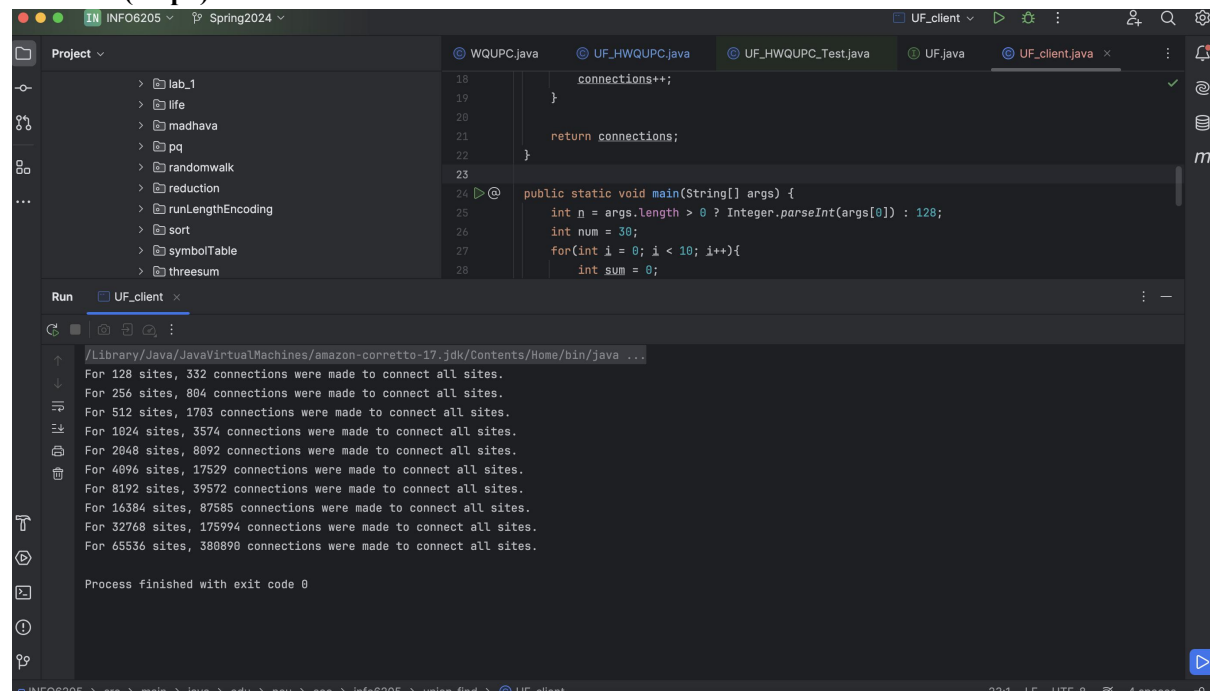
Calculating the slope between $\log(m)$ and $\log(n)$ for different data points revealed fluctuations around 1.1, implying a possible logarithmic relationship between m and n .

Specifically, m appears to be a power function of n , where the power value is close to 1.1.

This means, while the growth rate of m exceeds linear growth with n , it is moderated and does not reach exponential levels.

The linear relationship between $\log(m)$ and $\log(n)$ suggests that although the growth rate of m exceeds linear growth with n , this growth is controlled and does not escalate uncontrollably with increases in n . This can be attributed to the use of height-weighted quick union and path compression optimization techniques in the union-find algorithm, which significantly improve operational efficiency, maintaining high performance even on large datasets.

UF-client(Step2):



The screenshot shows an IDE with a project named 'INFO6205' and a file named 'UF_client.java'. The code in 'UF_client.java' is as follows:

```
18         connections++;
19     }
20
21     return connections;
22 }
23
24 public static void main(String[] args) {
25     int n = args.length > 0 ? Integer.parseInt(args[0]) : 128;
26     int num = 30;
27     for(int i = 0; i < 10; i++){
28         int sum = 0;
```

The 'Run' window shows the output of the program:

```
For 128 sites, 332 connections were made to connect all sites.
For 256 sites, 804 connections were made to connect all sites.
For 512 sites, 1703 connections were made to connect all sites.
For 1024 sites, 3574 connections were made to connect all sites.
For 2048 sites, 8092 connections were made to connect all sites.
For 4096 sites, 17529 connections were made to connect all sites.
For 8192 sites, 39572 connections were made to connect all sites.
For 16384 sites, 87585 connections were made to connect all sites.
For 32768 sites, 175994 connections were made to connect all sites.
For 65536 sites, 380890 connections were made to connect all sites.

Process finished with exit code 0
```

Unit Test Screenshots:

