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PROGRAM STRUCTURES AND ALGORITHMS
FALL 2021
ASSIGNMENT NO. 3

Task

- Implement *Height Weighted Quick Union with Path Compression* from the repository.
- Using this implementation, develop a UF Client that takes an integer value 'n' from the command line. Generate random pairs of integers between 0 and n-1, check if connected and perform union if not. This shall continue till the total number of components is 1 *i.e.* until all the sites are connected.
- Deduce a relationship between the total number of pairs generated to connect all the sites **'m'** and the total number of sites **'n'**.

Relationship Conclusion

On observing the results and using tools to understand the graph pattern, it can be concluded that the relationship between M and N is:
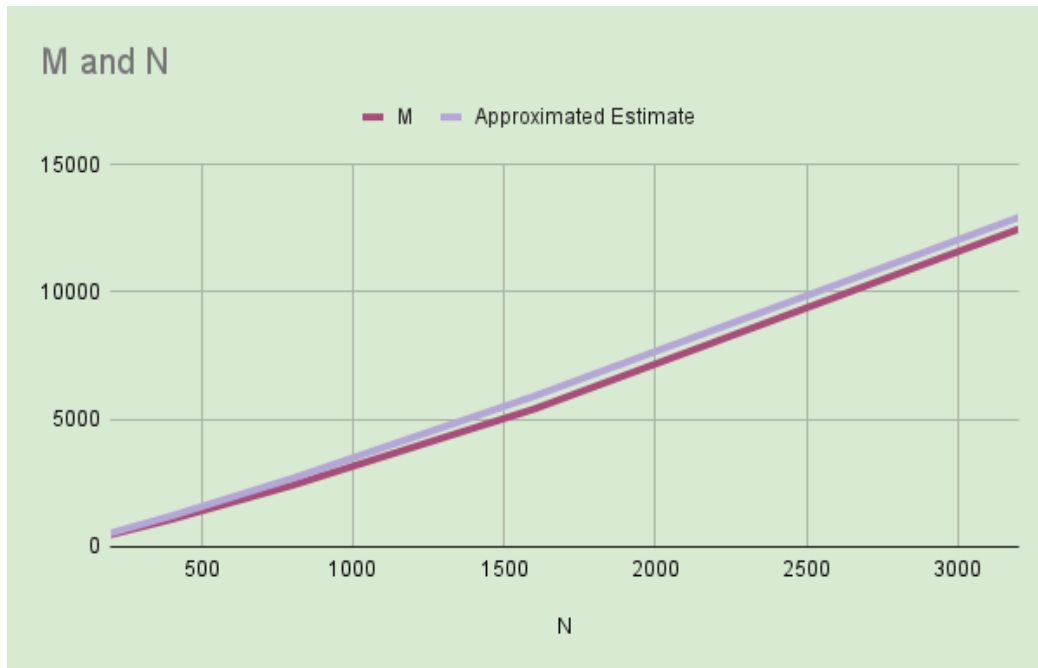
$$\frac{1}{2} N \ln N$$

Evidence

Table of Values From the Experiments

N	M	Estimated
200	467	529
400	1066	1198
800	2402	2673
1600	5399	5902
3200	12457	12913

Graph of Expected and Actual Values of M vs N

Unit Tests for UF_HWQUPC

UF Client Execution

```
Run:    UF_Client ×
  ▶  ↑    /Users/poojithakonduparti/Library/Java/JavaVirtualMachines/openjdk-16.0.2/Contents/Home/bin/java ...
  ⚒  ↓    Enter the number of sites n:
  ■  ⇥
  ⬚  ⬚    400
  ◎        Number of pairs generated in order to connect all sites: 1066
  🖶
  ⬚  🗑
           Process finished with exit code 0

  ⊞
  ★
   ⚘ Git  ⚲ Find  ▶ Run  ☰ TODO  ❶ Problems  ⊠ Terminal  🔧 Build  ❧ Dependencies              ❶ Event Log
```

```
Run:    UF_Client ×
  ▶  ↑    /Users/poojithakonduparti/Library/Java/JavaVirtualMachines/openjdk-16.0.2/Contents/Home/bin/java ...
  ⚒  ↓    Enter the number of sites n:
  ■  ⇥
  ⬚  ⬚    800
  ◎        Number of pairs generated in order to connect all sites: 2402
  🖶
  ⬚  🗑
           Process finished with exit code 0

  ⊞
  ★
   ⚘ Git  ⚲ Find  ▶ Run  ☰ TODO  ❶ Problems  ⊠ Terminal  🔧 Build  ❧ Dependencies              ❶ Event Log
```

```
Run:    UF_Client ×
  ▶  ↑    /Users/poojithakonduparti/Library/Java/JavaVirtualMachines/openjdk-16.0.2/Contents/Home/bin/java ...
  ⚒  ↓    Enter the number of sites n:
  ■  ⇥
  ⬚  ⬚    1600
  ◎        Number of pairs generated in order to connect all sites: 5399
  🖶
  ⬚  🗑
           Process finished with exit code 0
           |
  ⊞
  ★
   ⚘ Git  ⚲ Find  ▶ Run  ☰ TODO  ❶ Problems  ⊠ Terminal  🔧 Build  ❧ Dependencies              ❶ Event Log
```

```
Run:    UF_Client ×
  ▶  ↑    /Users/poojithakonduparti/Library/Java/JavaVirtualMachines/openjdk-16.0.2/Contents/Home/bin/java ...
  ⚒  ↓    Enter the number of sites n:
  ■  ⇥
  ⬚  ⬚    3200
  ◎        Number of pairs generated in order to connect all sites: 12457
  🖶
  ⬚  🗑
           Process finished with exit code 0

  ⊞
  ★
   ⚘ Git  ⚲ Find  ▶ Run  ☰ TODO  ❶ Problems  ⊠ Terminal  🔧 Build  ❧ Dependencies              ❶ Event Log
```