Program Structures and Algorithms
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GITHUB LINK: https://github.com/suchitadabir/INFO6205

Task
Determine the relationship between the number of objects (n) and the number of pairs (m) generated to accomplish to reduce the number of components from n to 1.

Conclusion
There exists a linear relationship between the number of objects (n) and the number of pairs (m) generated. Hence, HWQUPC is linear.

Evidence to support that conclusion:

- I created UFClient class which uses implemented UF_HWQUPC class methods to count the no. of pairs to connect all sites.
- The UFClient use the connected method to check if pairs are already connected, and if not, it uses the union method to connect them.
- I took 20 different values of n and generated random pairs of values between 0 and n-1.
- Using this client, I have exported the data having the number of objects along with the count of pairs made into a file viz. UFClientData.csv.
- Data is as follows:

n – No. of Objects	m – No. of Pairs
10	9
30	29
60	59
100	99
150	149
200	199
400	399
800	799
1600	1599
1700	1699
3200	3199
5200	5199
6400	6399
12800	12799
25600	25599
45600	45599
51200	51199
102400	102399
204800	204799
604800	604799

- Each pair significantly contributed to reducing the overall component count.
- Hence, experiments suggest that as n increases, m seems to grow approximately linearly.
- I wrote a simple python script to plot m i.e. no. of pairs along Y-axis and n i.e. no. of objects across X-axis. Below plotted graph shows the relationship between n & m.

Relationship between number of objects (n) and number of pairs (m)
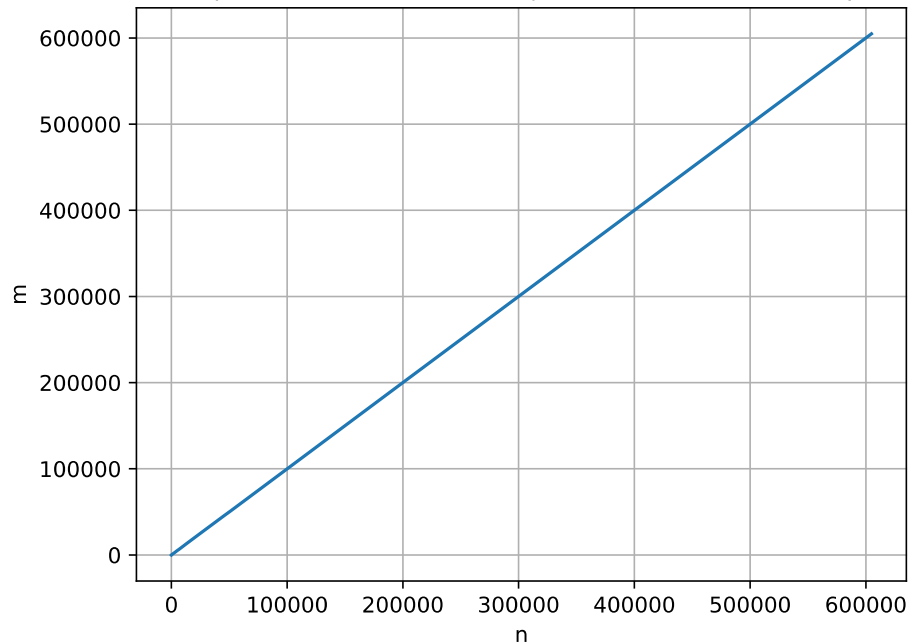
Unit Test Screenshots

UF_HWQUPC_Test– 13 of 13 tests passed.