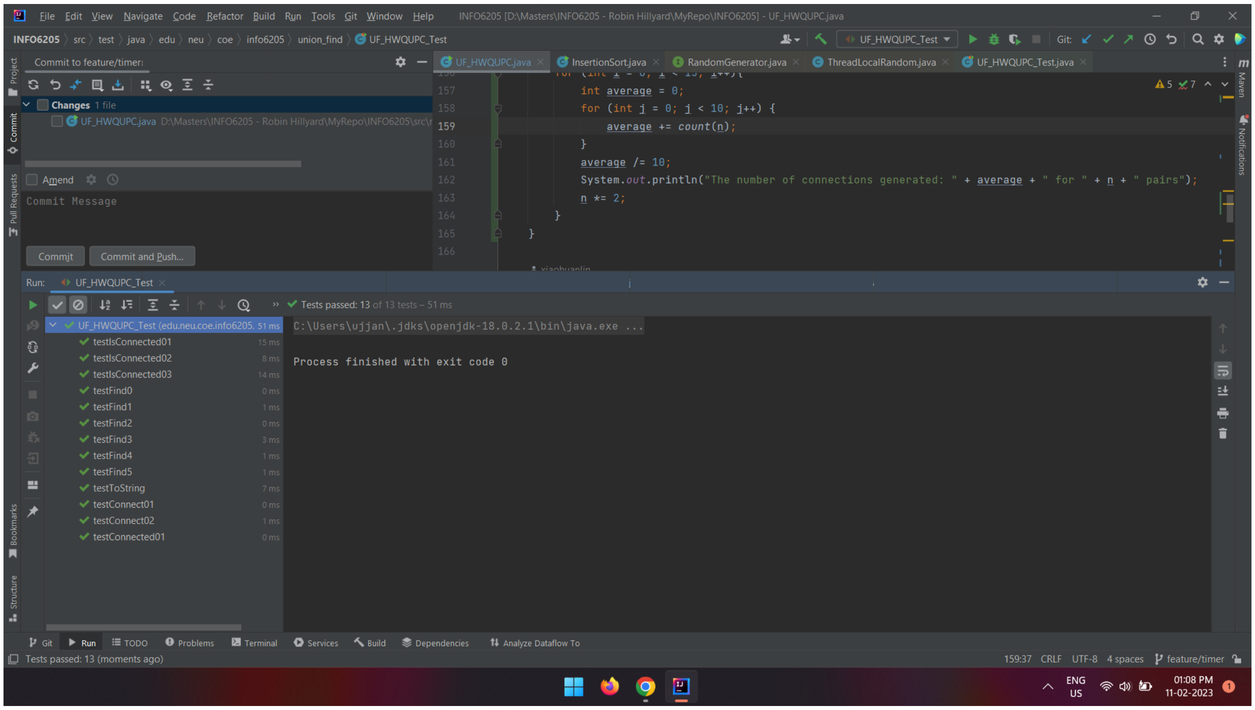
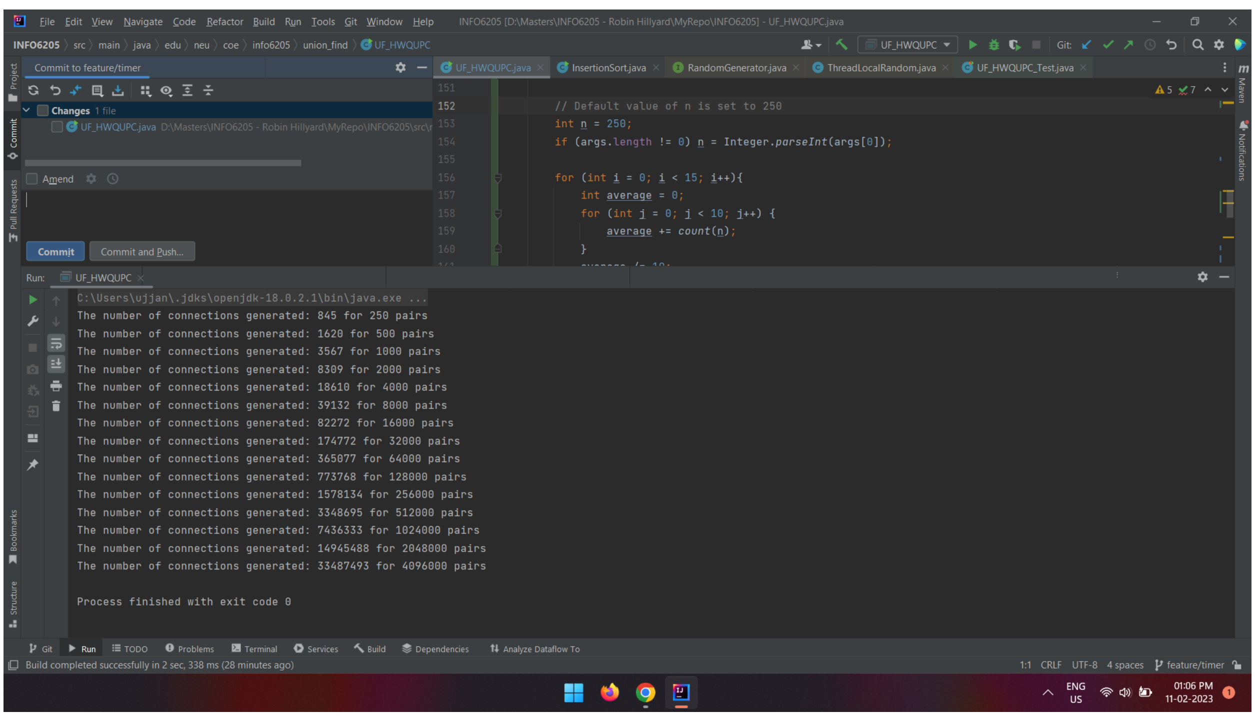
Part 1


INFO6205 [D:\Masters\INFO6205 - Robin Hillyard\MyRepo\INFO6205] - UF_HWQUPC.java
Commit to feature/timer
Changes 1 file
UF_HWQUPC.java D:\Masters\INFO6205 - Robin Hillyard\MyRepo\INFO6205\src\
Amend
Commit Message
Commit
Commit and Push...
int average = 0;
for (int j = 0; j < 10; j++) {
average += count(n);
}
average /= 10;
System.out.println("The number of connections generated: " + average + " for " + n + " pairs");
n *= 2;
}
}
Run: UF_HWQUPC_Test
Tests passed: 13 of 13 tests – 51 ms
UF_HWQUPC_Test (edu.neu.coe.info6205. 51 ms
testIsConnected01 15 ms
testIsConnected02 8 ms
testIsConnected03 14 ms
testFind0 0 ms
testFind1 1 ms
testFind2 0 ms
testFind3 3 ms
testFind4 1 ms
testFind5 1 ms
testToString 7 ms
testConnect01 0 ms
testConnect02 1 ms
testConnected01 0 ms
C:\Users\ujjan\.jdks\openjdk-18.0.2.1\bin\java.exe ...
Process finished with exit code 0
Tests passed: 13 (moments ago)
159:37 CRLF UTF-8 4 spaces feature/timer
01:08 PM
11-02-2023

Part 2

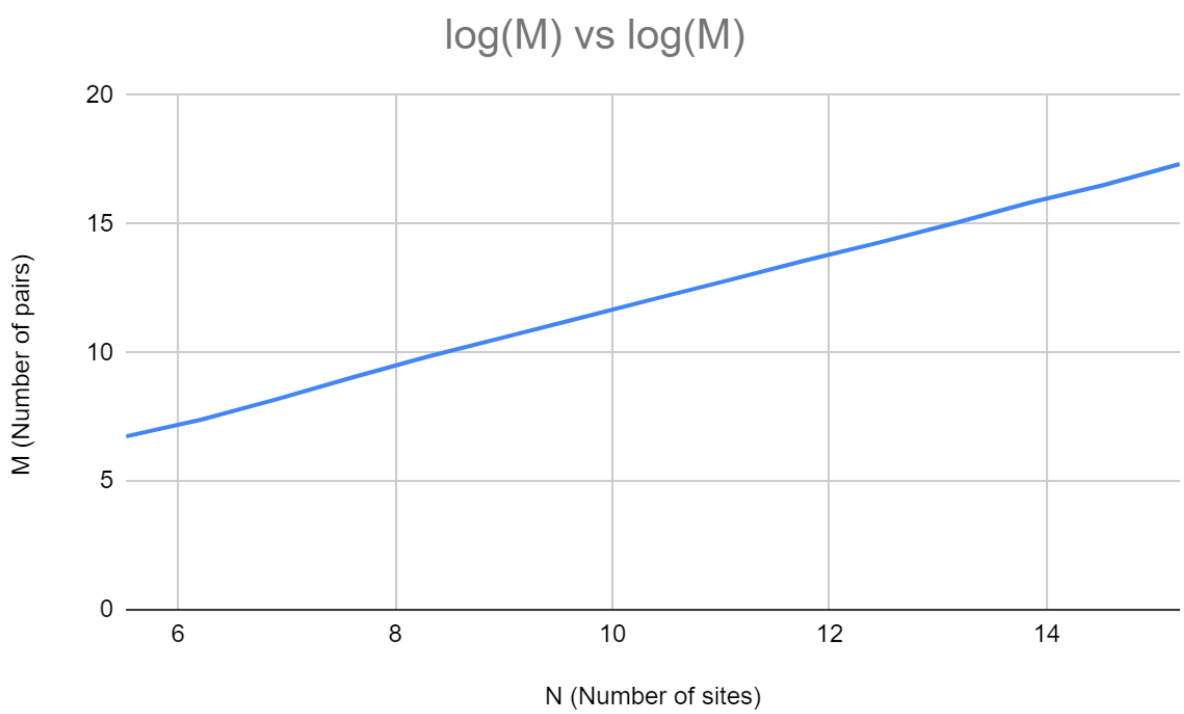

INFO6205 [D:\Masters\INFO6205 - Robin Hillyard\MyRepo\INFO6205] - UF_HWQUPC.java
Commit to feature/timer
Changes 1 file
UF_HWQUPC.java D:\Masters\INFO6205 - Robin Hillyard\MyRepo\INFO6205\src\
Amend
Commit
Commit and Push...
// Default value of n is set to 250
int n = 250;
if (args.length != 0) n = Integer.parseInt(args[0]);
for (int i = 0; i < 15; i++){
int average = 0;
for (int j = 0; j < 10; j++) {
average += count(n);
}
Run: UF_HWQUPC
C:\Users\ujjan\.jdks\openjdk-18.0.2.1\bin\java.exe ...
The number of connections generated: 845 for 250 pairs
The number of connections generated: 1620 for 500 pairs
The number of connections generated: 3567 for 1000 pairs
The number of connections generated: 8309 for 2000 pairs
The number of connections generated: 18610 for 4000 pairs
The number of connections generated: 39132 for 8000 pairs
The number of connections generated: 82272 for 16000 pairs
The number of connections generated: 174772 for 32000 pairs
The number of connections generated: 365077 for 64000 pairs
The number of connections generated: 773768 for 128000 pairs
The number of connections generated: 1578134 for 256000 pairs
The number of connections generated: 3348695 for 512000 pairs
The number of connections generated: 7436333 for 1024000 pairs
The number of connections generated: 14945488 for 2048000 pairs
The number of connections generated: 33487493 for 4096000 pairs
Process finished with exit code 0
Build completed successfully in 2 sec, 338 ms (28 minutes ago)
1:1 CRLF UTF-8 4 spaces feature/timer
01:06 PM
11-02-2023

Part 3

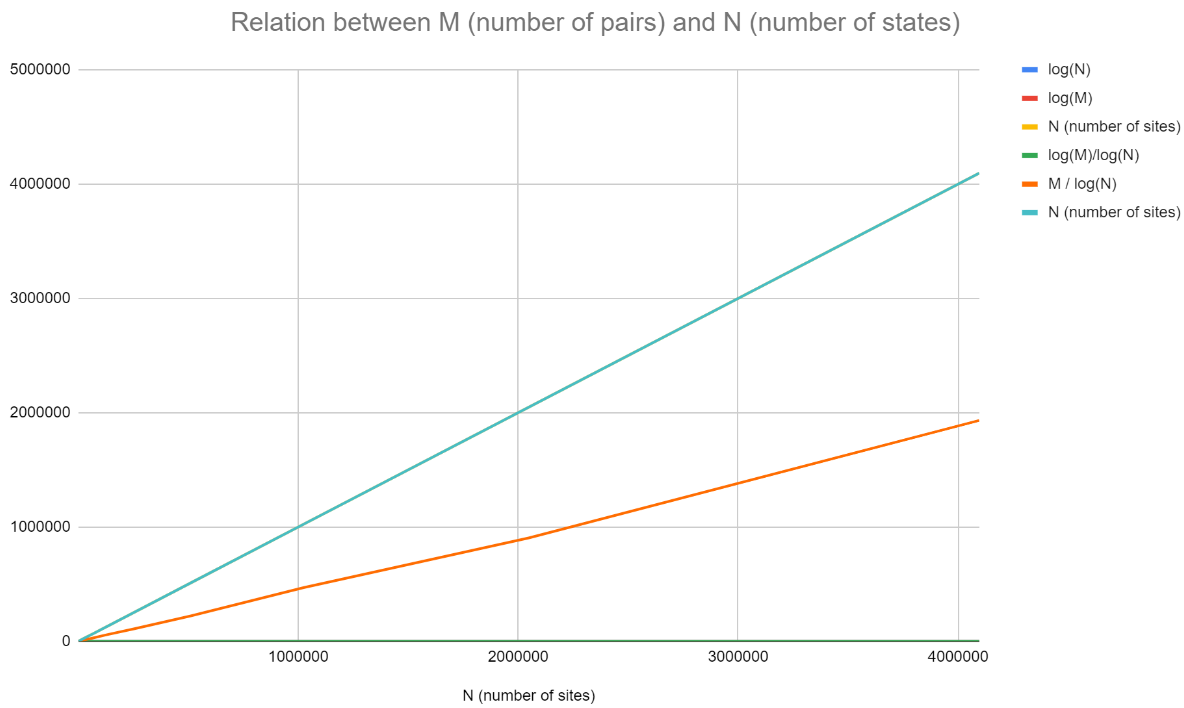
The values of the number of pairs needed ‘M’, for each size of the array ‘N’ along with the ‘log(N)’, ‘log(M)’ and ‘log(M)/log(N)’ values are shown in the table below.

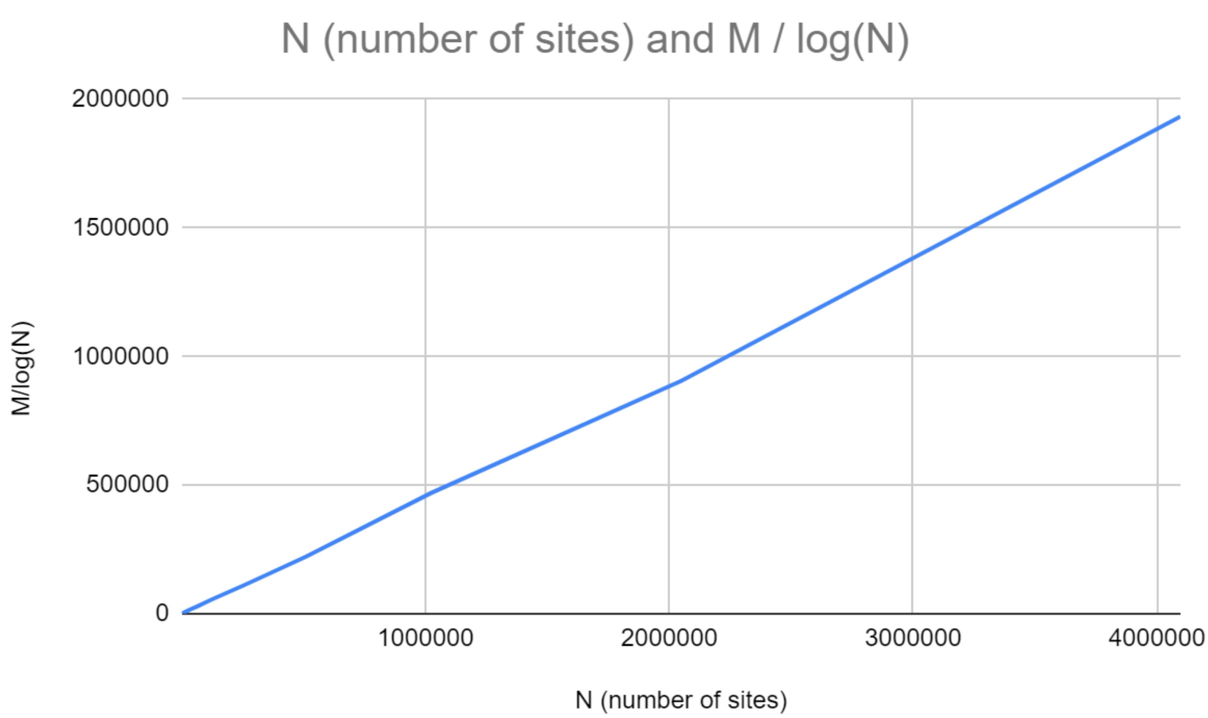
N (number of sites)	M (number of pairs generated)	log(N)	log(M)	N (number of si	log(M)/log(N)	M / log(N)	(M*2.15) / log(N)	(M / log(N))/(N)
250	845	5.521460918	6.739336627	250	1.220571281	125.3832605	269.5740101	0.501533042
500	1620	6.214608098	7.390181428	500	1.189162906	219.2097739	471.3010139	0.4384195478
1000	3567	6.907755279	8.179480185	1000	1.184101036	436.091282	937.5962563	0.436091282
2000	8309	7.60090246	9.025094544	2000	1.187371446	920.6551754	1979.408627	0.4603275877
4000	18610	8.29404964	9.83145435	4000	1.185362371	1892.904075	4069.743761	0.4732260187
8000	39132	8.987196821	10.57469583	8000	1.176640062	3700.531972	7956.14374	0.4625664965
16000	82272	9.680344001	11.31778611	16000	1.169151231	7269.266197	15628.92232	0.4543291373
32000	174772	10.37349118	12.07123755	32000	1.163662005	14478.38296	31128.52336	0.4524494675
64000	365077	11.06663836	12.80786357	64000	1.15734003	28504.12936	61283.87812	0.4453770212
128000	773768	11.75978554	13.55902737	128000	1.152999544	57066.63016	122693.2548	0.4458330481
256000	1578134	12.45293272	14.27175369	256000	1.146055633	110577.4409	237741.4978	0.4319431283
512000	3348695	13.1460799	15.02408128	512000	1.142856379	222888.504	479210.2837	0.4353291094
1024000	7436333	13.83922708	15.82188841	1024000	1.143263877	470002.8725	1010506.176	0.4589871801
2048000	14945488	14.53237427	16.51992001	2048000	1.13676676	904694.9376	1945094.116	0.441745575
4096000	33487493	15.22552145	17.32668258	4096000	1.138002573	1932712.326	4155331.501	0.4718535952

The plot of the relationship between ‘M’ and ‘N’ is shown below. The slope of the same is shown in the table above in the form of log(M) / log(N). This shows that it is not a quadratic graph. This means that it could be a linear relationship or anything greater than a linear relationship but less than a quadratic relationship. Since the value is more than 1, there are high chances of it being a logarithmic relationship of the kind N log (N) as this kind of relationship is greater than N but less than N^2.



We can consider the relationship to be N = kM where k is a constant. If M is a relation that is logarithmic, then dividing by log(N) would leave a value where this value could range from 1 to N times a constant value.



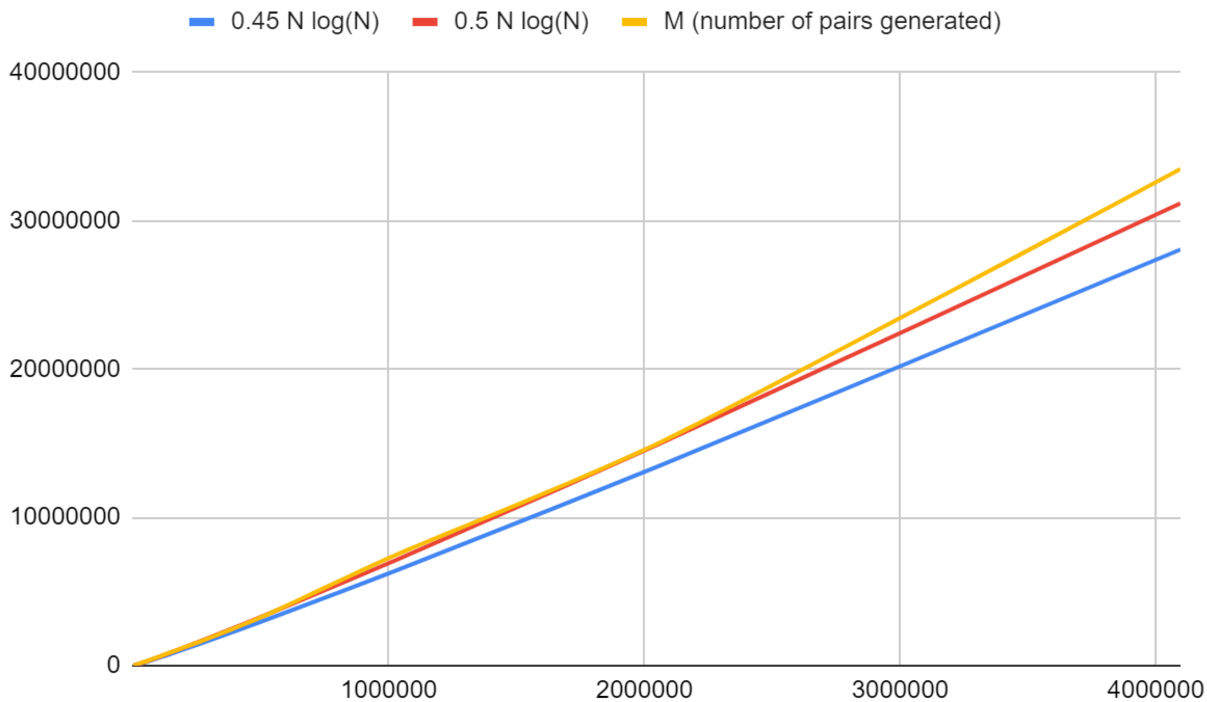


Dividing M by log(N) and plotting, we see that the value seems to be rising in a linear fashion proportional to N. If the slope of this is 1, that is if log(N) / log(M/log(N)), we can state that it is a linear expression. Furthermore, we can state that the equation also differs by a value of N, indicating that it is proportional to k N log N where k is a constant value.

log(N) / log(M/log(N))
1.097554485
1.117076523
1.105800742
1.086335542
1.074927415
1.07259931
1.069924525
1.065917419
1.063698037
1.059980475
1.059842323
1.056083275
1.048872756
1.049758448
1.042579039

We can see that it is increasing by 1, so it is a linear equation. To get the constant value it is different from, we can take the slope of log(N) vs log(M/log(N)) and average it. The values in the above table shows that it seems like a constant value that averages to ~ 0.45.
Using all this information, we could estimate that the M is going to be proportional to N and log(N) with a constant value. So, the relationship we can conclude is:
M ~ 0.45 N log(N)

We could verify the relationship by plotting M and 0.45 N log(N) to that of N.



The chart shows that the values match with the expectation more. The constant value of 0.5 matches more with M than the value of 0.45. We could based on the graph conclude that the relationship is ~ **0.45 N log(N)**