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Program Structures & Algorithms

Fall 2021

Assignment No. 3

- **Task**

  There are three parts of overall tasks:

  1. **Implement height-weighted Quick Union with Path Compression and check the unit tests.**
  2. **Use implementation of UF_HWQUPC, develop a UF ("union-find") client that takes an integer value n from the command line to determine the number of "sites." Then generates random pairs of integers between 0 and n-1, calling connected() to determine if they are connected and union() if not. Loop until all sites are connected then print the number of connections generated. Package the program as a static method count() that takes n as the argument and returns the number of connections; and a main() that takes n from the command line, calls count() and prints the returned value. Show evidence of the run(s)**
  3. **Determine the relationship between the number of objects (*n*) and the number of pairs (*m*) generated to accomplish this.**

- **Relationship Conclusion:**

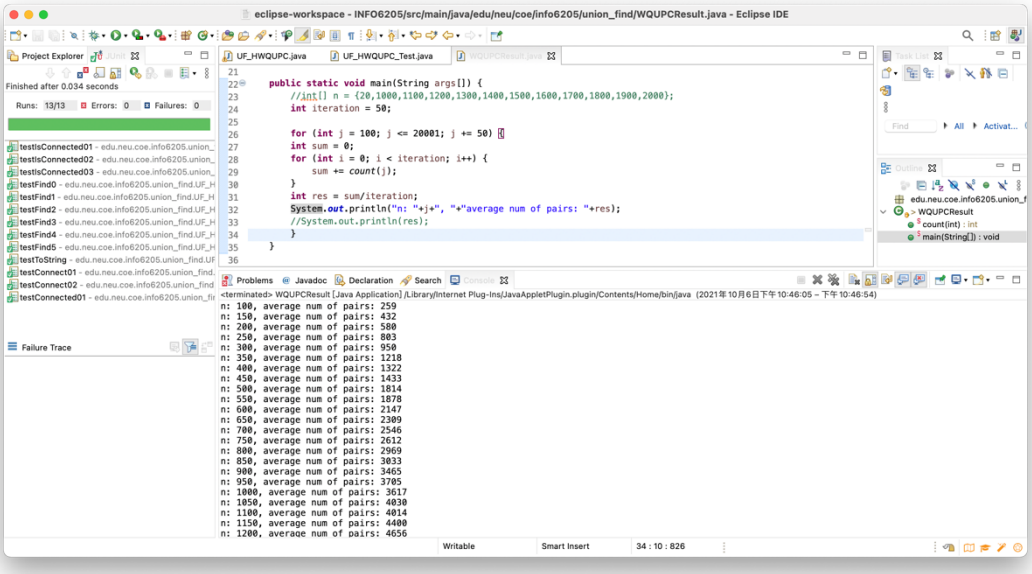
  1. **The relationship between N and M is linear.**

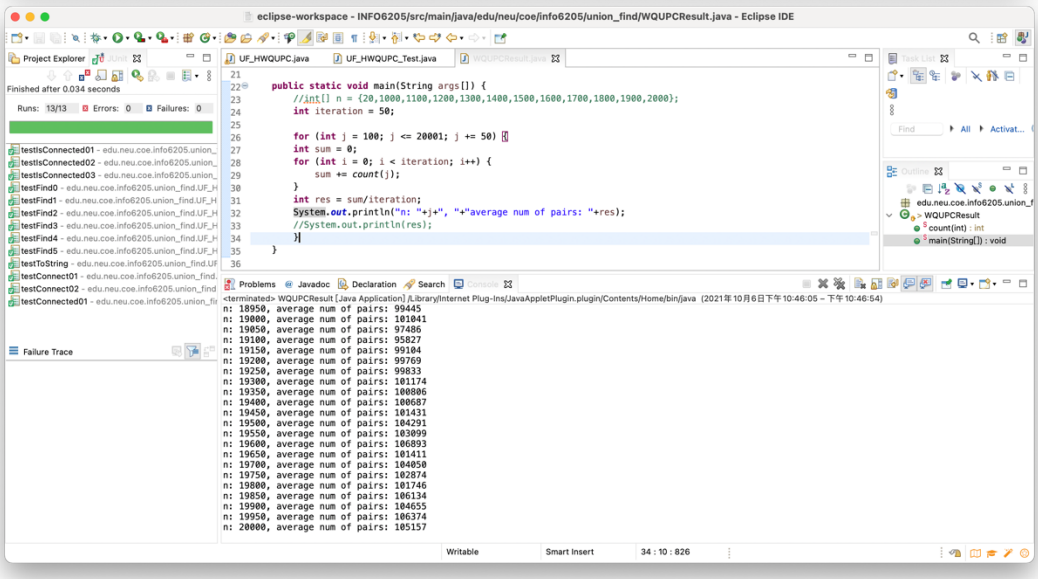
2. **The observed line approaches $\frac{1}{2}Nln(N)$. So, I think the relationship between two variables is $\frac{1}{2}Nln(N)$.**

- **Evidence to support the conclusion:**

1. **Output**

N is set from 100 to 20000 where the interval is 50, thus there are total 399 returned values. As it's hard to show all of 399 values here, only head and tail are shown up. For details, please check Assignment 3 result.xlsx within the Assignment 3 file.

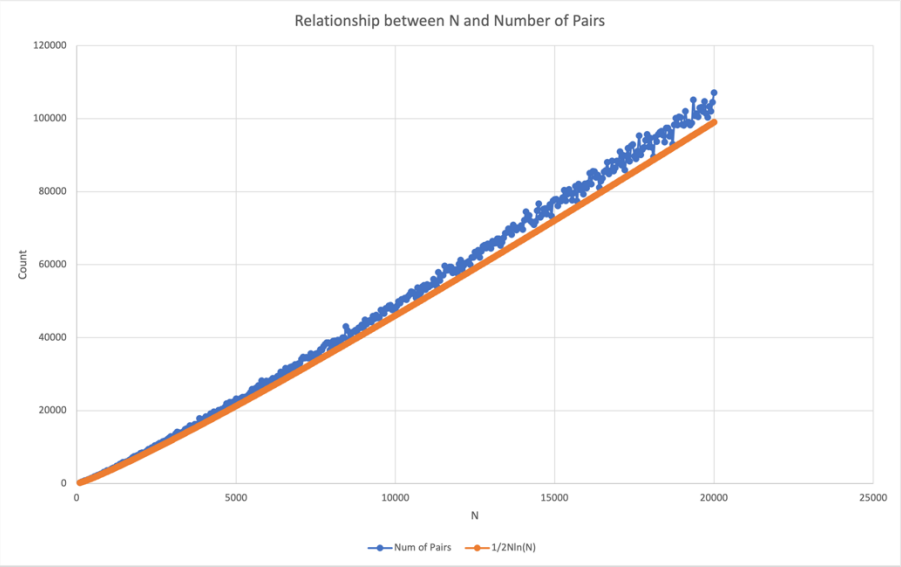




2. Graphical Representation

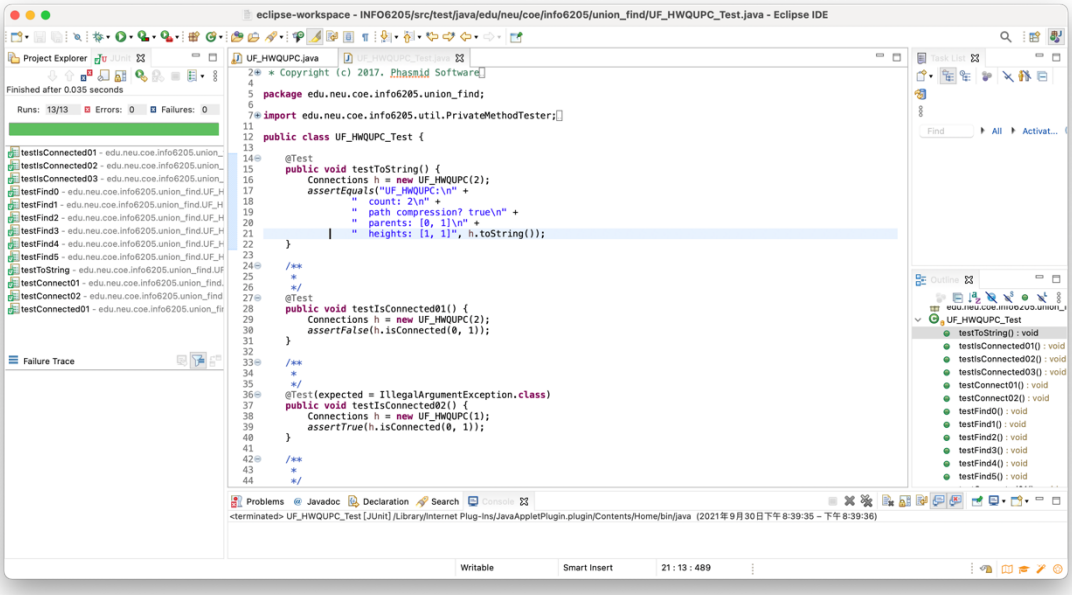
The graph observed with samples (details are in Assignment 3 result.xlsx):

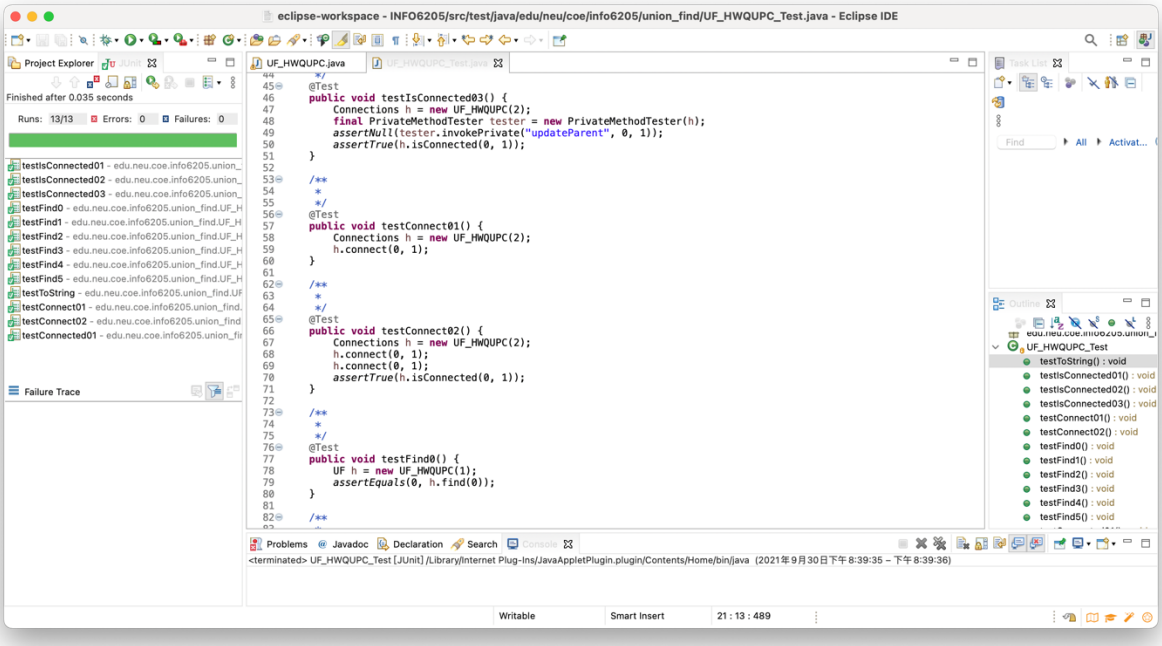
N	Num of Pairs	1/2Nln(N)
2050	8485	7816.23495
2100	8138	8032.17725
2150	8636	8248.71486
2200	9023	8465.8339



- **Unit tests result:**

UF_HWQUPC_Test are passed and none of code is modified:




eclipse-workspace - INFO6205/src/test/java/edu/neu/coe/info6205/union_find/UF_HWQUPC_Test.java - Eclipse IDE
Project Explorer
Finished after 0.035 seconds
Runs: 13/13 Errors: 0 Failures: 0
testIsConnected01 - edu.neu.coe.info6205.union_
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testToString - edu.neu.coe.info6205.union_find.UF
testConnect01 - edu.neu.coe.info6205.union_find.
testConnect02 - edu.neu.coe.info6205.union_find
testConnected01 - edu.neu.coe.info6205.union_fi
Failure Trace
UF_HWQUPC.java
UF_HWQUPC_Test.java
45 @Test
46 public void testIsConnected03() {
47 Connections h = new UF_HWQUPC(2);
48 final PrivateMethodTester tester = new PrivateMethodTester(h);
49 assertNull(tester.invokePrivate("updateParent", 0, 1));
50 assertTrue(h.isConnected(0, 1));
51 }
52
53 /**
54 *
55 */
56 @Test
57 public void testConnect01() {
58 Connections h = new UF_HWQUPC(2);
59 h.connect(0, 1);
60 }
61
62 /**
63 *
64 */
65 @Test
66 public void testConnect02() {
67 Connections h = new UF_HWQUPC(2);
68 h.connect(0, 1);
69 h.connect(0, 1);
70 assertTrue(h.isConnected(0, 1));
71 }
72
73 /**
74 *
75 */
76 @Test
77 public void testFind0() {
78 UF h = new UF_HWQUPC(1);
79 assertEquals(0, h.find(0));
80 }
81
82 /**
Outline
UF_HWQUPC_Test
testToString() : void
testIsConnected01() : void
testIsConnected02() : void
testIsConnected03() : void
testConnect01() : void
testConnect02() : void
testFind0() : void
testFind1() : void
testFind2() : void
testFind3() : void
testFind4() : void
testFind5() : void
Problems Javadoc Declaration Search Console
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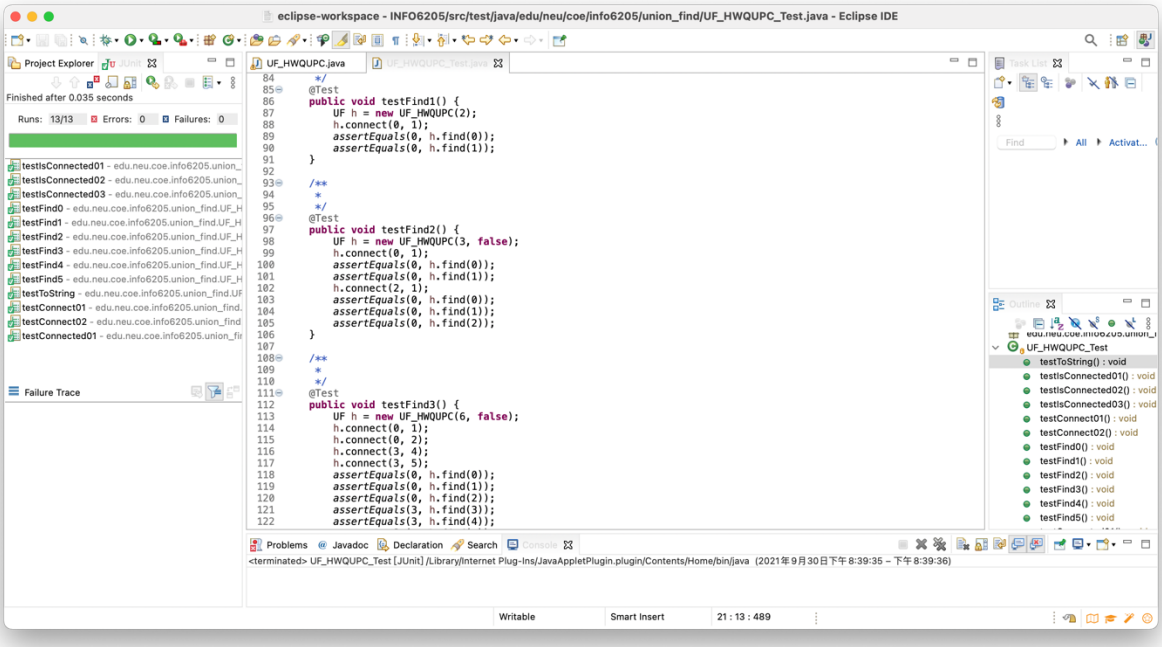
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Failure Trace
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UF_HWQUPC_Test.java
84 */
85 @Test
86 public void testFind1() {
87 UF h = new UF_HWQUPC(2);
88 h.connect(0, 1);
89 assertEquals(0, h.find(0));
90 assertEquals(0, h.find(1));
91 }
92
93 /**
94 *
95 */
96 @Test
97 public void testFind2() {
98 UF h = new UF_HWQUPC(3, false);
99 h.connect(0, 1);
100 assertEquals(0, h.find(0));
101 assertEquals(0, h.find(1));
102 h.connect(2, 1);
103 assertEquals(0, h.find(0));
104 assertEquals(0, h.find(1));
105 assertEquals(0, h.find(2));
106 }
107
108 /**
109 *
110 */
111 @Test
112 public void testFind3() {
113 UF h = new UF_HWQUPC(6, false);
114 h.connect(0, 1);
115 h.connect(0, 2);
116 h.connect(3, 4);
117 h.connect(3, 5);
118 assertEquals(0, h.find(0));
119 assertEquals(0, h.find(1));
120 assertEquals(0, h.find(2));
121 assertEquals(3, h.find(3));
122 assertEquals(3, h.find(4));
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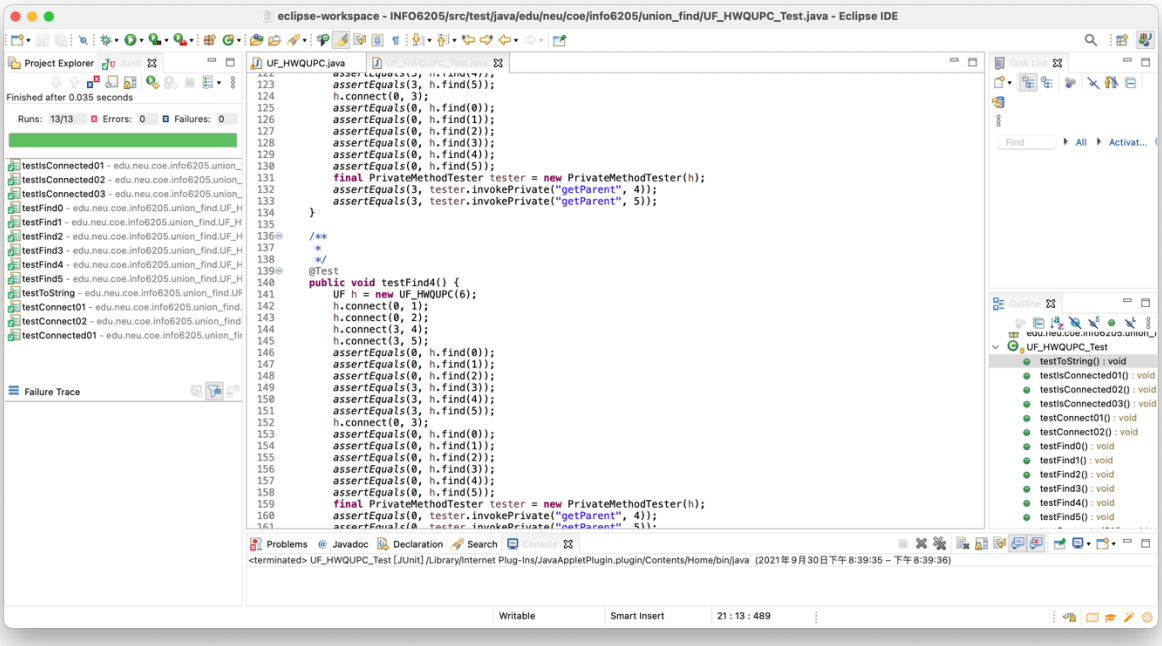
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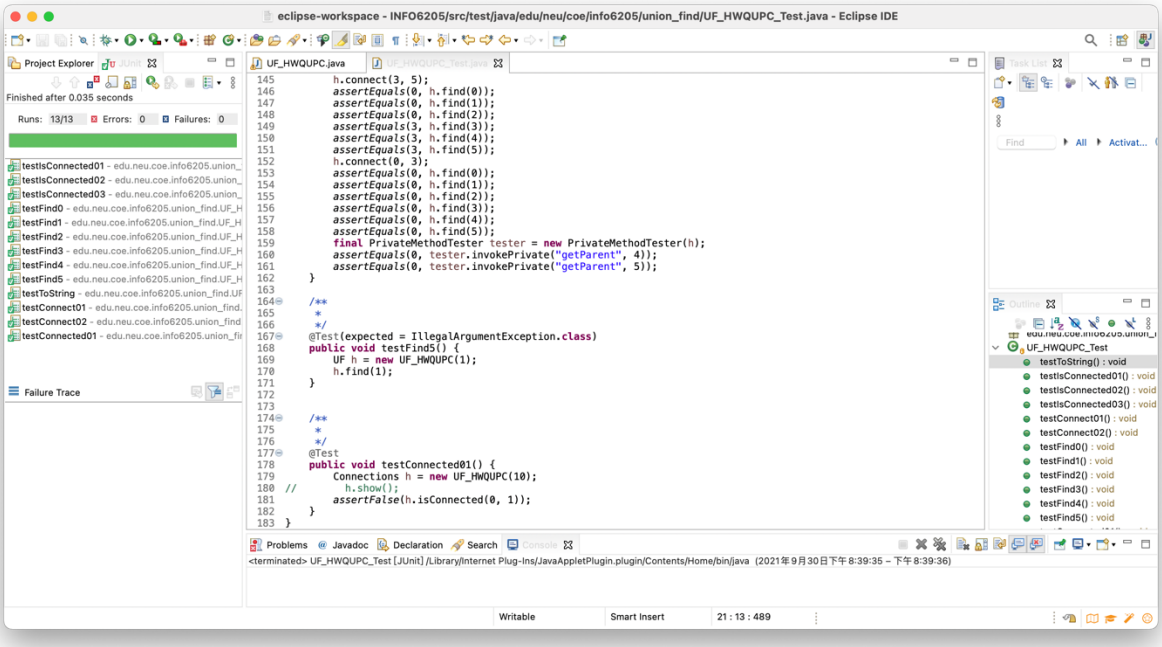
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