

Assignment 3 – INFO 6205(PSA)

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Task:

Step 1: (a) Implement height-weighted Quick Union with Path Compression.

(b) Check that the unit tests for this class all work.

Step 2:

Using your 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."

Step 3:

Determine the relationship between the number of objects (n) and the number of pairs (m) generated to accomplish this.

Relation:

After performing series of experiments for various values of n , I can conclude that number of random pairs (m) is equal to $\frac{1}{2} n \ln n$ where ' n ' is the number of objects.

$$m \approx \frac{1}{2} n \ln n$$

Findings:

Number of random pairs generated for $n = 1000$ is: 3699

$$\frac{1}{2} n \ln n = 3453$$

Number of random pairs generated for $n = 2000$ is: 7422

$$\frac{1}{2} n \ln n = 7600$$

Number of random pairs generated for $n = 3000$ is: 12141

$$\frac{1}{2} n \ln n = 12009$$

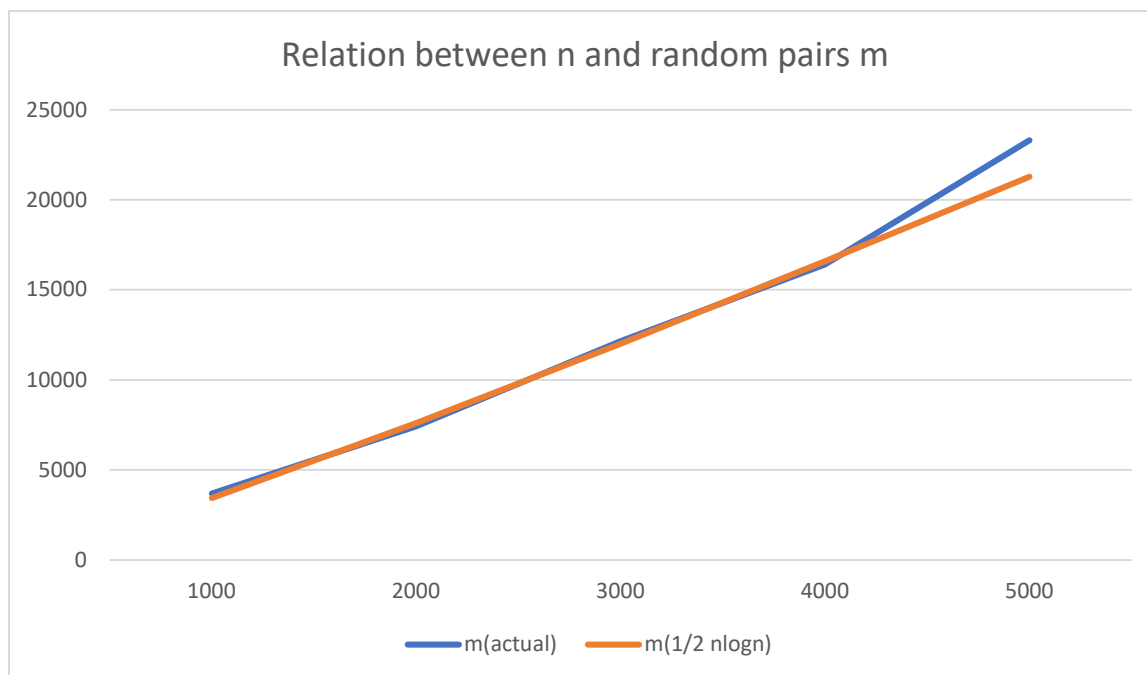
Number of random pairs generated for $n = 4000$ is: 16416

$$\frac{1}{2} n \ln n = 16588$$

Number of random pairs generated for $n = 5000$ is: 20989

$$\frac{1}{2} n \ln n = 21292$$

n	m(actual)	$m = \frac{1}{2} n \ln n$ (Expected)
1000	3699	3453
2000	7422	7600
3000	12141	12009
4000	16416	16588
5000	20989	21292



Output Screenshots:

```

package edu.neu.coe.info6205.union_find;
import java.util.Random;

public class HWQUPC_Solution {

    public static int count(int n){

        int noOfPairs = 0;
        UF unionFind = new UF_HWQUPC(n, pathCompression: true);
        Random random = new Random();

        while(unionFind.components() > 1){
            noOfPairs++;
            int x = random.nextInt(n);
            int y = random.nextInt(n);

            unionFind.connect(x,y);
        }

        return noOfPairs;
    }
}

```

Run: HWQUPC_Solution

10: Program Files\jdk-16.0.2\bin\java.exe

Number of random pairs generated for n = 1000 is: 3699

Process finished with exit code 0

The screenshot shows an IDE with the following components:

- Project Explorer:** A tree view on the left showing a project named 'INFO6205' with sub-packages 'src', 'main', 'java', 'edu', 'neu', 'coe', 'info6205', 'union_find', 'HWQUPC_Solution', and 'count'. The 'HWQUPC_Solution' package is expanded, showing files like 'TypeUP_HWQUPC', 'UP', 'UP_HWQUPC', 'UP_Exception', 'UPQUPC', 'util', 'BinarySearch', 'CallByValue', 'ComparableTuple', 'Counter', 'HuffmanCoding', 'InsertionSortBenchmarkTest', 'Iteration', 'Matrix', 'MyData', 'Mystery', 'NewtonApproximation', 'RecursionAndIteration', 'SizedIterable', 'Ticket', 'TicketChecker.java', 'Tuple', 'VLAZ', and 'resources'.
- Code Editor:** The main window displays the code for 'HWQUPC_Solution.java'. The code is as follows:

```
package edu.neu.coe.info6205.union_find;

import java.util.Random;

public class HWQUPC_Solution {

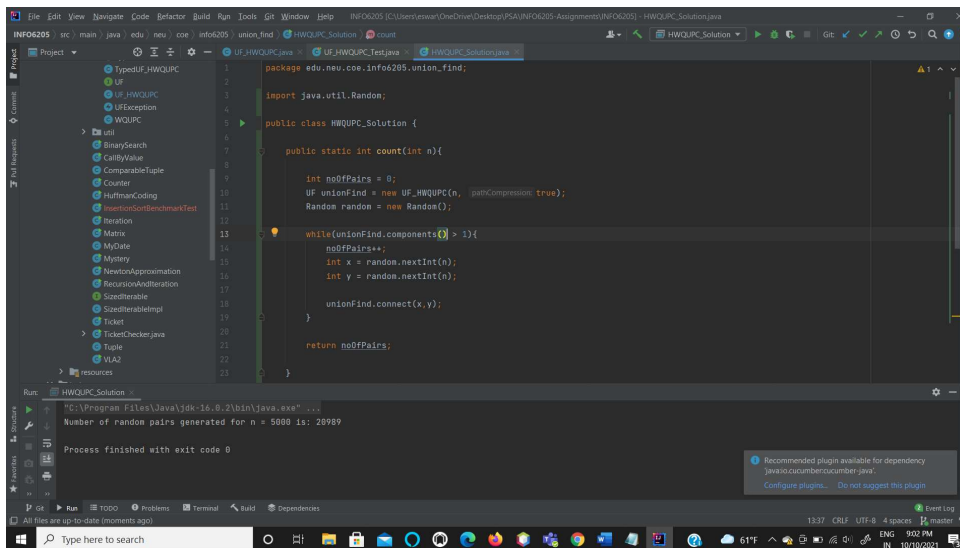
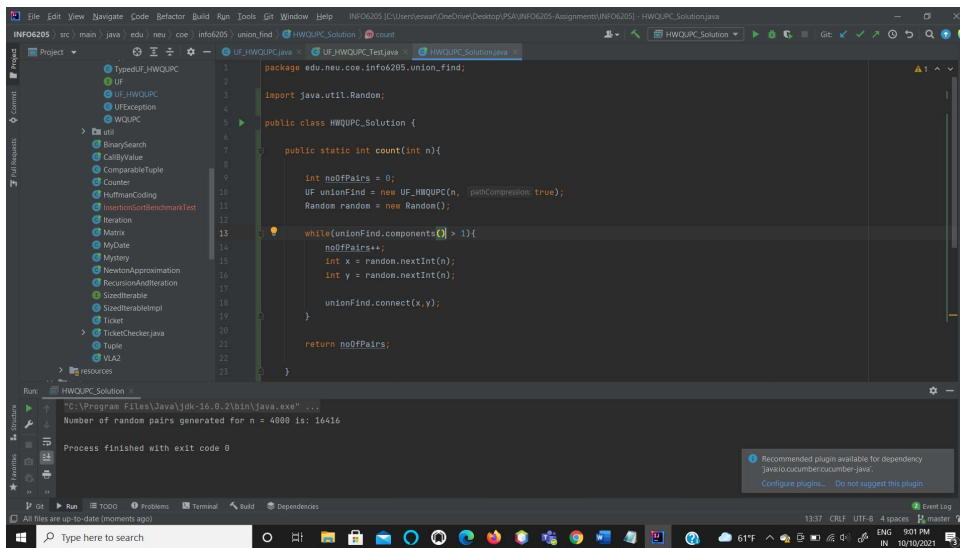
    public static int count(int n){

        int noOffPairs = 0;
        UP unionFind = new UP_HWQUPC(n, pathCompression: true);
        Random random = new Random();

        while(unionFind.components() > 1){
            noOffPairs++;
            int x = random.nextInt(n);
            int y = random.nextInt(n);
            unionFind.connect(x,y);
        }

        return noOffPairs;
    }
}
```
- Run Console:** The bottom panel shows the output of the program. It indicates that the Java executable is 'C:\Program Files\Java\jdk-16.0.2\bin\java.exe' and that 'Number of random pairs generated for n = 2000 is: 7422'. The process finished with exit code 0.
- StatusBar:** The bottom status bar shows the file encoding as 'UTF-8', 4 spaces, and the current time as 8:57 PM on 10/10/2021.

The screenshot shows the same IDE environment as the first image, but with the program executed for n=3000. The code in the editor is identical to the first image. The Run Console output now shows: 'Number of random pairs generated for n = 3000 is: 12141'. The process still finished with exit code 0. The status bar shows the time as 8:59 PM on 10/10/2021.



Unit test screenshot:

