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Program Structures & Algorithms

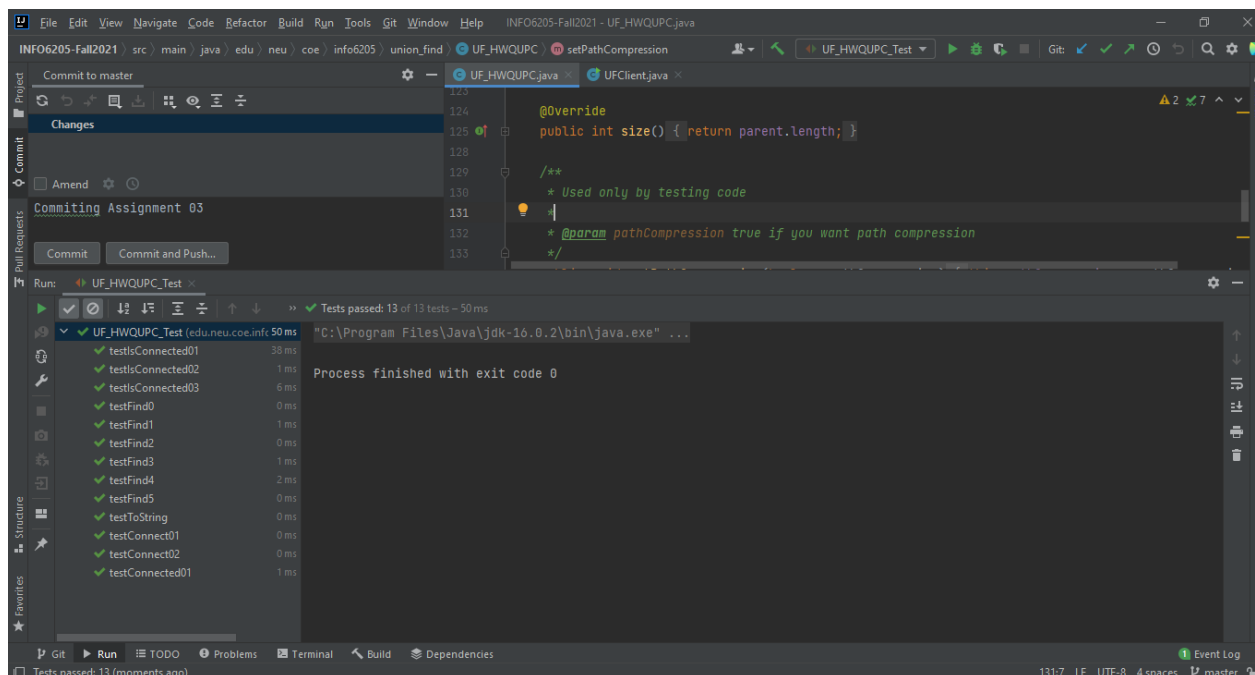
Fall 2021

Assignment No. 03

Tasks Performed :

- Implemented find, mergeComponents, pathCompression Functions in UF_HWQUPC class to implement height-weighted Quick Union with Path Compression. Successfully executed UF_HWQUPC_Test to run Unit Tests.
- Implemented the Union-Find Client class to generate random integer pairs and check if they are connected by path compression.
- From the arrived values predicted the relation between the number of objects(n) and number pairs generated(m).

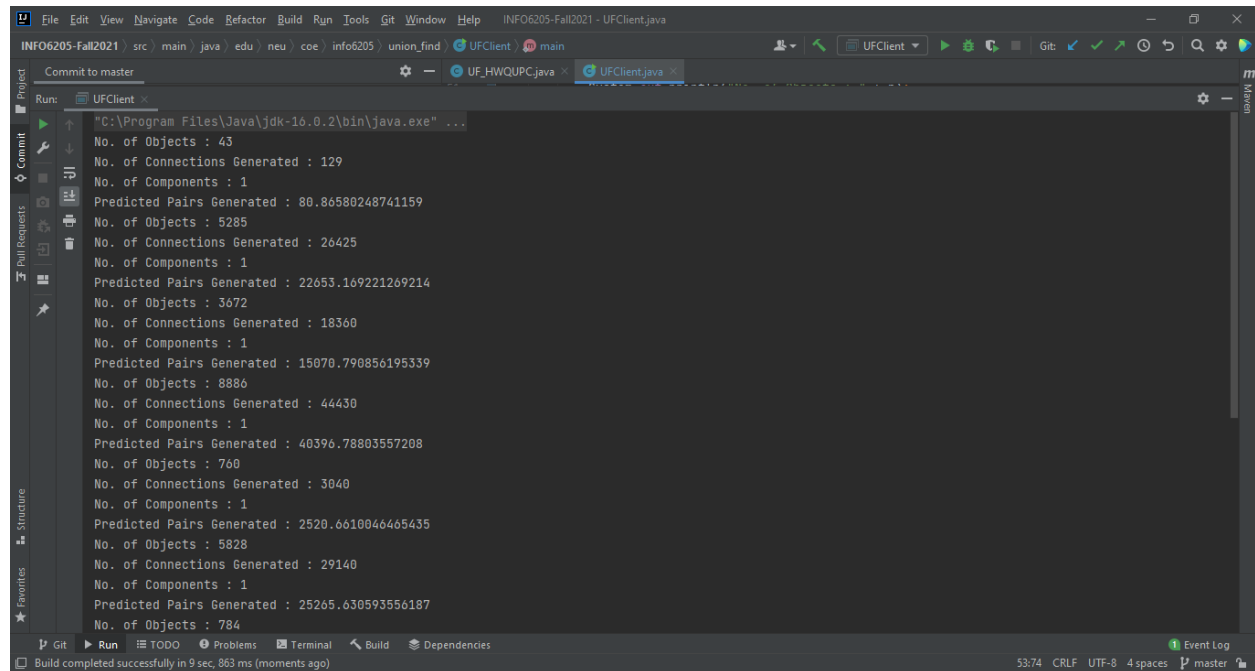
Successful Execution of UnitTests of UF_HWQUPC_Test



The screenshot displays an IDE window with the following components:

- Top Bar:** Shows the file path `INFO6205-Fall2021 - UF_HWQUPC.java` and various menu options like File, Edit, View, etc.
- Left Panel:** Contains a 'Commit' section with 'Commit to master' and 'Changes' (Amend, Commit, Commit and Push...). Below it is a 'Run' section showing 'UF_HWQUPC_Test' with a green checkmark and 'Tests passed: 13 of 13 tests - 50 ms'.
- Editor:** Displays the source code for `UF_HWQUPC.java`. The visible code includes an `@Override` method `public int size() { return parent.length; }` and a Javadoc comment: `/** * Used only by testing code * @param pathCompression true if you want path compression */`.
- Bottom Panel:** Shows the 'Run' output. It lists 13 tests with their durations: `testIsConnected01` (38 ms), `testIsConnected02` (1 ms), `testIsConnected03` (6 ms), `testFind0` (0 ms), `testFind1` (1 ms), `testFind2` (0 ms), `testFind3` (1 ms), `testFind4` (2 ms), `testFind5` (0 ms), `testToString` (0 ms), `testConnect01` (0 ms), `testConnect02` (0 ms), and `testConnected01` (1 ms). The output concludes with 'Process finished with exit code 0'.

Execution of UFClient.java



```
C:\Program Files\Java\jdk-16.0.2\bin\java.exe" ...
No. of Objects : 43
No. of Connections Generated : 129
No. of Components : 1
Predicted Pairs Generated : 80.86580248741159
No. of Objects : 5285
No. of Connections Generated : 26425
No. of Components : 1
Predicted Pairs Generated : 22653.169221269214
No. of Objects : 3672
No. of Connections Generated : 18360
No. of Components : 1
Predicted Pairs Generated : 15070.790856195339
No. of Objects : 8886
No. of Connections Generated : 44430
No. of Components : 1
Predicted Pairs Generated : 40396.78803557208
No. of Objects : 760
No. of Connections Generated : 3040
No. of Components : 1
Predicted Pairs Generated : 2520.6610046465435
No. of Objects : 5828
No. of Connections Generated : 29140
No. of Components : 1
Predicted Pairs Generated : 25265.630593556187
No. of Objects : 784
```

Evidence :

no. of objects(n)	no. of pairs generated(m)	predicted no of pairs
43	129	80
760	3040	2520
3672	18360	15070
5285	26425	22653
9343	56058	42708

It is observed that, from the values obtained from the execution of height-weight quick union graph with path compression, the relationship between the number of objects(components) **n** and the number of pairs generated **m** can be deduced as $m = (0.5) n (\ln n)$