Program Structures and Algorithms

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# Assignment-4 Benchmark WQUPC

1. ***Assignment Part 1***

**Task:** Implement height-weighted Quick Union with Path Compression.

**Unit Test Case Screenshots of UF\_HWQUPC\_Test Class**:

Graphical user interface, text

Description automatically generated

1. ***Assignment Part 2***

**Task:** Package your 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.

**Output of the main code (UF\_HWQUPC\_Main class):**

A screenshot of a computer

Description automatically generated with medium confidence

1. ***Assignment Part 3***

**Task:** Determine the relationship between the number of objects (*n*) and the number of pairs (*m*) generated to accomplish this (i.e. to reduce the number of components from *n* to 1). Justify your conclusion in terms of your observations and what you think might be going on.

**Conclusion:** As per the results obtained after executing the main program, it is observed that for larger values of ‘n’ (number of objects), the number of pairs (m) is related to ‘n’ by 0.5\*N\*(lnN) where N is ‘number of objects (n)’ i.e. approximately after 1/2N(lnN) the probability of nodes being connected is 0.5 (50-50 chance of them being connected)

**Evidence to Support Conclusion:** Below table shows number of objects (n), number of pairs (m) and calculated result from the relationship defined above (1/2\*n\*(ln n))

|  |  |  |
| --- | --- | --- |
| Number of Objects (n) | Number of Pairs (m) | Relationship: ½\*n\*(ln n) |
| 100 | 297 | 230.25850929940458 |
| 200 | 541 | 529.8317366548036 |
| 400 | 1824 | 1198.2929094215963 |
| 800 | 2565 | 2673.844691067171 |
| 1600 | 6387 | 5902.207126582298 |
| 3200 | 11577 | 12913.44974206051 |
| 6400 | 35797 | 28044.97046191284 |
| 12800 | 82175 | 60526.08287940933 |
| 25600 | 139676 | 129924.44966998596 |
| 51200 | 292134 | 277593.46716230654 |
| 102400 | 607102 | 590676.0699692823 |
| 204800 | 1455255 | 1252330.4112279029 |
| 409600 | 3392394 | 2646617.3650344824 |

**Graphical Representation:**

* **Graph of Number of Objects and Number of Pairs**