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Program Structures & Algorithms
Spring 2021
Assignment No. 04

- ## Task

  To implement two alternatives for Union-find and Benchmarking it against weighted quick union by storing the size and single pass path compression (assignment 3).

  1. For weighted quick union, store the depth rather than the size.
  2. For weighted quick union with path compression, do two loops, so that all intermediate nodes point to the root, not just the alternates.

- ## Output

  1. Benchmarking for weighted quick union, by storing the depth and by storing the size.

```
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Weighted Quick Union by storing the Size for 100 sites with 200 runs
0.015 milliseconds
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union by storing the Depth for 100 sites with 200 runs
0.015 milliseconds
************************************************
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Weighted Quick Union by storing the Size for 1000 sites with 200 runs
0.06 milliseconds
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union by storing the Depth for 1000 sites with 200 runs
0.095 milliseconds
************************************************
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Weighted Quick Union by storing the Size for 10000 sites with 200 runs
0.47 milliseconds
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union by storing the Depth for 10000 sites with 200 runs
0.42 milliseconds
************************************************
2021-03-02 10:21:28 INFO  Benchmark_Timer - Begin run: Weighted Quick Union by storing the Size for 100000 sites with 200 runs
5.625 milliseconds
2021-03-02 10:21:29 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union by storing the Depth for 100000 sites with 200 runs
5.9 milliseconds
************************************************
2021-03-02 10:21:30 INFO  Benchmark_Timer - Begin run: Weighted Quick Union by storing the Size for 500000 sites with 200 runs
33.44 milliseconds
2021-03-02 10:21:38 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union by storing the Depth for 500000 sites with 200 runs
34.44 milliseconds
************************************************
```

  2. Benchmarking for weighted quick union, with Single pass and Two pass path compression.

```
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Weighted Quick Union with Single pass path compression for 100 sites with 200 runs
0.015 milliseconds
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union with Two pass path compression for 100 sites with 200 runs
0.02 milliseconds
************************************************
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Weighted Quick Union with Single pass path compression for 1000 sites with 200 runs
0.22 milliseconds
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union with Two pass path compression for 1000 sites with 200 runs
0.065 milliseconds
************************************************
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Weighted Quick Union with Single pass path compression for 10000 sites with 200 runs
0.645 milliseconds
2021-03-02 10:18:11 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union with Two pass path compression for 10000 sites with 200 runs
0.685 milliseconds
************************************************
2021-03-02 10:18:12 INFO  Benchmark_Timer - Begin run: Weighted Quick Union with Single pass path compression for 100000 sites with 200 runs
9.185 milliseconds
2021-03-02 10:18:14 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union with Two pass path compression for 100000 sites with 200 run
7.035 milliseconds
************************************************
2021-03-02 10:18:15 INFO  Benchmark_Timer - Begin run: Weighted Quick Union with Single pass path compression for 500000 sites with 200 runs
51.045 milliseconds
2021-03-02 10:18:26 INFO  Benchmark_Timer - Begin run: Alternate Weighted Quick Union with Two pass path compression for 500000 sites with 200 run
30.215 milliseconds
************************************************
```

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- ## Conclusion:

1. Benchmarking for weighted quick union, by storing the depth and by storing the size.

Weighted quick union by storing depth gives almost equal run times when compared to stored by size, for small as well as large sites.

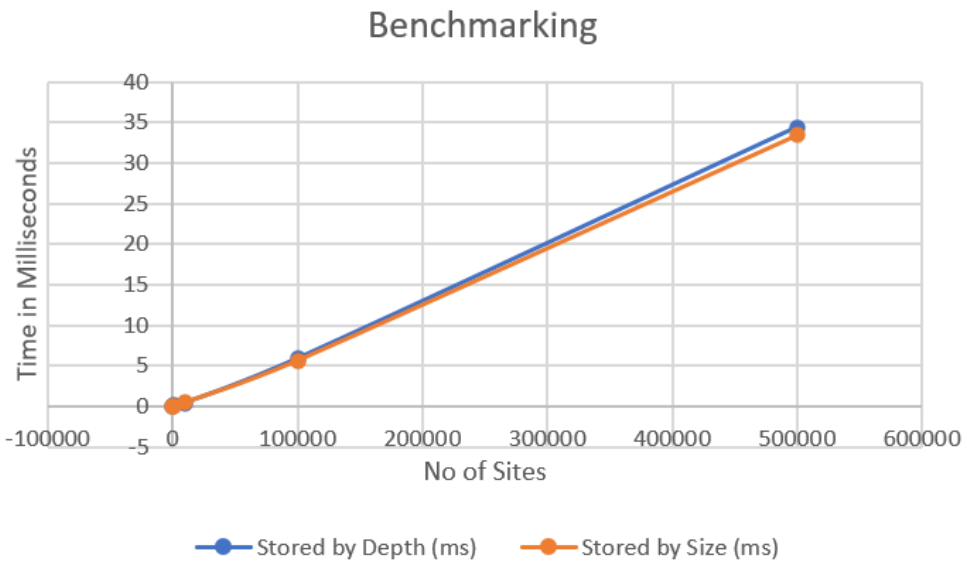
2. Benchmarking for weighted quick union, with Single pass and Two pass path compression.

Two pass path compression takes less run times when compared to single pass path compression as input increases.

- ## Evidence to support conclusion and Graphical Representation:

1. Benchmarking for weighted quick union, by storing the depth and by storing the size.

	A	B	C
1	No of Sites	Stored by Depth (ms)	Stored by Size (ms)
2	100	0.015	0.015
3	1000	0.095	0.06
4	10000	0.42	0.47
5	100000	5.9	5.625
6	500000	34.44	33.44



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2. Benchmarking for weighted quick union, with Single pass and Two pass path compression.

	A	B	C
1	**No of Sites**	**Two Pass Path Compression**	**Single Pass Path Compression**
2	100	0.02	0.015
3	1000	0.065	0.22
4	10000	0.685	0.645
5	100000	7.035	9.185
6	500000	30.215	51.045