Assignment 3 - Program Structures & Algorithms Fall 2021

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Task

- Implement height-weighted quick union with path compression
- Experiments to find out how many operations required to connect all sites

Conclusion

$$Number\ of\ objects\ (n) = Number\ of\ pairs\ (m) + 1$$

Evidence

We selected five different `N` values: 50, 100, 200, 300, 500.

And for each `N` value, we called `count()` method five times. From five runs we got the same results. Results as below:

N	50	100	200	300	500
m	49	99	199	299	499

And there is an easy way to explain it:

Initially, we have `n` number of [connected components] as they are all unconnected.

Each time when we connect two unconnected sites, we are connecting two unconnected [connected components]. So the number of [connected components] will decrease by `1`.

Our goal is to let the number of [connected components] to be `1`.

And the total number of union operations required to reduce it from `N` to `1` is `N - 1`.

Thus, `m = n - 1`.

Code

- `UF_HWQUPC` - implement union-find structure
- `UF_Experiment` - UF client file to run experiments. The main function defines a list of N values to run experiments.

Unit tests

✓ UF_HWQUPC_Test (edu.neu.coe.info6205.union_find)	5 ms
✓ testIsConnected01	2 ms
✓ testIsConnected02	1 ms
✓ testIsConnected03	1 ms
✓ testFind0	0 ms
✓ testFind1	0 ms
✓ testFind2	0 ms
✓ testFind3	1 ms
✓ testFind4	0 ms
✓ testFind5	0 ms
✓ testToString	0 ms
✓ testConnect01	0 ms
✓ testConnect02	0 ms
nected01	0 ms

Tests passed: 13