

ADS 2021: Week 1 Exercises

Exercises for Algorithms and Data Structures at ITU.

1.1.14 Algorithm Design Design an algorithm that takes an integer value N as argument and returns the largest integer not larger than the base-2 logarithm of N . Do not use a math library.

1.5.1 Quick-find. Show the contents of the `id[]` array and the number of times the array is accessed for each input pair when you use quick-find for the sequence 9-0 3-4 5-8 7-2 2-1 5-7 0-3 4-2.

1.5.2 Quick-union. Do Exercise 1.5.1, but use quick-union (page 224). In addition, draw the forest of trees represented by the `id[]` array after each input pair is processed.

1.5.3 Weighted Quick-union. Do Exercise 1.5.1, but use weighted quick-union (page 228).

1.5.8 Incorrect union() Give a counterexample that shows why this intuitive implementation of `union()` for quick-find is not correct:

```
# Python

def union (self, p: int, q: int) -> None:
    if self.connected(p, q):
        return

    # Rename p's component to q's name.
    for i in range(0, len(id)):
        if id[i] == id[p]:
            id[i] = id[q]
    self._count -= 1
```

```
// Java

public void union(int p, int q) {
    if (connected(p, q)) return;

    // Rename p's component to q's name.
    for (int i = 0; i < id.length; i++)
        if (id[i] == id[p]) id[i] = id[q];
    count--;
}
```

1.5.9 Weighted Quick-union Tree. Draw the tree corresponding to the `id[]` array depicted below. Can this be the result of running weighted quick-union? Explain why this is impossible or give a sequence of operations that results in this array.

<code>i</code>	0	1	2	3	4	5	6	7	8	9
<code>id[i]</code>	1	1	3	1	5	6	1	3	4	5