ComS 311
Recitation 3, 2:00 Monday
Homework 2

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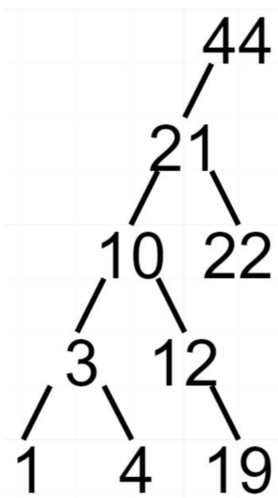
September 21, 2019

1)



0	44, 19, 4
1	22, 12
2	10
3	3
4	21, 1

2a)

```
succ(H, x){

    int succ = H[0]

    for(int i=1; i < H.length; i++){
        if(H[i] > x && H[i] < succ){
            succ = H[i]
        }
    }

    return succ
}
```

As there is only one for loop from 1 to n, runtime = O(n).

b) As there is one for loop from 0 to n containing succ() which runs O(n), this algorithm runs in O(n^2) time.

```
better(H){

    n = number of elements in H
    arr = new array of length n

    //Copy H into arr (O(n)):
    for (index, key in H)
        arr[index] = key

    //Sort arr (O(log(n))):
    mergeSort(arr)

    return arr
}
```

This algorithm runs in O(n) time.

3)

```
isUndirected(G){

    Make hashtable H with hash function 'val % G.length'

    for (k = 0 to G.length){
        pair = G[k]

        //Add a 'tally' to both vertices involved
        H[i] = j
        H[j] = i
    }

    for(k = 0 to H.length){
        arr = H[k]

        //If there aren't an even # of entries
        if( arr.length % 2 != 0)
            return false
    }

    return true
}
```

This algorithm runs in O(n) time.

4a)

```
decreaseKey(index, delta) {
    H[index] = H[index] - delta

    while( H[index] > current parent ){
        index2 = current parent index
        swap H[index] and (current parent)
        index = index2
    }
}
```

b) As it was not specified (thanks for that), I will be assuming we are conforming to average case time complexity.
An **average case** time complexity of O(1) for $findKey(v)$ can be acheived using a *hash table* with a *hash function* that allows a sufficiently large maximum index value (1000, maybe) so that conflicts are rare.
The process is explained below:

Adding to hash table :
Every time a value *val* is added to the *minheap*, it will be added to the *hash table* as well.
Value *val* will be put through the *hash function* to find the *hash table index*.
The item actually inserted into the *hash table* will be an object containing *val* and *val*'s index in the *minheap* (not the above index).

Finding index of k :
The given value k will then be put through the *hash function*, resulting in index i.
The contents of the *hash table* at i will be parsed through to find the object with the value of k, and thus its *index*.
In the **average case** this search will take O(1) time, as there will likely be very few entries at that index.