

Tutorial 10: July 24

1. Height of Quadtree

Show that height of quadtree is in $\Theta(\log(\beta(S)))$ in the worst-case where $\beta(S)$ denotes spread factor of a set of points, S .

2. The Return of the Revenge of Cuckoo Hashing

See Tutorial 9 Q2.

3. Programming Question: KD Tree

Construct a KD Tree in C++ with Expected $O(n \log n)$ time with the starter code as follows.

Challenge Question: Construct a KD Tree with worst case $O(n \log n)$ time.

```
#include <iostream>
#include <algorithm>
#include <utility>
#include <random>
#include <vector>

using namespace std;

// QuickSelect & Partition
// Implementation Omitted
int partitionX(vector<pair<int, int>> points);
int partitionY(vector<pair<int, int>> points);
// Returns the median index (i.e. index at floor(n/2));

class KDTree{
// Write the implementation of this
// Add whatever you want

bool divX; // If this Node divides points by X Axis it is 1, else 0

public:
    KDTree(vector<pair<int, int>> points, bool divOnX){
        // We want to use divOnX = 1 to denote we are splitting on X, 0 for Y
        // Add stuff here
    }

    ~KDTree(){
    }
};

int main(){
    vector<pair<int, int>> set_of_points;
    // Assume no duplicate x or y
```

```
// Input of data is omitted
// .....

KDTree root = KDTree(set_of_points, true);
}
```