

Q3 Code, no output were generated because code is incomplete

```
1  # import libraries
    import pandas as pd
    import seaborn as sns
    from matplotlib import pyplot as plt
    import random

6  # modifying code from Q2 to build quad-tree class
    class QTree:
        def __init__(self, value):
            self.value = value
            self.children = []
            self.xlo = None
            self.xhi = None
            self.ylo = None
            self.yhi = None
            self.type = None

7  # implementing 2-dimensional k-nearest neighbors using quad-tree
    def quad_tree(tree, data, val, k):
        # initialize n cluster centers
        n = random.randint(0, max(2, len(data)//10))
        centers = random.choices(data, n)
        for i in range(len(centers)):
            # attaching new node to existing non-empty tree via comparison of coordinates
            if tree:
                tree.children.append(centers[i])
                if centers[i][0] <= tree.value[0]:
                    if centers[i][1] <= tree.value[1]: tree = tree.xlo
                    else: tree = tree.xhi
                else:
                    if centers[i][1] <= tree.value[1]: tree = tree.ylo
                    else: tree = tree.yhi
            # filling in information in new node
            # I got completely lost by this part
            tree.xlo = QTree(0)
            tree.xhi = QTree(0)
            tree.ylo = QTree(0)
            tree.yhi = QTree(0)
            tree.value = centers[i]
            tree.type = centers[i][2]
        # go into recursive helper function for adding nodes
        output_tree = recurse(tree, data[:n], k)
        return output_tree

# recursive helper function
def recurse(tree, data, k):
    if not tree: return tree
    # recursively add children nodes here but I do not know how to do it
    return tree
```

