CS 240: Data Structures and Data Management   **Fall 2024**

Tutorial 8: Nov 8

1. **Range Trees:**
   Consider the following points being stored in a 2D range tree: $(2, 12)$, $(17, 77)$, $(23, 92)$, $(40, 47)$, $(55, 91)$, $(67, 27)$, $(89, 79)$, $(99, 53)$, $(10, 23)$, $(35, 7)$, $(61, 40)$, $(95, 56)$, $(22, 42)$, $(88, 15)$, $(42, 2)$.

   a) Draw the primary tree for this range tree.

   b) Draw the corresponding associate trees for the points $(88, 15)$, $(61, 40)$ and $(67, 27)$.

   c) Perform a range-search with the query rectangle $[35, 90] \times [5, 30]$, indicating all boundary nodes and topmost inside nodes.

2. **Quadtrees:**
   Build a quadtree on the following points: (1, 4), (2, 5), (3, 2), (4, 7), (7, 3), (6, 1), (5, 6), (3, 7).

3. **Hashing:**
   Consider a hash table of size 7. For each of the following scenarios insert the keys 14, 10, 20, 13, 7, 17. Then delete 14 and search for 13.

   (a) Linear Probing with $h(k) = k \bmod 7$

   (b) Double Hashing with $h_0(k) = k \bmod 7$ and $h_1(k) = (k \bmod 5) + 1$

   (c) Cuckoo Hashing with $h_0(k) = k \bmod 7$ and $h_1(k) = (k \bmod 5) + 1$