Exercise 1 (Quadtree Construction, 5 Credits)

Show that the bound $O((d+1)n)$ for the construction time of quadtree is “tight”, ie, there exist instances where the construction time is really necessary.

Exercise 2 (Balanced Quadtrees, 3 Credits)

What happens if we change the balancing criterium for balanced quadtrees? Assume the size of adjacent rectangles must be equal for all rectangles (instead of a factor of two that was presented in the lecture). Is the number of nodes still linear? If this is the case, please give a reason. If this is not the case: Can you provide another bound?

Exercise 3 (Range Queries, 8+4 Credits)

Quadtrees are perfectly suited for so-called range queries.

a) Describe an algorithm in pseudo-code that returns all points that are located inside an axis-aligned rectangle $R = [x_r, x'_r] \times [y_r, y'_r]$ (Such a query is called range query.).

b) Determine the worst-case running time for such a range query as a function of the number of points.