Algorithm Design

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Solution of Exercise C-12.15

Project a vertical line through every vertex of our convex polygon P. Such a set of lines cuts the boundary of P through two points (except for the lines through the leftmost and rightmost vertices). These lines also subdivide the plane into vertical slabs, which can be ordered left-to-right by a simple sorting step (that can even be implemented in $O(n)$ time if we use the ordering information around P). Given this ordered set of slabs, we can perform polygon inclusion by first determining the slab that contains our query point q using a binary search. Then in constant additional time we can determine if q is inside the part of P that this slab cuts (there are at most two more line comparisons to do this).