Homework 2

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1.

```
PROCEDURE LeftTangent(Polygon p, Point q):
    // first point is left tangent
    if isLeft(q, p[n-1], p[0]) AND !isLeft(q, p[0], p[1]):
        return (q, p[0])

    let i = 0, offset = 1
    loop:
        // direction of current edge
        let edgeDir = isLeft(q, p[i], p[i+1])

        // current edge is the left tangent point
        if isLeft(q, p[i-1], p[i]) AND !edgeDir:
            return (q, p[i])

        // check directions and continue search

        let prevEdgeDir = isLeft(q, p[i - offset], p[i - offset + 1])

        // current edge is left
        if edgeDir:
            // previous edge is left AND current point left of previous point
            if prevEdgeDir AND !isLeft(q, p[i-offset], p[i]):
                i -= offset
                offset = 1
            // prev edge is right OR current edge left of previous edge
            else:
                offset *= 2
        else:
            // previous edge is left
            if prevEdgeDir:
                i -= offset
                offset = 1
            else:
                offset *= 2

        i = min(i + offset, n - 1)
```

The algorithm performs an exponential search on the points of P and returns the line segment between q and the tangent point. The `isLeft(a, b, c)` function returns the polarity of `cross(<a,b>, <b,c>)`. Exponential search runs in $O(logn)$.

3.

a.

b.

4.

5.