Vertex reduction while retaining the original shape

Project title: 3D Geometry HULL Calculations
SEP group: HULL2
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Research scope:

Given a 2d shape, reduce the number of vertices making up the shape. To perform this vertex reduction implement the Ramer-Douglas-Peucker algorithm.

Basic concept:

Ramer-Douglas-Peucker algorithm is an algorithm that decimates a curve composed of line segments to a similar curve with fewer points. Doing this would reduce the accuracy of the shape but would simplify its structure resulting in better processing speeds.

Pseudocode of Ramer-Douglas-Peucker:

```
function DouglasPeucker(PointList[], epsilon)
    // Find the point with the maximum distance
    dmax = 0
    index = 0
    end = length(PointList)
    for i = 2 to (end - 1) {
        d = perpendicularDistance(PointList[i], Line(PointList[1], PointList[end]))
        if (d > dmax) {
            index = i
            dmax = d
        }
    }

    ResultList[] = empty;

    // If max distance is greater than epsilon, recursively simplify
    if (dmax > epsilon) {
        // Recursive call
        recResults1[] = DouglasPeucker(PointList[1...index], epsilon)
        recResults2[] = DouglasPeucker(PointList[index...end], epsilon)

        // Build the result list
        ResultList[] = {recResults1[1...length(recResults1) - 1], recResults2[1...length(recResults2)]}
    } else {
        ResultList[] = {PointList[1], PointList[end]}
    }
    // Return the result
    return ResultList[]
end
```

Explanation of the algorithm:

The input is an ordered set of lines and the distance dimension epsilon > 0. Then the algorithm recursively divides the line.

Initially it will mark the first and last points to keep and then will find the point that is farthest away from the line segment where the first and last points are the endpoints. It will then compare if the point is closer than epsilon to the line segment.

If it is then any points not marked to be kept can be discarded without the curve being worse. If it is greater than epsilon then the point must be kept otherwise the curve would lose too much of its shape. After checking all the points the simplified curve would become the output.

Source:

https://en.wikipedia.org/wiki/Ramer%E2%80%93Douglas%E2%80%93Peucker_algorithm