A1: Graham's Scan

[11 points]

Implement the Graham's Scan algorithm for the computation of the convex hull of a set of 2D points, observing the programming exercise guidelines available on OLAT. To receive full points, your Jupyter notebook should be able to do the following.

1. Load an input dataset from a PLY file (format see below).
2. Compute the vertices that define the boundary of the convex hull.
3. Visualize the result.
4. Save the result in a PLY file (format see below).

Input files can be expected to look like this.

```
ply
format ascii 1.0
element vertex NUM_VERTICES
property double x
property double y
end_header
x0 y0
x1 y1
…
xNUM_VERTICES-1 yNUM_VERTICES-1
```

Here, `NUM_VERTICES` denotes the number of points in the dataset. After the header the actual point data is given. Points are separated by a *new line* and the x- and y-coordinates are separated by a *blank*. For testing, the files `Resources/Datasets/points_{1-4}.ply` from OLAT can be used.

Output files must look like this.

```
ply
format ascii 1.0
element vertex NUM_VERTICES
property double x
property double y
element face 1
property list uint uint vertex_index
end_header
x0 y0
x1 y1
…
xNUM_VERTICES-1 yNUM_VERTICES-1
SIZE_HULL i0 i1 … iSIZE_HULL-1
```

So, additionally to the input, a `face` element must be mentioned in the header and another line must be added after the original points. This must first specify the number of vertices that contribute to the boundary of the convex hull and then list the indices of the respective vertices separated by a blank.