1 Point-clouds

1.1 Loading space separated ascii files

(i) Load the file *sandhausen_sample.xyz*, kindly provided by Katharina Anders, into Octave and visualize the point cloud. Color each point in your visualization by its position on the z-axis.

(ii) Write the result of your visualization to file named *A1_result.png*.

1.2 Obtaining a Digital Terrain Model from a Digitial Surface Model

(i) The transformation presented here, obtaining a digitial terrain model (DTM), is closely related to the non-maximum suppression. For each point, determine whether in its neighbourhood it is the lowest point, i.e. has the lowest value on the z-axis.

Let $p, q \in P$ denote two points in a point-cloud $P \in \mathbb{R}^3$. Let $\vec{z} = [0, 0, -1]$ be a vector pointing in the direction of the ground. Let $\vec{g} = [1, 1, 0]$ be a vector denoting the ground plane. Let $\langle \cdot, \cdot \rangle$ denote the the dot product, i.e. projection of a vector. Let λ be a threshold denoting the amount of detail you want to extract. Then, a point p is in the DTM point-cloud $\hat{P}$ only if the following holds.

$$\hat{P} = \{p \mid \forall p, q \in P : \|\langle p, \vec{g} \rangle - \langle q, \vec{g} \rangle\| < \lambda \textbf{ and } \langle p, \vec{z} \rangle > \langle q, \vec{z} \rangle\} \quad (1)$$

(ii) Implement the procedure outlined above. Make sure to vectorize your implementation where possible.

(iii) Visualize the point cloud, again coloring points by their position on the z-axis, after being processed to extract the DTM. Experiment with at least 3 values for λ. Save your plots to files named *A2_result1.png, A2_result2.png and A2_result3.png*.

1.3 Send me Your Results

(i) Compress your results into a zip file with the following file structure.

```
I3DCV_<matriculation number>_Exercise_3.zip
    |
    |- I3DCV_<matriculation number>_Exercise_3
        |
        |- sandhausen_sample.xyz
        |- A1_exercises.m
        |- A1_result.png
        |- A2_exercises.m
        |- A2_result1.png
        |- A2_result2.png
        |- A2_result3.png
```

(ii) Send me an email containing "[3DCV] Exercise 3" in the subject line with your zip file attached. My email address is *bartosz.bogacz@iwr.uni-heidelberg.de*.