Visualization
Prof. Bernhard Schmitzer, Uni Göttingen, summer term 2024

Problem sheet 4

- *Submission by **2024-05-13** 18:00 via StudIP **as a single PDF/ZIP**. Please combine all results into one PDF or archive. If you work in another format (markdown, jupyter notebooks), add a PDF converted version to your submission.*
- *Use Python 3 for the programming tasks as shown in the lecture. If you cannot install Python on your system, the GWDG jupyter server at https://jupyter-cloud.gwdg.de/ might help. Your submission should contain the final images as well as the code that was used to generate them.*
- *Work in groups of up to three. Clearly indicate names and enrollment numbers of all group members at the beginning of the submission.*

Exercise 4.1: evolution of age distribution.
The file `population_us.csv` contains data about the age and gender distribution of the US population between 1850 and 2000. (It is taken from the `vega_datasets` package and unfortunately does not provide a source, but it is good enough for our purpose of practicing.) `sex=1` encodes 'male', `sex=2` encodes 'female' (other gender assignments are not captured by the dataset), the rest of dataset format should be self-explanatory. Visualize (parts of) this dataset with a particular focus on the two following aspects:

1. The evolution of the population age distribution over time.
2. The deviations between male and female distributions.

Exercise 4.2: meshes.

1. The following array contains the vertices of the unit cube in three dimensions:

   ```
   points=np.array([[0,0,0],[0,1,0],[0,1,1],[0,0,1],
        [1,0,0],[1,1,0],[1,1,1],[1,0,1]],dtype=np.double)
   ```

   Similar as in the lecture, give a list of triangles that triangulate the surface of the unit cube as a `numpy` array. Use the mesh drawing functionality of plotly to visualize the cube based on this mesh (points + triangles).

2. Build a triangular mesh approximation for the unit disk

   $$D = \{(x, y, z) \in \mathbb{R}^3 \,|\, x^2 + y^2 \leq 1,\ z = 0\}.$$

   You can do this in a way similar to the Möbius strip and donut example from the lecture, by building a rectangular mesh first and then applying a suitable coordinate transformation (*Hint: polar coordinates*). Visualize this mesh with plotly, as above.

3. Build a mesh of the surface of the cylinder

   $$C = \{(x, y, z) \in \mathbb{R}^3 \,|\, x^2 + y^2 \leq 1,\ z \in [0, 1]\}$$

   and visualize it with plotly.