ARO Homework 4: RGB-D to colored 3D point cloud.

Karel Zimmermann, Vlada Kubelka

You are given `RGBD` array corresponding to the image captured by the Microsoft Kinect camera. Pixel at coordinates (u, v) has 4 components: red `RGBD`$[u, v, 0]$, green `RGBD`$[u, v, 1]$, blue `RGBD`$[u, v, 2]$ and depth `RGBD`$[u, v, 3]$. Red, green and blue components have values from $[0, 1]$ interval, depth component is provided in meters. We have already estimated intrinsic parameters of the camera, therefore matrix `K` is available.

1. Download `kinect_K.npy` and `RGBD.npy` data files, which contain intrinsic camera parameters and `RGBD` array.

2. Build camera matrix `P` corresponding to the camera located in the origin of the world coordinate frame (i.e. identity rotation matrix and $(0, 0, 0)^\top$ translation.

3. Derive explicit relation $(x, y, z) = f(u, v, d)$ assigning 3D world coordinates (x, y, z) to pixel (u, v) with depth $d = z = $ `RGBD`$[u, v, 3]$ in camera `P`.

4. Use function f to create 3D point-cloud and visualize it
(tip: `https://matplotlib.org/mpl_toolkits/mplot3d/tutorial.html`).

5. **Bonus:** Find a way to color the points by the `RGB` image values.