CS 685 Homework 3 (October 9) *J. Košecká*

1. **Perspective Projection** (5) It is often useful while testing some of the algorithms to simulate the perspective projection process. Write a function, which implements the image formation process.

   Write a function $x = \texttt{project}(\texttt{X}, \texttt{R}, \texttt{T}, \texttt{K})$ which takes as an input image coordinates of 3D points in the world coordinate frame and generates pixel coordinates of the projected points in the image, assuming that (R, T) is the displacement of the camera coordinate frame with respect to the world frame, K is the matrix of intrinsic image parameters, and X is a $3 \times n$ vector of the coordinates of 3D points. To test the function consider a unit cube placed in the origin of the world coordinate system (specified by 8 vertices $[0, 0, 0]'$, $[1, 0, 0]'$, *etc*, assume that the camera is translated along z-axis by some amount and rotated around x-axis by angle $20\circ$. You can assume that matrix K is $[800, 0, 250; 0, 800, 250; 0, 0, 1]$. Generate the image of the cube. Its enough when you plot the vertices of the cube and optionally connect them by line to visualize it better. Submit the code and generated figure. It is commonly assumed that in the coordinate system of the camera the z-axis if pointing towards the scene and y down and x to the right.

2. **Convolution** (2) Install OpenCV on our computer.

   https://pypi.org/project/opencv-python/

   Take a picture of yourself, convert the image to gray-level image and apply thresholding operation to generate a binary image

   https://docs.opencv.org/3.0-beta/doc/py_tutorials/py_tutorials.html

   https://docs.opencv.org/3.0-beta/doc/py_tutorials/py_imgproc/py_thresholding/py_thresholding.html