02561 COMPUTER GRAPHICS DTU COMPUTE

Worksheet 3: Projections (virtual camera) and transformations

Reading	Angel: Sections 1.3-1.5, 4.3-4.12, and 5-5.7.
Purpose	The purpose of this set of exercises is to investigate the virtual camera and start drawing in 3D. We will work with various methods for setting up the virtual camera and adjust the parameters of the camera. This requires that we define the matrices in the viewing pipeline and concatenate them into a transformation matrix. We will also make different pictures of the scene using various projection methods based on perspective projection and orthographic projection (axonometric views). We do this by drawing a cube using WebGL.
Part 1	Draw a wireframe unit cube in isometric view. • The default viewing volume uses orthographic projection. Draw a cube using orthographic projection. [Angel 2.6.1, 4.6] • Position the cube in the world coordinate system with its diagonal going from (0, 0, 0) to (1, 1, 1). • Draw lines instead of triangles to draw in wireframe. [Angel 2.4] • Build a model-view matrix that transforms the cube vertices so that the cube is in isometric view. [Angel 4.12, 5.1.3, 5.3]
Part 2	Draw the unit cube in different classical perspective views. • Introduce a projection matrix that sets the camera to be a pinhole camera with a 45 degrees vertical field of view. [Angel 1.4.1, 5.5-5.7] • Draw the cube three times in the same rendering. Transform the cubes so that one is in one-point (front) perspective, one is in two-point (X) perspective, and one is in three-point perspective. [Angel 4.9-4.11, 5.1.5]
Part 3	Reflect on the theory of affine transformations and viewing transformations by doing the following: • List the transformation matrices that you used in Parts 1 and 2 (use general expressions rather than concrete numbers). [Angel 4.9, 5.3-5.5] • For each cube, write down a formula showing how the matrices were concatenated to become the current transformation matrix (CTM) that was used to transform the vertices in the vertex shader. [Angel 4.10-4.11]

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Part 4 (**optional**)	Optional (that is, you can get full credit without doing this part). Make in WebGL a highly oversimplified aircraft in which the body, the wings, and the horizontal and vertical stabilizers each consists of a box. Use the transformation functions **translate**, **rotate**, and **scale** to position, orient, and scale the boxes in an appropriate way. The link https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/airplane-parts-function/ defines terminology used in aviation and shows a detailed picture. Add to the wings two aileron (simplified as boxes) which you can rotate around an edge (in order to make the aircraft roll). You may also add boxes to simulate elevators, which can change pitch (up and down), and rudders, which can change yaw (side to side).