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2019472

Computer Graphics
Assignment 2

Question 1

Note:- All changes are done in the main.py file.

Assumption:- 1 key press is equal to 1 unit movement in the camera space.

1. Setting arrow keys for moving the camera in camera space.

- a. In the camera space, the location of the camera is always (0, 0, 0) or the origin. Hence, after moving in any direction, the new coordinates can be calculated by adding or subtracting 1 in the required axis.

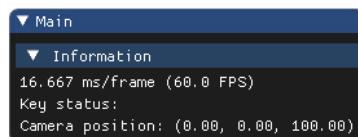
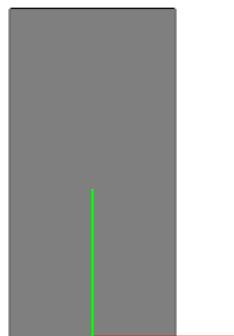
For example, after moving left, the new coordinates will be (-1, 0, 0). To calculate the new coordinates in the world space, we will multiply the new coordinates by the inverse of the View matrix.

$$x' = (M_V)^{-1} * x.$$

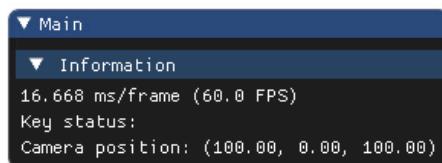
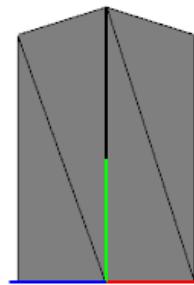
The new coordinates can be provided to the *lookAt* function to move the camera to the required place.

- b. The required outputs are given below.

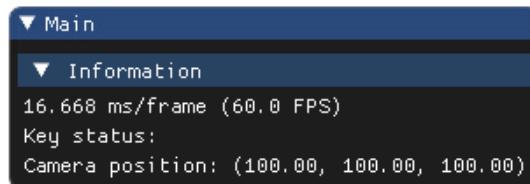
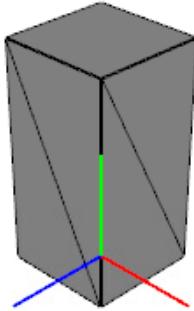
One Point Perspective



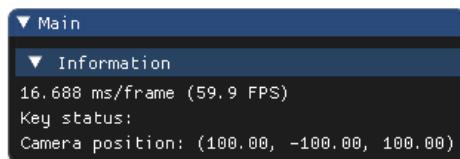
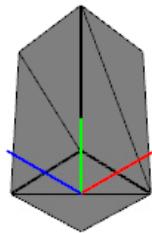
Two-point perspective.



Three Point Perspective - Bird's eye View



Three-Point Perspective - Rat's Eye View



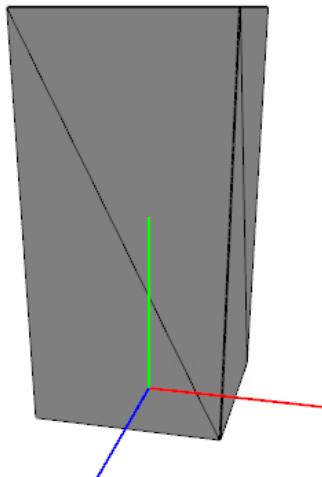
Question 2

1. The `glm::ortho` and `glm::perspective` are used for orthographic and perspective projections, respectively. The scaling factor is set to create a similar-sized cuboid as a perspective image.

Output

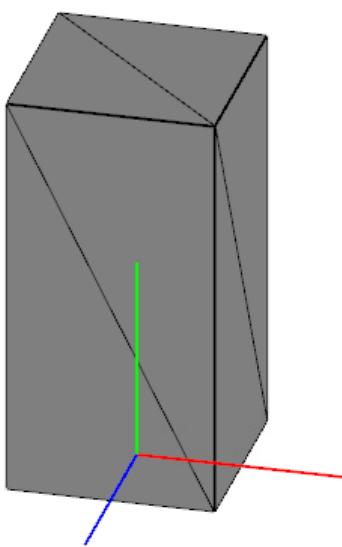
Perspective

Assignment 02



Orthographic

Assignment 02

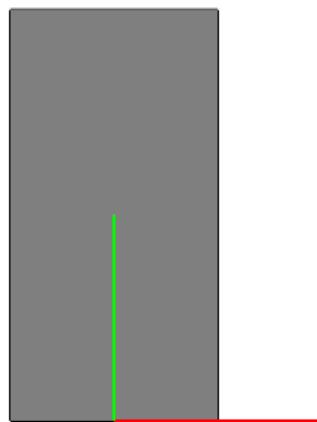
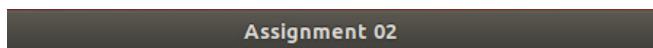


2. Assumption:- Use the 'C' key instead of CTRL

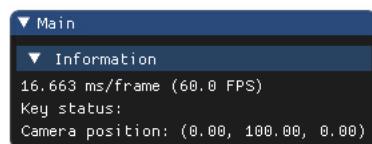
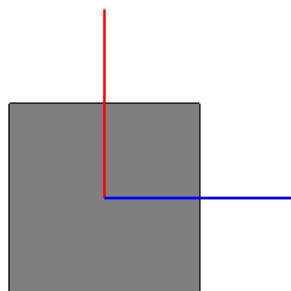
Three views are hardcoded in the code. Pressing C once gives a front view, the next time gives the top view, and the third press gives a side view. That is, they are set in a cyclic view.

Output.

Front View

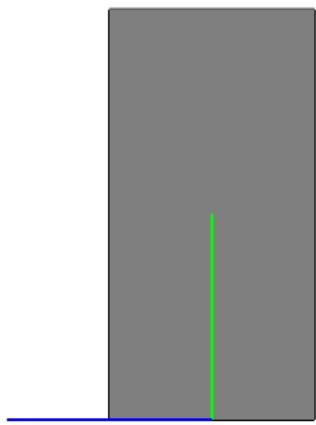


Top View



Side View

Assignment 02



Question 3

We need to prove that the function $z'(z)$ preserves the order of z .

That is,

for $z_1 < z_2$, we have $z'(z_1) < z'(z_2)$.

In other words, we need to prove the function $z'(z) = f + n - (n * f)/z$ is monotonically increasing.

We have,

$$z'(z) = f + n - (n * f)/z$$

Differentiating the equation by z ,

$$dz'(z)/dz = (n * f)/z^2$$

Here, $n < 0$ and $f < 0$, as in Camera Space, we are looking from negative z direction and camera is at the origin.

Thus,

$$n * f \geq 0$$

We also know that squares of a number is always positive.

Thus,

$$z^2 \geq 0$$

Hence,

$$\begin{aligned} (n * f)/z^2 &\geq 0 \\ dz'(z)/dz &\geq 0 \end{aligned}$$

This means, that z' is a monotonically increasing function, for any $n, f \leq 0$ and z' mapping leaves the order of z' intact post projection.

Graph of z' vs. z .

On x-axis, there is z and on y-axis, $z' = n + f - (n.f)/z$ where $n = -2$ and $f = -4$.

