CS100433
Computer Graphics

Assignment 2

Questions

1 Proof the composed transformations defined in global coordinate frame is equivalent to the composed transformations defined in local coordinate frame but in different composing order.

2 Describe the differences between orthographic and perspective 3D viewing processes? (Draw the view volume of the above two viewings)

Questions

3 Which one defines the default NDC? Why?

glm::ortho(-1., 1., -1., 1., -1., 1.)

glm::ortho(-1., 1., -1., 1., 1., -1.)

4 What is the difference between the clip space and NDC?

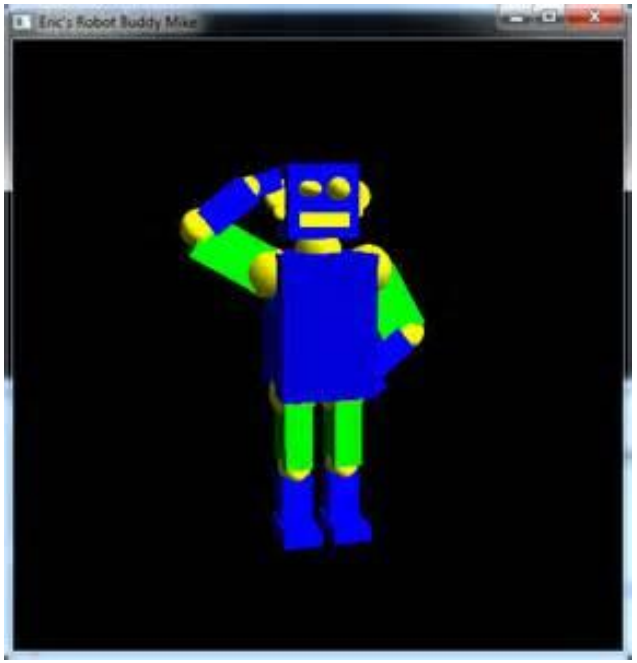
5 Why does clipping performed in the clip space?

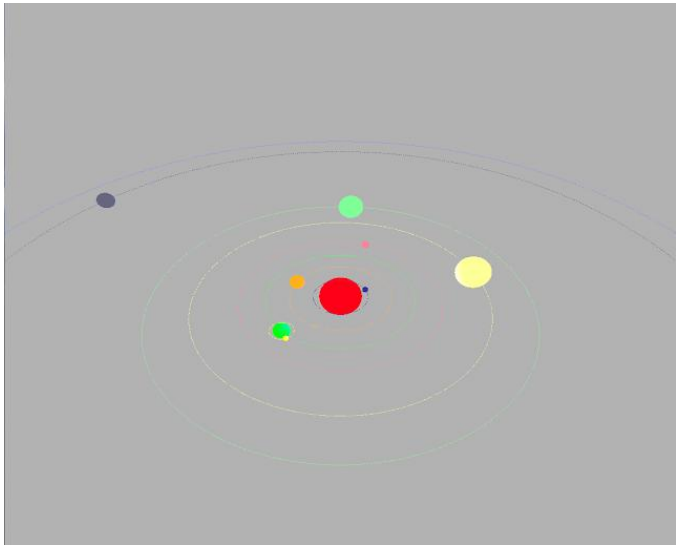
Questions

6 What is the cause of Z-fighting? And can we solve the Z-fighting?

Programming

- Animate a simple robot or a simple solar System using composed transformations (using cubes is *Goodenough,* but using shaders is a must)





https://kaixindeken.blogspot.com/2019/02/c.html

Answers

1 Proof the composed transformations defined in global coordinate frame is equivalent to the composed transformations defined in local coordinate frame but in different composing order.

- e.g. translate t (T) then rotate \theta (R) around the center of the object
- Def. in global frame (from right to left)
  - $TRT^{-1}T$
- Def. in local frame (from left to right)
  - TR

Answers

2 Describe the differences between orthographic and perspective 3D viewing processes? (Draw the view volume of the above two viewings)

- The definition of viewing volume
  - Orthographic Page 13 in 2019_5_2D_3D_Viewing.pdf
  - Perspective Page 25 in 2019_5_2D_3D_Viewing.pdf
- The normalization process
  - Orthographic Page 13-14 in 2019_5_2D_3D_Viewing.pdf
  - Perspective Page 25-31 in 2019_5_2D_3D_Viewing.pdf

Answers

3 Which one defines the default NDC? Why?

glm::ortho(-1., 1., -1., 1., -1., 1.)

glm::ortho(-1., 1., -1., 1., 1., -1.)

- The default NDC in OpenGL is the latter one. Because the NDC follow the left-hand coordinate frame and zNear and zFar are the distance measure in the direction of camera

Questions

4 What is the difference between the clip space and NDC?

- the clip space: After projection transformation and before perspective division. The clip space is 4D and the homogenous coordinate w of a vertex is not 1

- NDC: the space after perspective division. The homogenous coordinate w of a vertex is 1.

Questions

5 Why does clipping performed in the clip space?

- Efficiency: the clip space is regular.
- Correctness: the original depth information is well kept in the clip space, but is normalized in NDC.

Questions

6 What is the cause of Z-fighting? Can we solve Z-fighting?

- The depth is nonlinearly interpolated along z axis during normalization. Therefore, resolution of depth is lower when the coordinate is further from the nearest clipping plane.
- One can push the nearest clipping plane as far as possible or increase the precision of Z-buffer

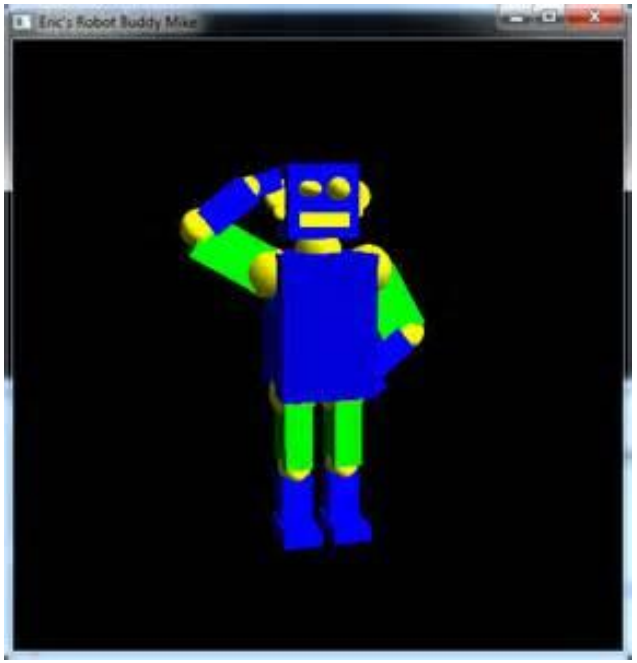
Questions

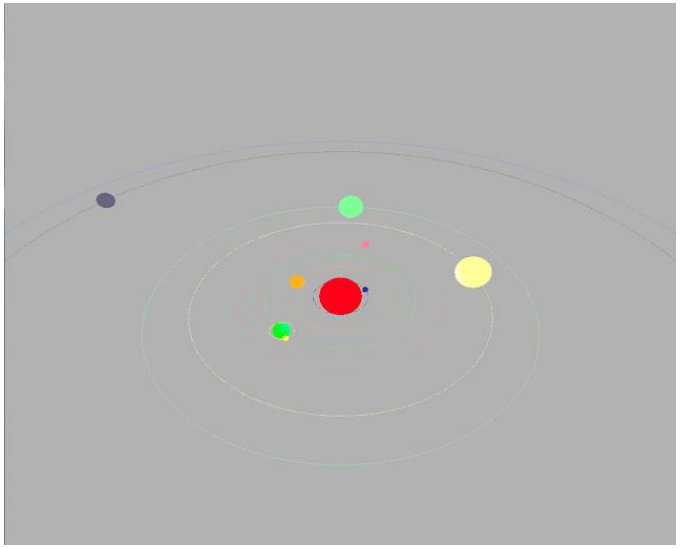
4 What are the differences between painter's algorithm and Z-buffer?

- Painter's algorithm is implemented in object space which require depth sorting of primitives
- Z-buffer algorithm is implemented in image space using a special hardware depth buffer. The minimum depth of each pixel is traced in the buffer.

Programming

- Animate a simple robot or a simple solar System using composed transformations (using cubes is *Goodenough,* but using shaders is a must)





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