

Geometry Transformation Pipeline

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Transforms through the pipe !!

- We have already covered vectors, matrices, coordinate systems, geometric transforms, projections.
- During this module we'll see how these are used together in the geometric transformation pipeline.
- This pipeline essentially describes all the geometric transformations which every vertex has to go through until it reaches the screen.
- Both OpenGL and DirectX follow the same transformation pipeline ... Perhaps implementing it in a slightly different way.

Pipeline Transforms overview ...

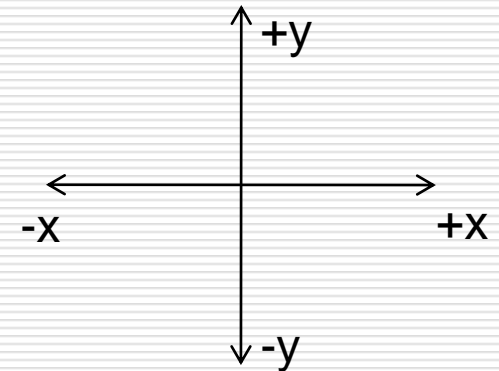
- We use 3D to describe how something looks like ... We manipulate 3D data ... But ultimately we produce something which is displayed on a 2D display.
- The transformations carried out are referred to
 - Modelling : Moves objects around the scene
 - View : Specifies the location of the camera (viewer)
 - Projection : Sizes and reshapes the viewing volume
- These are all specified as matrices that can be combined together. Hence for eg. The model view matrix describes the duality of viewing and modelling transformations.

Pipeline Transforms (Descriptions)

- Viewing : Specifies the location of the viewer or camera
- Modeling : Moves objects around the scene
- Modelview : Describes the duality of viewing and modeling transformations
- Projection : Sizes and reshapes the viewing volume
- Viewport : A pseudo-transformation that scales the final output to the window.

Eye Coordinate System

- The eye coordinate system refers to the coordinate system which is used as a common frame of reference for all transformations.
- We can think of it as the world space, and looking at it from the origin towards the $-ve$ z -axis.
- In OpenGL $-ve$ z -axis points into the screen. The 'eye' is located on the $+ve$ z -axis looking in the direction $-z$.



Viewing Transformation

- This is the first transformation that needs to be defined ... Since every vertex passed over to the pipeline will need to know about this transform..
- It is used to determine the vantage point of the scene ... i.e. the camera position and orientation.
- Thus the viewing transformation allows you to place the point of observation anywhere you want and look in any direction.

Modelling Transformation

- We've already discussed these in quite some detail a couple of weeks ago.
- Modelling transformation are used to manipulate your model moving it in place.
- Rotations, scaling, translations ... Remember the order of transformation here is important.
- The modelling transformation takes your geometry from model space to world space.

The Modelview Duality

- As we've already discussed ... The viewing and modeling transformations are, in fact, the same in terms of their internal effects on the final appearance of the scene.
- There is no real difference between moving the camera forward close to an object as opposed to moving the object forward in the direction of the camera, the net effect is the same.
- The viewing transformation is a modelling-like transformation that is applied to the whole scene.
- The term modelview indicates that these transformation can be combined in the transformation pipeline.

Projection Transformation

- The projection transformation is applied to your vertices after the modelview transformation is carried out.
- This projection (as you know) defines the viewing volume and establishes clipping planes.
- This transformation specifies how a finished scene (after all the modelling is done) is projected to the final image on the screen.
- You should know how to work with both Orthographic and Perspective projection at this stage.

Viewport Transformation

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