

Computer Graphics

Written by
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Course Outline

- This course is about synthesising images on a display.
 - Scene modelling
 - Transformations & projections
 - Drawing algorithms
 - Hidden surface removal
 - Ray tracing
 - Radiosity & textures
 - Colour models
 - Illumination & shading

Suggested Reading

- OpenGL, A Primer
 - E. Angel
 - Pearson Education, 2007
 - ISBN: 0-321-39811-4
- Computer Graphics. Principles and Practice
 - Foley, van Dam, Feiner & Hughes
 - Addison-Wesley, 1996
 - ISBN: 0-321-21056-6
- The Essence of Computer Graphics
 - P. Cooley
 - Pearson Education, 2001
 - ISBN: 0-13-016283-3

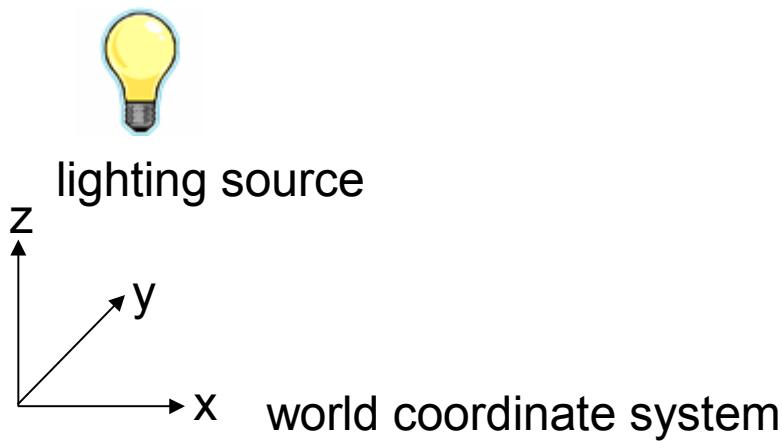
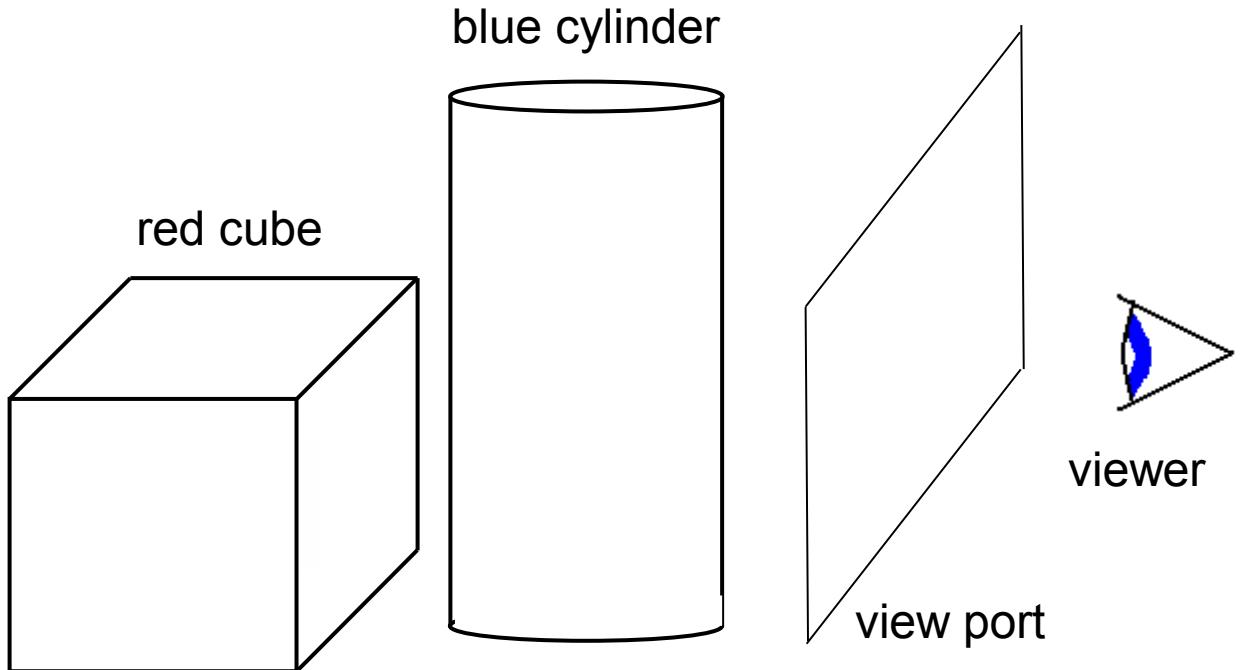
These books are C oriented.

The Goal



A photorealistic computer-generated (CG) image created by Gilles Tran using POV-Ray 3.6 (Persistence of Vision Ray-tracer). The glasses, ashtray and pitcher were modeled with Rhino and the dice with Cinema 4D.

“The Big Picture”



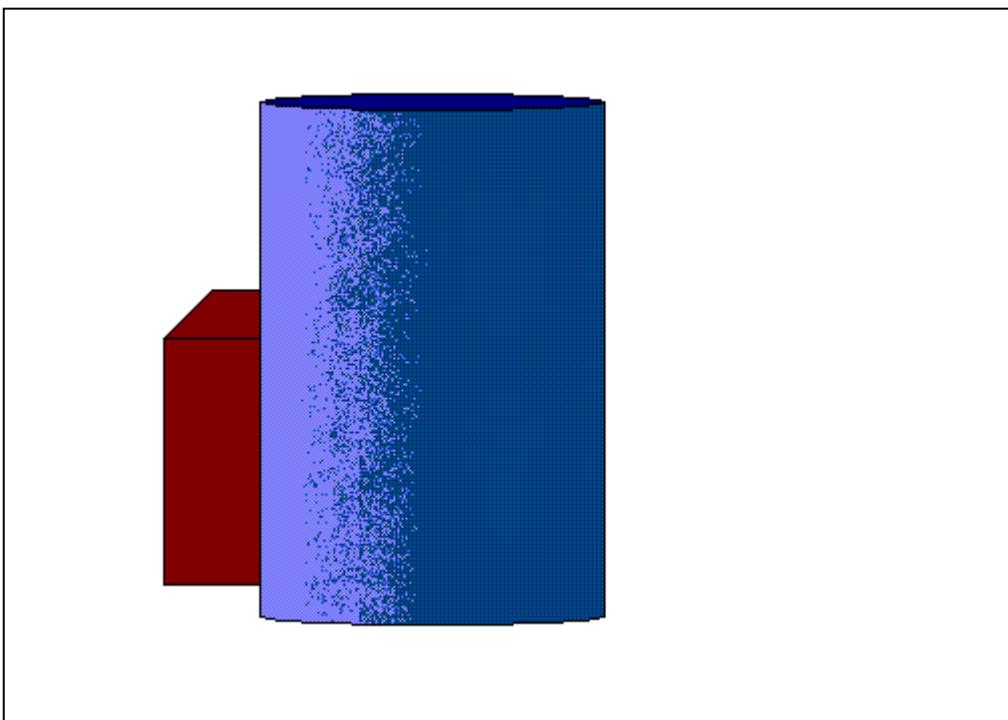
Facts about our “universe”

- Objects can be placed anywhere in our “universe”. They can be described in terms of a world coordinate system.
- There can be several sources of lighting.
- We are viewing our “universe” from a particular position in the universe.
- We are viewing our universe through a particular “window” which we call a view port.

Creating the image

- In order to figure out what appears in the view port we need to:
 - Orient the universe
 - so that the view point is at the origin and
 - the viewer is looking down an axis.
 - Project the universe on the view port.
 - Clip the projection to the view port.
 - Remove hidden surfaces.
 - Calculate the colour and intensity based on:
 - the relative positions of the lighting sources and viewer;
 - the types of lighting sources; and
 - the properties of the surfaces of the objects in our universe.

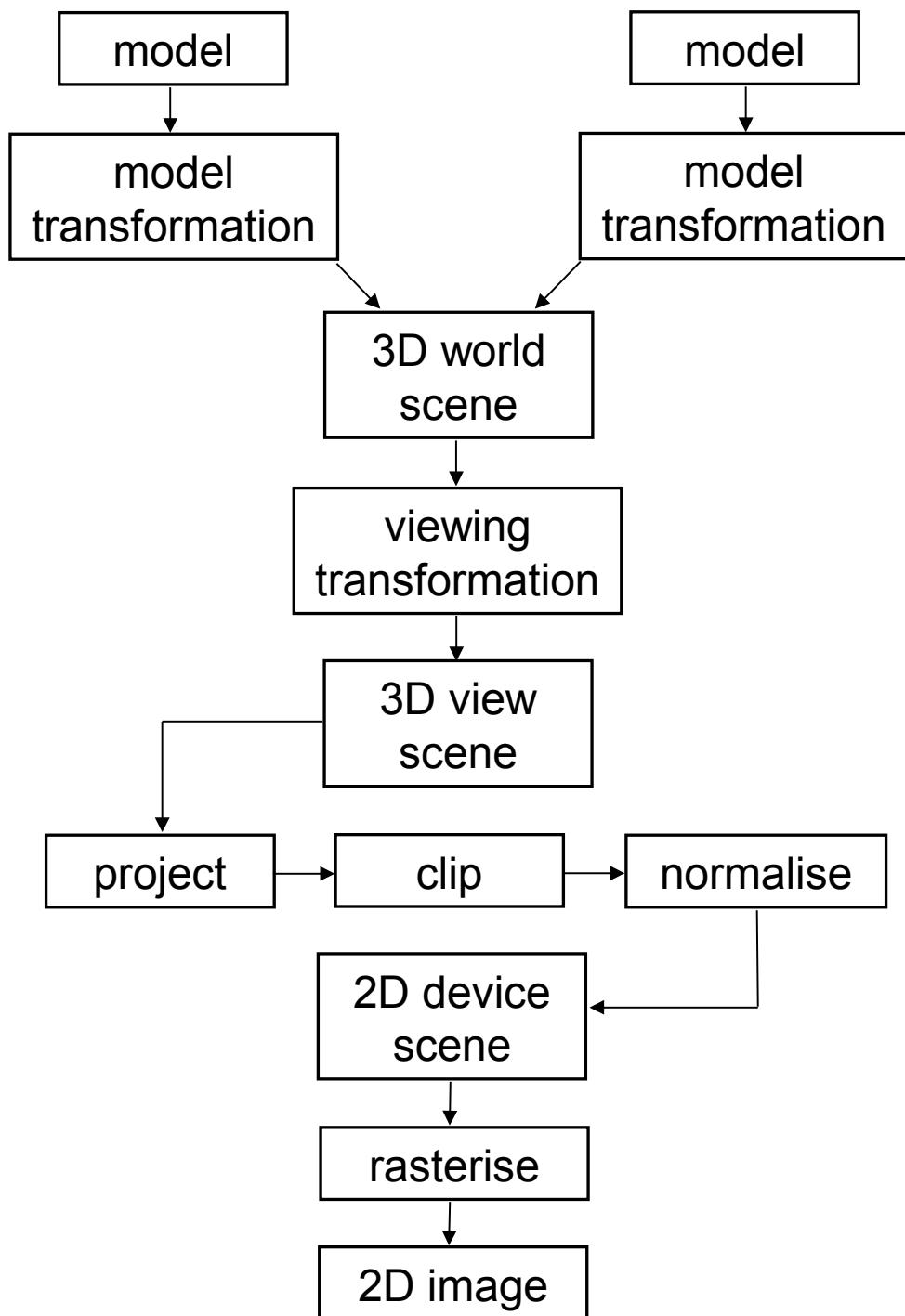
The result



The Graphics Pipeline

- A scene consists of a set of models placed in the scene.
 - Trees in a forest.
 - Models are specified in a model coordinate system (MCS).
 - Models are built of primitive shapes (usually triangles).
 - Models are transformed to place them in the world/universe.
- The world/universe is specified in the world coordinate system (WCS).
- To view the world we transform the world to place the viewer at the origin looking down an axis. Now the world is specified in the viewer coordinate system (VCS).
- This 3D world from the viewer's point of view is projected onto and clipped to a viewing window. Now we have a 2D device scene in the normalised device coordinate system.
- Last step is to rasterise the 2D image in the device coordinate system (DCS).

The Graphics Pipeline (contd.)



Viewing Devices

- Viewing devices fall into 2 categories.
 - Calligraphic devices.
 - aka vector graphic devices.
 - Draw line segments and polygons directly.
 - Plotters
 - Laser light projection systems.
 - Raster devices.
 - An image is represented as a regular grid of pixels (picture elements).
 - CRT/LCD/Plasma monitors
 - Rasterisation is the process of converting an graphical primitive (points, line, curve, etc.) into a set of pixels.