

Miscellanea

Blending

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Blending

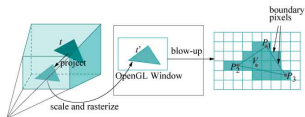
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Recall rasterization:

- ▶ Triangle vertices are projected to screen space.
- ▶ Pixels associated with triangle are found.
- ▶ Color value and z-value (depth) calculated for each (often using interpolation on vertex values, as well as texture look-ups).



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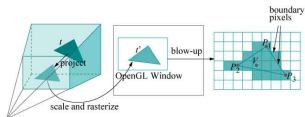
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Fragment = pixel coordinate + calculated color value and z-value. (A “potential” pixel in the final picture).

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Exactly how can be set in various way in OpenGL. Note: the averaging takes place individually on each of the color channels (including A-channel).

Blending Example

A typical example:

```
glEnable(GL_BLEND);  
glBlendFunction(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
```

$$\text{Dest}_X = \text{Source}_{\text{alpha}} \cdot \text{Source}_X + (1 - \text{Source}_{\text{alpha}}) \cdot \text{Dest}_X$$

for $X = \text{red, green, blue, alpha}$. Dest is colorbuffer pixel value, Source is fragment value.

(All resulting channel values clamped to 1.0.)

Applications

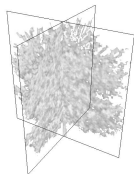
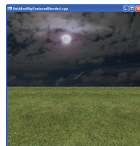
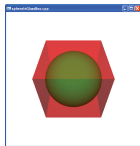
Blending useful for e.g.:

- ▶ Translucent objects.
- ▶ Reflections.
- ▶ Morphing between textures.
- ▶ Billboarding.

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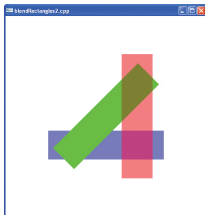


(From OpenGL Programming Guide)

Translucent Objects

Drawing translucent objects:

- ▶ First draw all opaque objects (no blending)
- ▶ Then draw all translucent objects, with blending enabled, in back-to-front order wrt. the viewer [BSP trees may be used].



Fog

Automatic depth-based blending with fog-color.

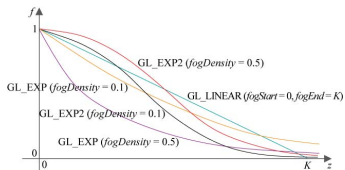


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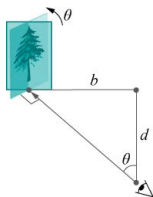
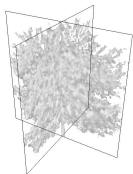


Various depth-functions can be chosen:



Billboards

A plain rectangle with a texture, simulating objects.

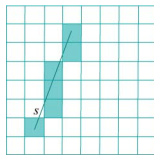


Useful for many things (especially when combined with translucent edges via blending), e.g.:

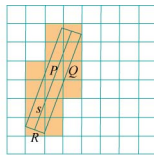
- ▶ Clouds
- ▶ Trees
- ▶ Laser beams
- ▶ Smoke
- ▶ Explosions

Anti-Aliasing

OpenGL may be asked to anti-alias using blending.



(a)

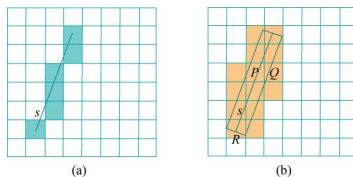


(b)

s

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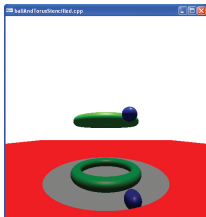


s

Another method is multisampling (several subpixels/rays per final pixel).

Further OpenGL Buffers

- ▶ Accumulation buffer: combining place for color buffer contents (entire pictures). Used for e.g. depth-of-field effects, motion blur effects.
- ▶ Stencil buffer: used to restrict drawings to various areas (think boolean bits per pixel - first set bits during a rendering to stencil buffer, then use bits during rendering to color buffer (stencil test)).



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Picking = select an object via mouse on screen.

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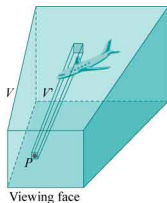
How?!?

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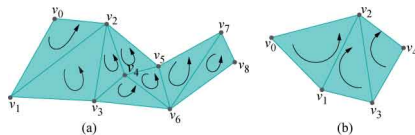
How?!?

- ▶ Special render mode allows OpenGL to report on which rendered objects intersected the frustum.
- ▶ You can name (number) the objects rendered.
- ▶ For each, OpenGL can report the min and max z-value inside the frustum.
- ▶ Glu has command for setting up a pixels-wide frustum.



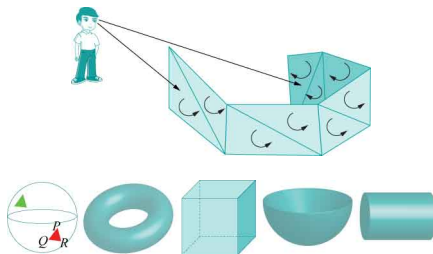
Orientation

Vertex order gives **orientation** on triangles [CCW side and CW side].
Several neighboring triangles: consistent orientation.



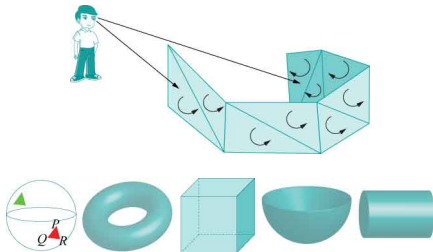
Backface Culling

Save time by not shading backfacing triangles of closed objects.

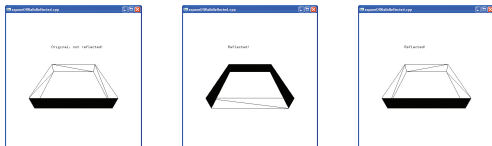


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Note: reflections are orientation reversing transformations:



Occlusion culling

Save time by not rendering objects occluded by others.

OpenGL can test-render an object, to see if any pixels in framebuffer was changed. That object can be a simple bounding box of a complicated model. Only render model if test returned true.

Other occlusion culling methods work by data structures (CPU side code) keeping track of the scene (not curriculum).