CS130 : Computer Graphics

Lecture 5: Viewing Transformations

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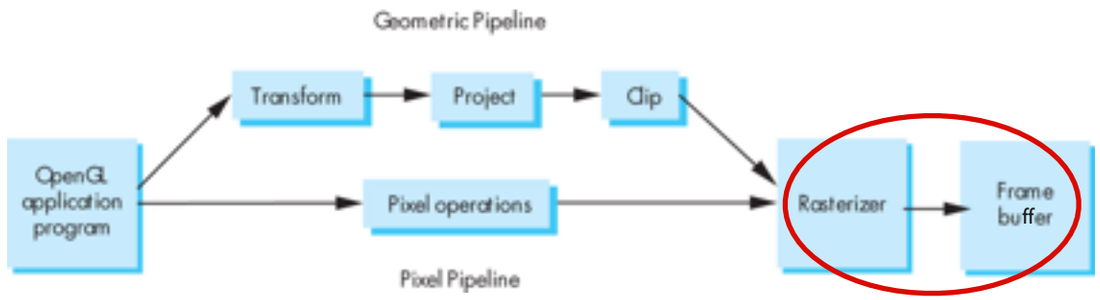
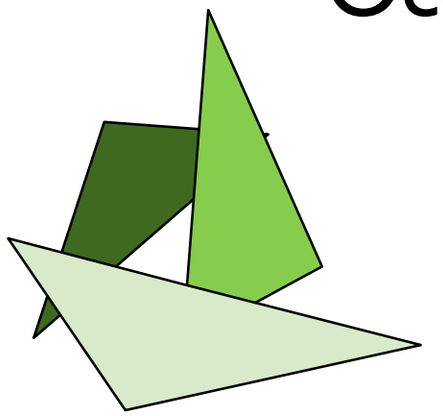
Hidden Surface Removal

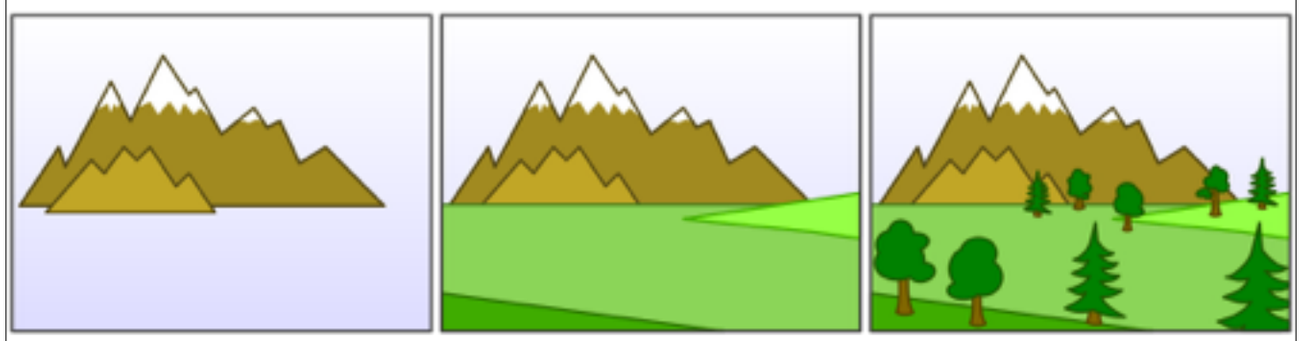


which polygons are visible, which are hidden?

Occlusion



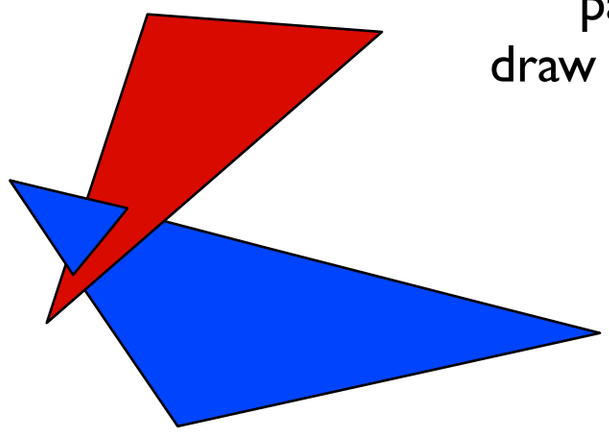
"painter's algorithm"
draw primitives in
back-to-front order



[Wikimedia Commons]

paint distant objects before near objects
sort polygons in a scene by depth and draw in that order
- still draws invisible parts
uses "depth ordering"
- Example: note parts of meadow are nearer than distant trees - but ordering is based on occlusion

Occlusion

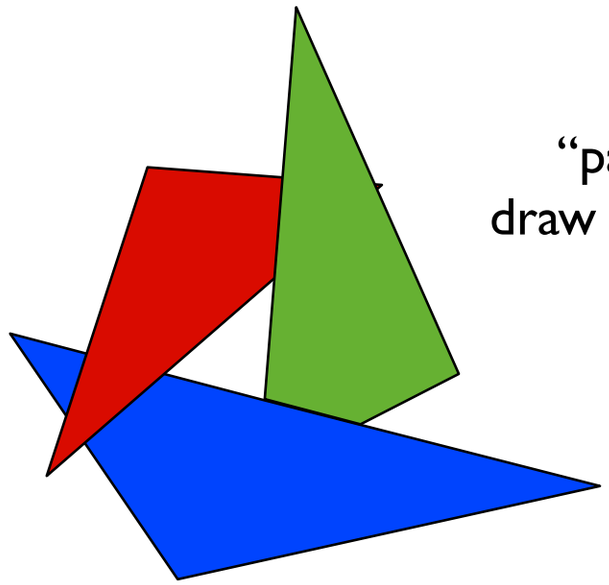


"painter's algorithm"
draw primitives in back-to-front order

problem:
triangle intersection

who's in front of whom?

Occlusion



"painter's algorithm"
draw primitives in back-to-front order

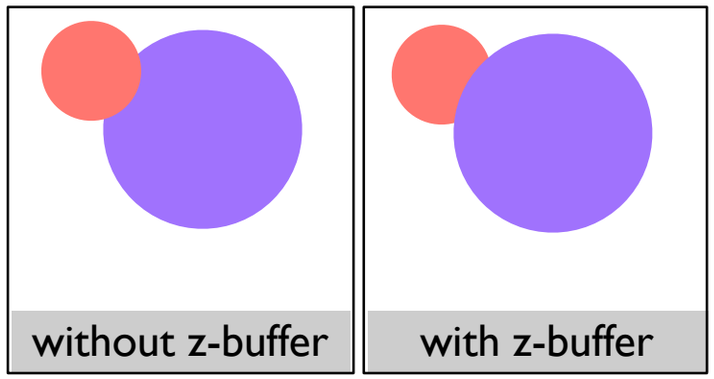
problem:
occlusion cycle

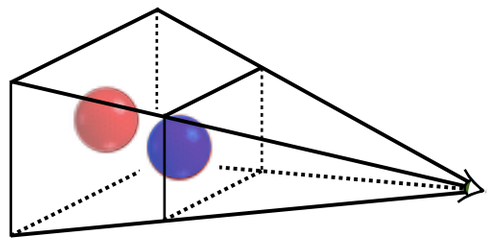
also, sorting primitives by depth is **slow**
both of these problems can be resolved by **cutting triangles**

Use a *z-buffer* for hidden surface removal

test depth on a pixel by pixel basis

red drawn last

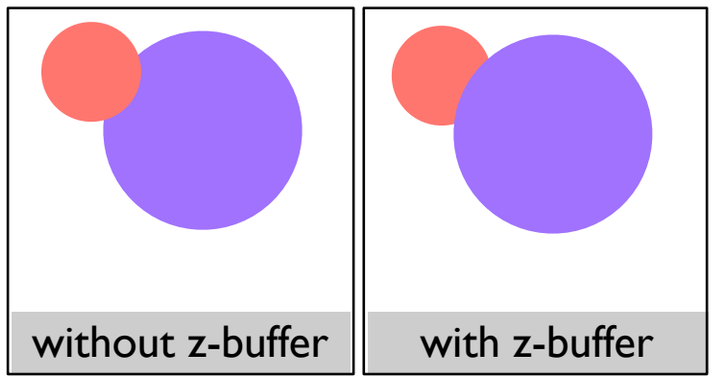


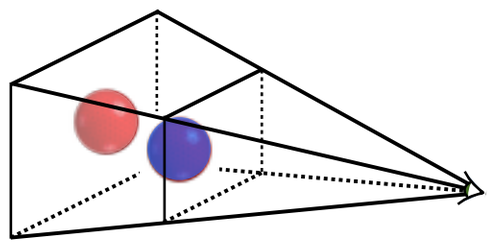


- assume both spheres of the same size, red drawn last

Use a *z-buffer* for hidden surface removal

at each pixel, record distance to the closest object that has been drawn in a *depth* buffer





Use a *z-buffer* for hidden surface removal

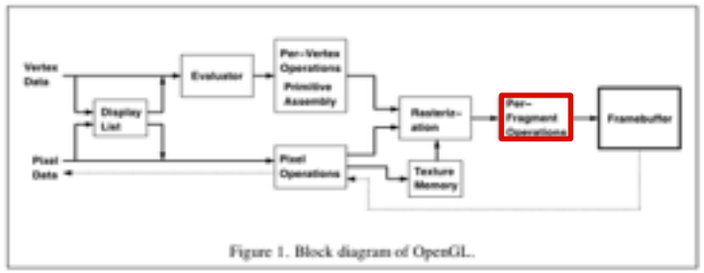
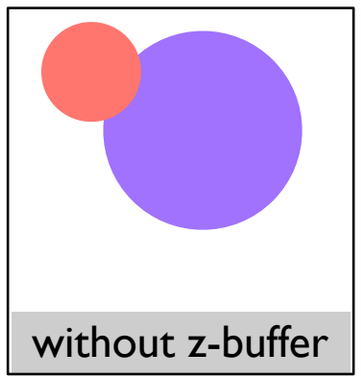
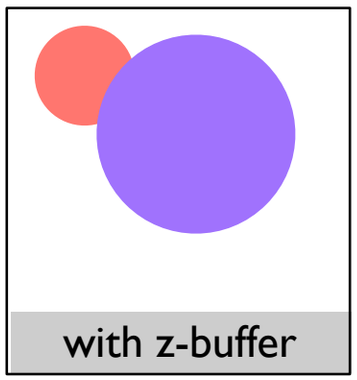
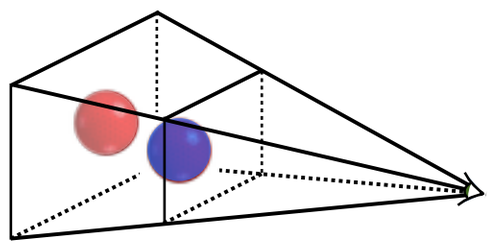


Figure 1. Block diagram of OpenGL.

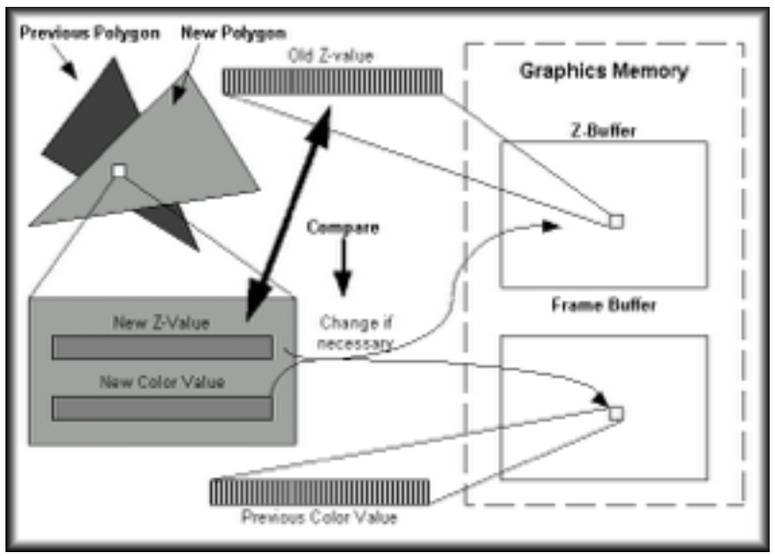

without z-buffer


with z-buffer



done in the **fragment blending** phase
-each fragment must carry a depth
– usually used fixed precision depth buffers – can get errors due to roundoff

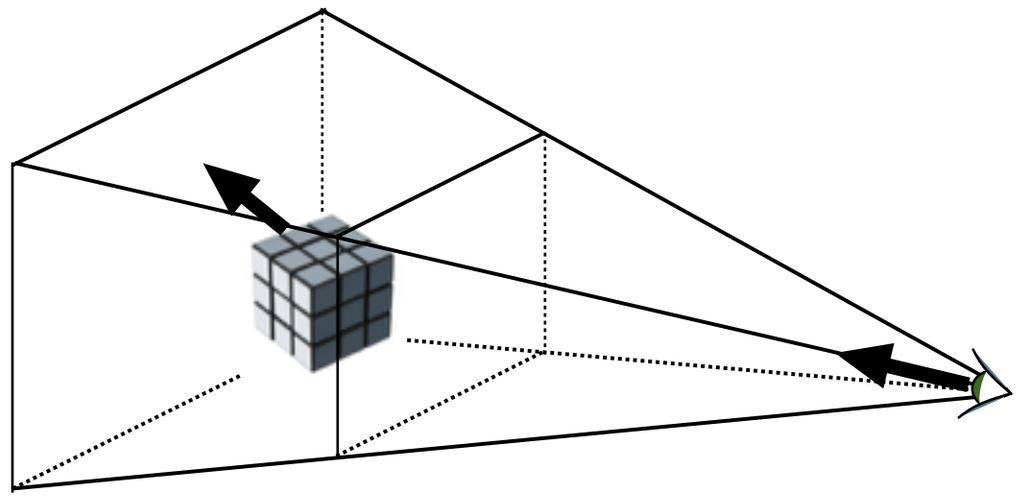
Use a *z-buffer* for hidden surface removal



http://www.beyond3d.com/content/articles/41/

- fragment has z value and color value
- compare z value to old z value at that pixel
- if new value is nearer replace *both* color value and z value

Backface culling: another way to eliminate hidden geometry



this is only okay for closed surfaces

Hidden Surface Removal in OpenGL

```
glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
glEnable(GL_DEPTH_TEST);
glEnable(GL_CULL_FACE);
```

For a perspective transformation, there is more precision in the depth buffer for z-values closer to the near plane

Transformation Matrices
<whiteboard>