Computer Graphics (CS 4731)
Clipping and Culling

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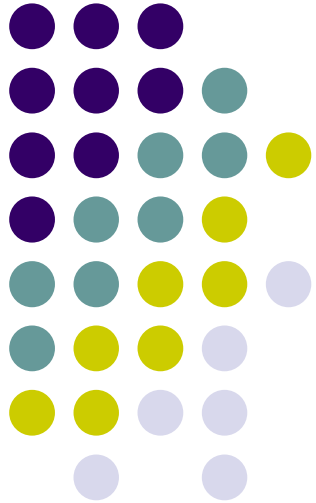
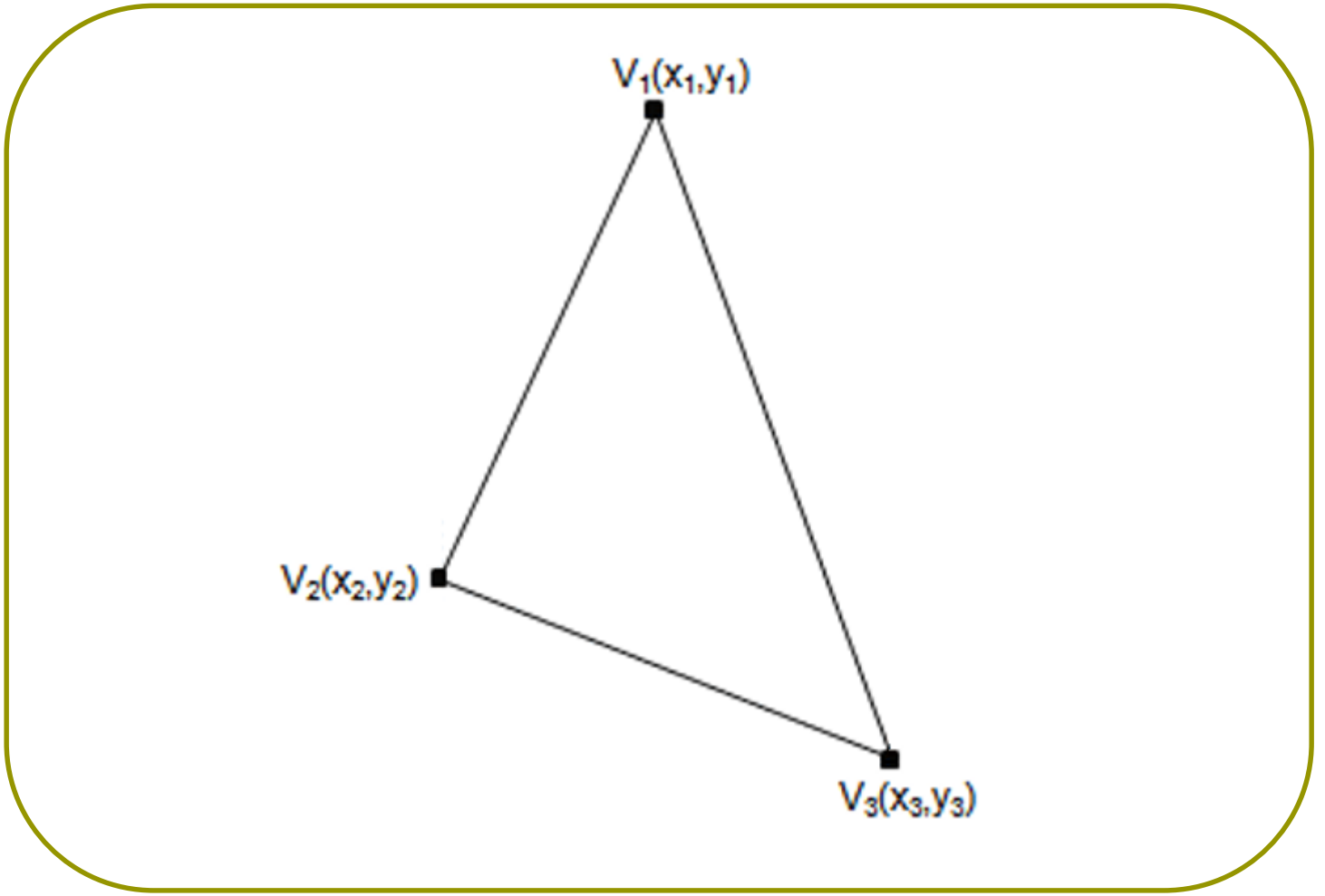


Slides Courtesy of Emmanuel Agu (WPI) and Matt Stoker (Utah)

Think-Pair-Share

What's the problem and how can we improve it?

Screen



Cull (verb)

to reduce or control the size of by removal

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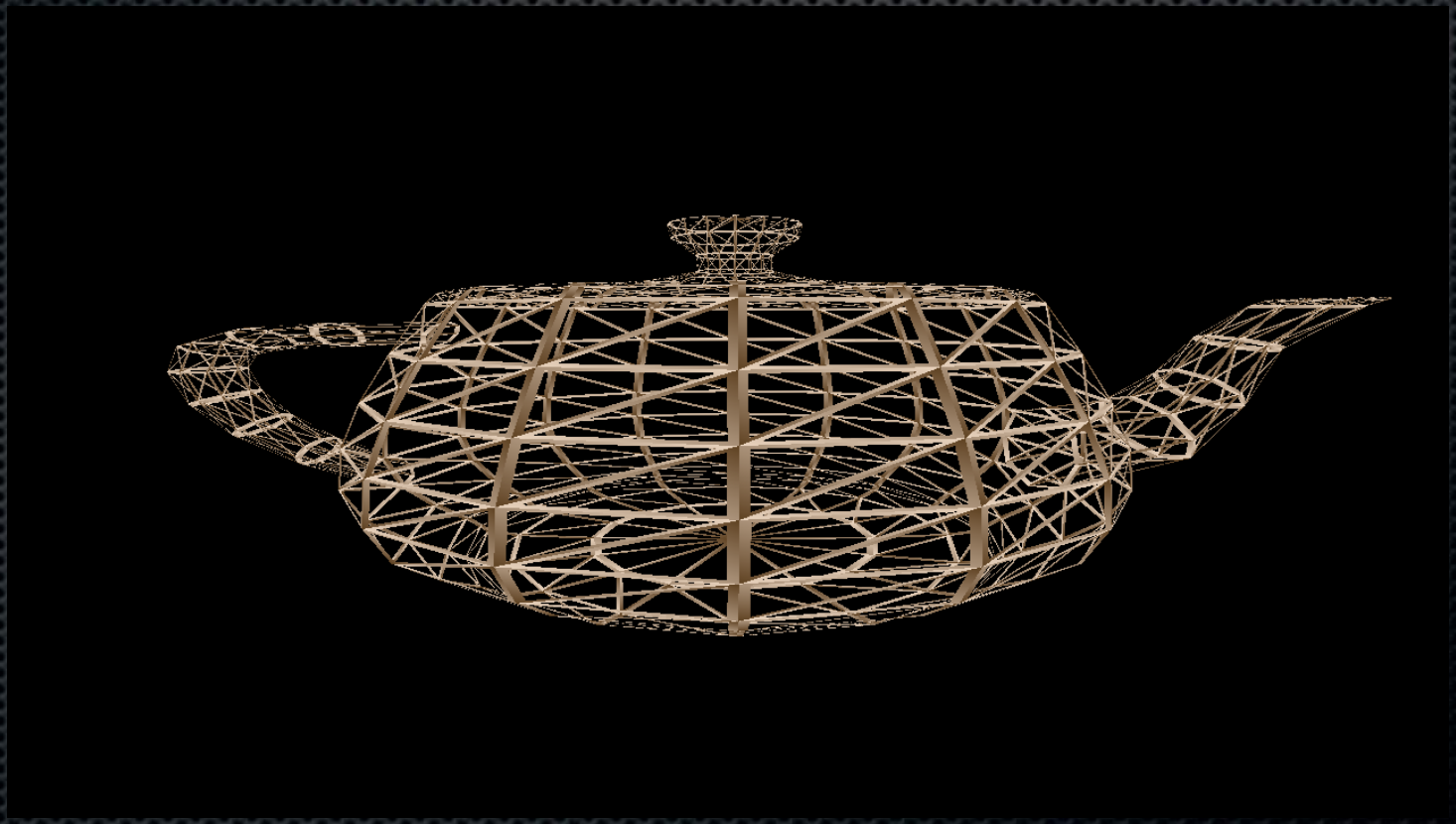

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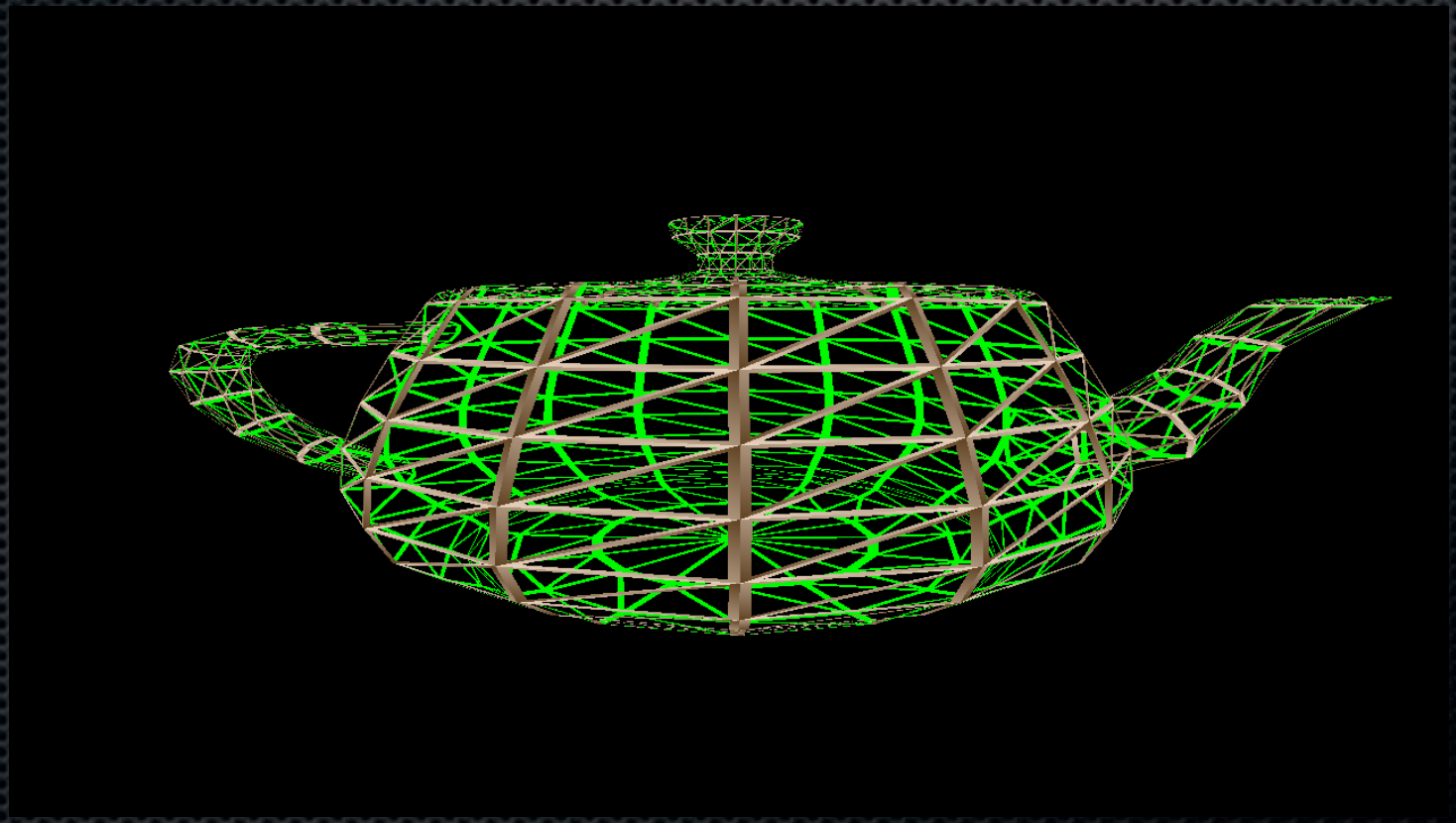
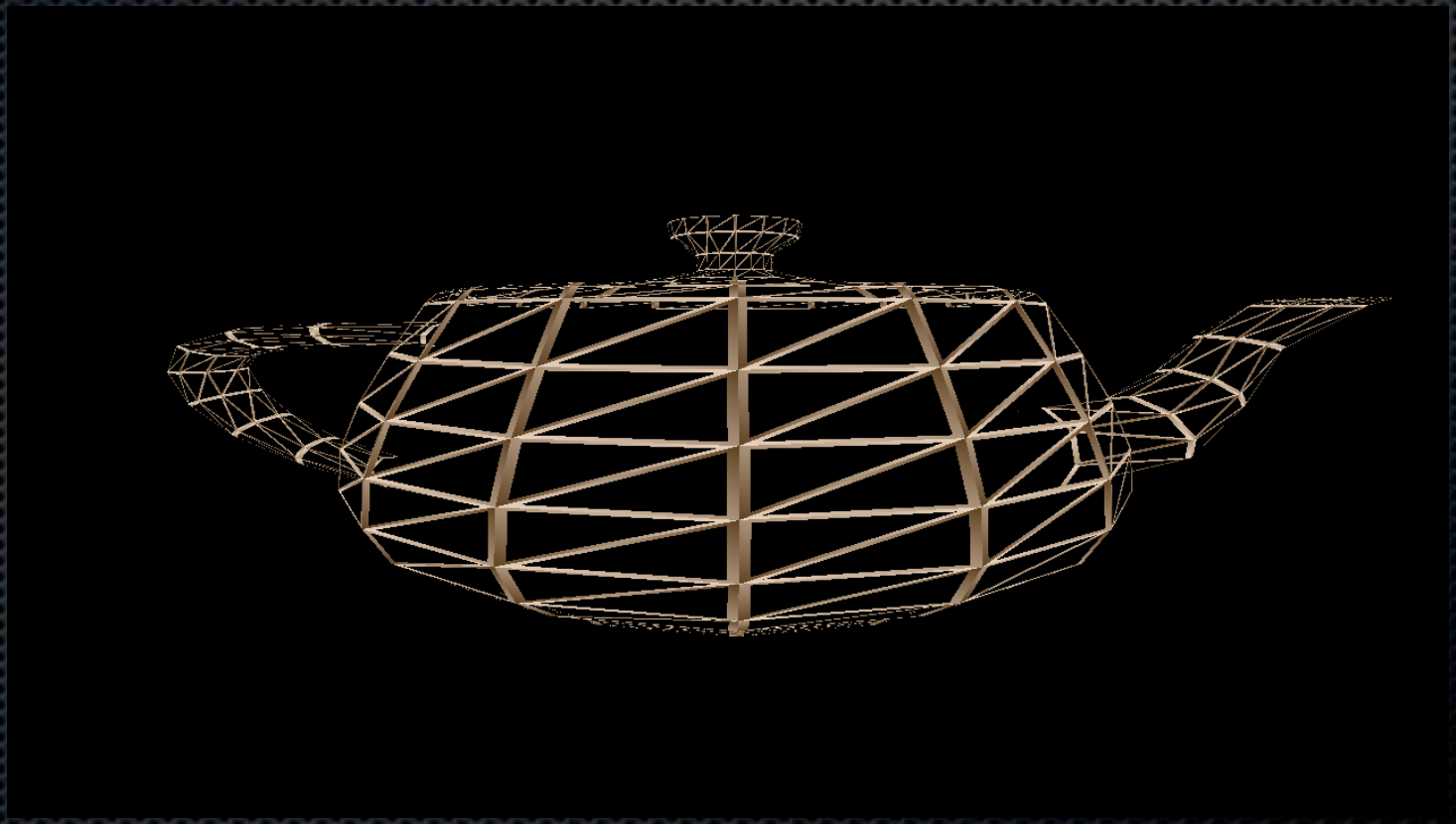


Back-Face Culling

Drew 37% (382 of 1024) of triangles in scene

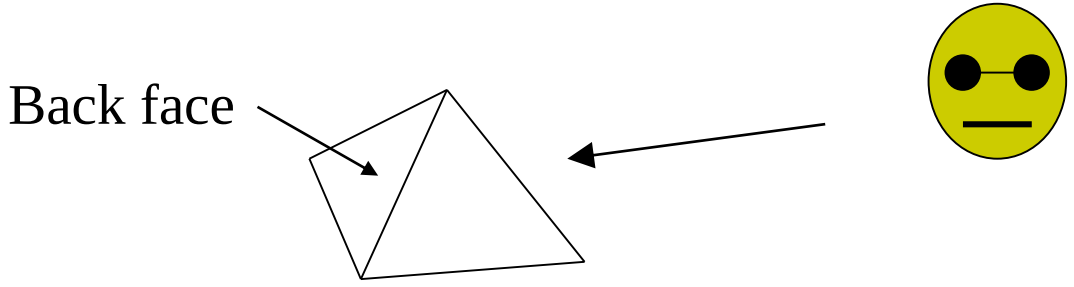


Back-Face Culling

Drew 37% (382 of 1024) of triangles in scene

Back Face Culling

- **Back faces:** faces of opaque object that are “pointing away” from viewer
- **Back face culling:** do not draw back faces (saves resources)

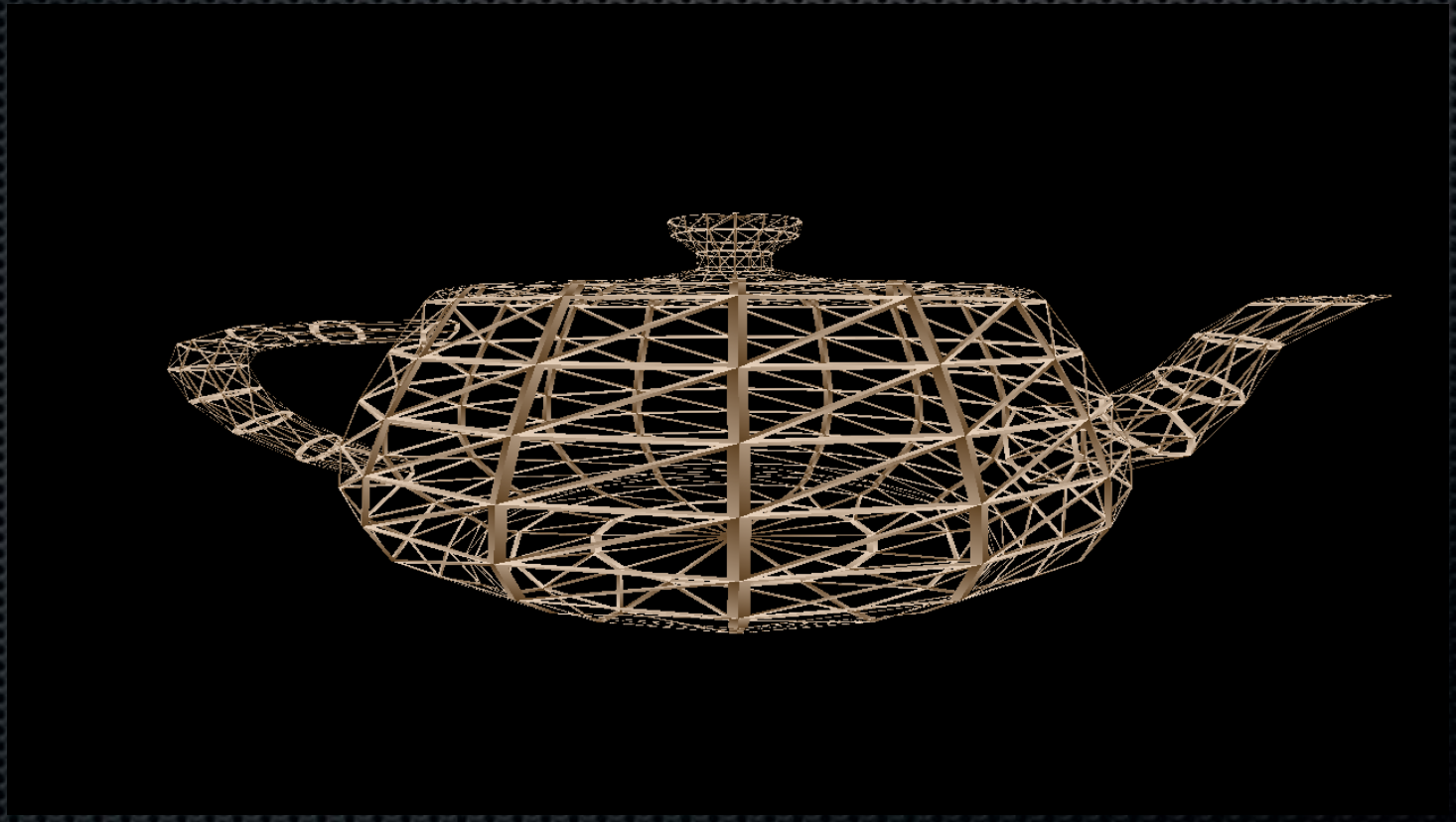


Back-Face Culling

Which triangles are back-facing?

Think-Pair-Share

How can we determine which triangles are back-facing?

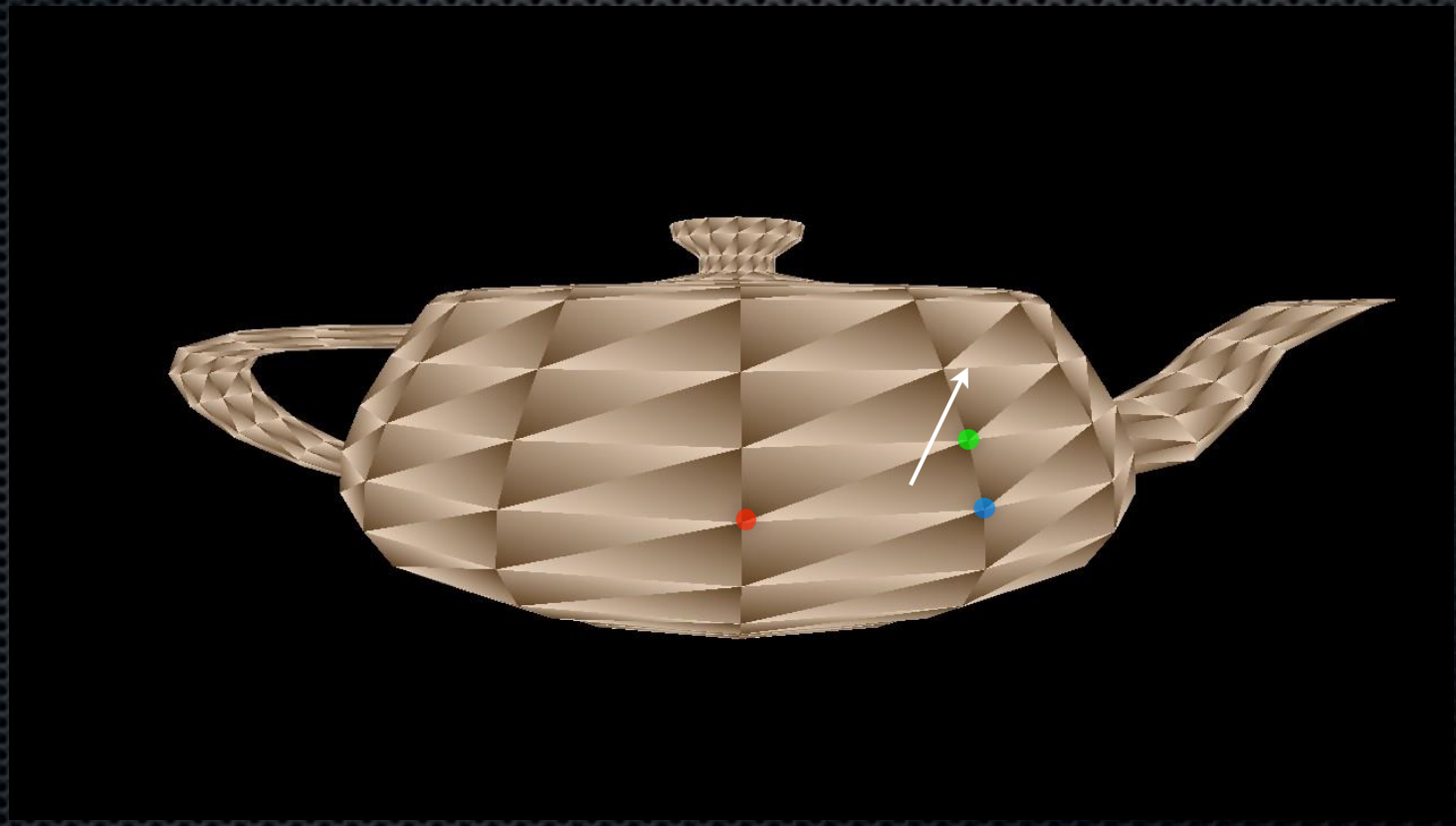


Back-Face Culling

What is the triangle's normal?

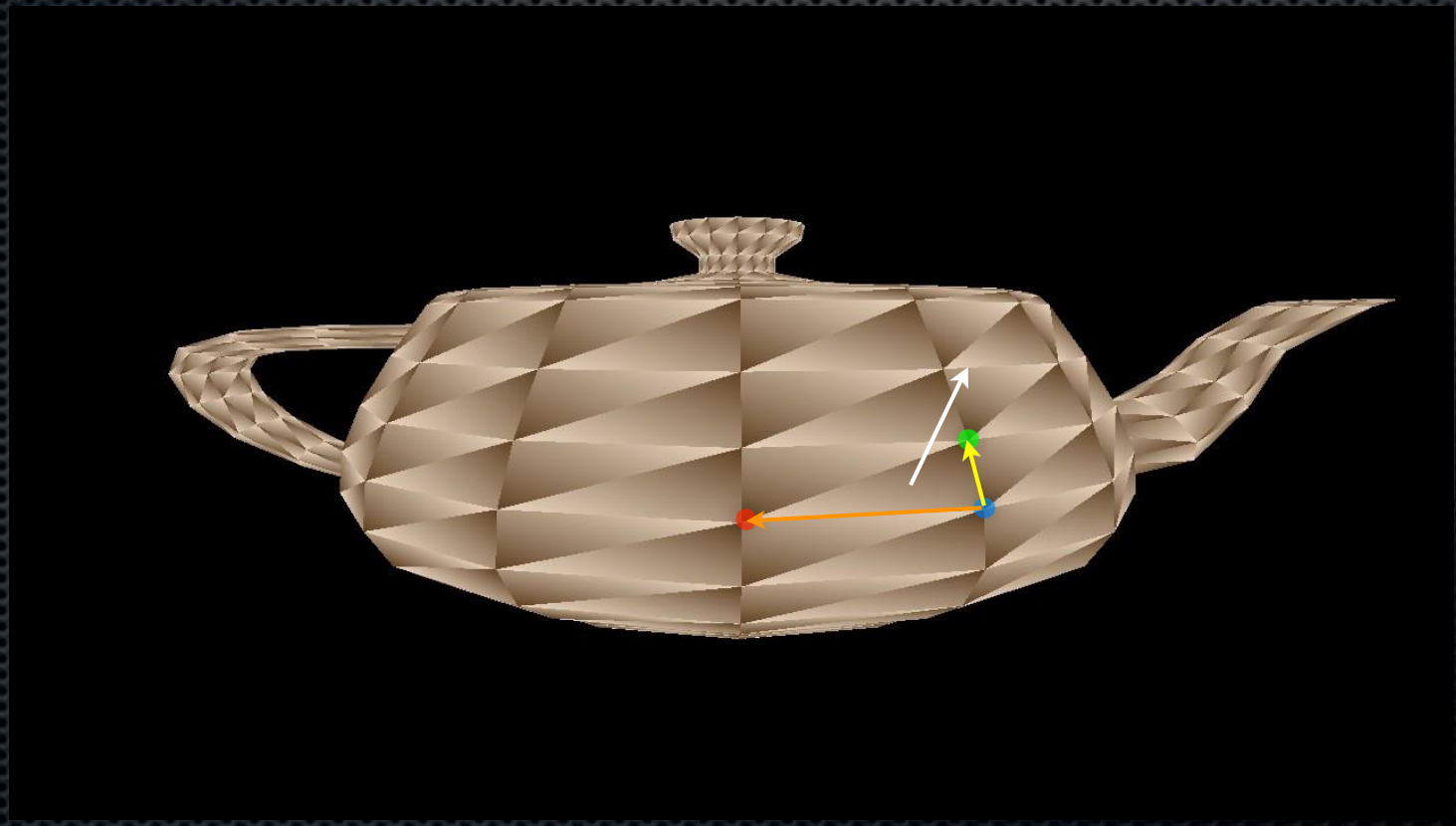
Back-Face Culling

A B C



Back-Face Culling

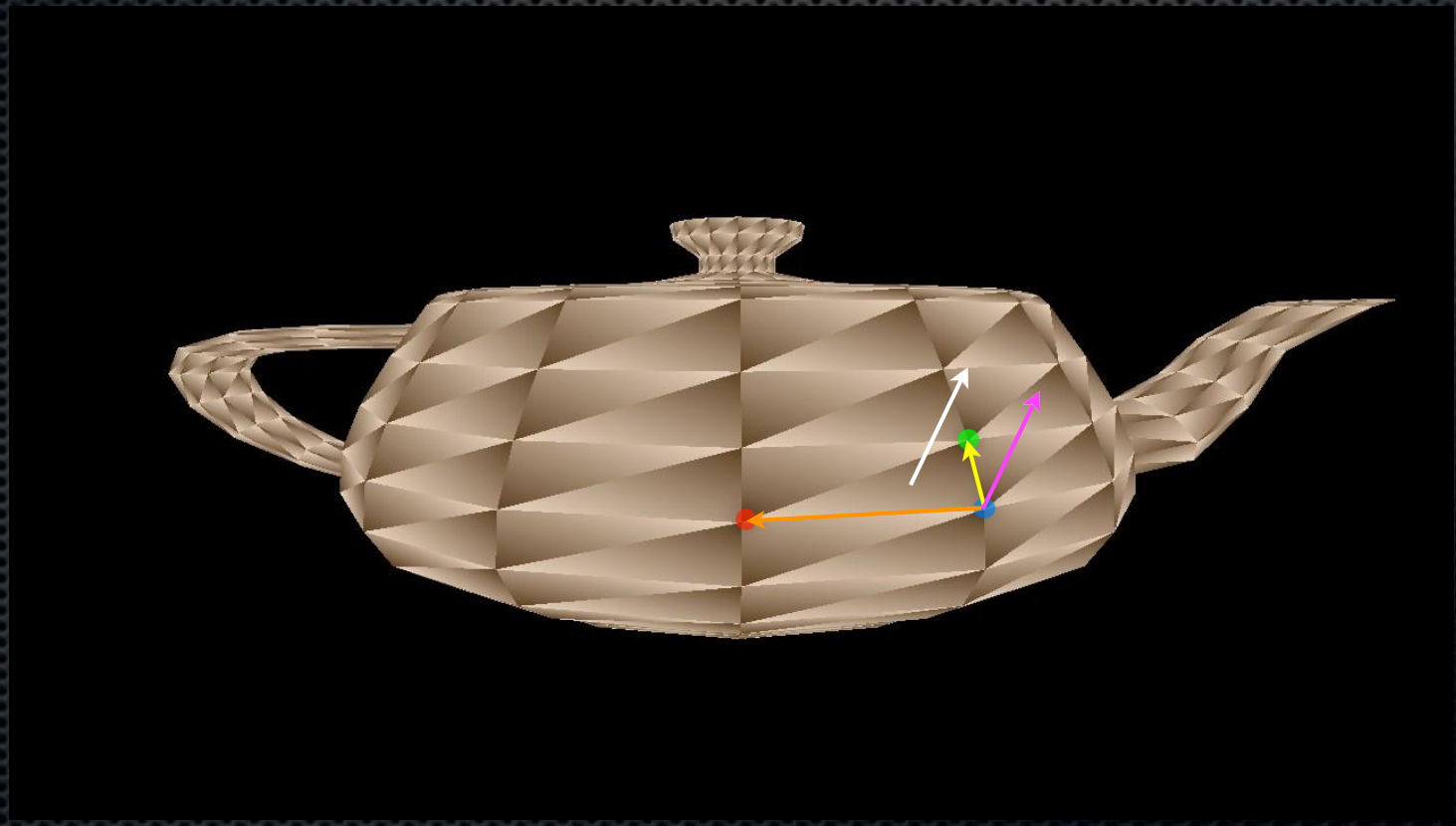
$v_0 = B - A \quad v_1 = C - A$



Back-Face Culling

$v_0 = B - A \quad v_1 = C - A$

$n = v_0 \times v_1$

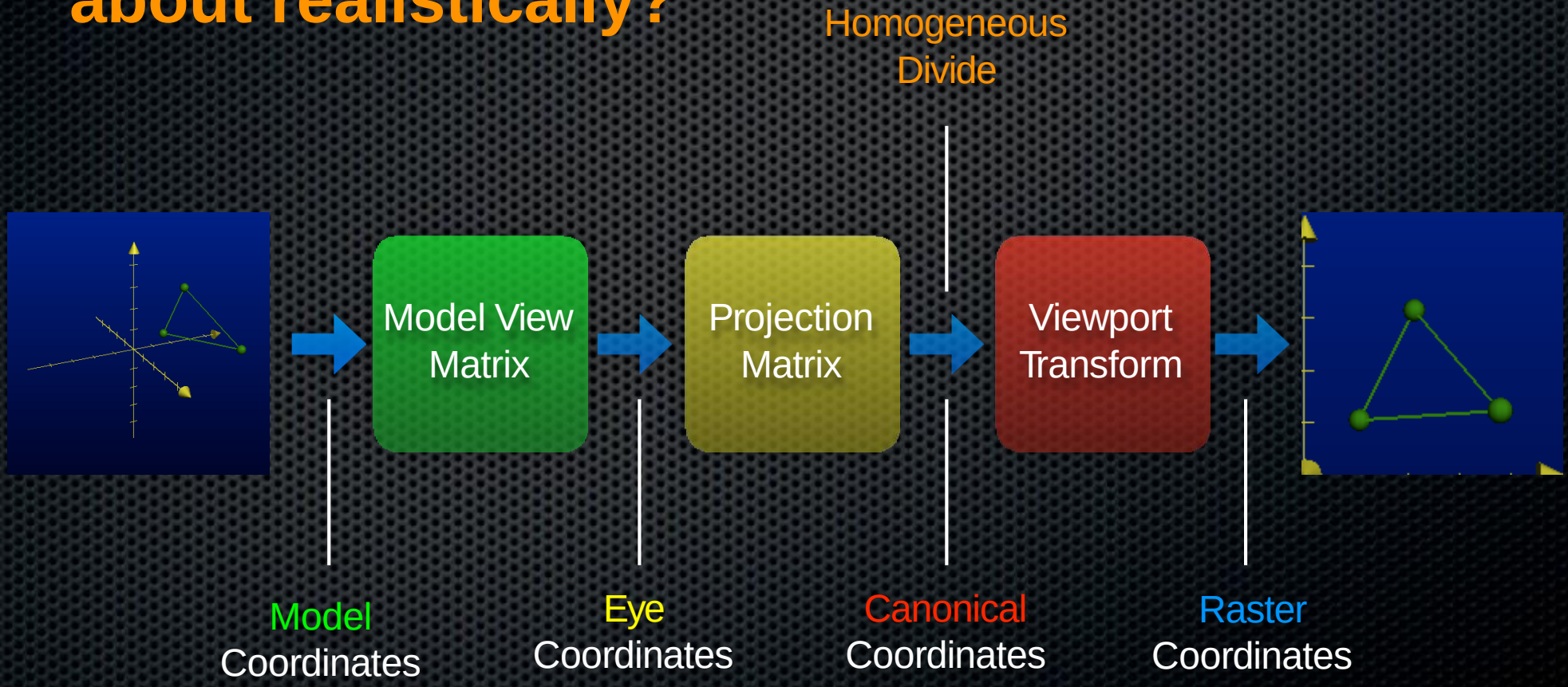


Back-Face Culling

- When to back-face cull?

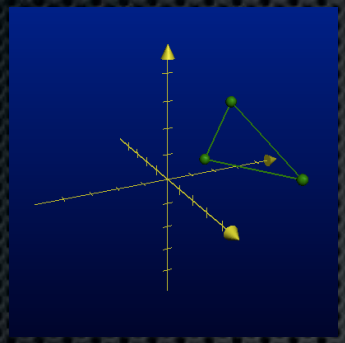
Think-Pair-Share

Ideally, where is the best place to cull? What about realistically?



Back-Face Culling

if (n.z < 0)
cull

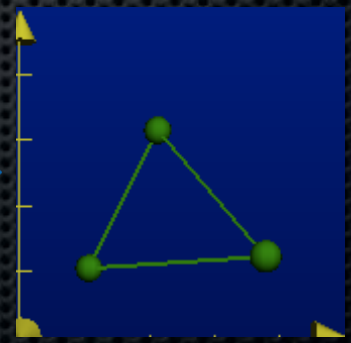


Model View Matrix

Projection Matrix

Homogeneous Divide

Viewport Transform



Model Coordinates

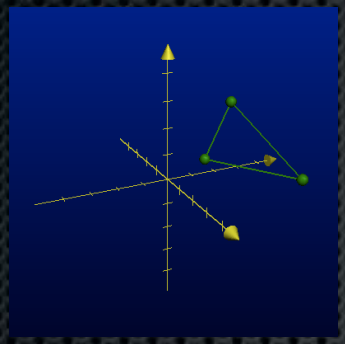
Eye Coordinates

Canonical Coordinates

Raster Coordinates

Back-Face Culling

if (n.z < 0)
cull



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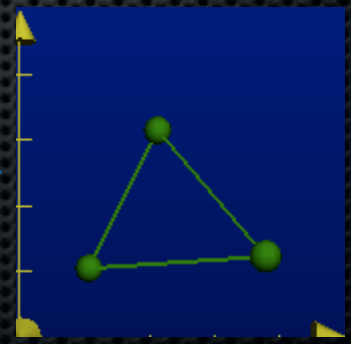

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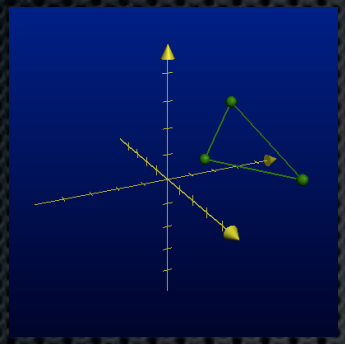
Back-Face Culling

if ($n \bullet (t_{center} - origin) > 0$)
cull



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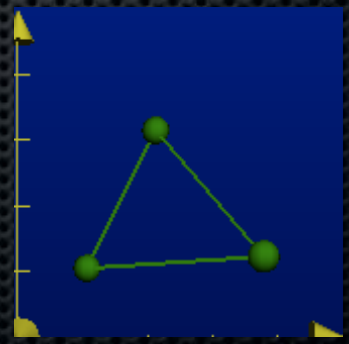

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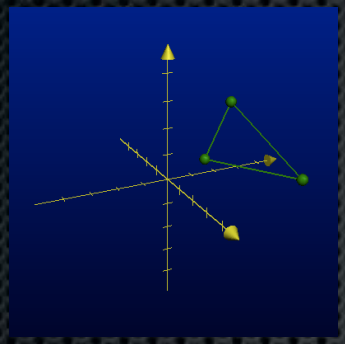
Back-Face Culling

transform eye to model coordinates

if $(n \bullet (t_{center} - eye) > 0)$
  cull



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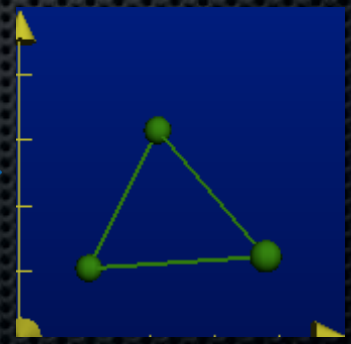

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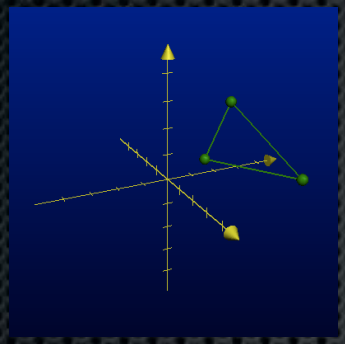

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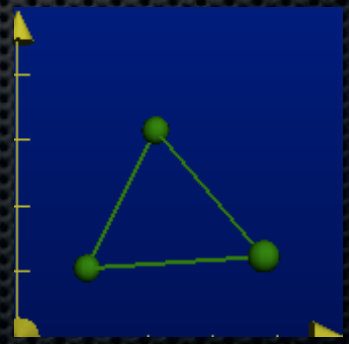

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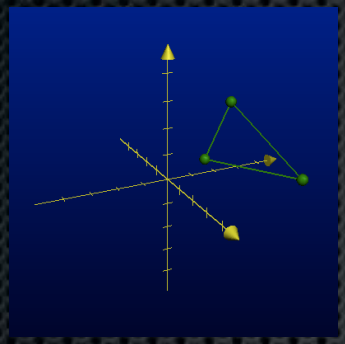

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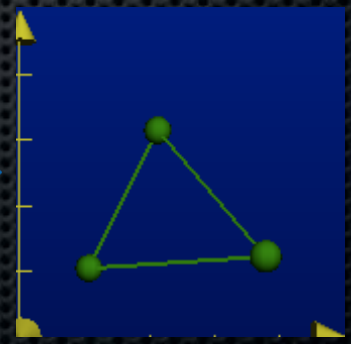

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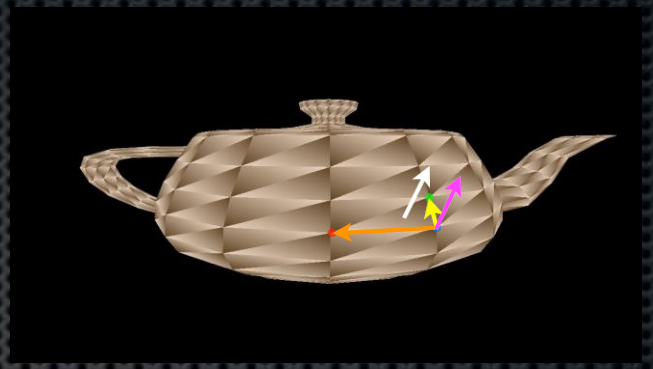

if ($n \bullet t_a > 0$)
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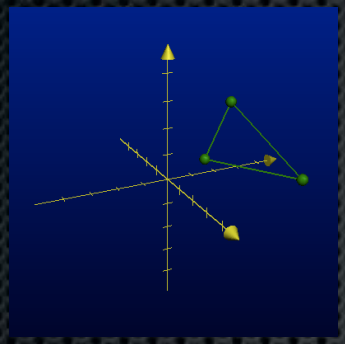
Homogeneous Divide



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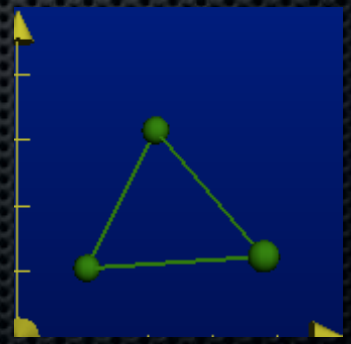

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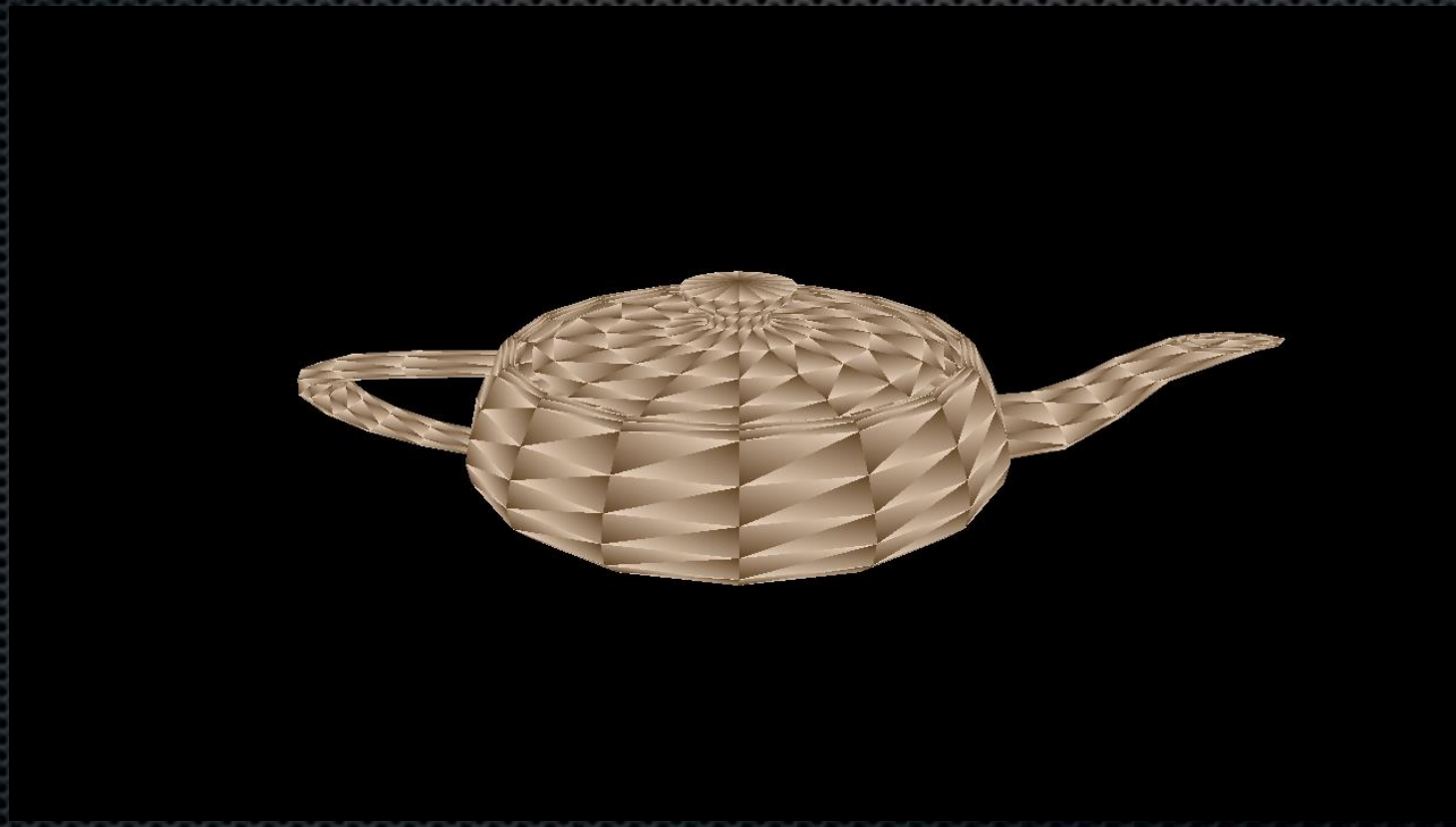
Back-Face Culling Issues



Back-Face Culling Issues

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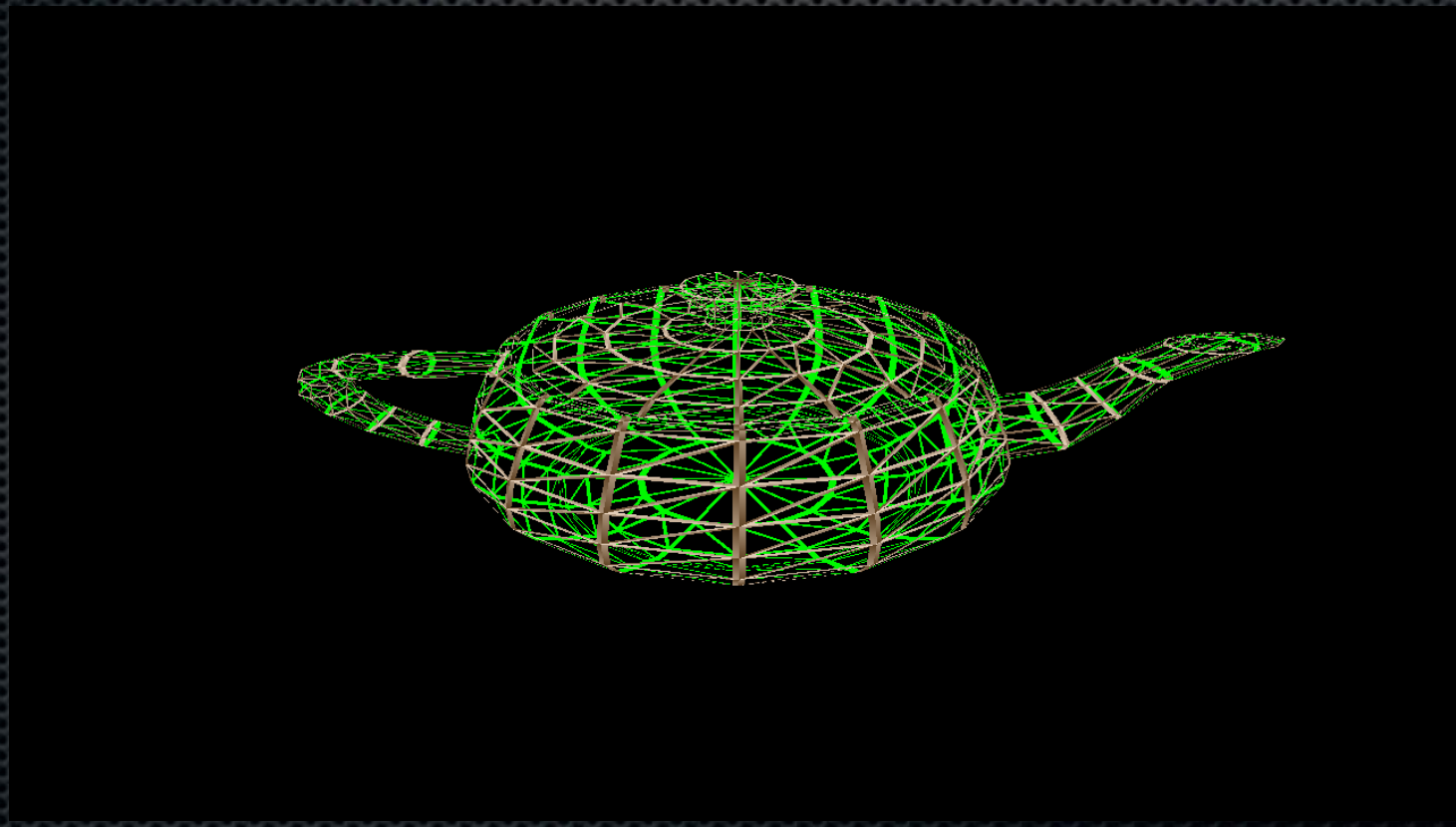
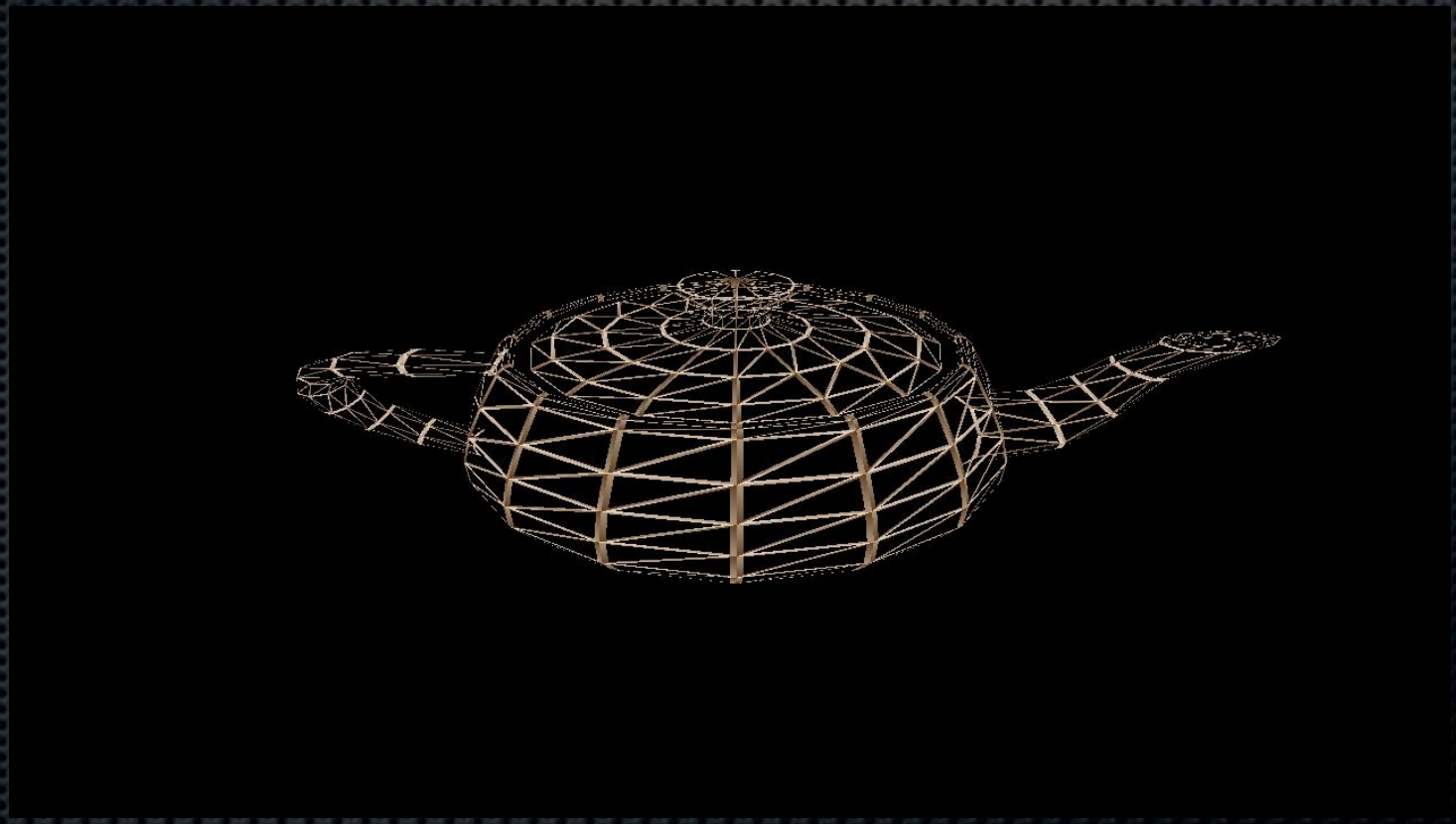


Back-Face Culling Issues

Think-Pair-Share

What's the problem here?



Back-Face Culling Issues

Other Culling Opportunities

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