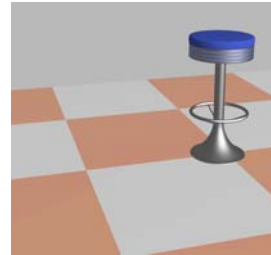


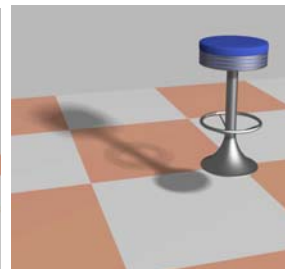
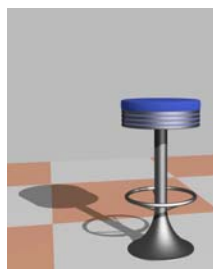
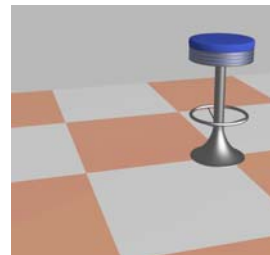
Chapter 10

Shadows



Shadows

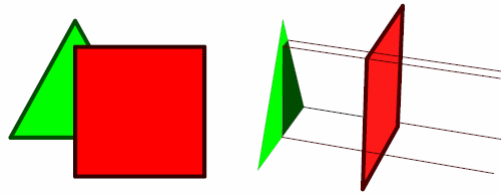
- Realistic illumination includes shadows cast by objects
- Simple shadow generation methods
 - Z-buffer extension
 - Shadow volumes
- Advanced – ray-tracing & radiosity





Z-Buffer Shadow Generation

- Object is in shadow if not “seen” by light source
- Idea – compute visibility from light source to decide if shadowed



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Z-Buffer Shadow Algorithm

- Render scene from light-source “viewpoint”
- For each pixel save z depth instead of color
- Render scene from eye view point
- Map every (visible) non-background pixel to light source space (perspective transformation)
- Compare z values
 - If identical – pixel illuminated by light source (add light source to its illumination equation)
 - If not, it is shadowed
- Need to repeat rendering & projection for each light source

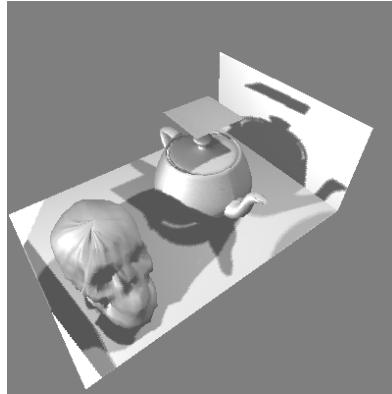


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Properties

- Can shadow ANY scene which can be rendered using Z-buffer
- However -requires separate memory buffer for each light source
- Every polygon rendered **N+1** times (for **N** light sources)
 - **N** views do not need lighting calculations



Shadows from 2 light-sources

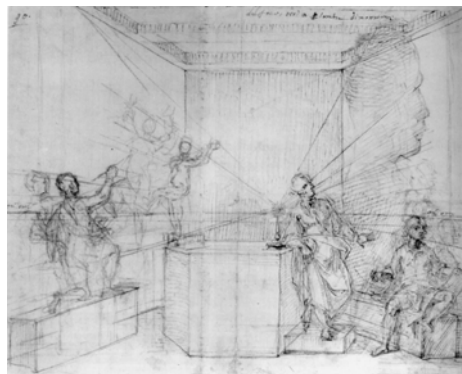


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Shadow Volumes

- Shadow – boundary between illuminated & shades space
- Compute as extrusion of silhouettes along light direction
- Compute intersection of extruded volume with other objects



Shadow volumes
circa Leonardo
daVinci



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Shadow Volumes

- Shadow Volumes illustrated (2D)

The diagram illustrates the concept of shadow volumes in a 2D perspective. On the left, a sun icon represents the 'light source', and an eye icon represents the 'eye position'. A red, irregularly shaped polygon represents the 'shadowing object'. From this object, a green, semi-transparent polygon extends away from the viewer, representing the 'shadow volume (infinite extent)'. The area between the shadowing object and the shadow volume is labeled 'partially shadowed object'. The area outside the shadow volume is labeled 'surface outside shadow volume (illuminated)', and the area inside the shadow volume is labeled 'surface inside shadow volume (shadowed)'.

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Algorithm

- For each object and light source compute object silhouette from light source viewpoint
- Extend each silhouette to form semi-infinite volumes
- Feed boundaries into regular Z-buffer as fully transparent polygons
- Front facing shadow polygons cause object behind to be shadowed
- Back facing shadow polygons cancel effect of front facing ones
- Consider vector from viewpoint to point on object – point is shadowed if vector intersects more front facing polygons than back facing

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Properties

- Object space – does not depend on view point
- High complexity per object
- Time - function of scene complexity
- Requires modeling methods
 - Silhouette computation
 - Extrusion



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