Hologram shader

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Motivation: Ice

Example of deep blue ice in nature.

- Enhanced sense of translucency.
- Illusion of submerged structures.
- Sensitive to viewing direction.
- Not too expensive (no raytracing).
- Done by surfacing artist (no modelling).

Hologram shader

Idea:

- A shading node that offsets UVs.
- Based on a soft "depth" map.
- Approximates location of “sunken” surface.
- Offset UVs are used to look up textures.
- Sunken textures blended with "surface-level" shading.

Hologram shader

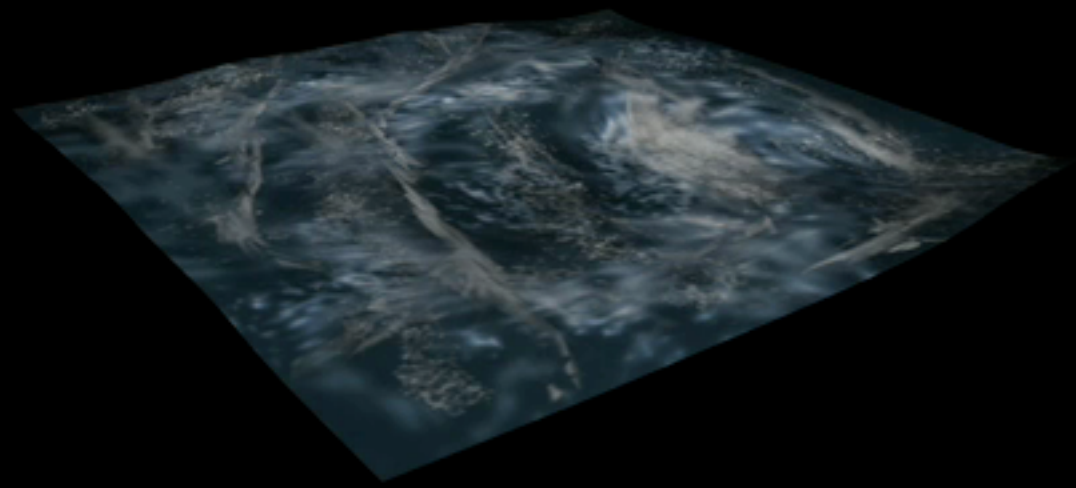
Application:

- Used on floors and walls for deep, non-frosty ice.

Hologram shader

Problems:

- Required an very soft, low-frequency depth map to avoid artifacts.
- Sunken pseudo-surfaces not shaded well.



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Parallax mapping:

- A better idea developed in the games industry.
- "Steps" down through higher frequency depth maps.

McGuire, McGuire. "Steep Parallax Mapping", I3D 2005

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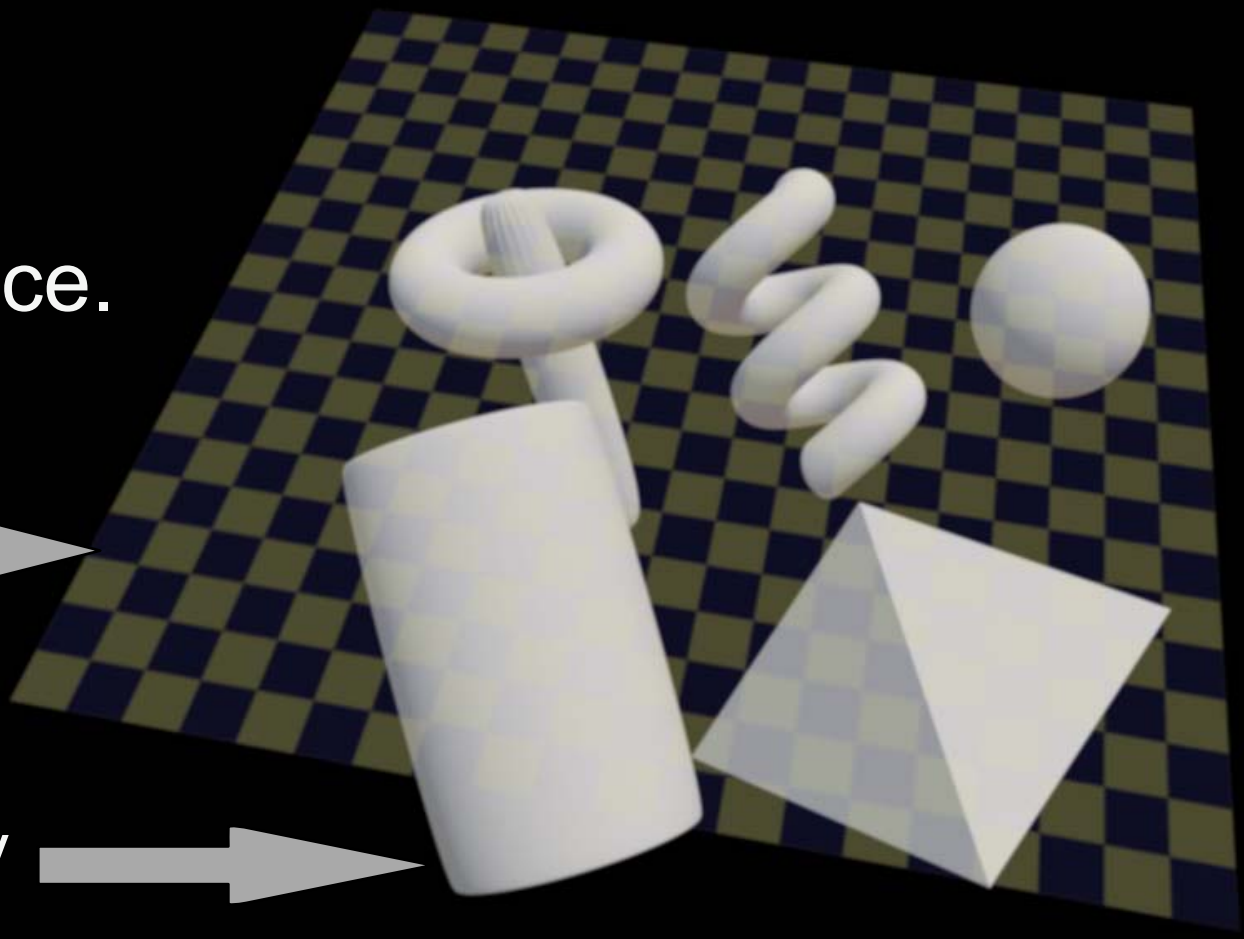
Task:

- Encase arbitrary geos in a plane of ice.



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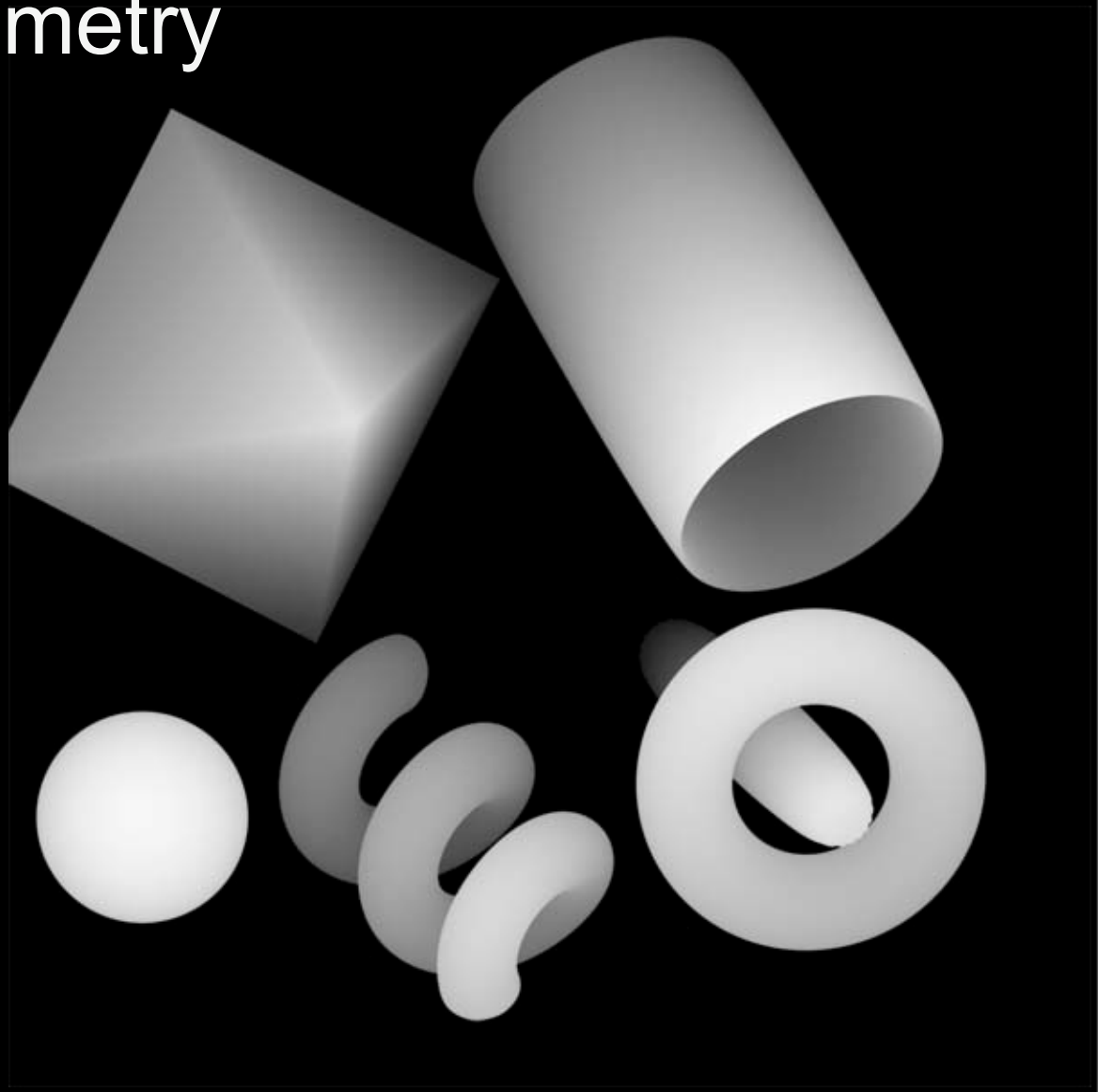
Depth pass of the geometry

- Minimum and maximum depth recorded for use in shader.



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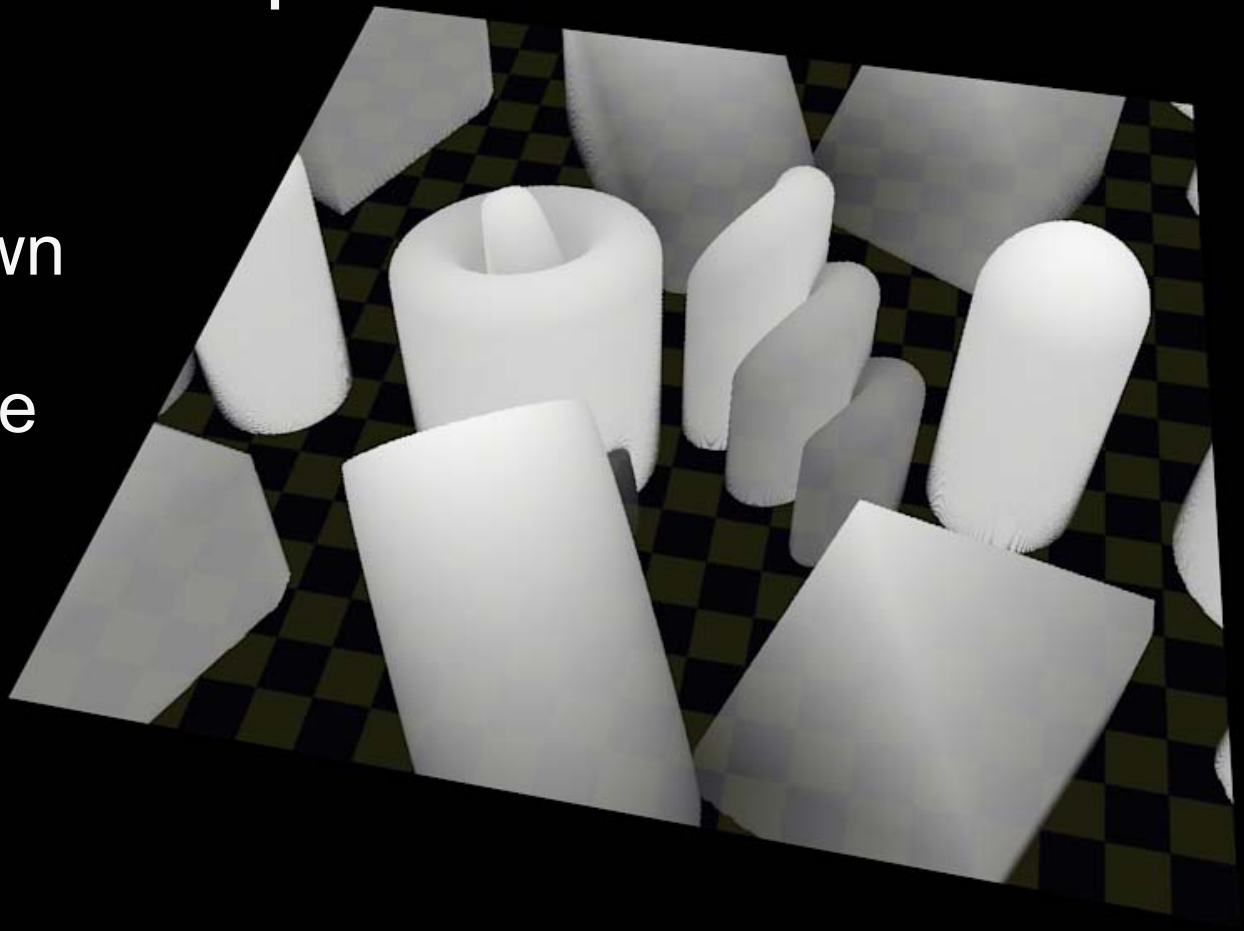
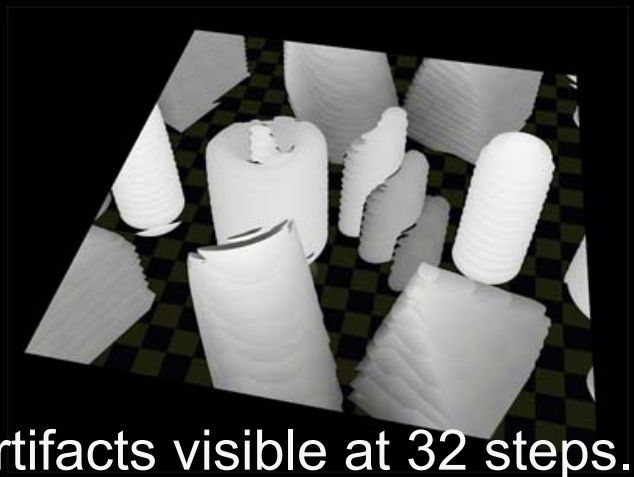
Steep Parallax variant implemented in RSL.

- 512 steps per pixel
- Edges run straight down
- Extra geos from texture wrapping.





Artifacts visible at 32 steps.

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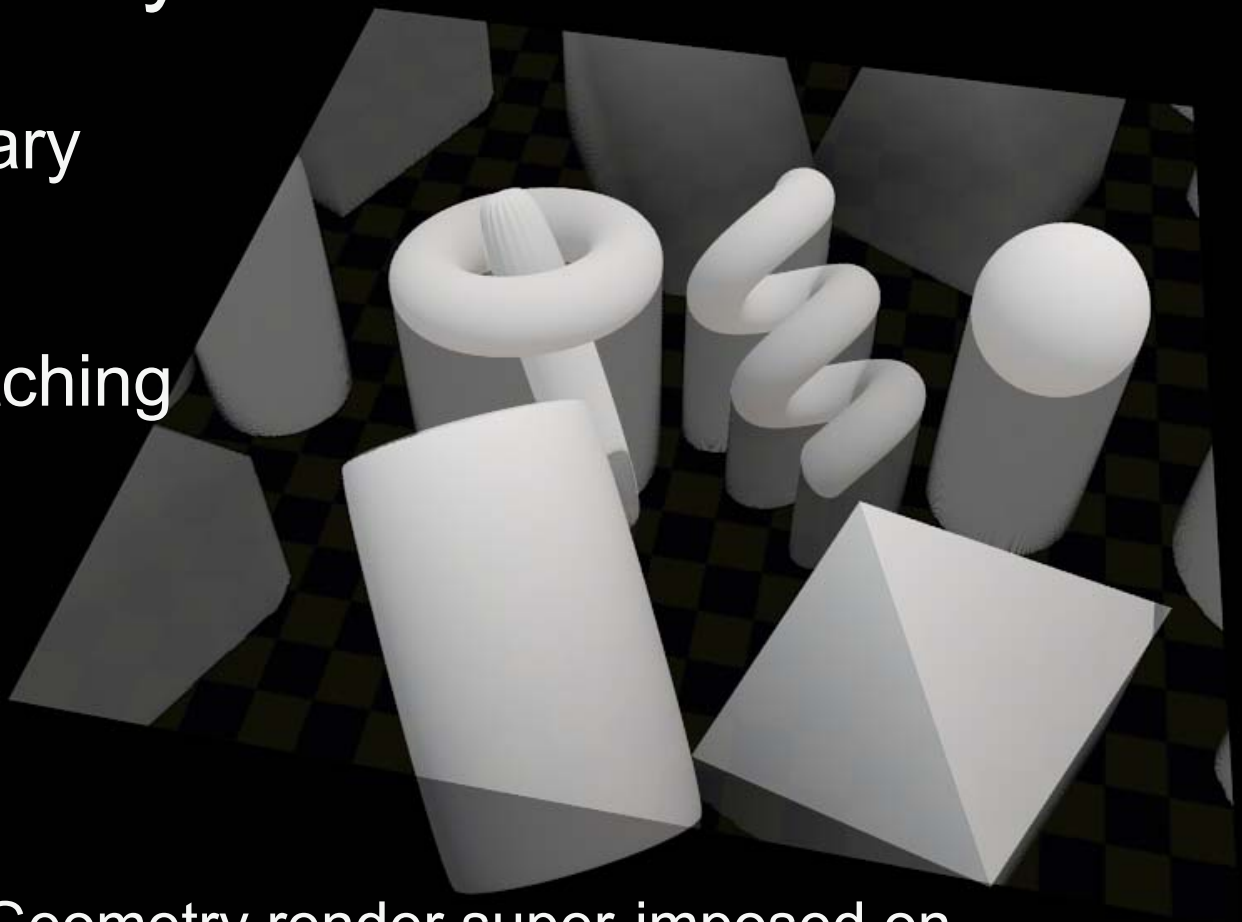
Verification of accuracy

- Registration at arbitrary camera angles.
- Required careful matching of depth camera and shader settings.



Geometry render super-imposed on hologram plane render.

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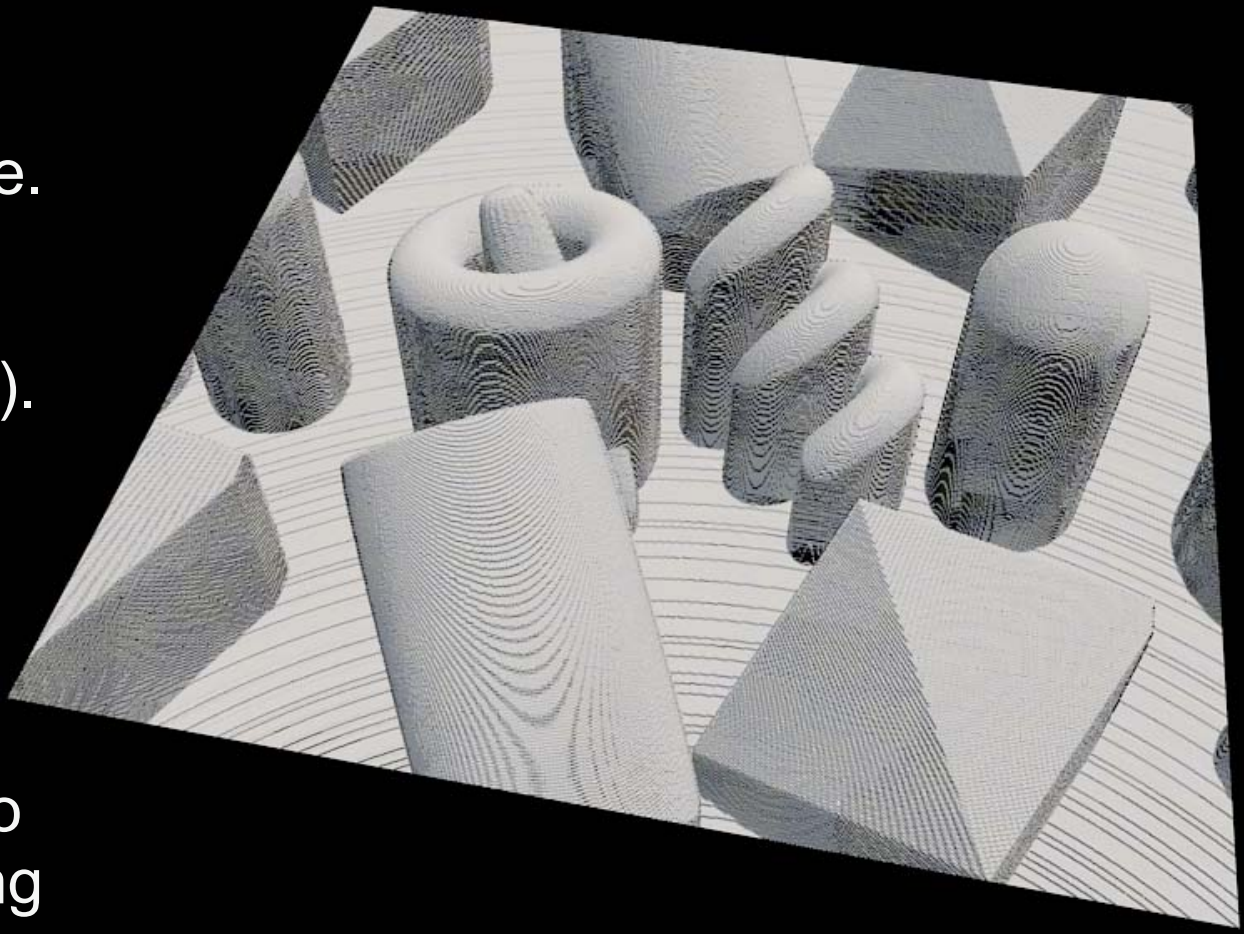
Offset UVs used for texture lookups.

- UV output to other shading nodes.
- Multiple "holograms" can produce a layered effect.

Same shader with 20% depth.

Hologram shader

Final hit point used to calculate normals.



- We'd like to shade the hologram pseudo-surface.
- Final step point can be used to calculatenormal().
- Discontinuities cause severe artifacts :(
- (But the hit point can also be used for more forgiving 3D textures and procedurals!)

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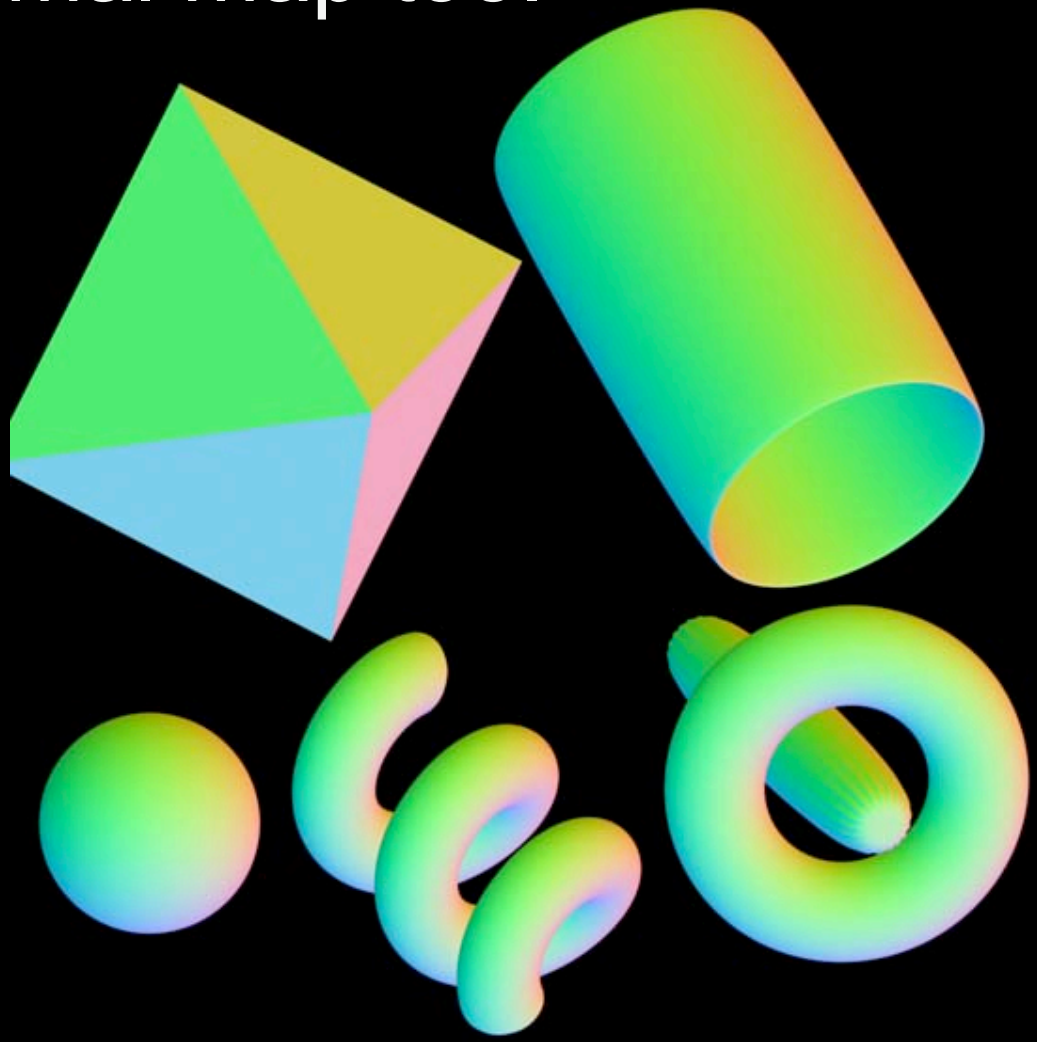
Okay, we'll make a normal map too.

- Considered as being in "tangent space"



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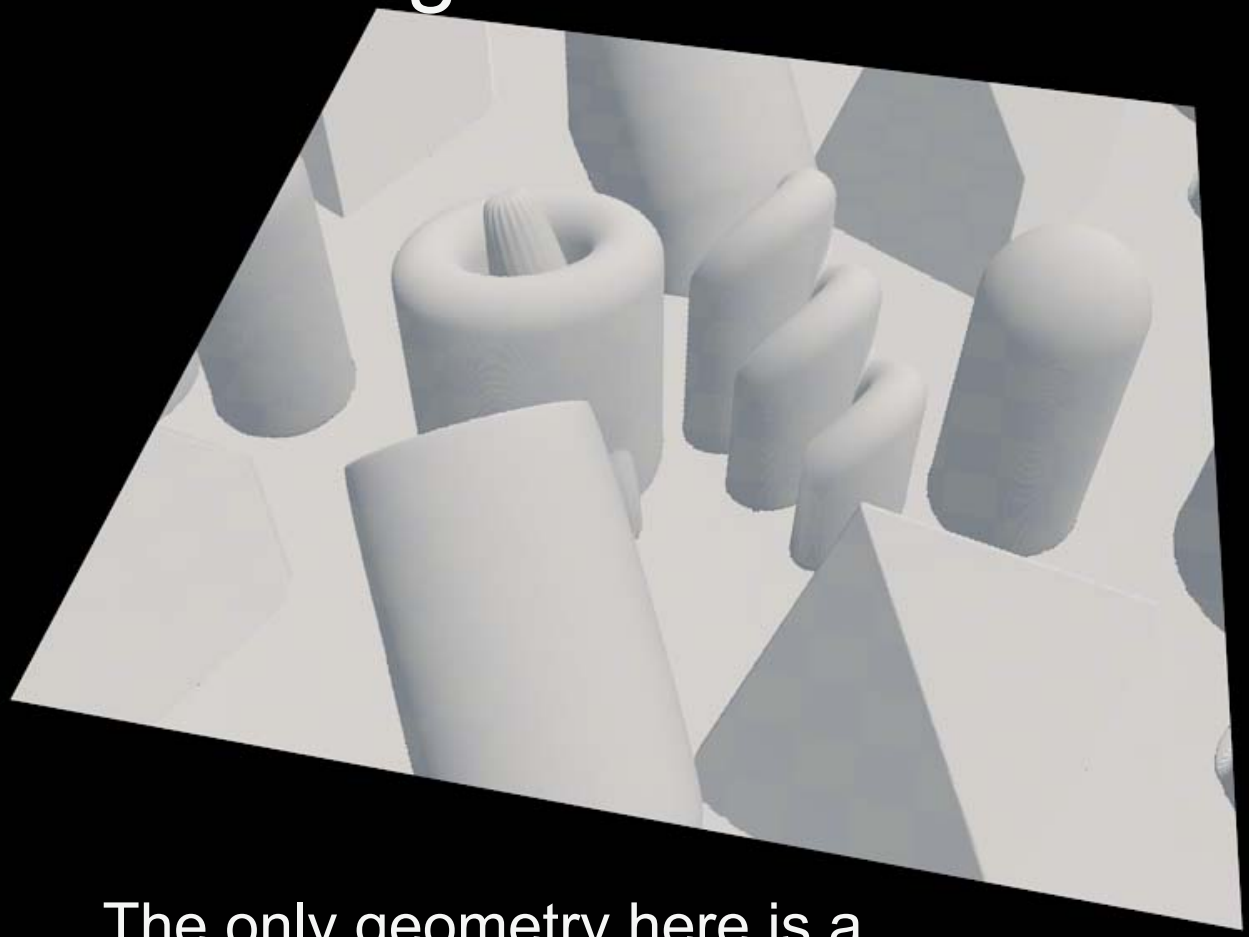
Normal map used for shading instead.

- Looks much nicer.
- Normals need transforming from tangent space.



The only geometry here is a single plane.

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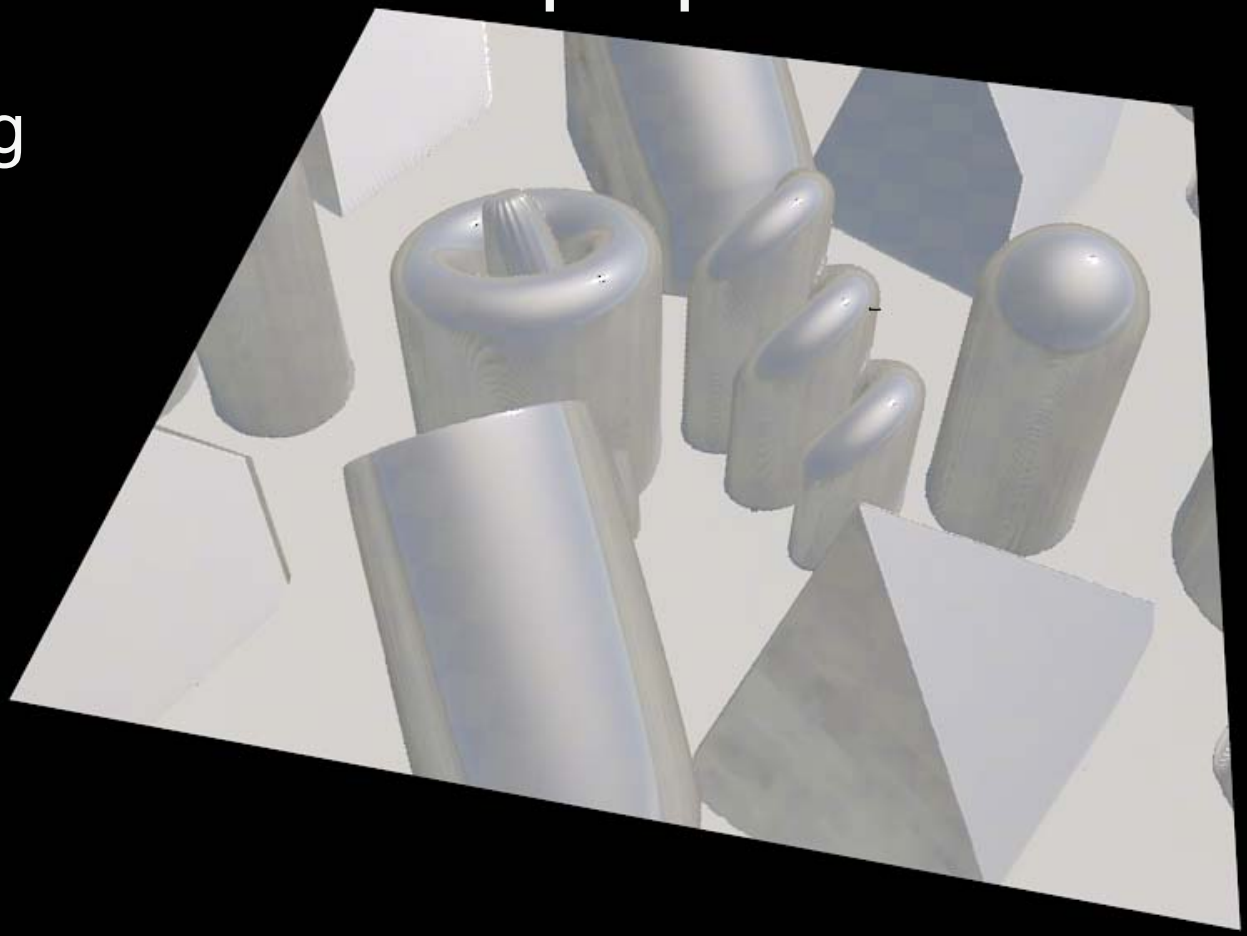
Normals used for other surface properties.

- All our relevant shading nodes take normal overrides.
- E.g. the hologram normals can be used for diffuse, specular or reflections.



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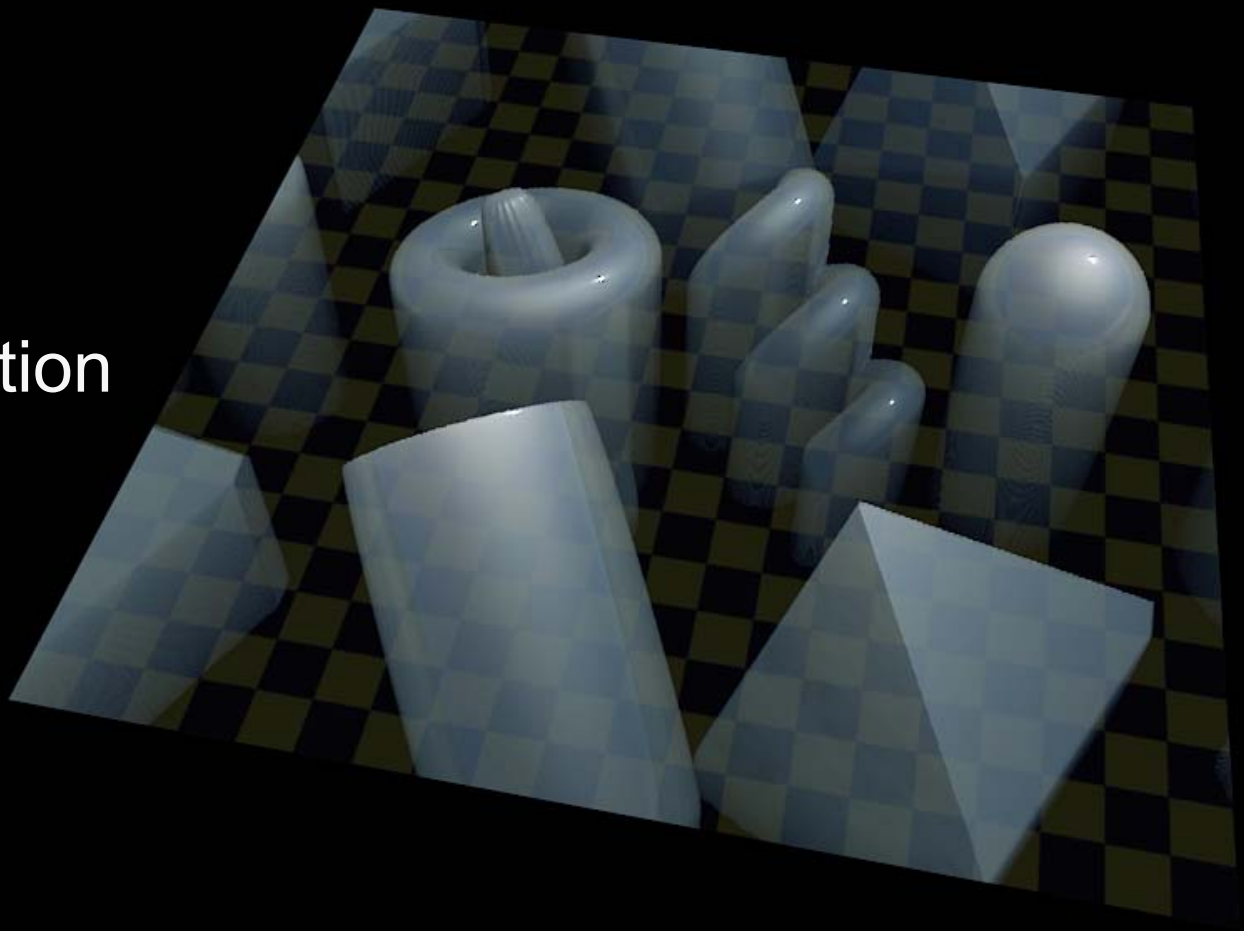
Per-channel depth attenuation

- Based on the distance stepped through map.
- Simulates light attenuation in ice.
- Helps hide lack of underside and other artifacts.



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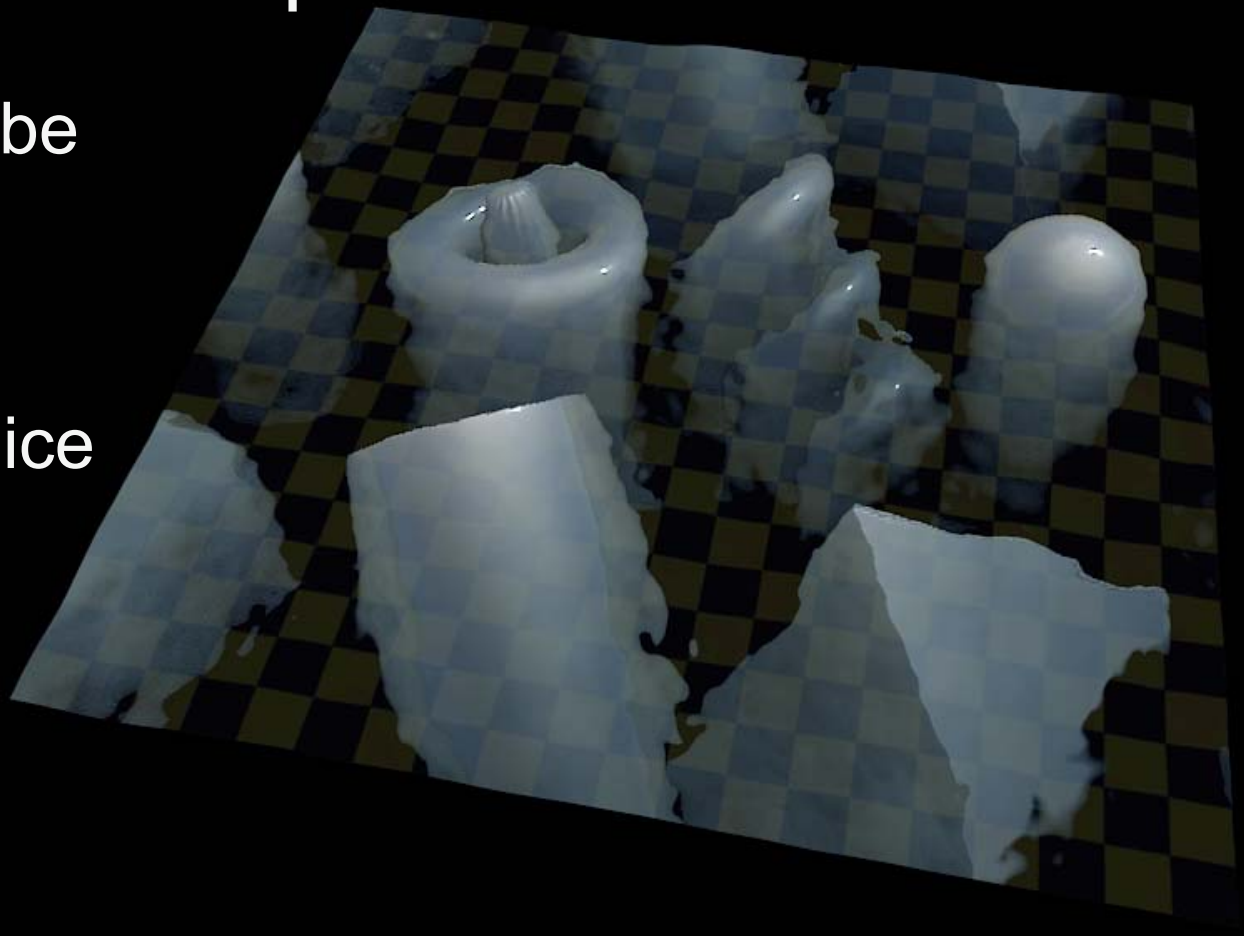
Fresnel refraction and displacement.

- The step direction can be bent using a standard Fresnel equation.
- Simulates refraction in ice (or other mediums).
- Displacement can be used to distort the direction further.



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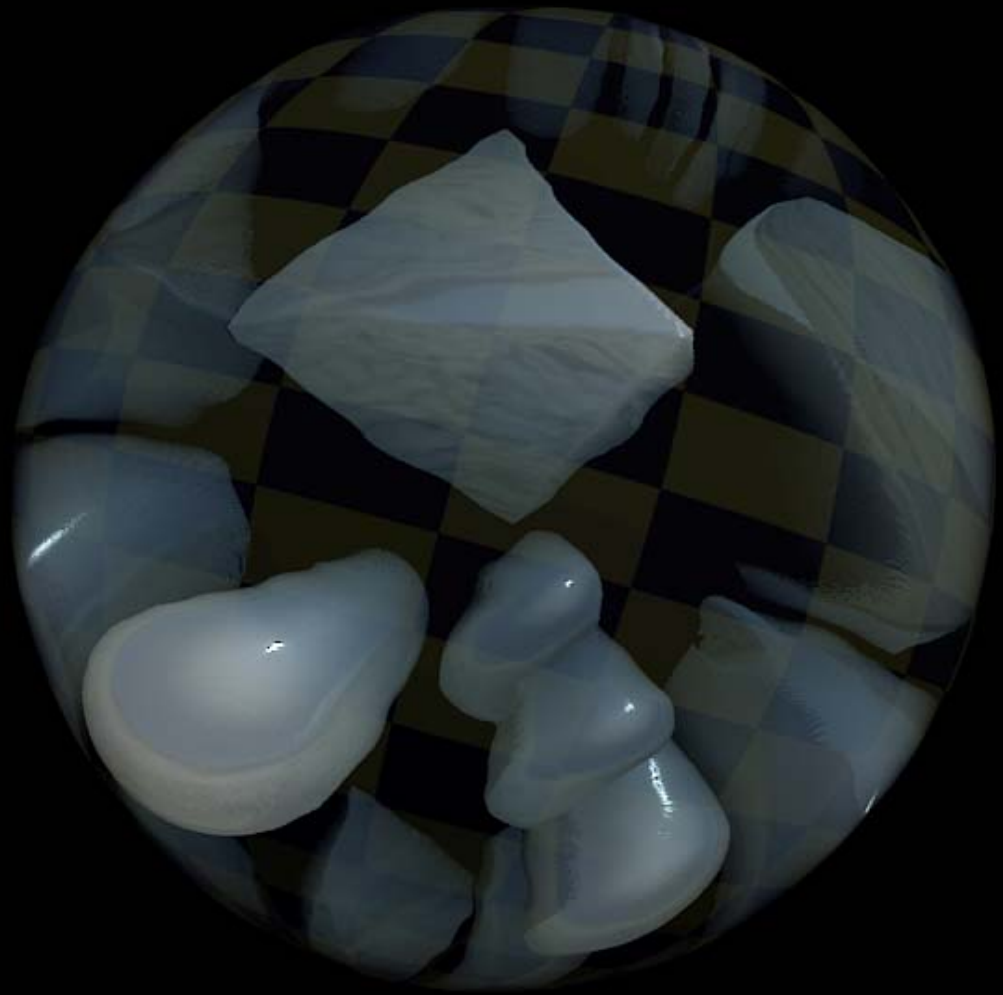
Other shapes

- Can be applied to anything with UVs.
- High curvature + depth = distortion



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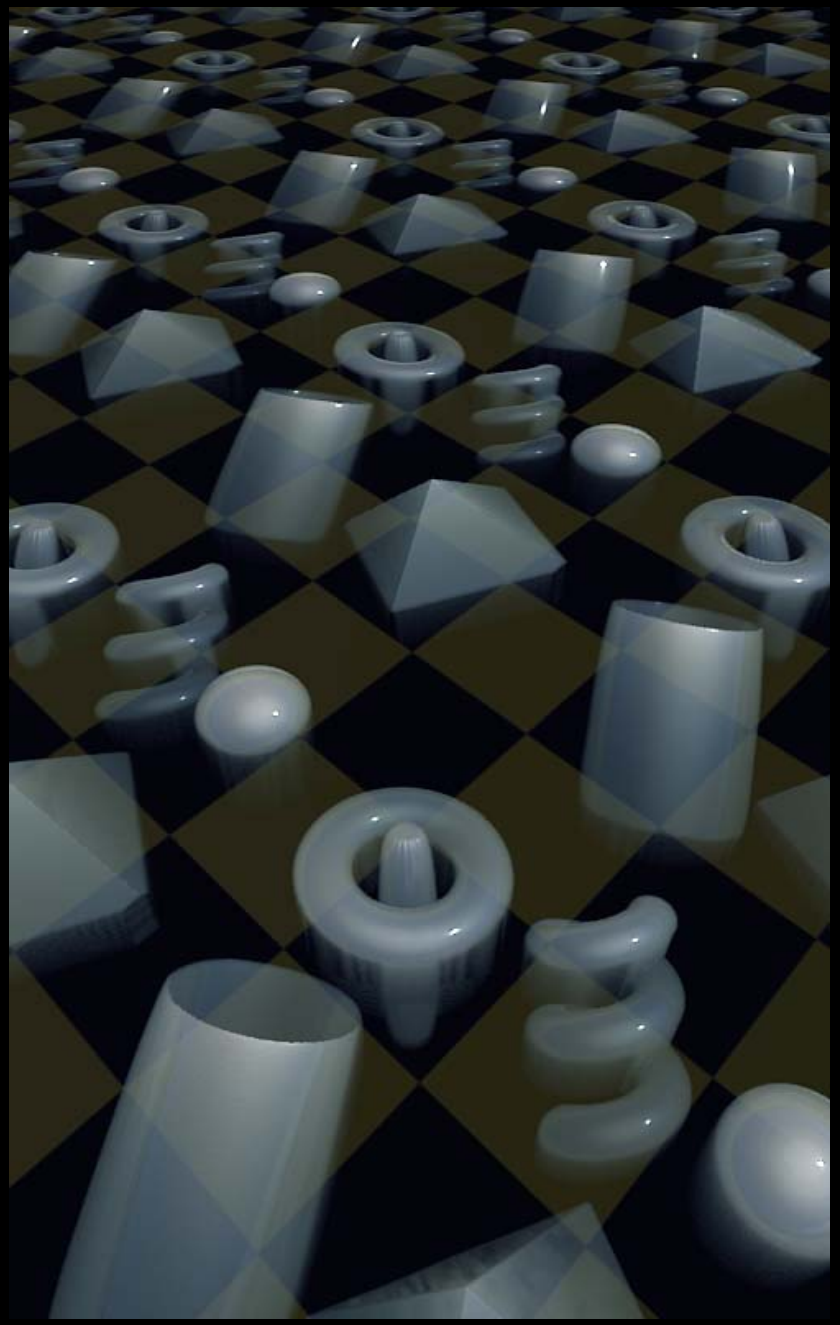
Limitations

Can't be done: (yet)

- Self-shadowing
- Self-reflection
- Ambient self-occlusion
- Subsurface scattering
- etc etc

These probably could be implemented, but might complicate our shading workflow...



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The End