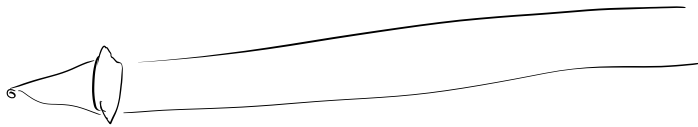


Pinhole camera

Penumbra



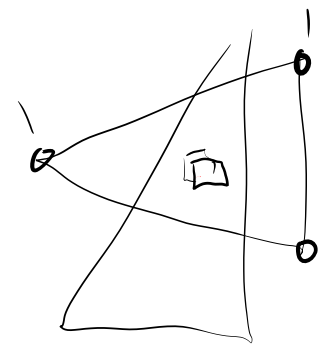
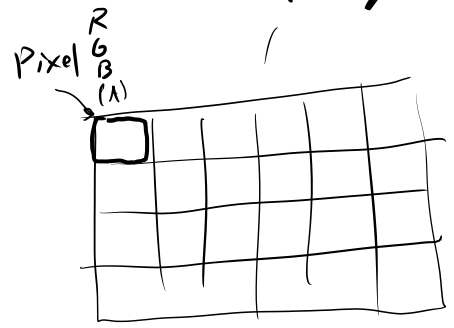
Vertex
 frag
 geom
 compute

Shaders

1 object's contrib
 to 1 pixel

fragment

Programmable
 shader



Shade - light or dark



lighting
 textures

frag shader

in $s_x, s_y, s_z, \vec{P}, \vec{n}, (u, v), \vec{c}$

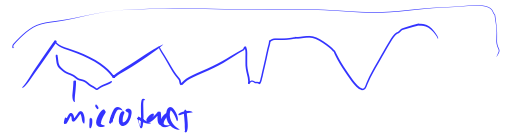
out r, g, b α z $down?$

from DDA/Bes/scanline

$$\text{Color}_{light} * [a \cdot \text{Color}_{obj} + \text{diff}(l, n) \cdot (\text{Color}_{obj} + \text{spec}(l, n, e))]$$

☼ light source

microscope



Oren-Nayar

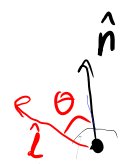
lighting

(a point, w/a normal)
obj color

Ambient light

↳ flat hit to all

Diffuse light (view-angle indep)

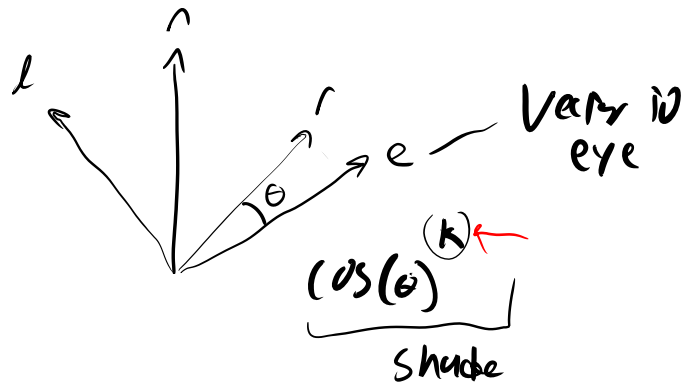


→ Lambert $\max(0, \cos(\theta) = \hat{n} \cdot \hat{l})$

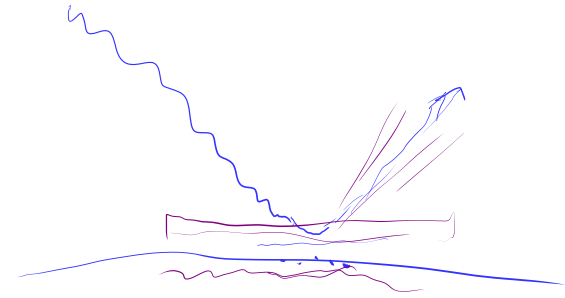
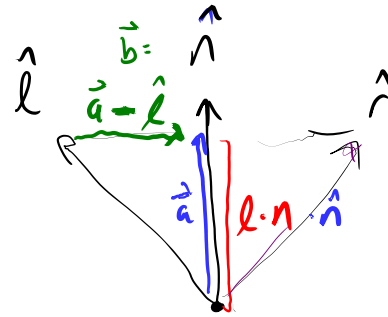
why doesn't the moon look like a ball?

Min aert

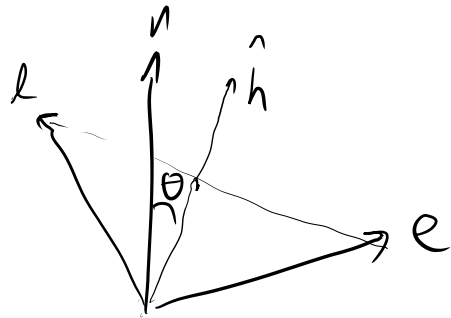
Phong



Specularity
 shininess
 color - white



Blinn - Phong



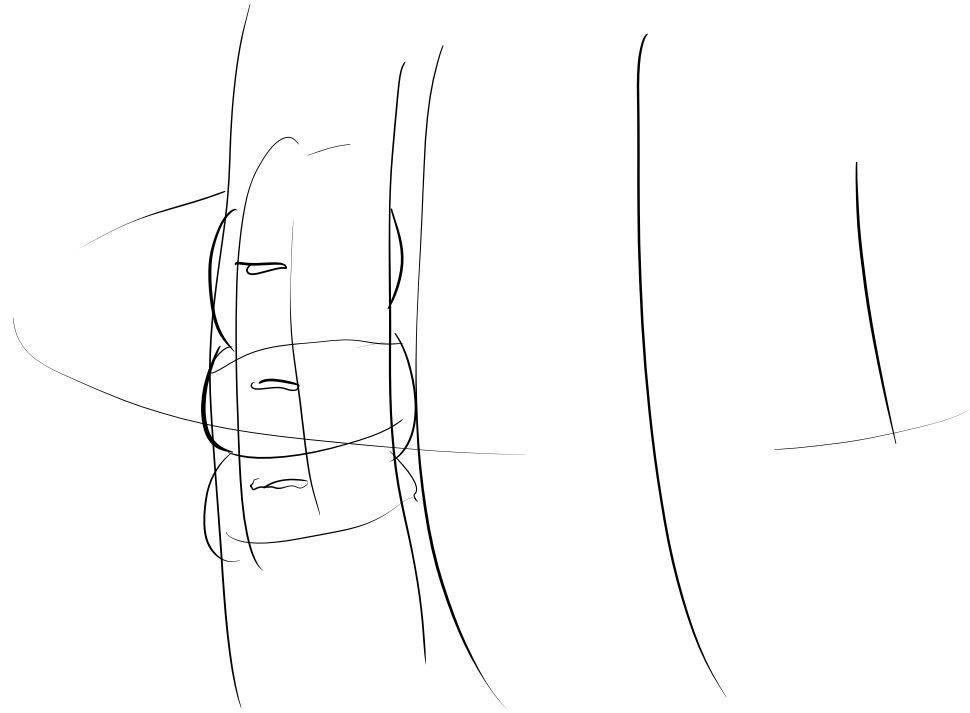
$$\hat{l} + 2\vec{b} = \hat{r}$$

Gaussian

Beckman

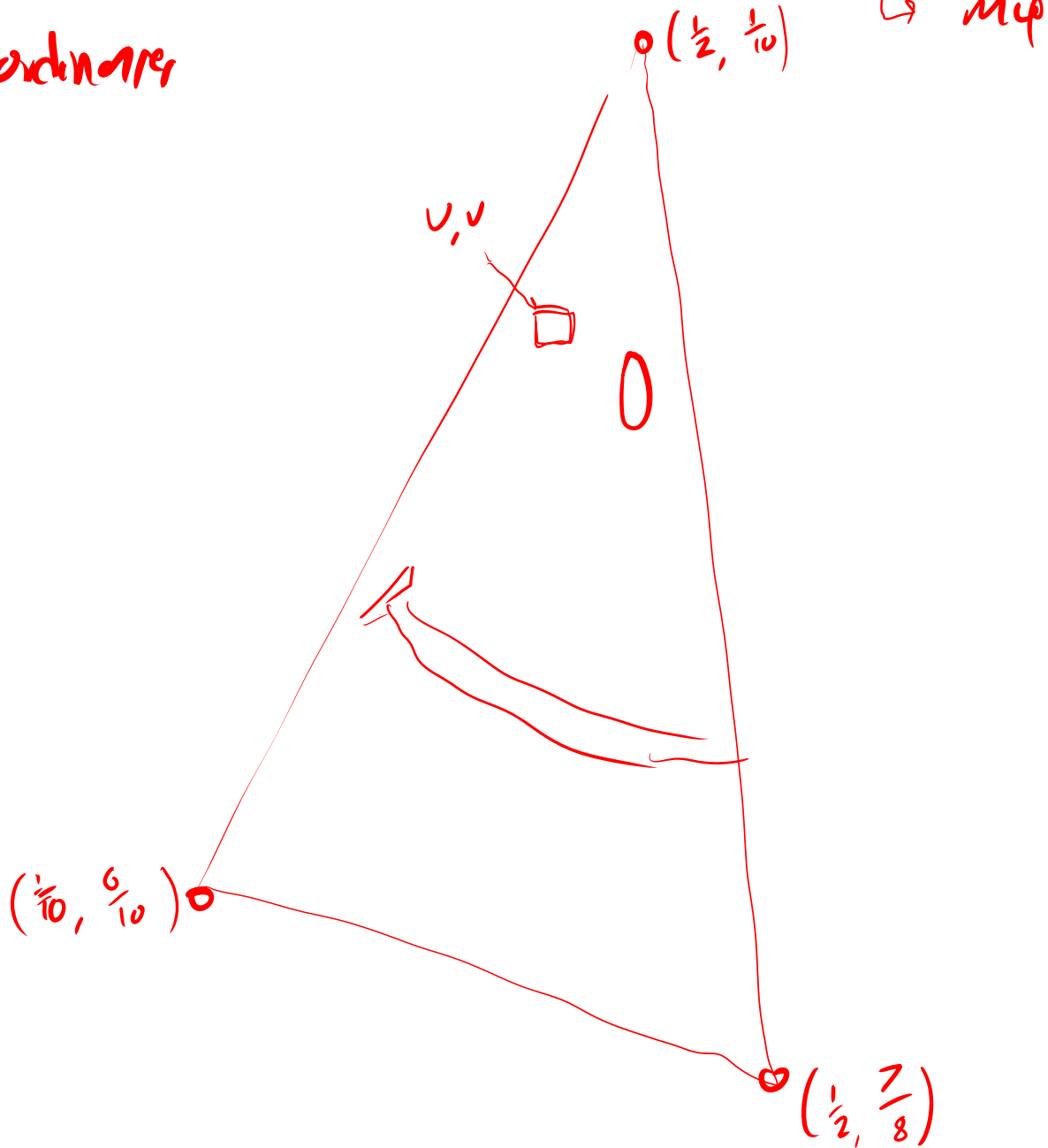
Cook Torrance

not
Anisotropic
all
specularity
total

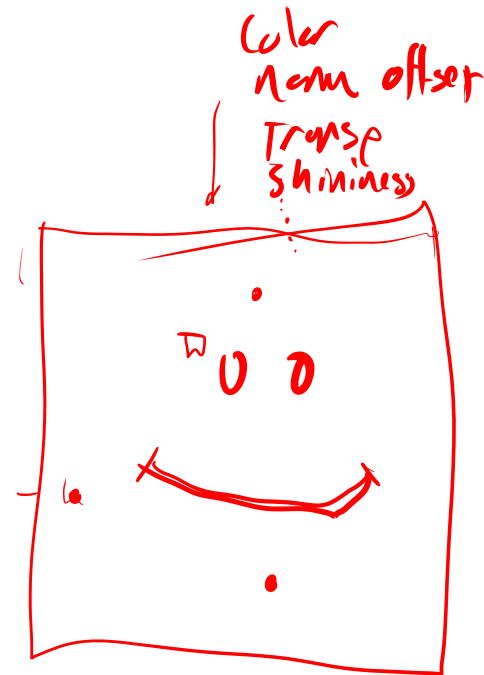


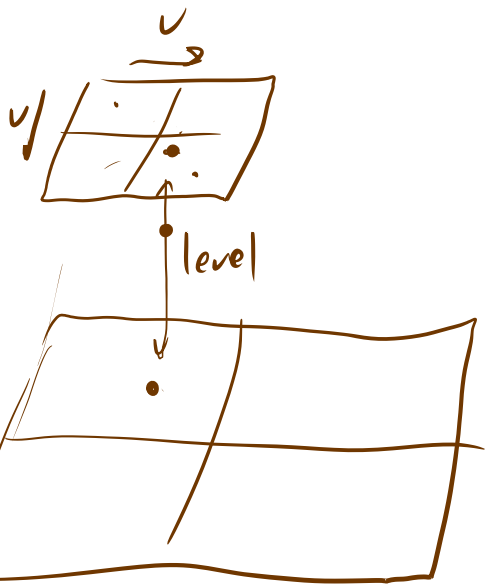
Texture map

Texture coordinates

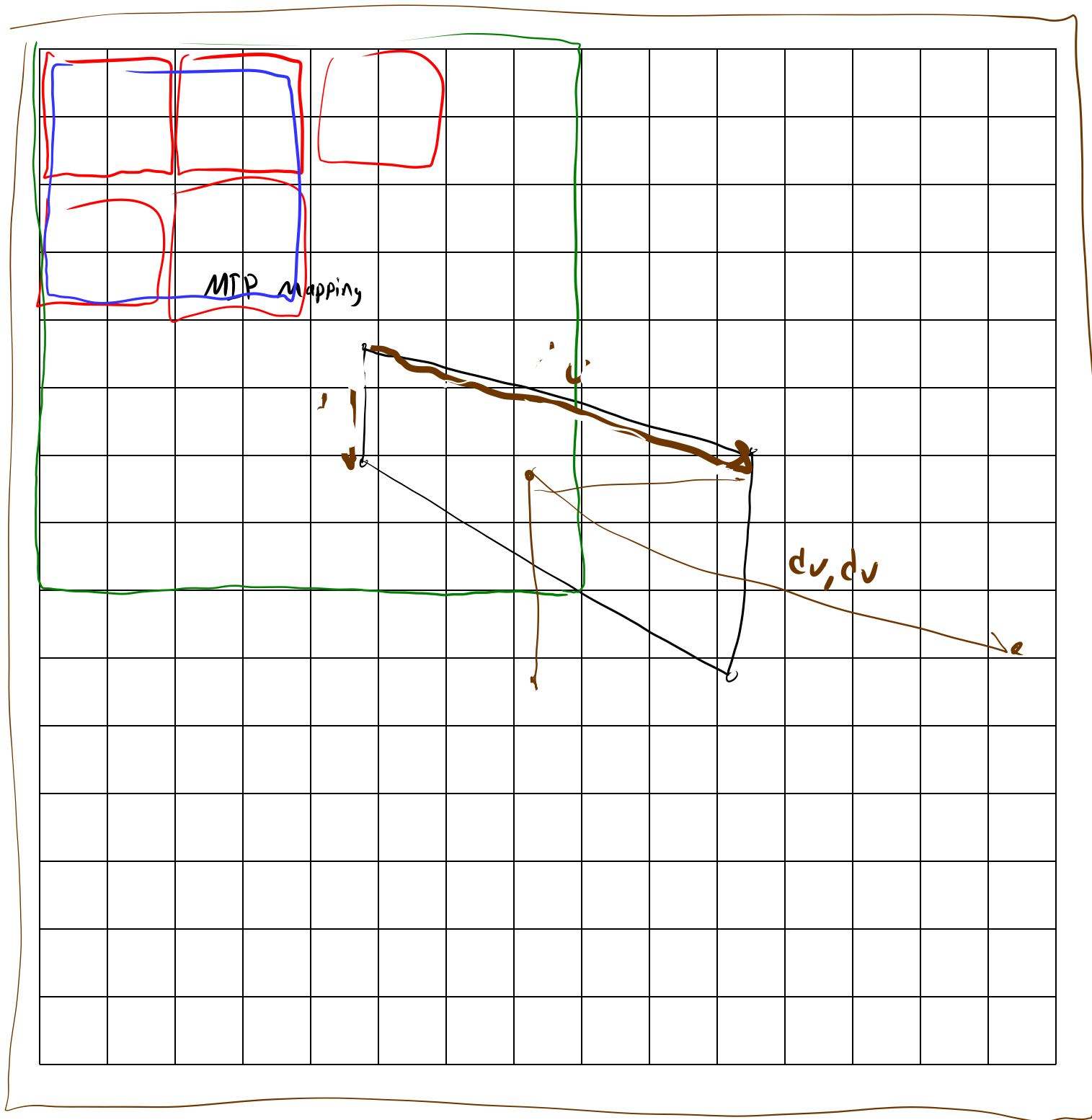


forward \rightarrow
texel to fragment
 \leftarrow
backward





tri-linear
filtering



aliasing

