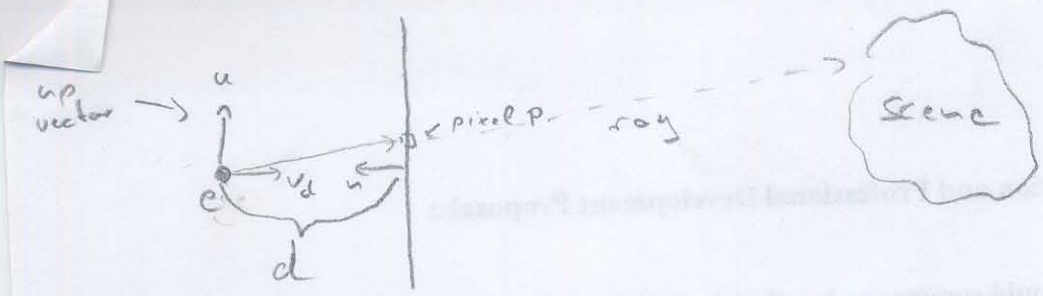
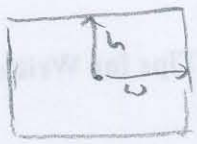




$e_2 = u$
$e_1 = u \times v_d$ $\Rightarrow (v_d, e_1, e_2)$ viewing coordinate system

Define distance d between eye and image plane, as well as width w & height h.

Discretize image plane according to the size of your output window

Compute ray through pixel (x, y):

$$p = e + d \cdot v_d + e_1\left(x - \frac{x_{max}}{2}\right) \cdot \frac{w}{\frac{x_{max}}{2}} + e_2\left(y - \frac{y_{max}}{2}\right) \cdot \frac{h}{\frac{y_{max}}{2}}$$

$$v = \frac{p - e}{\|p - e\|}$$

Set up equation for ray:

$$r(t) = e + t \cdot v$$

Intersect with triangle defined by v_1, v_2, v_3:

$$n_t := \frac{(v_2 - v_1) \times (v_3 - v_1)}{\|(v_2 - v_1) \times (v_3 - v_1)\|}$$

Then, the plane defined by the triangle is:

$$n_t (x - v_1) = 0$$

Intersection with plane:

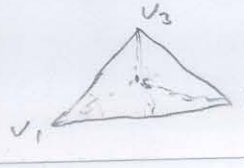
$$t = (v_1 - e) \cdot n_t / v \cdot n_t$$

$\Rightarrow$ point of intersection: $s = r(t) = e + \left((v_1 - e) \cdot n_t / (v \cdot n_t)\right) \cdot v$

Check if point of intersection is inside the triangle

area of triangle:

$$A = \frac{1}{2}\|(v_2 - v_1) \times (v_3 - v_1)\|$$



other areas:

$$A_1 = A_{v_1 s v_2} = \frac{1}{2}\|(v_1 - s) \times (v_2 - s)\|$$

$$A_2 = A_{v_3 s v_2} = \frac{1}{2}\|(v_2 - s) \times (v_3 - s)\|$$

$$A_3 = A_{v_1 v_2 s} = \frac{1}{2}\|(v_1 - s) \times (v_2 - s)\|$$

check if $A_1 + A_2 + A_3 > A$

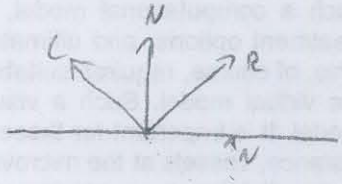
Apply Phong illumination model:

Define constant I_i, I_a, k_d, k_s, k_a, and n

$$L = V = \frac{e - s}{\|e - s\|}$$

$$N = n$$

$$R = (2\ (N \cdot L)) \cdot N - L$$



$$\Rightarrow I = I_i \left(k_d \left(\frac{e - s}{\|e - s\|} \cdot n \right) + k_s \left(\left(2 \left(n \cdot \frac{e - s}{\|e - s\|} \right) \right) \cdot n - \frac{e - s}{\|e - s\|} \right) \cdot \frac{e - s}{\|e - s\|} + k_a I_a \right.$$