Project 3 written

1) For any vector $\vec{v}$, let $\hat{v} = \frac{\vec{v}}{\|\vec{v}\|}$ (The vector normalized to unit length)

Let $e_3 = \hat{t}$ (+z ; into scene)

$e_2' = \vec{u} - (\vec{u} \cdot \vec{t}) \cdot \vec{t}$

$e_2 = \widehat{e_2'}$

$e_1 = \hat{t} \times e_2$

in retrospect I would have done this cross-product with $\hat{u}$ instead of e_2, which would have made calculating e_2 nicer as well

This is a left-hand frame

+x to the right

+y up

+z in

2) $\vec{q} = Q - C$ (vector from C to Q)

$d = \vec{q} \cdot e_3$ (depth from camera into scene)

$\vec{q'} = \vec{q} \cdot \frac{\|e_3\|}{d} = \frac{\vec{q}}{d}$ (vector from C to Q')

$Q' = C + \vec{q'}$

are these also correct?

$x = (O - Q') \cdot e_1$

$y = (O - Q') \cdot e_2$

$x = \vec{q'} \cdot e_1$

$y = \vec{q'} \cdot e_2$

3) $\vec{p} = P_1 - P_0$

In order to intersect the <u>line</u> — not line segment — P_0P_1, Q_0 and Q_1 must be on opposite sides

$\vec{v} = p^{\perp}$

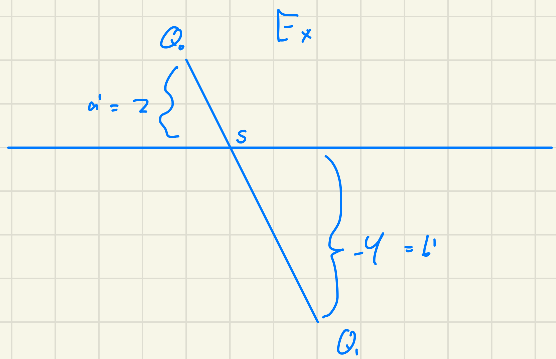
$a' = \left((Q_0 - P_0) \cdot \vec{v}\right)$ $\qquad$ $\vec{a} = a' \cdot \vec{v}$

$b' = \left((Q_1 - P_0) \cdot \vec{v}\right)$ $\qquad$ $\vec{b} = b' \cdot \vec{v}$

$\vec{a} + \vec{b}$ must equal 0

aka $\operatorname{sign}\left((Q_0 - P_0) \cdot \vec{v}\right) \neq \operatorname{sign}\left((Q_1 - P_0) \cdot \vec{v}\right)$

$S = (1-s)Q_0 + sQ_1$ when $s = \dfrac{a'}{a' - b'}$



S must be between P_0 and P_1

$\vec{c} = S - P_0$

$0 < ||\vec{c}|| < ||\vec{p}||$

$\Rightarrow \quad 0 < \dfrac{||\vec{c}||}{||\vec{p}||}$

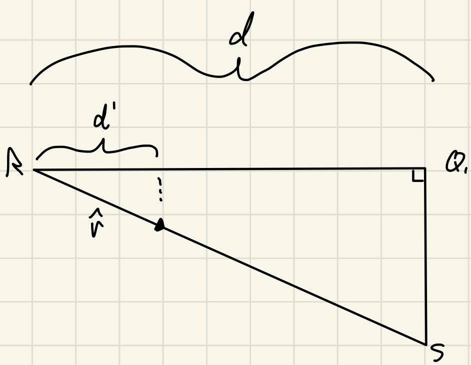
4) Let $\vec{q}_2 = Q_2 - Q_1$
$\vec{q}_3 = Q_3 - Q_1$

The vector normal to the triangle is thus $\vec{q}_1 \times \vec{q}_2$

$$\hat{n} = \hat{q}_1 \times \hat{q}_2$$

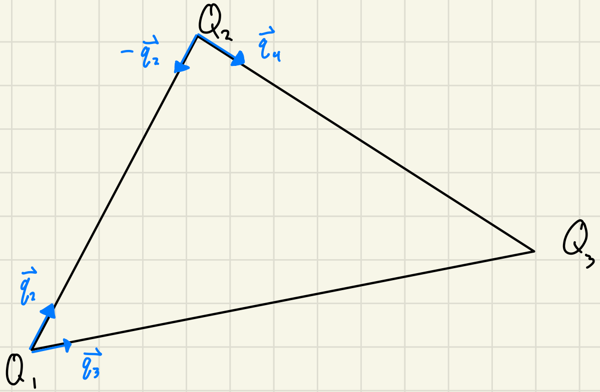
Distance from R to the plane is

$$d = (Q_1 - R) \cdot \hat{n} \quad = \| Q_1 - R \|$$



$$S = R + \frac{d}{d'} \hat{r}$$

S is on the plane, but maybe not a point of intersection



S is in $\triangle Q_1 Q_2 Q_3$

iff

$(S - Q_1)$ is within $\angle \vec{q}_2 \ \vec{q}_3$

and

$(S - Q_2)$ is within $\angle -\vec{q}_2 \ \vec{q}_4$

$$\operatorname{sign}\left(\vec{q}_2 \times (S - Q_1)\right) = \operatorname{sign}\left(\vec{q}_2 \times \vec{q}_3\right)$$

and

$$\operatorname{sign}\left(\vec{q}_3 \times (S - Q_1)\right) = \operatorname{sign}\left(\vec{q}_3 \times \vec{q}_2\right)$$

$$\operatorname{sign}\left(-\vec{q}_2 \times (S - Q_2)\right) = \operatorname{sign}\left(-\vec{q}_2 \times \vec{q}_4\right)$$

and

$$\operatorname{sign}\left(\vec{q}_4 \times (S - Q_2)\right) = \operatorname{sign}\left(\vec{q}_4 \times -\vec{q}_2\right)$$