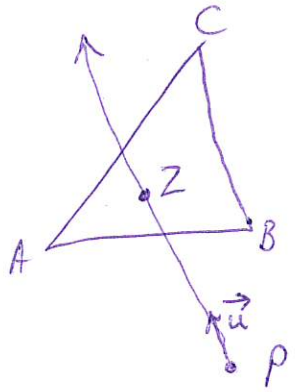
Ray - triangle intersection



on ray: $Z = P + s\vec{u}$ $\boxed{s \geq 0}$

on triangle: $Z = \alpha A + \beta B + \gamma C$ $\alpha + \beta + \gamma = 1$

$= A + \beta \overbrace{(B-A)}^{v} + \gamma \underbrace{(C-A)}_{\omega}$

combine:

$P + s\vec{u} = A + \beta \vec{v} + \gamma \vec{\omega}$

$v = B - A$
$\omega = C - A$
$y = P - A$

$\beta \vec{v} + \gamma \vec{\omega} - s\vec{u} = \underbrace{P - A}_{\vec{y}} = \vec{y}$

trick: $(u \times v) \cdot u = 0$
$(u \times v) \cdot v = 0$

solve for β, γ, s

$\beta \cancel{(u \times v) \cdot v} + \gamma (u \times v) \cdot \omega - s \cancel{(u \times v) \cdot u} = (u \times v) \cdot y$

$$\gamma = \frac{(u \times v) \cdot y}{(u \times v) \cdot \omega}$$

Same trick with $v \times \omega$

$\beta \cancel{(v \times \omega) \cdot v} + \gamma \cancel{(v \times \omega) \cdot \omega} - s (v \times \omega) \cdot u = (v \times \omega) \cdot y$

$$s = -\frac{(v \times \omega) \cdot y}{(v \times \omega) \cdot u}$$

repeat with $\omega \times u$:

$$\beta = \frac{(\omega \times u) \cdot y}{(\omega \times u) \cdot v}$$

optimization: $(u \times v) \cdot \omega = (v \times \omega) \cdot u = (\omega \times u) \cdot v$

feasibility: $s \geq 0$ in front of you

$\beta \geq 0$ $\gamma \geq 0$ $\alpha = 1 - \beta - \gamma \geq 0$ inside triangle