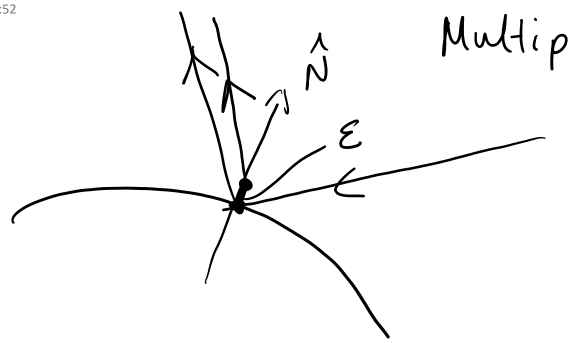
Ray Tracing - Part 3

Monday, 21 March 2022 09:52

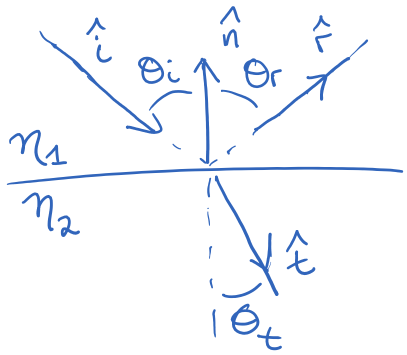


Multiple Intersect Bug Fixed!

Reflection and Refraction

$R + A = 1$

$R + T + A = 1$



Snell's Law

$$\eta_1 \sin\theta_i = \eta_2 \sin\theta_t$$

$$\sin\theta_t = \frac{\eta_1}{\eta_2}\sin\theta_i$$

$$\sin\theta_i > \frac{\eta_2}{\eta_1} \Rightarrow \text{TIR}$$

total internal reflection

$$\underline{t} = t_{\parallel} + t_{\perp}$$

$$\boxed{T + R = 1}$$

FRESNEL EQUATION

$$\boxed{\begin{aligned} R_{\perp}(\theta_i) &= \left(\frac{\eta_1\cos\theta_i - \eta_2\cos\theta_t}{\eta_1\cos\theta_i + \eta_2\cos\theta_t}\right)^2 \\ R_{\parallel}(\theta_i) &= \left(\frac{\eta_2\cos\theta_i - \eta_1\cos\theta_t}{\eta_2\cos\theta_i + \eta_1\cos\theta_t}\right)^2 \end{aligned}}$$

$$\sin^2\theta_t = \left(\frac{\eta_1}{\eta_2}\right)^2 \sin^2\theta_i = \left(\frac{\eta_1}{\eta_2}\right)^2 (1 - \cos^2\theta_i)$$

$$\cos\theta_t = \sqrt{1 - \sin^2\theta_t}$$

$$R(\theta_i) = \begin{cases} R_{\perp}(\theta_i) + R_{\parallel}(\theta_i) & \text{for no TIR} \\ 1 & \text{for TIR} \end{cases}$$

$R(\theta_i) = \Big\{ \qquad 1 \qquad$ for TIR

$$T(\theta_i) = 1 - R(\theta_i)$$

can use this to modify your reflection for the opaque case.

Schlick's Approximation

$$R_{SCH}(\theta_i) = R_0 + (1-R_0)(1-\cos\theta_i)^5$$

where $R_0 = \left(\dfrac{\eta_1 - \eta_2}{\eta_1 + \eta_2}\right)^2$

careful : $\eta_1 > \eta_2$

use $\cos\theta_t$ instead of $\cos\theta_i$

$$R_{SCH} = \begin{cases} R_0 + (1-R_0)(1-\cos\theta_i)^5 & \eta_1 \le \eta_2 \\ R_0 + (1-R_0)(1-\cos\theta_t)^5 & \eta_1 > \eta_2 \text{ and } \underline{\text{no}} \text{ TIR} \\ 1 & \eta_1 > \eta_2 \text{ and TIR} \end{cases}$$

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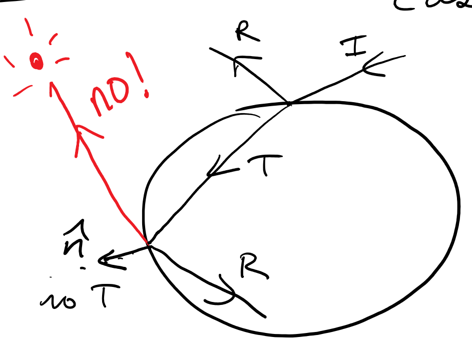
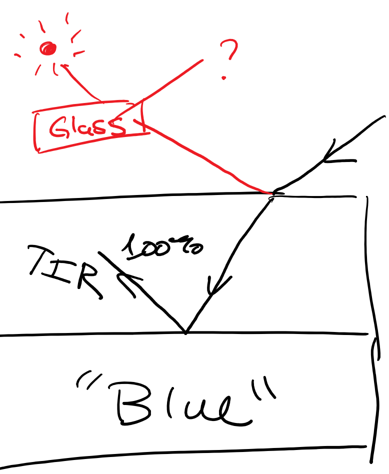
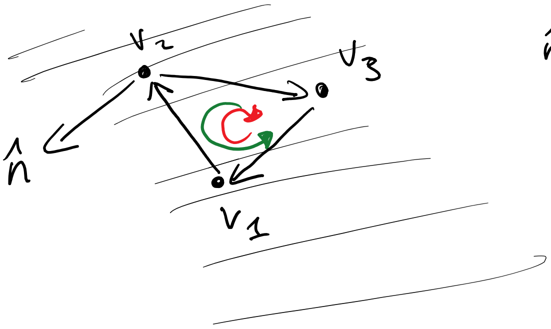
case





Intesection of Ray and triangle.



$$\hat{n}\cdot\underline{v}_i + \underline{D} = 0$$

?

$$D = -\hat{n}\cdot\underline{v}_i$$

$$\underline{n} = (\underline{v}_2-\underline{v}_1)\times(\underline{v}_3-\underline{v}_1)$$

$$\underline{r} = \underline{d}t + \underline{o}$$

Put this into the plane equation and solve for t:

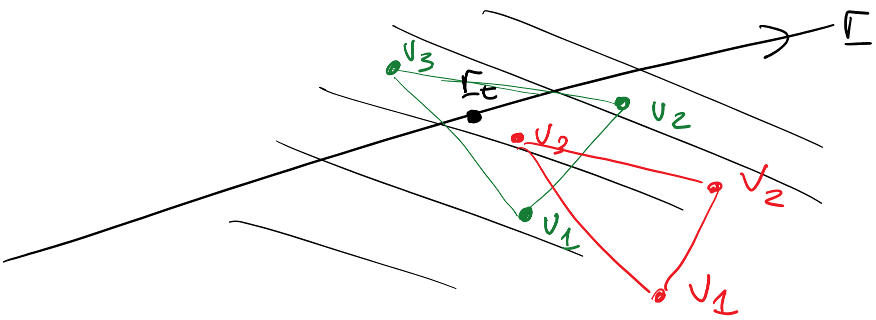
$$\hat{n}\cdot\underline{r} + D = 0$$

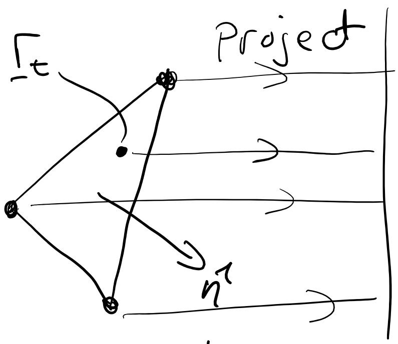
$$(\hat{n}\cdot\underline{d})t + (\hat{n}\cdot\underline{o}) + D = 0$$

$$t = \frac{-(\hat{n}\cdot\underline{o}) - D}{(\hat{n}\cdot\underline{d})}$$

! what if $= 0$!?

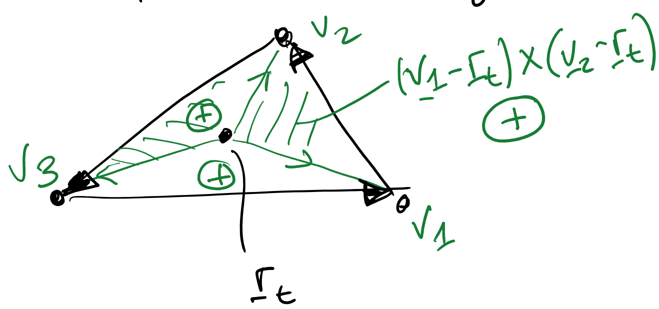
$\underline{r}_t$ is a possible point in the triangle.



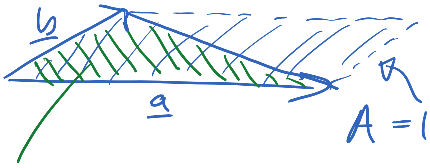


x-direction

In 2-D (x,y)



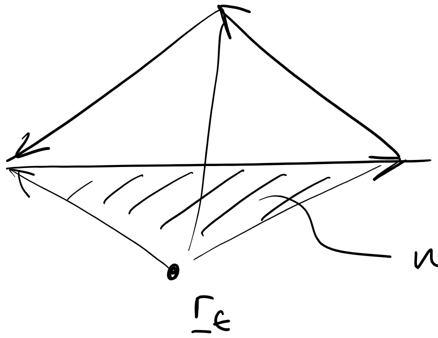
x-direction
has the
largest component
of $\hat{n}$



$A = |\underline{a} \times \underline{b}|$

$A_T = \frac{1}{2} |\underline{a} \times \underline{b}|$

All 3 subtriangles are $\oplus$ cross product
if $\underline{r}_t$ is inside the triangle
or all $\ominus$ $\Rightarrow$ r_t inside



Bounding Volume
Hierarchy — "TREE"