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CS 4620 a4-Shaders
Warmup Exercise

1. Given a viewing direction, how does one compute the reflection direction?

Let $\vec{v}$ be the viewing direction, pointing outward from the surface, *vecr* be the reflection direction likewise outward from the surface, and *vecn* be the normal. We assume all quantities are normalized, and solve for *vecr*.

We know that $\vec{v} + \vec{r}$ is parallel to $\vec{n}$, because $\vec{r}$ is the reflection of $\vec{v}$ across $\vec{n}$. And since both starting vectors are normalized,

$$\frac{\vec{v} + \vec{r}}{||\vec{v} + \vec{r}||} = \vec{n}$$

$$\vec{v} + \vec{r} = (||\vec{v} + \vec{r}||)\vec{n}$$

$$\vec{v} + \vec{r} = 2(\dot{\vec{v}}\vec{n})\vec{n} \text{ as dot(v, n) = dot(n, r) and when we sum v + r,}$$

we equivalently project each onto n, the direction of the final sum, and then add from there

$$\vec{v} + \vec{r} = 2(\vec{v} \bullet \vec{n})\vec{n}$$

$$\vec{r} = 2(\vec{v} \bullet \vec{n})\vec{n} - \vec{v}$$

So, the reflection vector $\vec{r} = 2(\dot{\vec{v}}\vec{n})\vec{n} - \vec{v}$