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Hunter Herbst
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CAP4720

Vectors

Defined using a magnitude and direction, possibly also with an origin

Notations

- Ordered set notation $\vec{v} = (x, y, z)$ or $\vec{v} =< x, y, z >$
- Unit vector notation $\vec{v} = x\hat{i} + y\hat{j} + z\hat{k}$
- Matix notation $\vec{v} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

Magnitude

$\|\vec{v}\| = \sqrt{v_x^2 + v_y^2 + v_z^2}$ $\|\vec{v}\| = \sqrt{\vec{v} \cdot \vec{v}}$

Unit Vector

$\vec{u} = \frac{\vec{v}}{\|\vec{v}\|}$

Dot Product

Computes the "likeness" of two vectors. For two unit vectors dotted together, -1 is facing opposite directions 0 is orthagonal, and 1 is facing the same direction.

Hunter side-note: Dot products with surface normals are going to be useful later, as they can be used in conjunction with a normalized vector pointing towards a scene's light source to calculate how much of that given pixel is facing the light.

$u \cdot v = \vec{u}_x\vec{v}_x + \vec{u}_y\vec{v}_y + \vec{u}_z\vec{v}_z = \|\vec{u}\|\|\vec{v}\|cos(\theta)$

Triangle Cosine Law

Refresh on the Law of Cosines from Trig.

$2ab \times cos(\theta) = a^2 + b^2 - c^2$

Projection

$proj_{\vec{w}}\vec{v} = \|\vec{v}\| cos(\theta) \frac{\vec{w}}{\|\vec{w}\|}$
$proj_{\vec{w}}\vec{v} = \frac{(\vec{v} \cdot \vec{w})\vec{w}}{\|\vec{w}\|^2}$

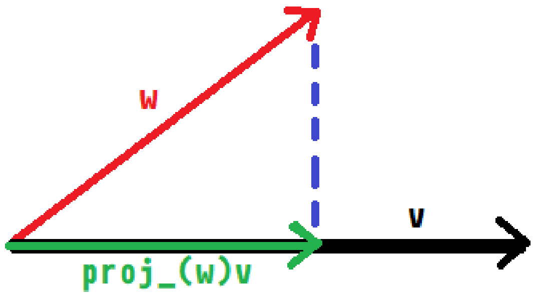

Diagram of $\vec{w}$ being projected onto $\vec{v}$