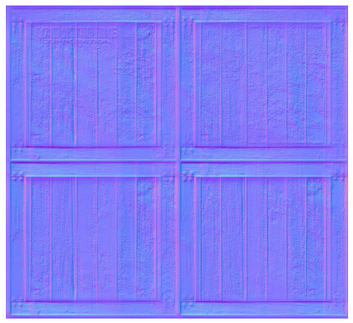
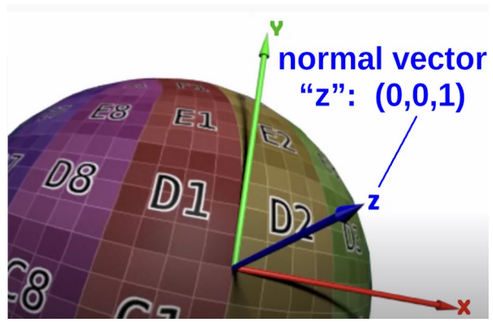
Normal Mapping

Diffuse map



Normal map



Tangent space (per vertex):
x,y are in the plane of the triangle.
The normal vector "z" is up: XYZ(0,0,1)
Range for X, Y, and Z each: -1 to 1

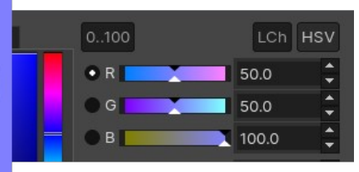
Normals are unit vectors perpendicular to the surface of a 3D object.

In the normal map, the RGB color value for an perpendicular normal vector is:

(normalVector / 2) + vec3(0.5,0.5,0.5) = RGB(0.5, 0.5, 1.0)

Range for R, G, and B each: 0 to 1

RGB
(0.5, 0.5, 1.0)

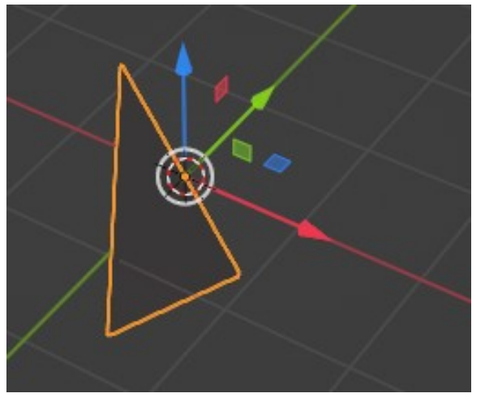


UV Coordinates

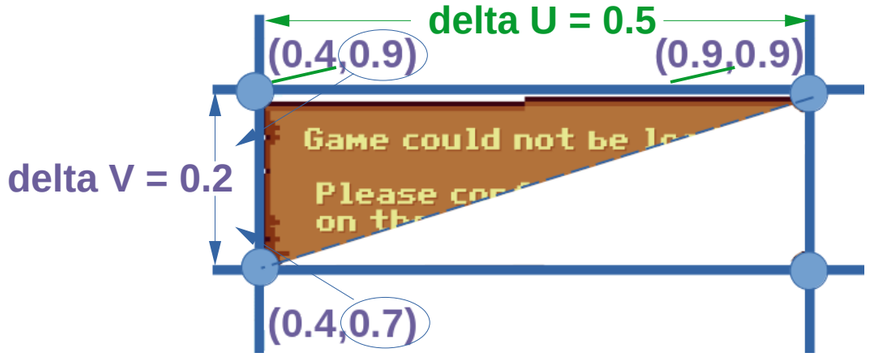
Used to define a sub-area in an image; for example in a texture atlas:

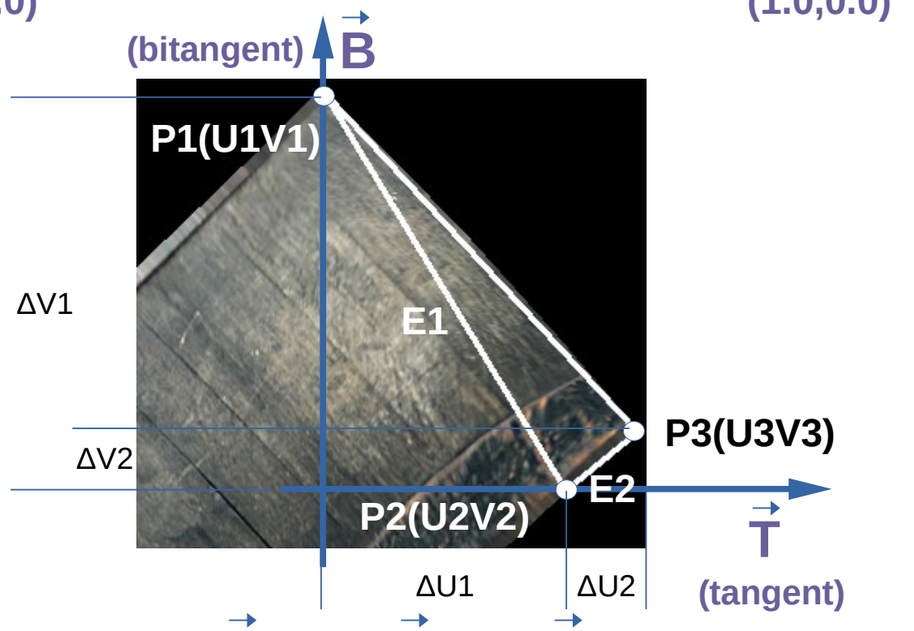
Each vertex gets a pair of UV coordinates.

The three vertices of a triangle can be anywhere in a **3D** space:



However, UV coordinates are a **2D** projection onto a triangle and can be used to calculate the tangent and bitangent:





$$\vec{E1}=\Delta U1\vec{T}+\Delta V1\vec{B}$$
$$\vec{E2}=\Delta U2\vec{T}+\Delta V2\vec{B}$$

$$\begin{bmatrix} E1x & E1y & E1z \\ E2x & E2y & E2z \end{bmatrix} = \begin{bmatrix} \Delta U1 & \Delta V1 \\ \Delta U2 & \Delta V2 \end{bmatrix} \begin{bmatrix} Tx & Ty & Tz \\ Bx & By & Bz \end{bmatrix}$$

$$\begin{bmatrix} Tx & Ty & Tz \\ Bx & By & Bz \end{bmatrix} = \frac{1}{\Delta U1\Delta V2-\Delta U2\Delta V1} \begin{bmatrix} \Delta V2 & -\Delta V1 \\ -\Delta U2 & \Delta U1 \end{bmatrix} \begin{bmatrix} E1x & E1y & E1z \\ E2x & E2y & E2z \end{bmatrix}$$