

Ortho Matrix

See <http://www.opengl.org/sdk/docs/man/xhtml/glOrtho.xml>

```
glOrtho[left_, right_, bottom_, top_, near_, far_] :=  
Module[{tx, ty, tz},  
  tx = -  $\frac{\text{right} + \text{left}}{\text{right} - \text{left}}$  ;  
  ty = -  $\frac{\text{top} + \text{bottom}}{\text{top} - \text{bottom}}$  ;  
  tz = -  $\frac{\text{far} + \text{near}}{\text{far} - \text{near}}$  ;  
  
  
$$\begin{pmatrix} \frac{2}{\text{right-left}} & 0 & 0 & \text{tx} \\ 0 & \frac{2}{\text{top-bottom}} & 0 & \text{ty} \\ 0 & 0 & \frac{-2}{\text{far-near}} & \text{tz} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

```

Frustum Matrix

See <http://www.opengl.org/sdk/docs/man/xhtml/glFrustum.xml>

```
glFrustum[left_, right_, bottom_, top_, near_, far_] :=  
Module[{A, B, C, D},  
  A =  $\frac{\text{right} + \text{left}}{\text{right} - \text{left}}$  ;  
  B =  $\frac{\text{top} + \text{bottom}}{\text{top} - \text{bottom}}$  ;  
  C = -  $\frac{\text{far} + \text{near}}{\text{far} - \text{near}}$  ;  
  D = -  $\frac{2 \text{ far near}}{\text{far} - \text{near}}$  ;  
  
  
$$\begin{pmatrix} \frac{2 \text{ near}}{\text{right-left}} & 0 & \text{A} & 0 \\ 0 & \frac{2 \text{ near}}{\text{top-bottom}} & \text{B} & 0 \\ 0 & 0 & \text{C} & \text{D} \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

```

Myth Frustum

Special frustum for Myth II

```
mythFrustum[width_, height_, near_, far_] :=  
Module[{hoffset, voffset, aspect, fov, hd, vd, h, v},  
  hoffset = 0;  
  voffset = -1 / 7;  
  aspect = width / height;  
  fov = ArcTan[Tan[50 * (Degree / 2)]3 / 4 aspect] * (2 / Degree);  
  hd = near Tan[(fov / 2) * Degree];  
  vd = hd / aspect;  
  h = 2 hoffset;  
  v = 2 voffset;  
  glFrustum[(h - 1) hd, (h + 1) hd, (v - 1) vd, (v + 1) vd, near, far]]
```

Computing the depth coordinates

```
ortho = glOrtho[0, width, height, 0, near, far]; ortho // MatrixForm
```

$$\begin{pmatrix} \frac{2}{\text{width}} & 0 & 0 & -1 \\ 0 & -\frac{2}{\text{height}} & 0 & 1 \\ 0 & 0 & -\frac{2}{\text{far-near}} & -\frac{\text{far+near}}{\text{far-near}} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

```
frustum = mythFrustum[width, height, near, far]; frustum // MatrixForm
```

$$\begin{pmatrix} \frac{4 \text{ height Cot}[25^\circ]}{3 \text{ width}} & 0 & 0 & 0 \\ 0 & \frac{4}{3} \text{ Cot}[25^\circ] & -\frac{2}{7} & 0 \\ 0 & 0 & -\frac{\text{far+near}}{\text{far-near}} & -\frac{2 \text{ far near}}{\text{far-near}} \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

```
DepthCoordinate[M_] := Module[{v},
  v = M.{x, y, z, 1};
  FullSimplify[(1 + Last[Most[v] / Last[v]]) / 2]]
```

```
DepthCoordinate[ortho]
```

$$-\frac{\text{near} + z}{\text{far} - \text{near}}$$

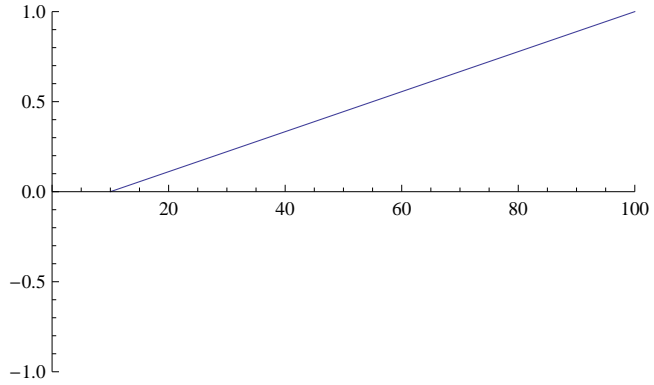
```
DepthCoordinate[frustum]
```

$$\frac{\text{far} (\text{near} + z)}{(\text{far} - \text{near}) z}$$

Visualizing the depth coordinates

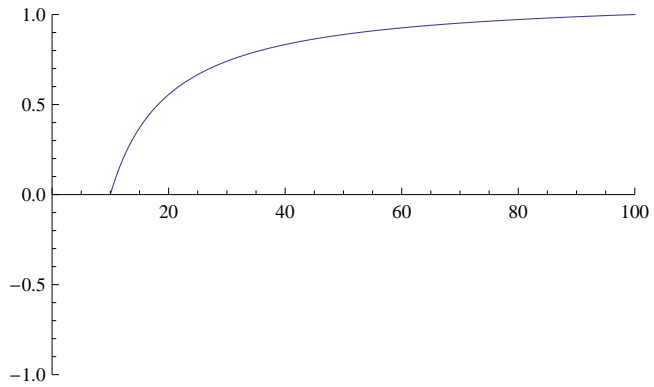
```
f[x_] := Block[{z = x, near = 10, far = 100}, DepthCoordinate[ortho]]
```

```
Plot[f[-z], {z, 10, 100}, PlotRange -> {{0, 100}, {-1, 1}}]
```



```
g[x_] := Block[{z = x, near = 10, far = 100}, DepthCoordinate[frustum]]
```

```
Plot[g[-z], {z, 10, 100}, PlotRange -> {{0, 100}, {-1, 1}}]
```



Computing z'

```
DepthCoordinate [frustum] == (DepthCoordinate [ortho] /. {z -> z', near -> 0, far -> oFar})
```

$$\frac{\text{far} (\text{near} + z)}{(\text{far} - \text{near}) z} == - \frac{z'}{\text{oFar}}$$

```
First@Solve[%, z']
```

$$\left\{ z' \rightarrow - \frac{\text{far} \text{oFar} (\text{near} + z)}{(\text{far} - \text{near}) z} \right\}$$