Lookat matrix: reminder

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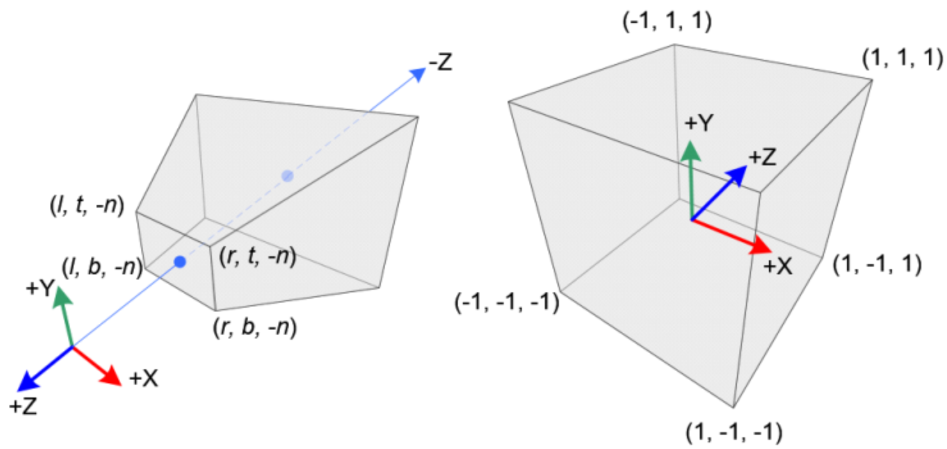
Remember that this is the view frustum.



But what if you want to move it around? Well, that's what the lookat matrix is for.
Although, in reality, you move the world around you instead of the camera itself, to give the illusion that the camera is moving.
The lookat matrix is applied to each vertex, and consists of translation and rotation.

First, let's do translation. Whatever the camera position is, the world has to move in the opposite direction, so you get:

$$\begin{bmatrix} 1 & 0 & 0 & -P_x \\ 0 & 1 & 0 & -P_y \\ 0 & 0 & 1 & -P_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} x - p_x \\ x - p_y \\ x - p_z \\ 1 \end{bmatrix}$$

Where p_x, p_y and p_z are the camera coordinates.

Next, what about rotation? For this, we can store the camera's pitch (rotation around X axis) and yaw (rotation around Y axis).
Then, we can use rotation matrices for the rest.

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\theta_x) & \sin(\theta_x) & 0 \\ 0 & -\sin(\theta_x) & \cos(\theta_x) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{bmatrix} \cos\theta_y & 0 & \sin\theta_y & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta_y & 0 & \cos\theta_y & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -P_x \\ 0 & 1 & 0 & -P_y \\ 0 & 0 & 1 & -P_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Which gives you this. **In the equation above, the theta's should all be minus theta's.** Note the order: first we undo the x rotation (putting the camera at eye level), then undo the y rotation (having the camera face the -z axis), then undoing the translation (putting the camera in its original position).

Alternatively, you can also use the forward (D), right (R) and up (U) vectors of the camera.

$$LookAt = \begin{bmatrix} R_x & R_y & R_z & 0 \\ U_x & U_y & U_z & 0 \\ D_x & D_y & D_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 & -P_x \\ 0 & 1 & 0 & -P_y \\ 0 & 0 & 1 & -P_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$