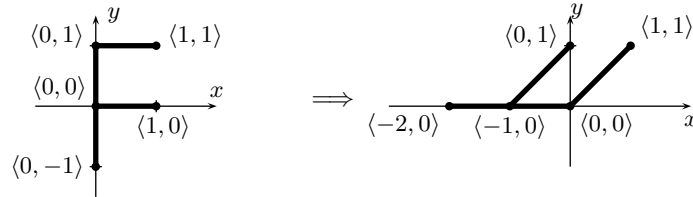


1. An affine transformation $A(x) : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ maps the “F”-shape on the left to the “F” on the right.

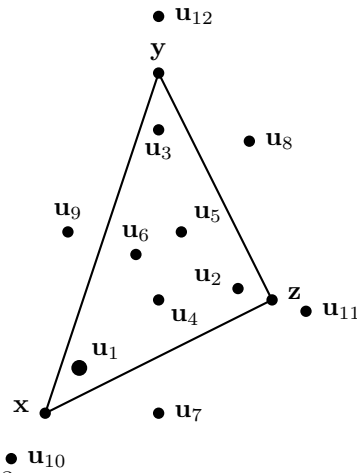


- a. Give a 3×3 matrix that represents A over homogeneous coordinates.
 b. Give a 3×3 matrix that represents A^{-1} over homogeneous coordinates.
2. Consider the following sequence of OpenGL commands:

```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glRotatef( 180.0, 1, 0, 0 );
glRotatef( 90.0, 0, 0, 1 );
glScalef( 2, 2, 2 );
glTranslatef( 3, 4, 5 );
```

Show explicitly the contents of the 4×4 ModelView matrix after these commands have been executed.

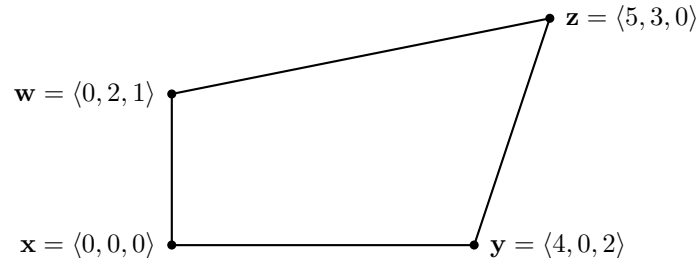
5. A triangle is shown with vertices \mathbf{x} , \mathbf{y} and \mathbf{z} . Also shown are 12 points $\mathbf{u}_1, \dots, \mathbf{u}_{12}$. In each of (a)-(d) the barycentric coordinates of a point are given. In each case, write on the blank line which point has those barycentric coordinates.



- a. $\alpha = 1, \beta = 0, \gamma = 0$ is which point? _____
 b. $\alpha = 0.1, \beta = 0.8, \gamma = 0.1$ is which point? _____
 c. $\alpha = -0.1, \beta = -0.1, \gamma = 1.2$ is which point? _____
 d. $\alpha = 0.6, \beta = 0.6, \gamma = -0.2$ is which point? _____

6. A color is specified with RGB values $R = 0.9$, $G = 0.6$, and $B = 0.3$. Give the HSL representation of this color.

7. Consider the following non-planar quadrangle.



Give explicitly the points that have the following bilinear coordinates with respect to this quadrangle.

(a) $\alpha = 0$ and $\beta = \frac{1}{2}$.

(b) $\alpha = 1$ and $\beta = 1$.

(c) $\alpha = \frac{1}{3}$ and $\beta = \frac{1}{2}$.

10. Describe bump mapping. Explain in English what it does, and how/why it works. (You do not need to give detailed mathematical formulas for bump mapping unless you think will help explain the concepts.)

11. Describe the difference between sphere-mapped environment map (that uses a sphere projection), and a cube-mapped environment map (that uses a box projection). What are their relative advantages?