

Computer Graphics

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Chapter 1

Question 1 - Geometry and vertex attributes

Y-axis up, X axis left to right and Z axis towards you is a Right handed coordinate system. I have proven this by using my right-hand with the X-axis being on the thumb, the Y-axis being on the first finger and the Z-axis being on my middle finger and rotating it to meet the 3 requirements. You cannot rotate the left hand to do this.

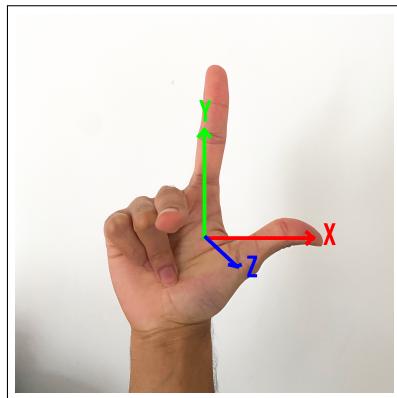


Figure 1.1: Image of hand with axis labeled.

I decided to draw out the model I was going to make in Blender first and then place the vertices on top of it.

The colors of the axis are consistent in all images: Red : X , Green : Y , Blue : Z

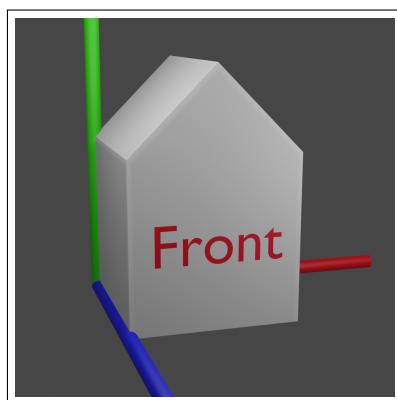


Figure 1.2: House in blender with drawn axis.

I chose the bottom vertex on the rear left of the house as the origin as I would only have to work with positive numbers for the rest of the vertices, and they would also be round numbers (except for the roof) as I am going to make the house with a square base of 1x1.

Below is a wireframe view of the same house with the coordinates labeled.

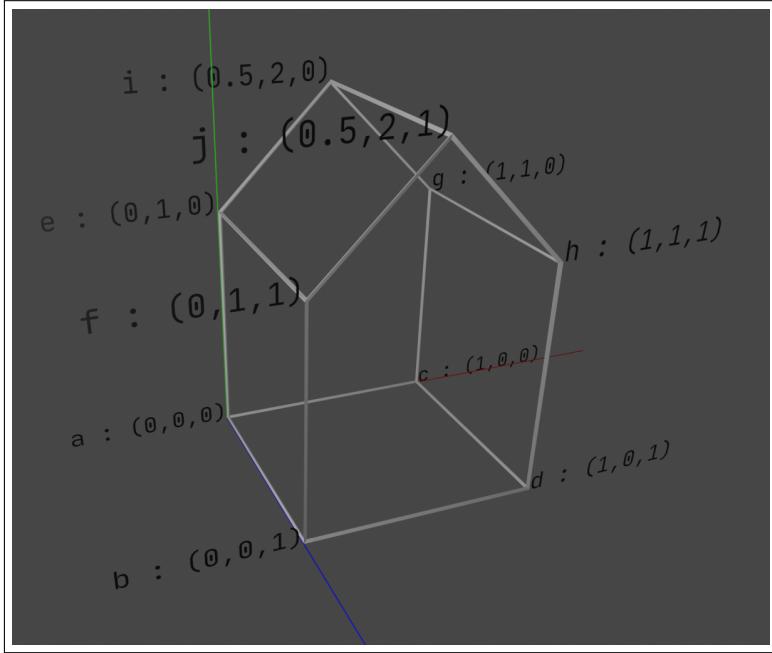


Figure 1.3: House in blender with wireframe and coordinates.

Coordinates for the vertices:

- (a) (0, 0, 0)
- (b) (0, 0, 1)
- (c) (1, 0, 0)
- (d) (1, 0, 1)
- (e) (0, 1, 0)
- (f) (0, 1, 1)
- (g) (1, 1, 0)
- (h) (1, 1, 1)
- (i) (0.5, 2, 0)
- (j) (0.5, 2, 1)

16 triangles will be used to make up the house, and there will be normals that are shared between them.

I calculated the vector normals by using the following equation:

If we have 3 vectors that make up a triangle in an anti-clockwise manner: $V0, V1, V2$, to calculate the normal facing outwards we do:

$$A = V1 - V0 \quad | \quad B = V2 - V0$$

$$\text{Normal} = A \times B$$

Doing this with the first triangle on the table (triangle on the left face of the house) give you:

$$A = (0, 0, 1) - (0, 0, 0)$$

$$A = (0, 0, 1)$$

Triangles	Normals
(a, b, f) (a, f, e)	(-1, 0, 0)
(b, h, f) (b, d, h) (f, h, j)	(0, 0, 1)
(d, g, h) (d, c, g)	(1, 0, 0)
(c, e, g) (c, a, e) (g, e, i)	(0, 0, -1)
(a, c, b) (b, c, d)	(0, -1, 0)
(e, j, i) (e, f, j)	(-1, 0.5, 0)
(h, i, j) (h, g, i)	(1, 0.5, 0)

$$B = (0, 1, 1) - (0, 0, 0)$$

$$B = (0, 1, 1)$$

$$\text{Normal} = (0, 0, 1) \times (0, 1, 1)$$

$$\text{Normal} = (-1, 0, 0)$$

I confirmed this calculation to be correct by looking at the shape itself in 3D space, and $(-1, 0, 0)$ is the normal that would be correct.

I had no need to normalise the vectors as they output from the cross product was a sensible number.

Same calculation is done for the rest of the sides, triangles facing the same direction will have the same surface normals.