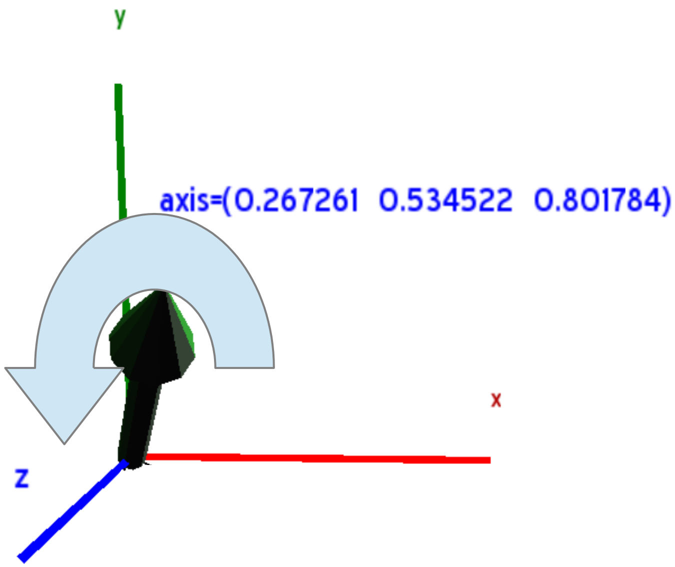
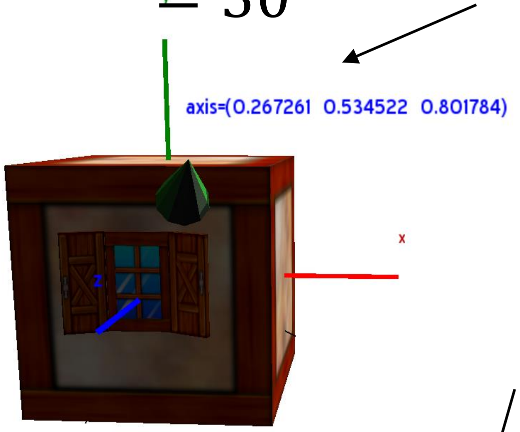
Let's compute the rotation matrix R

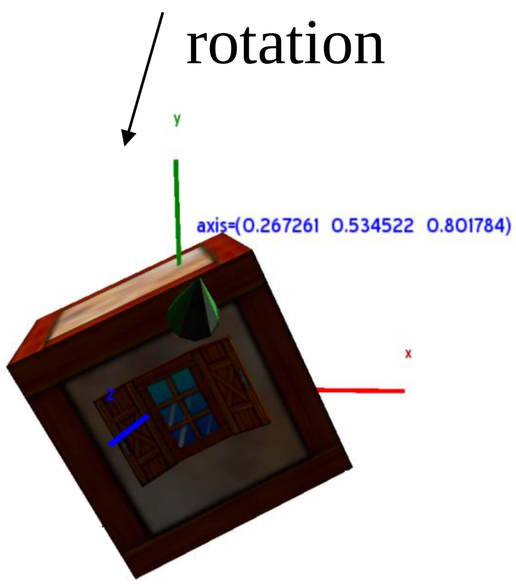
Rotation about $axis = (1,2,3)$ by $\theta = 30$ degrees

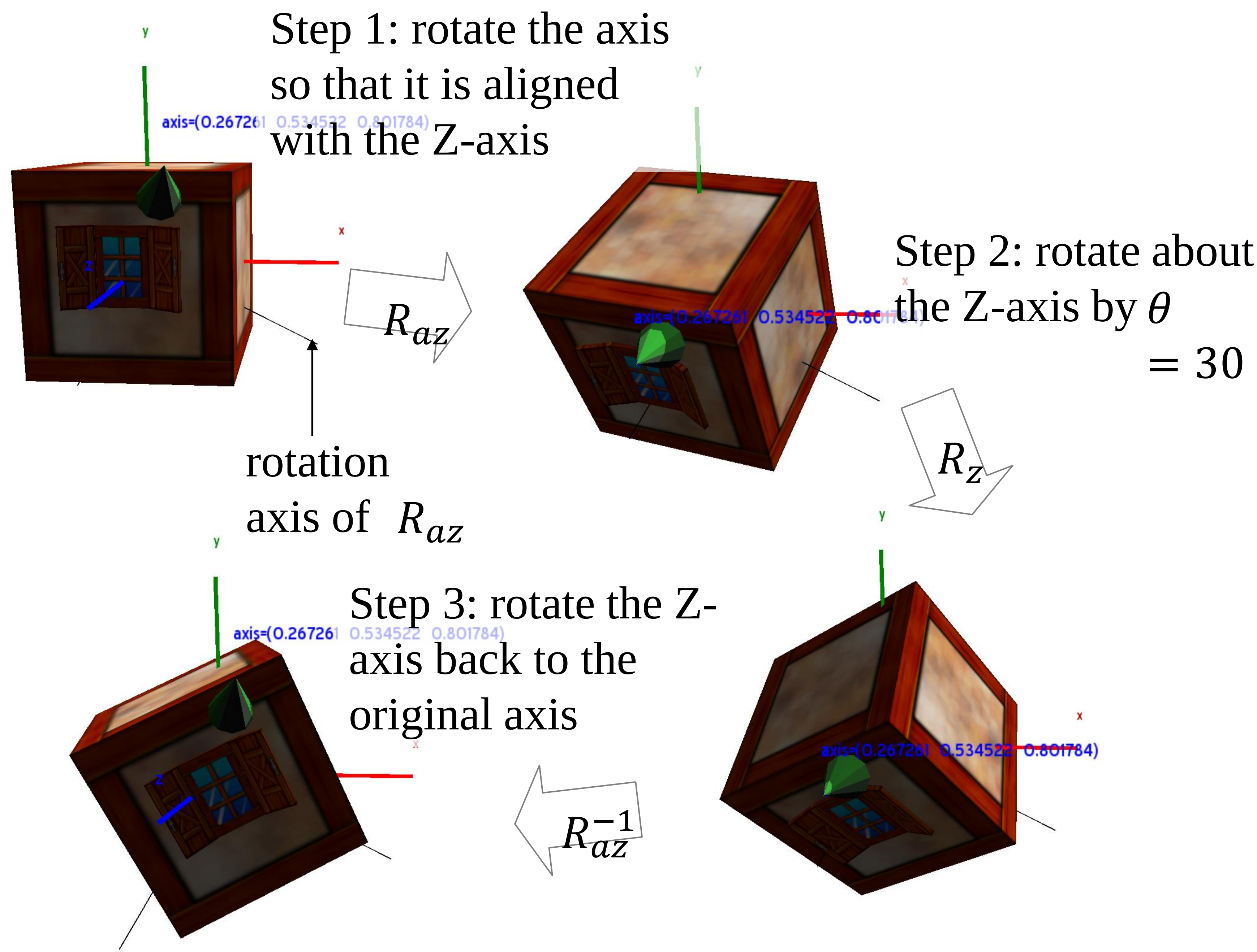


Before rotation



After rotation




Step 1: rotate the axis so that it is aligned with the Z-axis
axis=(0.267261 0.534522 0.801784)
R_{az}
rotation axis of R_{az}
Step 2: rotate about the Z-axis by $\theta = 30$
R_z
Step 3: rotate the Z-axis back to the original axis
R_{az}^{-1}
y
x
z

How to compute R_{az} (Axis a to axis z)

1. Let the normalize axis

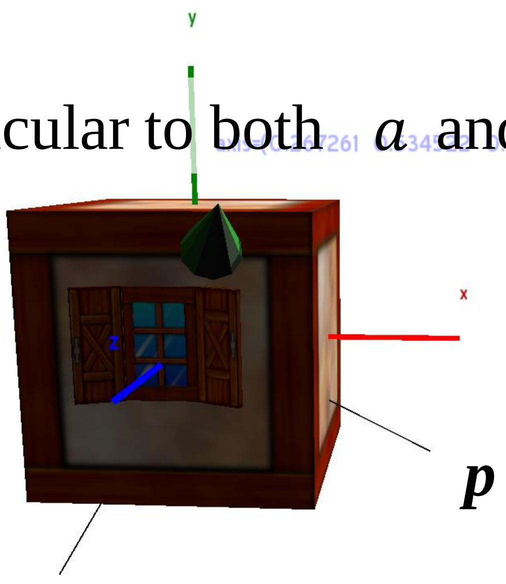
$$a = \frac{axis}{\|axis\|} \approx (0.27, 0.53, 0.80)$$

$$\|v\| = \sqrt{v \cdot v} = x^2 + y^2 + z^2$$

where $v = (x, y, z)$

2. Calculate vector p that is perpendicular to both a and Z-axis

$$p = \frac{a \times (0,0,1)}{\|a \times (0,0,1)\|}$$



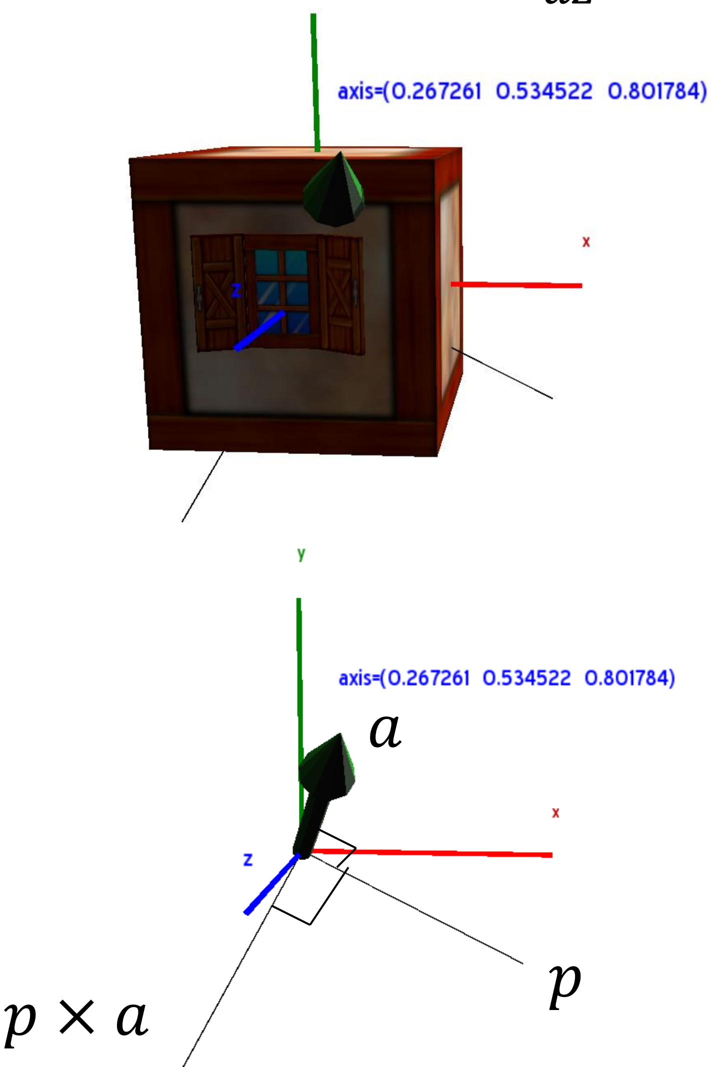
How to compute R_{az}

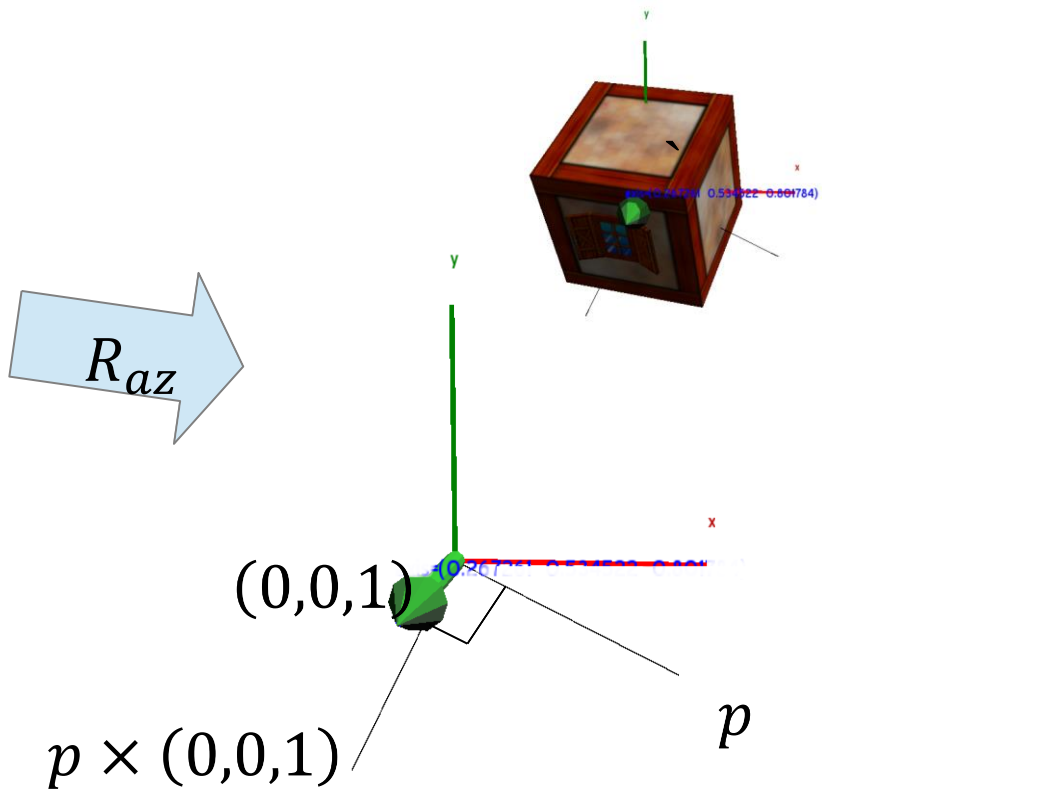
3. after rotation R_{az}

$R_{az}a$ becomes $(0,0,1)$

$R_{az}p$ becomes p

$R_{az}(p \times a)$ becomes $p \times (0,0,1)$





How to compute R_{az}

3. Then after the rotation R_{az}

$R_{az}a$ becomes $(0,0,1)$

$R_{az}p$ becomes p

$R_{az}(p \times a)$ becomes $p \times (0,0,1)$

Therefore,

$$R_{az}([a][p][p \times a]) = \begin{pmatrix} 0 & & \\ 0 & [p] & [p \times (0,0,1)] \\ 1 & & \end{pmatrix}$$

Finally,

$$R_{az} = \begin{pmatrix} 0 & & \\ 0 & [p] & [p \times (0,0,1)] \\ 1 & & \end{pmatrix} ([a][p][p \times a])^{-1}$$

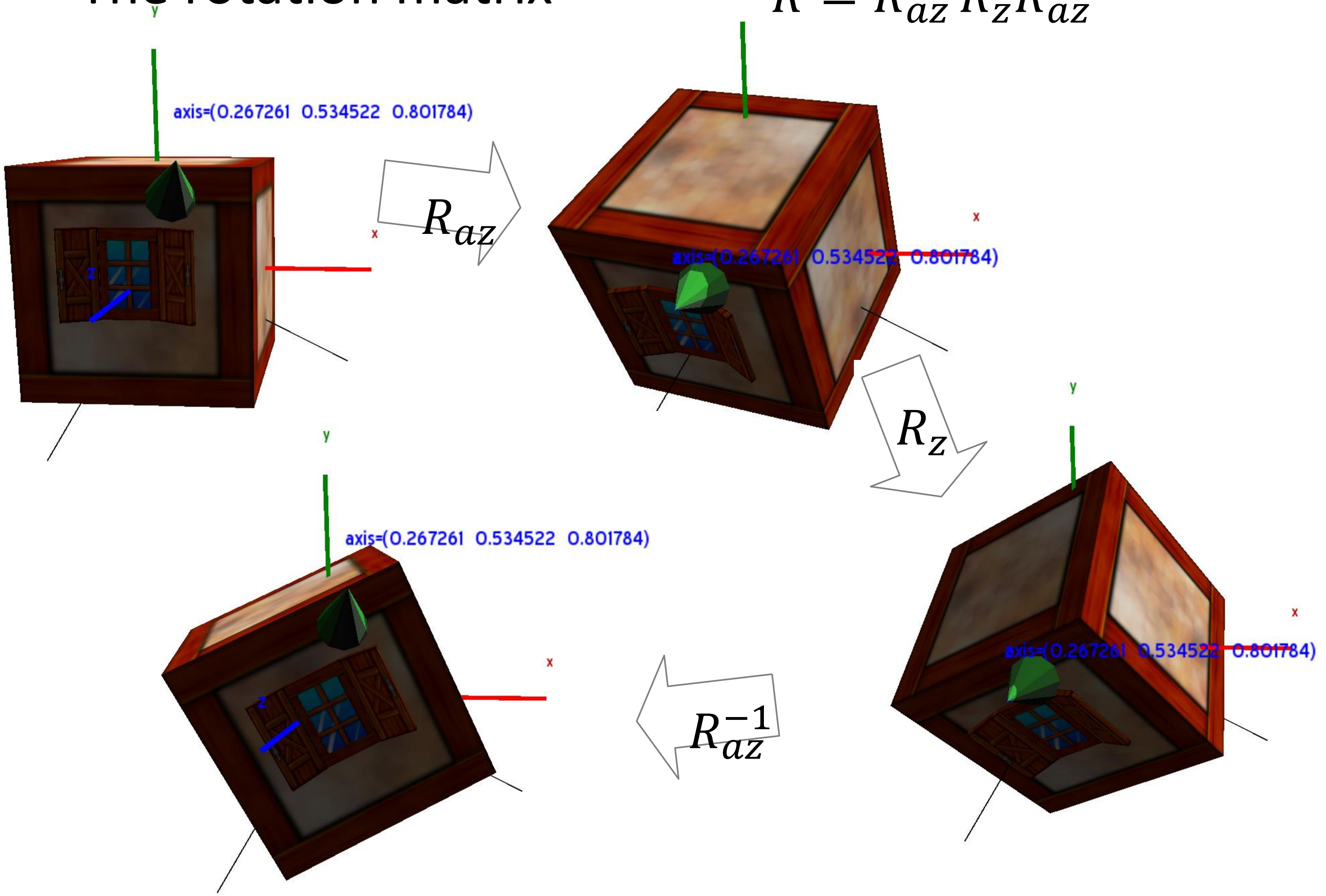
Matlab codes:

```
> z=[0;0;1]
> Raz=[z p cross(p,z)] *inv([a p cross(p,a)])
```

Finally,

- The rotation matrix

$$R = R_{az}^{-1} R_z R_{az}$$



Acknowledgement

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