1 Moving to $\mathbb{R}^3$

In $\mathbb{R}^3$, we often have that y is facing towards us. However, in this course, y will be facing upwards while z is facing towards us.

Let $f(\mathbf{x}) = M\mathbf{x}$, where M is a 3×3 matrix. Here, M is denoted by

$$\begin{bmatrix} f(\mathbf{i}) & f(\mathbf{j}) & f(\mathbf{k}) \end{bmatrix}.$$

Additionally, note that the unit vectors in $\mathbb{R}^3$ are given by

$$\mathbf{i} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \qquad \mathbf{j} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \qquad \mathbf{k} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}.$$

1.1 Scaling

For $\alpha \in \mathbb{R}$, we say that $S_\alpha(\mathbf{x}) = \alpha\mathbf{x}$ is known as *uniform scaling.*

Now, for $a, b, c \in \mathbb{R}$, we say that $S_{\langle a,b,c \rangle}(\langle x_1, x_2, x_3 \rangle) = \langle ax_1, bx_2, bx_3 \rangle$ is known as *non-uniform scaling.*

(Example.) Suppose we have $S = S_{\langle 1/2,1,1 \rangle}$ and $R = R_{90^\circ,\mathbf{j}}$. Find the following:

- $S \circ R$.
- $R \circ S$.