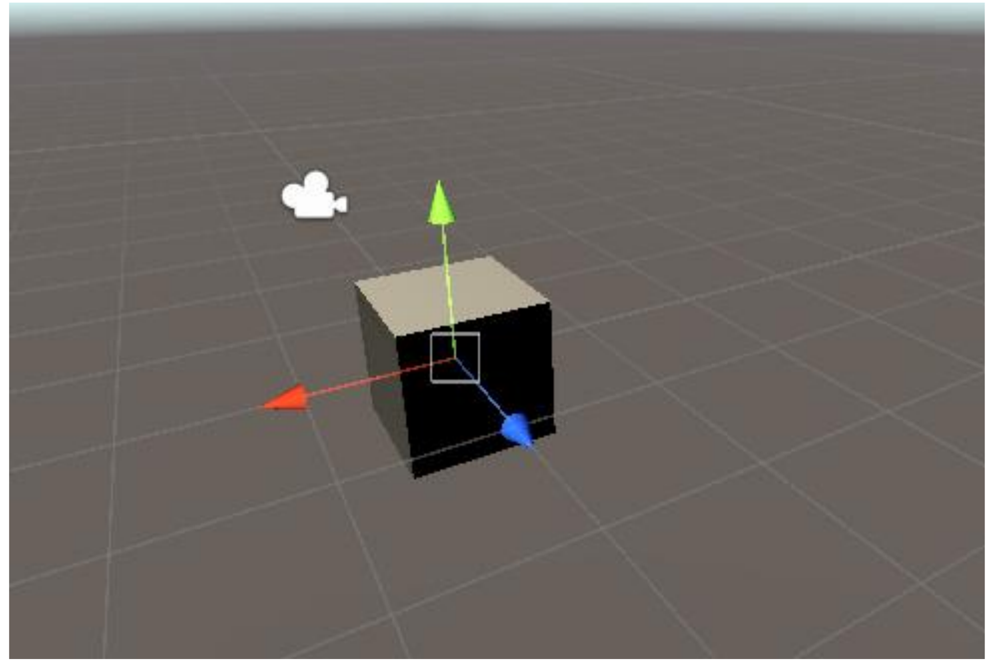
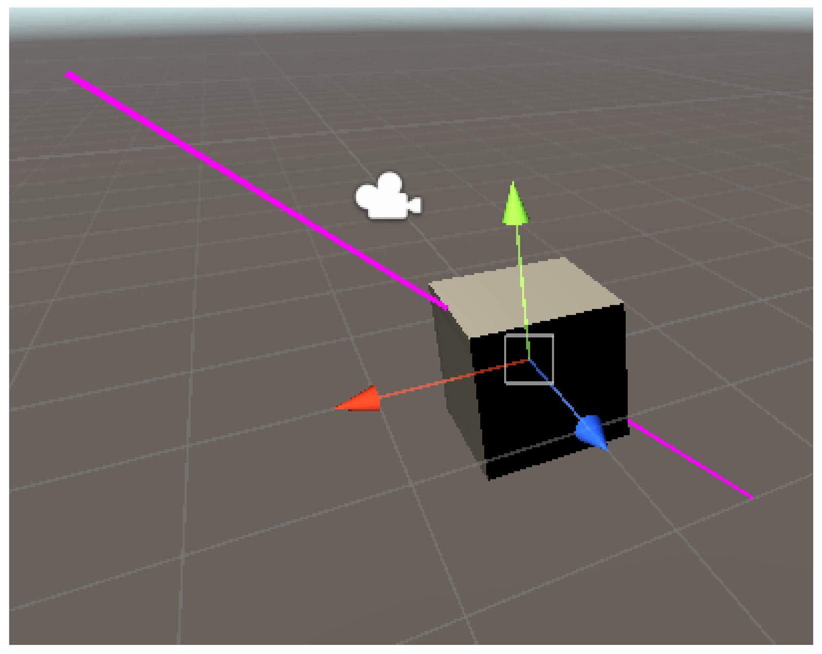
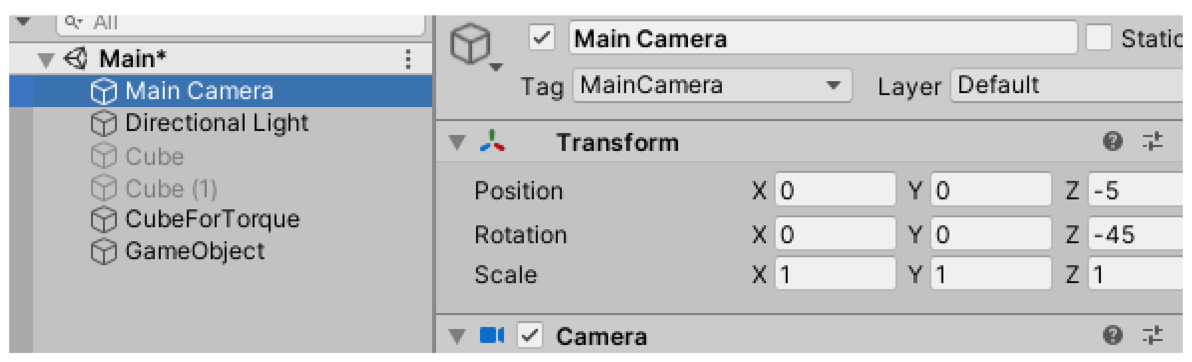
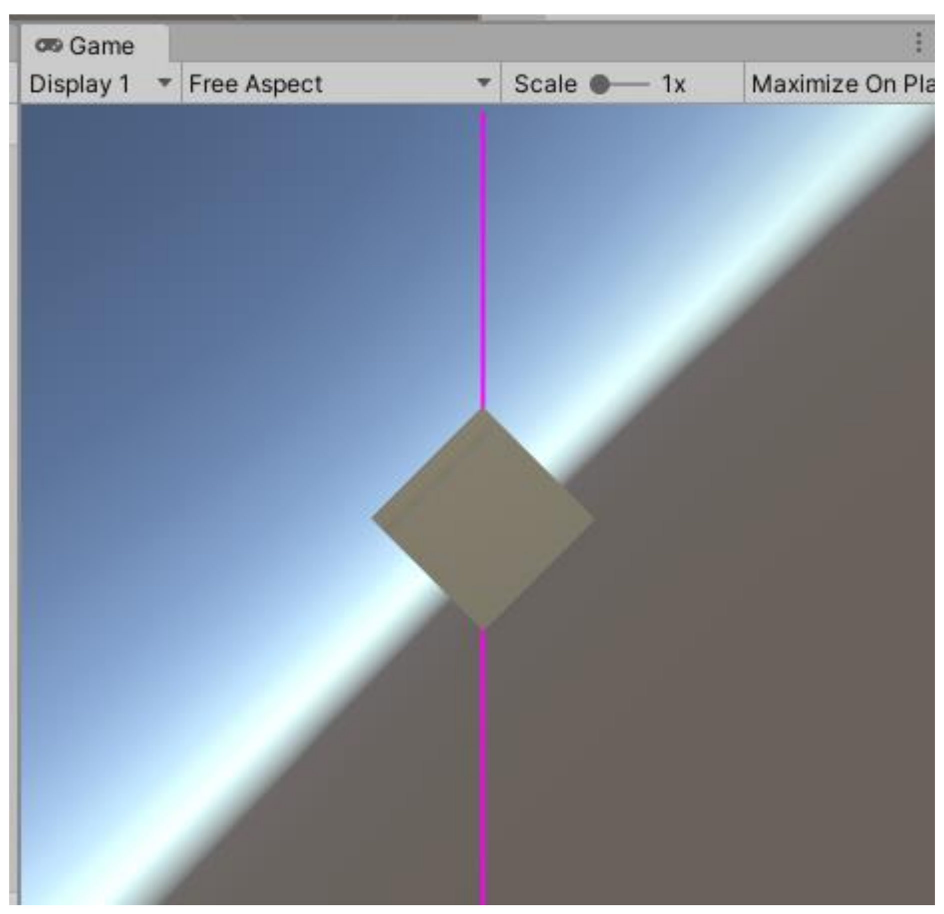
How to find the characteristics of a Transform?

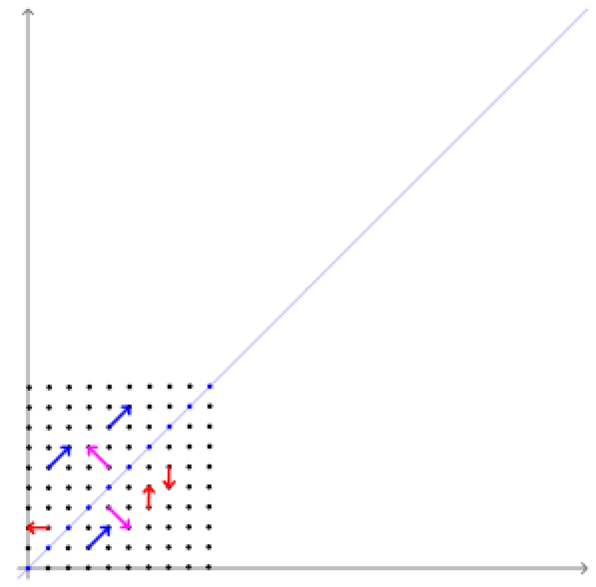


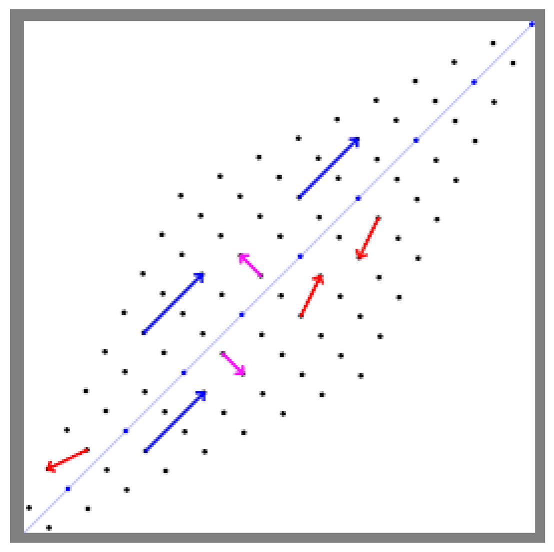


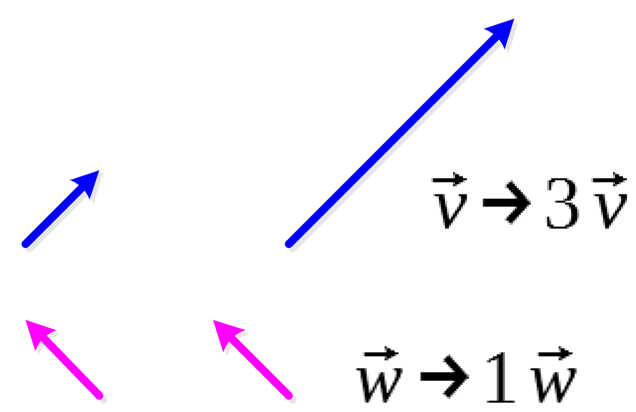





```
float theta = Mathf.PI;
Quaternion rot = Quaternion.Euler(0, 0, -45.0f);
torque = Vector3.down * theta * 2.0f;
torque = rot * torque;
_rb.AddTorque(torque);
```







Formal definition [edit]

If T is a linear transformation from a vector space V over a field F into itself and $\mathbf{v}$ is a nonzero vector in V, then $\mathbf{v}$ is an eigenvector of T if $T(\mathbf{v})$ is a scalar multiple of $\mathbf{v}$. This can be written as

$$T(\mathbf{v}) = \lambda\mathbf{v},$$

where λ is a scalar in F, known as the **eigenvalue**, **characteristic value**, or **characteristic root** associated with $\mathbf{v}$.

There is a direct correspondence between *n*-by-*n* square matrices and linear transformations from an *n*-dimensional vector space into itself, given any basis of the vector space. Hence, in a finite-dimensional vector space, it is equivalent to define eigenvalues and eigenvectors using either the language of matrices, or the language of linear transformations.[3][4]

If V is finite-dimensional, the above equation is equivalent to[5]

$$A\mathbf{u} = \lambda\mathbf{u}.$$

where A is the matrix representation of T and $\mathbf{u}$ is the coordinate vector of $\mathbf{v}$.

Eigenvalues and eigenvectors

From Wikipedia, the free encyclopedia
(Redirected from Eigen vector)

"Characteristic root" redirects here. For other uses, see Characteristic root (disambiguation).

In linear algebra, an **eigenvector** (/ˈaɪɡən ˌvɛktər/) or **characteristic vector** of a linear transformation is a nonzero vector that changes by a scalar factor when that linear transformation is applied to it. The corresponding **eigenvalue**, often denoted by λ,[1] is the factor by which the eigenvector is scaled.

If it occurs that v and w are scalar multiples, that is if

$$Av = w = \lambda v, \qquad (1)$$

then v is an **eigenvector** of the linear transformation A and the scale factor λ is the **eigenvalue** corresponding to that eigenvector. Equation (**1**) is the **eigenvalue equation** for the matrix A.

Equation (**1**) can be stated equivalently as

$$(A - \lambda I)v = 0, \qquad (2)$$

where I is the n by n identity matrix and 0 is the zero vector.

Eigenvalues and the characteristic polynomial [edit]

$(A-\lambda I)v=0$

$v=(A-\lambda I)^{-1}0$

Main article: Characteristic polynomial

Equation (**2**) has a nonzero solution *v* if and only if the determinant of the matrix (*A* − *λI*) is zero. Therefore, the eigenvalues of *A* are values of *λ* that satisfy the equation

$$|A - \lambda I| = 0 \qquad (3)$$

Using Leibniz' rule for the determinant, the left-hand side of Equation (**3**) is a polynomial function of the variable *λ* and the degree of this polynomial is *n*, the order of the matrix *A*. Its coefficients depend on the entries of *A*, except that its term of degree *n* is always $(-1)^n\lambda^n$. This polynomial is called the *characteristic polynomial* of *A*. Equation (**3**) is called the *characteristic equation* or the *secular equation* of *A*.

The fundamental theorem of algebra implies that the characteristic polynomial of an *n*-by-*n* matrix *A*, being a polynomial of degree *n*, can be factored into the product of *n* linear terms,

$$|A - \lambda I| = (\lambda_1 - \lambda)(\lambda_2 - \lambda)\cdots(\lambda_n - \lambda), \qquad (4)$$

where each λ_i may be real but in general is a complex number. The numbers $\lambda_1, \lambda_2, \ldots \lambda_n$, which may not all have distinct values, are roots of the polynomial and are the eigenvalues of *A*.

As a brief example, which is described in more detail in the examples section later, consider the matrix

$$\boxed{A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}.}$$

Taking the determinant of (*A* − *λI*), the characteristic polynomial of *A* is

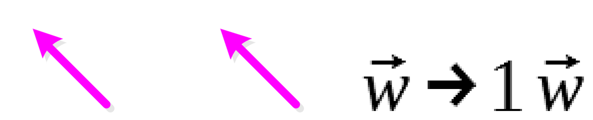
$$I=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$|A - \lambda I| = \begin{vmatrix} 2-\lambda & 1 \\ 1 & 2-\lambda \end{vmatrix} = 3 - 4\lambda + \lambda^2.$$

Setting the characteristic polynomial equal to zero, it has roots at λ=1 and λ=3, which are the two eigenvalues of *A*. The eigenvectors corresponding to each eigenvalue can be found by solving for the components of *v* in the equation $(A - \lambda I)v = 0$. In this example, the eigenvectors are any nonzero scalar multiples of

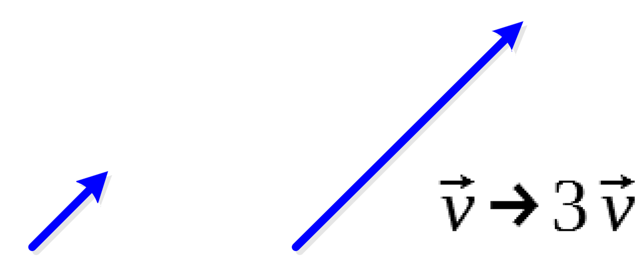
$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$x+y=0 \rightarrow x=-y \rightarrow (1,\ -1)$$



$$\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{matrix} -x+y=0 \\ x-y=0 \end{matrix} \rightarrow x=y \rightarrow (1,\ 1)$$



$$\boxed{A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \qquad v_{\lambda=1} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}, \quad v_{\lambda=3} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}}$$