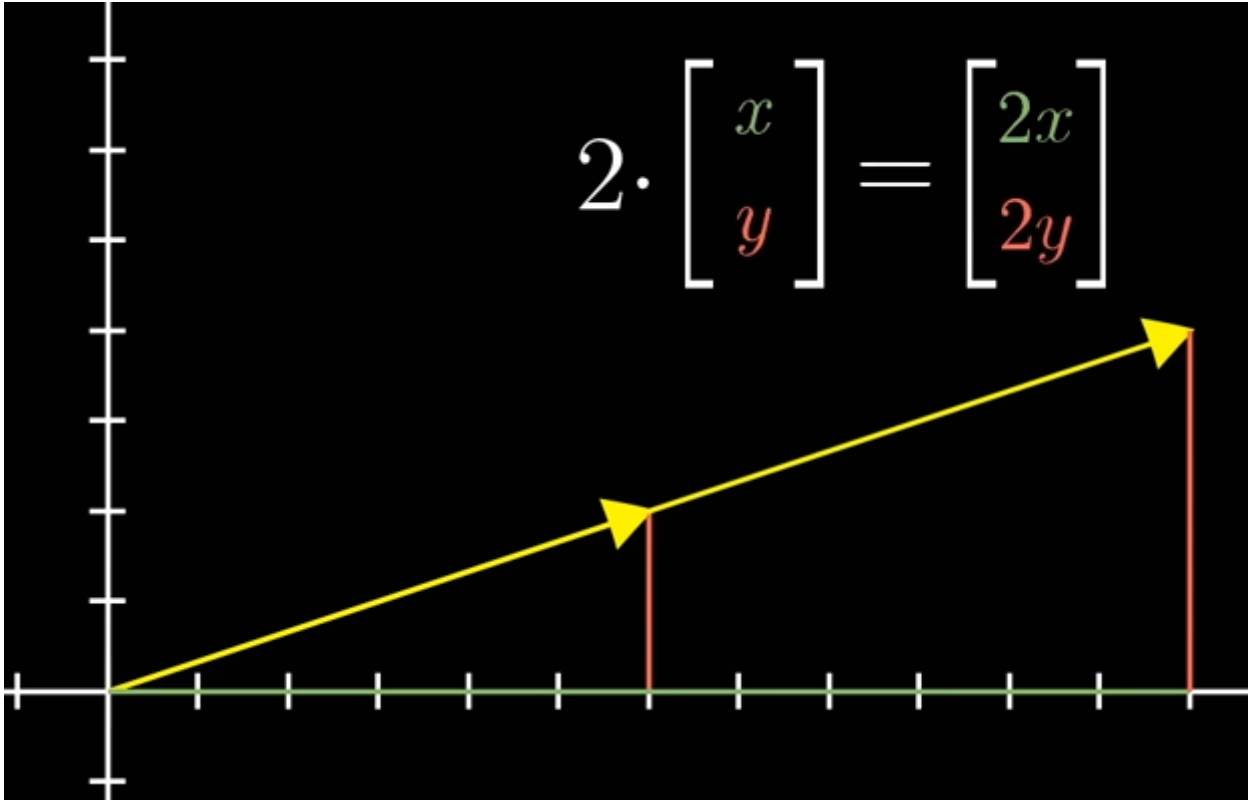


# Vector Multiplication

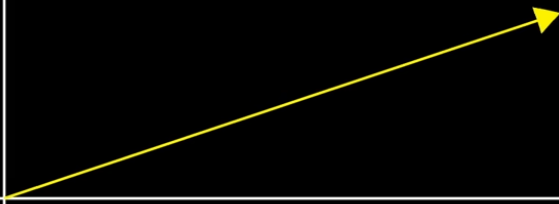
Formula



Input: Scalar (Number) and a vector

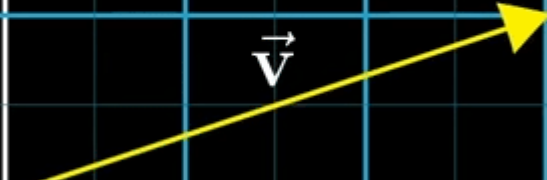
Output: Vector

“Scaling”

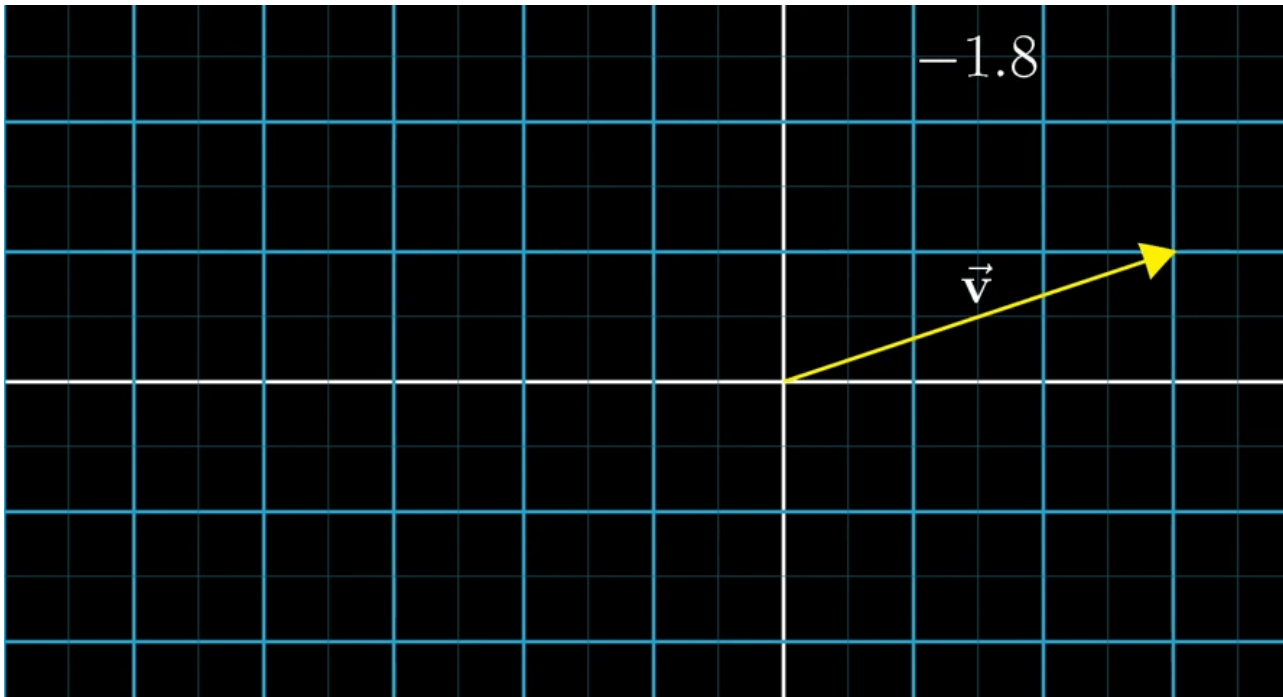


2

$\vec{v}$



Stretching out the vector twice as long as it started



Vector multiplication plays a crucial role in various aspects of computer graphics and technical art. Here are some applications of vector multiplication for a technical artist:

1. **Scaling Objects:**

- Vector multiplication can be used for scaling objects in a scene. By multiplying the position vectors of vertices by a scaling factor, you can resize objects.

2. **Transformations:**

- In 3D graphics, transformations involve multiplying vectors by matrices. This includes translation, rotation, and scaling. Understanding vector multiplication is essential for implementing these transformations.

3. **Shader Programming:**

- In shader programming, vectors representing colors, positions, normals, etc., are often multiplied by matrices or scalars to achieve desired effects in rendering.

4. **Normalizing Vectors:**

- Vector normalization involves dividing each component of a vector by its magnitude. This operation ensures that the vector has a length of 1. Normalized vectors are often used in lighting calculations and shading.

5. **Cross Product for Surface Normals:**

- The cross product of two vectors is used to compute surface normals. Surface normals are essential for shading and determining how light interacts with surfaces.

6. **Dot Product for Lighting Calculations:**

- The dot product of vectors is used in lighting calculations, such as the Lambertian reflectance model. It helps determine the angle between light and surface normals.

7. **Reflection and Refraction:**

- Vector multiplication is used in calculating reflection and refraction vectors, which are crucial for simulating realistic lighting in computer graphics.

8. **Particle Systems:**

- In particle systems and simulations, vectors representing particle velocities and forces are often multiplied by scalar values to update their positions and behavior over time.

9. **Animation:**

- Vector multiplication is used in animation to apply transformations to objects, bones, or characters. This includes scaling, rotation, and translation.

10. **Physics Simulations:**

- Vector multiplication is used in physics simulations for applying forces, calculating accelerations, and updating positions based on the laws of motion.

11. **Geometry Deformation:**

- Technical artists might use vector multiplication to deform or manipulate the geometry of characters or objects. This can be part of rigging or character animation.

Understanding how to appropriately use vector multiplication allows technical artists to control the appearance and behavior of objects, characters, and scenes in computer graphics applications. It's a fundamental operation in the creation of visually appealing and realistic virtual environments.

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