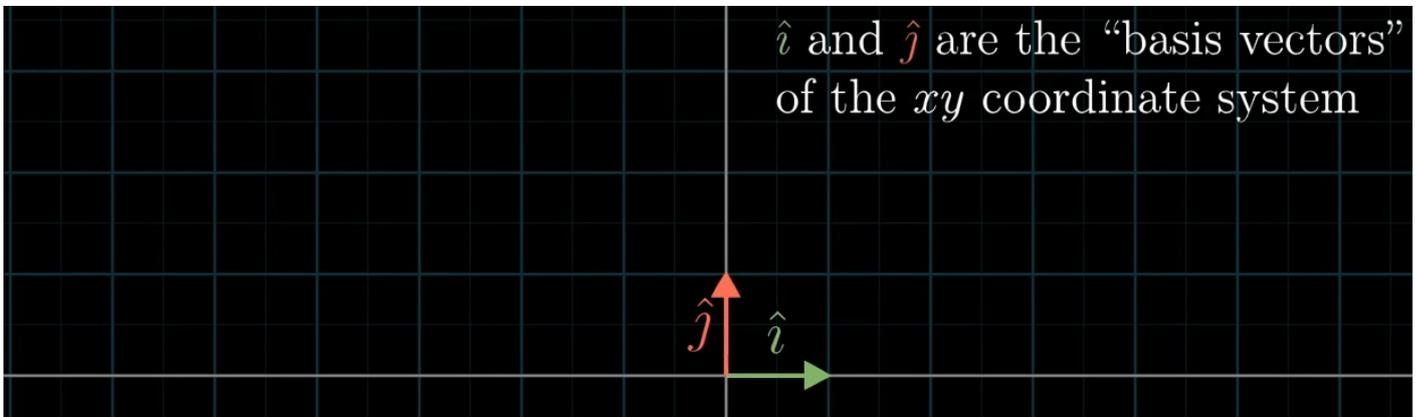


Basis Vectors



If you do not constrain \hat{i} or \hat{j} , then it's possible to reach any point of the coordinate system.

If both are 0, then it's stuck in origin.

Basis Vectors vs Normalized/Unit Vectors

Basis Vectors:

- Basis vectors are a set of vectors that form the basis of a vector space. They are often chosen to be mutually orthogonal (perpendicular) and linearly independent, meaning that no vector in the set can be expressed as a linear combination of the others. In 3D space, a common set of basis vectors is the standard unit vectors \hat{i} , \hat{j} , and \hat{k} , each pointing along one of the coordinate axes (x, y, and z).
- Basis vectors are not required to have a unit length (magnitude of 1). They simply define the directions along which other vectors in the space can be expressed.

Normalized Vectors:

- A normalized vector is a vector that has been scaled to have a length (magnitude) of 1. It is obtained by dividing each component of the original vector by its magnitude. If \vec{v} is a vector, its normalized counterpart is often denoted as \hat{v} .
- Normalized vectors are used when the direction of a vector is important, but its magnitude is not. Normalization simplifies calculations involving vectors and is particularly useful in algorithms, such as those related to computer graphics, physics simulations, or

machine learning.

In summary, while basis vectors are a set of vectors chosen to form a basis for a vector space, normalized vectors are vectors that have been scaled to have a length of 1. Basis vectors may or may not be normalized, depending on the specific context or requirements of a problem.

Technical artists need to understand basis vectors because they play a crucial role in representing and manipulating objects within a coordinate space, particularly in 3D computer graphics and related fields. Here are several reasons why knowledge of basis vectors is essential for technical artists:

1. **Coordinate Systems:**
 - Basis vectors define the coordinate system of a space. Understanding the basis vectors allows technical artists to work within different coordinate systems, such as world space, local space, or camera space.
2. **Transformations:**
 - Basis vectors are used in transformation matrices to represent translations, rotations, and scaling. Technical artists often apply these transformations to objects in a 3D scene to achieve the desired positioning and orientation.
3. **Rigging and Animation:**
 - In character rigging and animation, basis vectors are employed to control the movement and deformation of character joints and bones. They play a role in creating realistic and natural animations.
4. **Texture Mapping:**
 - Basis vectors are utilized in texture mapping to define the orientation of textures on 3D surfaces. Technical artists may manipulate basis vectors to achieve specific visual effects.
5. **Shading and Lighting:**
 - In shading and lighting calculations, basis vectors are used to determine the direction of light sources and the orientation of surfaces. This is crucial for realistic rendering.
6. **Camera Transformations:**
 - Understanding basis vectors helps technical artists manipulate camera transformations, controlling the view and perspective of a scene.
7. **Programming and Scripting:**
 - When writing scripts or shaders, technical artists may need to work with basis vectors to implement custom transformations or effects.
8. **Coordinate Conversions:**
 - Basis vectors are essential for converting coordinates between different spaces, such as transforming from world space to camera space or vice versa.
9. **Physics Simulations:**
 - In simulations involving physics, basis vectors may be used to represent forces and orientations in the simulation space.
10. **Workflow Optimization:**
 - Knowledge of basis vectors contributes to an efficient workflow. Technical artists can more effectively control and manipulate objects in 3D space by understanding how

basis vectors interact in various contexts.

11. **Procedural Generation:**

- In procedural generation of content, basis vectors are used to create patterns, structures, or landscapes by manipulating coordinates.

Understanding basis vectors is foundational to many aspects of computer graphics, animation, and simulation. It provides technical artists with the tools to position, rotate, scale, and manipulate objects within a 3D environment effectively.

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