linear_transformation example with numpy

Certainly! Linear transformations are fundamental in linear algebra and can be efficiently implemented using NumPy. Let's go through a basic example of a linear transformation using NumPy:

Example: Linear Transformation

Suppose we want to perform a linear transformation on a set of 2D vectors. A common transformation is scaling and rotating vectors.

1. **Scaling Transformation:** A scaling transformation changes the size of a vector but not its direction. It can be represented by a diagonal matrix.
2. **Rotation Transformation:** A rotation transformation changes the direction of a vector but not its size. It can be represented by a rotation matrix.

Code Example

Let's use NumPy to perform both scaling and rotation on a 2D vector.

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```python
import numpy as np

# Define a 2D vector
vector = np.array([1, 2])

# Define a scaling matrix (scaling by a factor of 2 in both directions)
scaling_matrix = np.array([[2, 0],
                           [0, 2]])

# Define a rotation matrix (rotating by 90 degrees counterclockwise)
theta = np.pi / 2  # 90 degrees in radians
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                            [np.sin(theta),  np.cos(theta)]])

# Apply scaling transformation
scaled_vector = np.dot(scaling_matrix, vector)
print("Scaled Vector:", scaled_vector)

# Apply rotation transformation
rotated_vector = np.dot(rotation_ma
print("Rotated Vector:", rotated_vector)
```

What is dot product? How to invert matrices?

Explanation

1. **Scaling Transformation:**
   - The scaling matrix `[[2, 0], [0, 2]]` scales the vector `[1, 2]` by a factor of 2 in both x and y directions.
   - The result is `[2, 4]`.
2. **Rotation Transformation:**
   - The rotation matrix `[[0, -1], [1, 0]]` rotates the vector `[1, 2]` by 90 degrees counterclockwise.
   - The result is `[-2, 1]`.

This example demonstrates how to use NumPy to apply linear transformations to vectors using matrices. You can modify the matrices to perform different transformations as needed.

What is dot product? How to invert matrices?

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