**Shiv Nadar University, Chennai**

**School of Engineering**

**Department of Computer Science**

CS1802 -- Programming in Python Lab Class: 2024-2028 B. Tech CSE (Cyber)

Date: 08/04/2025 Continuous Lab Evaluation – 10 (10 Marks)

**Statement:** Given a set of 2D data, use the following algorithm which uses transform coding to compact the information using few elements of transformed sequence.

Discarding the elements of least significant, the original sequence can be reconstructed using reverse transform with minimum error.

**Task:** Develop a python program to represent a 2D data as 1D data sequence with maximum information. Algorithm is attached next section.

Make use of following functions accordingly.

import numpy as np

import matplotlib.pyplot as plt

file\_pointer = open('sample1.txt')

array = [[x for x in line.split()] for line in file\_pointer]

print(array[0][0][0]);

....

....

x = np.array([65, 75, 60, 70, 56, 80, 68, 50])

y = np.array([170, 188, 150, 170, 130, 203, 160, 110])

*# a – slope of the line & b gives x intercept*

*# Straight line approximation – Line of best fit*

a, b = np.polyfit(x, y, 1)

*#add points to plot*

plt.scatter(x, y)

*#add line of best fit to plot: x is an array having independent variables*

plt.plot(x, a\*x+b)

plt.show()

....

....

....

*# slope in radian -> converted to degrees*

math.degrees(math.atan(2.5)))

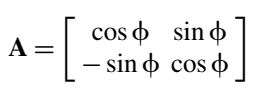
**Algorithm Steps:**

1. Consider the height and weight as the coordinates of a point in two-dimensional space, the sequence as vector

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1. The output values tend to cluster around the line (line of best bit) with a slope (**ϕ)** and x-intercept.
2. **Define the Transformation Matrix**

For example, if you want to rotate a vector by an **angle ϕ** in the counterclockwise direction, the 2D rotation matrix (orthonormal matrix) *R* is:



1. **Apply the Transformation**

To transform the vector 𝑣 using the orthonormal matrix 𝑅, you perform matrix multiplication:

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AI-generated content may be incorrect.

1. **Interpret the Result**

Notice that for each pair of values, almost all the energy is compacted into the first

element of the pair, while the second element of the pair is significantly smaller.

1. Suppose we set all the second elements of the transformation to zero, that is, the second coordinates of the sequence as new vector,
2. Reconstruct the original vector v back using,
3. Interpret the result by comparing and original v vectors. Compute the error between the vectors as a single metric called squared error. is the original sequence, is the reconstructed sequence.

A mathematical equation with numbers and symbols

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**Summary:**

1. **Define the orthonormal matrix** RRR, which could represent rotation or reflection.
2. **Define the vector** *v* that you want to transform.
3. **Multiply** the orthonormal matrix RRR by the vector *v* to get the transformed vector *v′.*
4. **Interpret the result**, depending on whether R represents a rotation, reflection, or other orthonormal transformation.
5. This algorithm is core concept of **method of principle components.**