

# Assignment 4: Spanning, and Linear Independence and Basis in $\mathbb{R}^n$

Math 264  
Dr. Rebin Muhammad

## Objective:

To implement Python functions that determine if a set of vectors spans a space, is linearly independent, and forms a basis for  $\mathbb{R}^n$ .

## Prerequisites:

- Understanding of vector spaces, spanning sets, and linear independence.
- Installed `numpy` library.
- Previous work with `Math264_RREF` function.

## Tasks:

### 1. Understanding the Matrix $A$ :

1. Accept the matrix  $A$  as a list of lists, where each list is a column vector.
2. Convert the list of lists into a numpy array.

### 2. Check if $A$ Spans $\mathbb{R}^n$ :

[resume]Write a function named `math264_Span(A)`. Utilize the `Math264_RREF` function to convert  $A$  into its RREF. Count the number of pivot columns in the RREF. Determine if  $A$  spans  $\mathbb{R}^n$  based on the number of pivot columns.

### 3. Check for Linear Independence:

[resume]Write a function named `math264_LI(A)`. Use the `Math264_RREF` function to get the RREF of  $A$ . Count the number of pivot columns in the RREF. Determine if  $A$  consists of linearly independent vectors.

### 4. Check for Basis:

[resume]Write a function named `math264_Basis(A)`. Utilize `math264_Span(A)` and `math264_LI(A)` to check if  $A$  is spanning and linearly independent. Determine if  $A$  forms a basis for  $\mathbb{R}^n$ .

## Instructions:

- Each function should accept a single argument: the matrix  $A$ .
- Include comments in your code for better clarity.
- Test all functions with different matrices to ensure their functionality.

## Submission:

Complete the tasks using Google Colab or any Python environment you're comfortable with. Once finished, share the link of your Colab notebook or submit the Python script.

## Additional Resources:

For further reading and clarification, students can refer to the notes available at this link.