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.