PH504M Lab 7 (Part B): Matrix Algebra

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Part B

Instructions

- You must write Python functions to perform the specified operations without using built-in NumPy functions for calculations.

- Test each function on a matrix of your choice and compare your output with the built-in NumPy functions.

Questions

1. Transpose of a Matrix
Write a function to compute the **transpose** of any given $m \times n$ matrix. The function should return a new matrix where the rows and columns are swapped. Test your function on a matrix of your choice.
Verification: Compare your result with NumPy's `numpy.transpose()` function.

2. Replace Diagonal Elements
Write a function that replaces the **diagonal elements** of a square matrix with a given number n. The function should modify the matrix in-place.
Verification: Compare your result with NumPy's `numpy.fill_diagonal()` function.

3. Matrix-Vector Multiplication
Write a function to perform the multiplication of a given $m \times n$ matrix A with an $n \times 1$ column vector v. Test your function on a matrix and vector of your choice.
Verification: Compare your result with NumPy's `numpy.dot(A, v)` or `A @ v`.

4. Determinant of a square Matrix
Write a function to compute the **determinant** of a $m \times m$ matrix.
Verification: Compare your result with NumPy's `numpy.linalg.det()` function.

5. Inverse of a 2×2 Matrix
Write a function to compute the **inverse** of a 2×2 matrix. Your function should check if the matrix is invertible and return an appropriate message if it is not.
Verification: Test your function on a matrix of your choice and compare your output with NumPy's `numpy.linalg.inv()` function.