Math 108C Homework 1

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1.) Compute the product of the following matrices using the column-row defintion of matrix multiplication

$$A = \begin{bmatrix} 1 & 2 \\ 2 & -3 \\ 0 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 0 & 1 \\ 2 & -1 & 0 \end{bmatrix}$$

Proof:

We can do this by **Proposition 5, Section 4.3** which yields:

$$\begin{bmatrix} 1 & 0 & 1 \\ 2 & 0 & 2 \\ 3 & 0 & 3 \end{bmatrix} + \begin{bmatrix} 4 & -2 & 0 \\ -6 & 3 & 0 \\ 2 & -1 & 0 \end{bmatrix} = \begin{bmatrix} 5 & -2 & 1 \\ -4 & 3 & 2 \\ 2 & -1 & 0 \end{bmatrix}$$

3.) Express the product of AB in terms of

1. A and the columns of B.
2. B and the rows of A.

Proof:

1. The columns of AB can be expressed as A times the ith column of B.
That is, $AB = A[b_1, b_2, \dots, b_i] = [Ab_1, Ab_2, \dots, Ab_i]$ where b_i is the ith column of B.
2. The rows of AB can be expressed as the jth row of A times B, i.e.,

$$AB = \begin{bmatrix} a_1^T B \\ a_2^T B \\ \vdots \\ a_j^T B \end{bmatrix}$$ where a_j^T is the jth row of A.

4.) Assume the following matrices are partitioned comformably for block multiplication.
Compute the product

$$\begin{bmatrix} I & 0 \\ -X & I \end{bmatrix} \begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

Proof:

By **Theorem 2**, the product is given by:

$$\begin{bmatrix} AI & BI \\ -AX + CI & -BX + DI \end{bmatrix}$$

13.)(Matlab/Python) For block operations, it may be necessary to access or enter submatrcies of a large matrix.
Describe the functiosn or commands in Matlab that accomplix the following tasks.
Suppose A is 20×30 matrix.
(a) Display the submatrix of A from rows 15 to 20 and columns 5 to 10.
(b) Insert a 5×10 matrix B into A, beginning at row 10 and column 20.
(c) Create a 50×50 matrix of the form

$$B = \begin{bmatrix} A & 0 \\ 0 & A^T \end{bmatrix}$$

Proof:

We can use 2D list in Python to represent a matrix.
Therefore, a block matrix can be represented by a 2D list, with each element being another 2d list.

In [1]:

```python
import numpy
big_matrix = [[f"A_{r+1}_{c+1}" for c in range(30)] for r in range(20)]
print("(a)")
for row in big_matrix[14:20]:
    print(row[4:10])

print("(b)")
matrix_B = [[f"B_{r+1}_{c+1}" for c in range(10)] for r in range(5)]
for i in range(10,20):
    big_matrix[i][20] = matrix_B
print("row 10, column 20 of matrix A:")
for x in big_matrix[10][20]:
    print(x)
print("row 15, column 20 of matrix A")
for x in big_matrix[15][20]:
    print(x)

print("(c)")
very_big_matrix = [[big_matrix for c in range(50)] for r in range(50)]
matrix_B = [[big_matrix for i in range(2)] for j in range(2)]
# too braindead to do this properly.
matrix_B[0][1] = 0
matrix_B[1][0] = 0
t_big_matrix = [list(x) for x in numpy.transpose(big_matrix)]
matrix_B[1][1] = t_big_matrix
for i in range(10,20):
    very_big_matrix[i][20]=matrix_B
print("row 15, column 20 of matrix A")
for x in very_big_matrix[15][20]:
    print(x)
```

```
(a)
['A_15_5', 'A_15_6', 'A_15_7', 'A_15_8', 'A_15_9', 'A_15_10']
['A_16_5', 'A_16_6', 'A_16_7', 'A_16_8', 'A_16_9', 'A_16_10']
['A_17_5', 'A_17_6', 'A_17_7', 'A_17_8', 'A_17_9', 'A_17_10']
['A_18_5', 'A_18_6', 'A_18_7', 'A_18_8', 'A_18_9', 'A_18_10']
['A_19_5', 'A_19_6', 'A_19_7', 'A_19_8', 'A_19_9', 'A_19_10']
['A_20_5', 'A_20_6', 'A_20_7', 'A_20_8', 'A_20_9', 'A_20_10']
(b)
row 10, column 20 of matrix A:
['B_1_1', 'B_1_2', 'B_1_3', 'B_1_4', 'B_1_5', 'B_1_6', 'B_1_7', 'B_1_8', 'B_1_9', 'B_1_10']
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row 15, column 20 of matrix A
['B_1_1', 'B_1_2', 'B_1_3', 'B_1_4', 'B_1_5', 'B_1_6', 'B_1_7', 'B_1_8', 'B_1_9', 'B_1_10']
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(c)
row 15, column 20 of matrix A
[[['A_1_1', 'A_1_2', 'A_1_3', 'A_1_4', 'A_1_5', 'A_1_6', 'A_1_7', 'A_1_8', 'A_1_9', 'A_1_10', 'A_1_11', 'A_1_12', 'A_1_13', 'A_1_14', 'A_1_15', 'A_1_16', 'A_1_17', 'A_1_18', 'A_1_19', 'A_1_20', 'A_1_21', 'A_1_22', 'A_1_23', 'A_1_24', 'A_1_25', 'A_1_26', 'A_1_27', 'A_1_28', 'A_1_29', 'A_1_30'], ['A_2_1', 'A_2_2', 'A_2_3', 'A_2_4', 'A_2_5', 'A_2_6', 'A_2_7', 'A_2_8', 'A_2_9', 'A_2_10', 'A_2_11', 'A_2_12', 'A_2_13', 'A_2_14', 'A_2_15', 'A_2_16', 'A_2_17', 'A_2_18', 'A_2_19', 'A_2_20', 'A_2_21', 'A_2_22', 'A_2_23', 'A_2_24', 'A_2_25', 'A_2_26', 'A_2_27', 'A_2_28', 'A_2_29', 'A_2_30'], ['A_3_1', 'A_3_2', 'A_3_3', 'A_3_4', 'A_3_5', 'A_3_6', 'A_3_7', 'A_3_8', 'A_3_9', 'A_3_10', 'A_3_11', 'A_3_12', 'A_3_13', 'A_3_14', 'A_3_15', 'A_3_16', 'A_3_17', 'A_3_18', 'A_3_19', 'A_3_20', 'A_3_21', 'A_3_22', 'A_3_23', 'A_3_24', 'A_3_25', 'A_3_26', 'A_3_27', 'A_3_28', 'A_3_29', 'A_3_30'], ['A_4_1', 'A_4_2', 'A_4_3', 'A_4_4', 'A_4_5', 'A_4_6', 'A_4_7', 'A_4_8', 'A_4_9', 'A_4_10', 'A_4_11', 'A_4_12', 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```

```
c:\Users\rmallari\PersonalProjects\math_hw\venv\lib\site-packages\numpy\core\fromnumeric.py:43: VisibleDeprecationWarning: Creating an ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant to do this, you must specify 'dtype=object' when creating the ndarray.
  result = getattr(asarray(obj), method)(*args, **kwds)
```