VIETNAM GENERAL CONFEDERATION OF LABOR
TON DUC THANG UNIVERSITY
FACULTY OF INFORMATION TECHNOLOGY

MIDTERM ESSAY

APPLIED LINEAR ALGEBRA FOR IT

Instructor: **MAI DUY TÂN**

Executor: **LÊ TOÀN HIỂN – 521K0008**

Class **:** **21K50201**

Course **:** **25**

HO CHI MINH CITY , YEAR 2022

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Special thanks to Mr. Mai Duy Tan for providing me lots of useful and important knowledge in either Linear Algebra and Python programming. Therefore, I was able to finish this Mid-term essay. You are the one who gives me effort to keep studying Mathematics and Algebra, which is the subject that I used to feel bored at when I was in high school. Also, you helped me find the easiness and the interest of coding in Python, which used to be a language that I thought it was difficult to understand the codes. I'm very grateful to have you as my lecturer for the practical lessons of Applied Linear Algebra for IT.

ĐẠI HỌC TÔN ĐỨC THẮNG TON DUC THANG UNIVERSITY	***Applied Linear Algebra for IT*** *Faculty of Information Technology*

LECTURER'S COMMENTS AND COMMITMENT

LECTURER'S COMMITMENTS:

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Ho Chi Minh City, April 5th, 2022

Hien

Le Toan Hien

LECTURER'S COMMENTS:

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Ho Chi Minh City, April 5th, 2022

ABSTRACT

This essay is divided into 2 parts:

1. The solutions and Python codes for all 4 questions given by Mr. Tan.
2. My self-evaluation form about this assignment.

TABLE OF CONTENTS

REFERENCES

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ASSIGNMENT

Question 1 (2 marks): Given the vector: a = (1, -1, 3); b = (1, 0, 1). Print the following:

a) $a.ans1a = a + b$

Result: (2, -1, 4)

Solution:

```
import numpy
#Question 1
a = numpy.array([1, -1, 3])
b = numpy.array([1, 0, 1])
#1a
ans1a = numpy.add(a, b)
print("The addition of 2 matrices: ")
print(ans1a)
```

b) $a.ans1b = 3a - 2b$

Result: (1, -3, 7)

Solution:

```
import numpy
#Question 1
a = numpy.array([1, -1, 3])
b = numpy.array([1, 0, 1])
#1b
ans1b = numpy.subtract(3*a, 2*b)
print("The subtraction of 3a and 2b is: ")
print(ans1b)
```

<u>Question 2</u> (3 marks): Given the following matrix:

$$M = \begin{pmatrix} 1 & 2 & -1 \\ 0 & 4 & 3 \\ 2 & 1 & 3 \end{pmatrix}$$

Print the following:

a) *a.ans2a* = "The 2nd row of the matrix M"
Result: (0, 4, 3)
Solution:

```
import numpy
#Question 2
M = numpy.array([[1, 2, -1], [0, 4, 3], [2, 1, 3]])
#2a
ans2a = M[1]
print("The 2nd row of the matrix M: ")
print(ans2a)
```

b) *a.ans2b* = "The 3rd element of the 2nd row of M^3"
Result: 114
Solution:

```
import numpy
#Question 2
M = numpy.array([[1, 2, -1], [0, 4, 3], [2, 1, 3]])
#2b
ans2b = numpy.linalg.matrix_power(M, 3)
print("The 3rd element of the 2nd row of M**3: ")
print(ans2b[1, 2])
```

c) *a.ans2c* = "The 1st column of M^2"
Result: (-1, 6, 8)
Solution:

```
import numpy
#Question 2
M = numpy.array([[1, 2, -1], [0, 4, 3], [2, 1, 3]])
#2c
M2cd = numpy.linalg.matrix_power(M, 2)
ans2c = M2cd[:, 0]
print("The 1st column of M2: ")
print(ans2c)
```

d) *a.ans2d* = "The transpose matrix of M^2"

Result: $\begin{pmatrix} -1 & 6 & 8 \\ 9 & 19 & 11 \\ 2 & 21 & 10 \end{pmatrix}$

Solution:

```
import numpy
#Question 2
M = numpy.array([[1, 2, -1], [0, 4, 3], [2, 1, 3]])
#2d
M2cd = numpy.linalg.matrix_power(M, 2)
ans2d = numpy.transpose(M2cd)
print("The transpose matrix of M2")
print(ans2d)
```

<u>Question 3</u> (3 marks): Given 2 matrices:

$$A = \begin{pmatrix} 1 & 2 & -2 \\ 3 & 2 & 0 \\ 2 & 1 & 9 \end{pmatrix}; B = \begin{pmatrix} 3 & 1 & 1 \\ 2 & -7 & 0 \\ 3 & 2 & 1 \end{pmatrix}$$

Print the following:

a) *a.ans3a* = A + B

Result: $\begin{pmatrix} 4 & 3 & -1 \\ 5 & -5 & 0 \\ 5 & 3 & 10 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3a
ans3a = numpy.add(A, B)
print("The addition of 2 matrices A and B is: ")
print(ans3a)
```

b) *a.ans3b* = 2A + 12B

Result: $\begin{pmatrix} 38 & 16 & 8 \\ 30 & -80 & 0 \\ 40 & 26 & 30 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3b
ans3b = numpy.add(2*A, 12*B)
print("The addition of 2*A and 12*B is: ")
print(ans3b)
```

c) *a.ans3c* = $(A + B)^{-1}$

Result: $\begin{pmatrix} 0.12820513 & 0.08461538 & 0.01282051 \\ 0.12820513 & -0.11538462 & 0.01282051 \\ -0.1025641 & -0.00769231 & 0.08974359 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3c
ans3a = numpy.add(A, B)
ans3c = numpy.linalg.matrix_power(ans3a, -1)
print("The addtion of 2 matrices A and B power -1 equals: ")
print(ans3c)
```

d) *a.ans3d* = $(3A + B)^2$

Result: $\begin{pmatrix} 68 & 10 & -170 \\ 55 & 78 & -55 \\ 361 & 198 & 739 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3d
sum3d = numpy.add(3*A, B)
ans3d = numpy.linalg.matrix_power(sum3d, 2)
print("The result of the addtion of 3*A and B power 2 is: ")
print(ans3d)
```

e) *a.ans3e* = (A + B).(A – B)

Result: $\begin{pmatrix} -4 & 32 & -20 \\ -15 & -40 & -15 \\ -17 & 22 & 65 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3e
ans3a = numpy.add(A, B)
sub3e = numpy.subtract(A, B)
ans3e = numpy.dot(ans3a, sub3e)
print("The multiplication of the addtion and the subtraction of 2 matrices A and B is: ")
print(ans3e)
```

f) *a.ans3f* = $(A^3 – B)^T$

Result: $\begin{pmatrix} -28 & 25 & 219 \\ -7 & 39 & 151 \\ -187 & -72 & 646 \end{pmatrix}$

Solution:

```
import numpy
#Question 3
A = numpy.array([[1, 2, -2], [3, 2, 0], [2, 1, 9]])
B = numpy.array([[3, 1, 1], [2, -7, 0], [3, 2, 1]])
#3f
powA3 = numpy.linalg.matrix_power(A, 3)
ans3f = numpy.transpose(numpy.subtract(powA3, B))
print("The transposed matrix of the subtraction of A power 3 and B is: ")
print(ans3f)
```

<u>Question 4</u> (2 marks): Given the linear system of equations $\begin{cases} x + y + z = 6 \\ x - y + 2z = 5 \\ x + 3y + mz = 4 \end{cases}$,

where $m \in \mathbf{R}$.

Print the following:

a) *a.ans4a* = "The solution of the system when $m = 1$"
Result: $x = 10$, $y = -1$, $z = -3$
Solution:

```
import sympy
from sympy.solvers.solveset import linsolve
x, y, z = sympy.symbols('x, y, z')
#Question 4
#4a
ans4a = linsolve([x + y + z - 6, x - y + 2*z - 5, x + 3*y + z - 4], (x, y, z))
print("The solution of the system when m = 1 is: ")
print(ans4a)
```

b) *a.ans4b* = "The value of m so that $x = 1$, $y = 2$, $z = 3$ is the solution of the system"
Result: m = -1
Solution:

```
import sympy
from sympy.solvers.solveset import linsolve
m = sympy.symbols('m')
#Question 4
#4b
ans4b = linsolve([1 + 3*2 + m*3 - 4], (m))
print("The value of m so that x = 1, y = 2, z = 3 is the solution of the system is: ")
print(ans4b)
```

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SELF-EVALUATION FORM

Requirements	Score/10	Level 1 0 score	Level 2 1/2 score	Level 3 Full score	Self - evaluation	Reason(s)
In right format		Wrong format. and outlines.	Some errors.	In right format and outlines, no error.		
Question 1	2.0	No content.	Partial answered, some errors.	Fully answered, no error.	2.0	Fully answered, no error.
Question 2	3.0	No content.	Partial answered, some errors.	Fully answered, no error.	3.0	Fully answered, no error.
Question 3	3.0	No content.	Partial answered, some errors.	Fully answered, no error.	3.0	Fully answered, no error.
Question 4	2.0	No content.	Partial answered, some errors.	Fully answered, no error.	2.0	Fully answered, no error.
Total:	10.0	Result:			10.0	

THE END.