

## Linear Algebra Project ( Week # 1)

### A ) Solving a system of linear equation using Python

Let 's say we want to solve the following system  $\begin{cases} 2x - 3y = 17 \\ 4x + 7y = -5 \end{cases}$  in Python .

- 1) We need to import all the math libraries numpy ( numerical Python ) , scipy (Scientific computing Python) , and sympy (Symbolic Python ) .

It will look like :

```
import numpy as np
import sympy as sy
import scipy as sp
```

- 2) Our unknowns here are x and y .They are symbols for the answers.  
So we define the symbols in Python by importing the symbols library from sympy .  
Our code will look like :

```
import numpy as np
import sympy as sy
import scipy as sp
from sympy import symbols
x,y = symbols("x,y")
```

- 3) Now let's solve the equation

$$\begin{cases} 2x - 3y = 17 \\ 4x + 7y = -5 \end{cases} \text{ is the same as } \begin{cases} 2x - 3y - 17 = 0 \\ 4x + 7y + 5 = 0 \end{cases}, \text{ Python does not need the = sign}$$

In the function sympy.Solve() ,  $2x-3y-17=0$  will be  $2x-3y-17$ .

Example code is :

```
import numpy as np
import sympy as sy
import scipy as sp
from sympy import symbols
x,y = sy.symbols("x,y")
```

# this is a comment in python

```
ans = sy.solve([2*x-3*y-17, 4*x+7*y+5]) # our answer is in ans
sy.pprint(ans) # this is to print the answer
```

# pprint is for prettyprint from sympy ,

# do not use Python print to display your math answers.

See a screenshot of the code from Jupyter below.

```

: import numpy as np
import sympy as sy
import scipy as sp
from sympy import symbols
x,y = sy.symbols("x,y")

# this is a comment in python
ans = sy.solve([2*x-3*y-17, 4*x+7*y+5]) # our answer is in ans
print("The answer is : \n") # this Python print function
sy.pprint(ans) # this is to print the answer ( math printing)
# pprint is for prettyprint from sympy ,
# do not use Python print to display your math answers.

```

The answer is :

{x: 4, y: -3}

4) Now that you have seen an example code in Python ,

Solve the following system of linear equations using Python.

$$\begin{cases} x+3y-z+t+u=26 \\ 2x+4y+z+t+u=35 \\ 5x-2y-z+t-4u=-11 \\ 3x+y-5z-7t-u=-28 \\ 4x+5y-3z+2t+7u=80 \end{cases}$$

B) Word problem

John wants to make some phone calls within the US, to Canada ,to France and to Germany. The rates per minute for these calls vary for the different countries. Use the information in the following table to determine the rates.

The table below shows the number of minutes he used for each country from January to April, and the money spent ( Total charge) in each month

Month	Call time in the US (min)	Call time To Germany ( min)	Call time To Canada ( min)	Call time To France ( min)	Total charge in \$

January	15	10	6	5	\$ 273
February	20	5	3	4	\$ 266
March	10	2	5	5	\$ 167
April	12	4	10	1	\$ 227

If

**x** represents the rate in \$/ min for calls within the US.

**y** represents the rate \$/ min for calls to Germany.

**z** represents the rate\$/ min for calls to Canada.

**t** represents the rate \$/ min for calls to France.

1) Write a mathematical model for the problem.

This is going to be a system of linear equation with unknown x, y, z, and t (the rates).

2) Find the rate for each country.

< solve the system of linear equation using PYTHON>