Homework 1 (Question 1)

In [1]:
```python
import sys
!{sys.executable} -m pip install pulp
```

Requirement already satisfied: pulp in c:\users\muntakim\appdata\local\programs\python\python38-32\lib\site-packages (2.4)
Requirement already satisfied: amply>=0.1.2 in c:\users\muntakim\appdata\local\programs\python\python38-32\lib\site-packages (from pulp) (0.1.4)
Requirement already satisfied: docutils>=0.3 in c:\users\muntakim\appdata\local\programs\python\python38-32\lib\site-packages (from amply>=0.1.2->pulp) (0.17.1)
Requirement already satisfied: pyparsing in c:\users\muntakim\appdata\local\programs\python\python38-32\lib\site-packages (from amply>=0.1.2->pulp) (2.4.7)

In [2]:
```python
import pulp
from pulp import *
```

In [3]:
```python
"""
Linear Programming Problem 1.0

Author : Muntakim Rahman 2021
"""
```

Out[3]: '\nLinear Programming Problem 1.0\n\nAuthor : Muntakim Rahman 2021\n'

Linear Programming Problem 1.0

$$
\begin{aligned}
\text{Minimize} \quad & x_1 - 3x_2 - x_3 \\
\text{Subject to} \quad & x_1 + x_2 + x_3 = 3 \\
& -x_1 + x_2 \leq 1 \\
& x_1 \geq 0 \\
& x_2 \ unconstrained \\
& x_3 \geq 0
\end{aligned}
$$

In [4]:
```python
decision_variables = {}
for i in range(3) :
    decision_variables['x_' + str(i + 1)] = LpVariable(name = 'x_' + str(i + 1), cat =

## Print Decision Variables -> Mainly for Debugging Purposes.
print(decision_variables)
```

{'x_1': x_1, 'x_2': x_2, 'x_3': x_3}

In [5]:
```python
LP_Prob = LpProblem(name = 'LP_Problem_1.0', sense = LpMinimize)

# The Objective Function is Added to 'LP_Prob' First.
LP_Prob += decision_variables['x_1'] - 3 * decision_variables['x_2'] - decision_variabl
```

In [6]:
```python
# The Constraints are Added to 'LP_Prob'
```

```
LP_Prob += decision_variables['x_1'] + decision_variables['x_2'] + decision_variables['
LP_Prob += - decision_variables['x_1'] + decision_variables['x_2'] <= 1
LP_Prob += decision_variables['x_1'] >= 0
LP_Prob += decision_variables['x_3'] >= 0
```

In [7]:
```
print(LP_Prob)
```

```
LP_Problem_1.0:
MINIMIZE
1*x_1 + -3*x_2 + -1*x_3 + 0
SUBJECT TO
_C1: x_1 + x_2 + x_3 = 3

_C2: - x_1 + x_2 <= 1

_C3: x_1 >= 0

_C4: x_3 >= 0

VARIABLES
x_1 free Continuous
x_2 free Continuous
x_3 free Continuous
```

In [8]:
```
LP_Prob.writeLP('LP_Problem.lp')
```

Out[8]: [x_1, x_2, x_3]

In [9]:
```
# The Problem is Solved Using PuLP's Choice of Solver.
LP_Prob.solve()
```

Out[9]: 1

In [10]:
```
print(f'Status: {LpStatus[LP_Prob.status]} \n')

for variable in LP_Prob.variables() :
    print(f'{variable.name} = {variable.varValue}')
print('\n')

if (LpStatus[LP_Prob.status] == 'Optimal') :
    print(f'Optimal Value : Z = {value(LP_Prob.objective)}')
else :
    print(f'No Optimal Value. Status Code : {value(LP_Prob.objective)}')
```

```
Status: Optimal

x_1 = 1.0
x_2 = 2.0
x_3 = 0.0


Optimal Value : Z = -5.0
```