HW2

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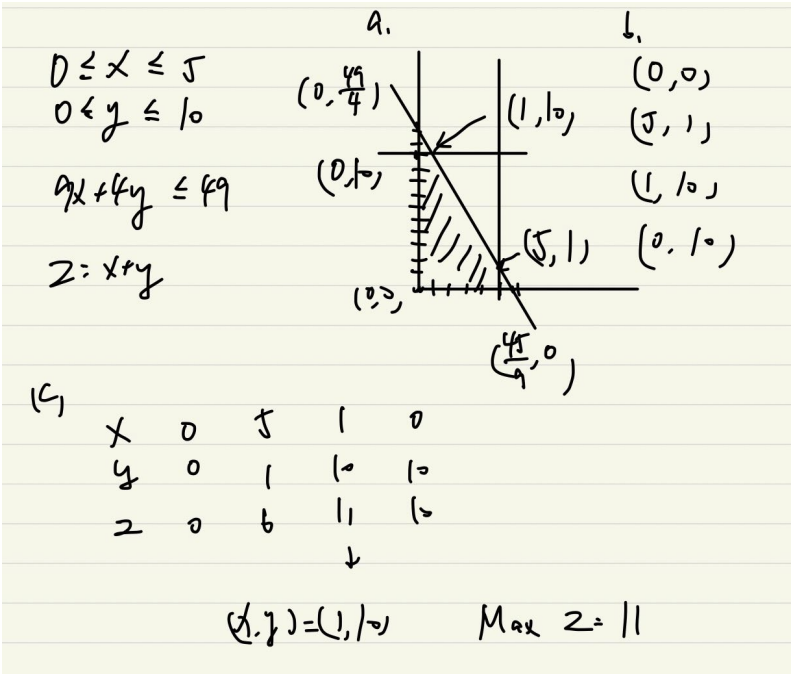
```python
#HW2
#1
import random
import math
import numpy as np
import pandas as pd



def volume_estimate(numNeedles):
    inCircle = 0
    for Needles in range(1, numNeedles + 1) :
        x1 = random.uniform(0, 1)
        x2 = random.uniform(0, 1)
        x3 = random.uniform(0, 1)
        x4 = random.uniform(0, 1)
        x5 = random.uniform(0, 1)

        if x1**2 + x2**2 + x3**2 + x4**2 + x5**2 <= 1:
            inCircle+=1
    return inCircle/numNeedles * 2**5
# Run 10 experiments with N=10^6
volumes = []
for i in range(10):
    v = volume_estimate(10**6)
    volumes.append(v)

# Calculate the average and standard deviation of the volumes
avg_volume = np.mean(volumes)
std_dev = np.std(volumes)

print(f"Average volume estimate: {avg_volume:.6f}")
print(f"Standard deviation: {std_dev:.6f}")
```

```
Average volume estimate: 5.272960
Standard deviation: 0.006010
```

2.



```python
#HW2
#3
import  random
import  math
import  numpy  as  np
import  pandas  as  pd

x1  =  0
y1  =  0.5
x2  =  1
y2  =  2.5
x3  =  3
y3  =  12.5

X  =  [[1,  x1,  x1**2],
       [1,  x2,  x2**2],
       [1,  x3,  x3**2]]
X  =  np.array(X)
y  =  np.array([[y1],
                [y2],
                [y3]])
w  =  np.linalg.inv(X.T*X)*X.T*y
#  print(X)
#  [[1  0  0]
#    [1  1  1]
#    [1  3  9]]

#  print(y)
#  [[  0.5]
#    [  2.5]
#    [12.5]]
print("X.T*X  =\n",X.T*X)
print("w  =\n",w)
```

```
X.T*X =
 [[ 1  0  0]
 [ 0  1  3]
 [ 0  3 81]]
w =
 [[ 0.5         0.          0.        ]
 [ 0.          2.8125     -0.3125    ]
 [-0.         -0.52083333  1.5625    ]]
```