IT 542: Pattern Recognition and Machine Learning

Assignment 4

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(1) Draw samples from p(x) = P1.p1(x) + P2.p2(x)

Where, P1 = 0.6, P2 = 0.4, p1(x) ~ N(5,10) and p2(x) ~ N(10,15).

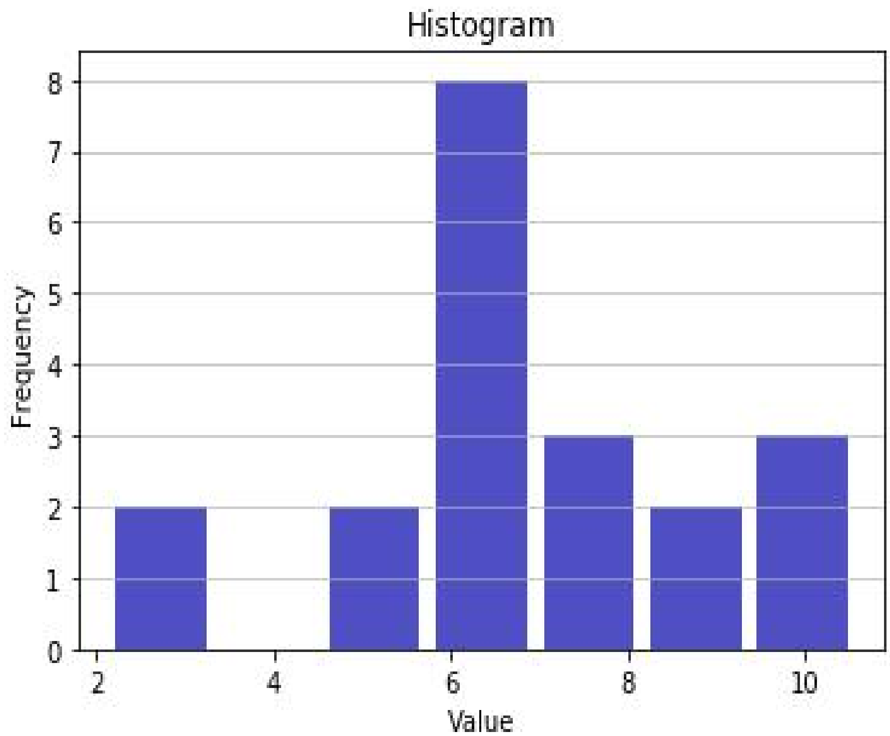
Draw a histogram for the data.

Code:

```
from scipy.stats import norm

import matplotlib.pyplot as plt

import numpy as np

P1=0.6

P2=0.4

mu1,mu2,sigma1,sigma2=5,10,np.sqrt(10),np.sqrt(15)
```

```
s1 = np.random.normal(mu1, sigma1, 20)

s2 = np.random.normal(mu2, sigma2, 20)

s=P1*s1+P2*s2

#s=s1+s2

n, bins, patches = plt.hist(x=s, bins='auto',
color='#0504aa',alpha=0.7, rwidth=0.85)

plt.grid(axis='y', alpha=0.75)

plt.xlabel('Value')

plt.ylabel('Frequency')

plt.title('Histogram')

print(n)

print(bins)

print(patches)
```

OUTPUT:



2. Use the KDE to estimate pdf of given samples:

Code:

```
import numpy as np

import matplotlib.pyplot as plt

x1= np.random.normal(5,1,100)

x2=np.random.normal(-5,1,100)

data=x1

data= np.append(data,x2)

#data=0.6*x1+0.4*x2


print(np.shape(data))

N=200

print(data)

def phi(x):

  return (np.exp(-0.5*(x**2))/(np.sqrt(2*np.pi)))    #
Normal Density-> Mean =0, var=1
```

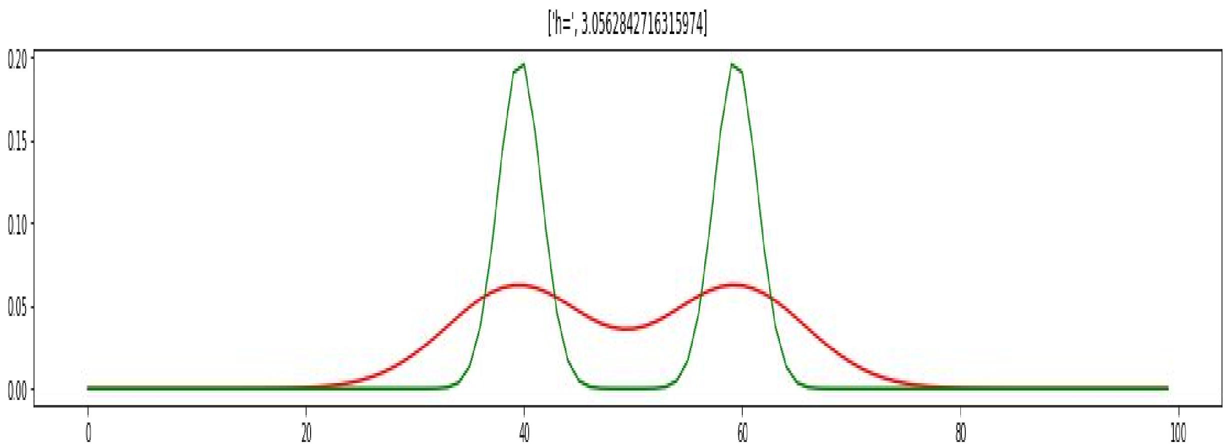
```
def tpdf(x):
  return (phi(x-5)*0.5) +    (phi(x+5)*0.5) # True
Density-> Mean 10,-10, var=1




def kernel(x,h):
        return np.mean(phi((x-data)/h)/h) #    Kernel
Density


def kpdf(x,h):
        temp=[]
        for i in range(len(x)):
                temp.append(kernel(x[i],h))


        return temp
x = np.linspace(-25,+25,100)
```

```
x

h=0.3

print(len(kpdf(x,h)))

print(len(tpdf(x)))

# Kernel - Bandwidth estimated by Silverman's Rule of Thumb

h=np.power((4/3*N),1/5)

ax1 = plt.axes([0, 0, 3, 0.5])

plt.plot(kpdf(x,h),'r') # Kernel Density Estimated

plt.plot(tpdf(x),'g') # True density

plt.title(['h=',h])

plt.show()


h=np.linspace(0.01,5,num=50)

for i in range(len(h)):

  ax1 = plt.axes([0, 0, 3, 0.5])

  plt.plot(kpdf(x,h[i]),'r') # Kernel Density Estimated
```

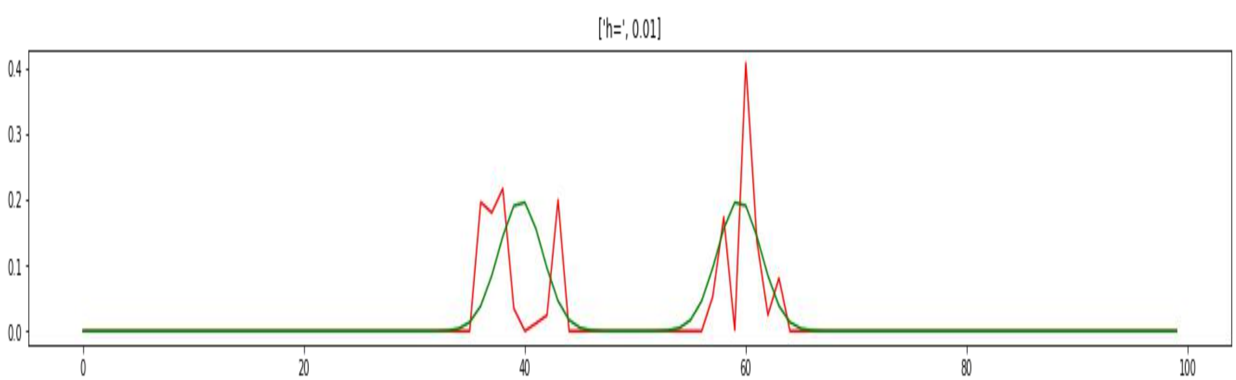
```
plt.plot(tpdf(x),'g') # True density
plt.title(['h=',h[i]])
plt.show()
```

Output:

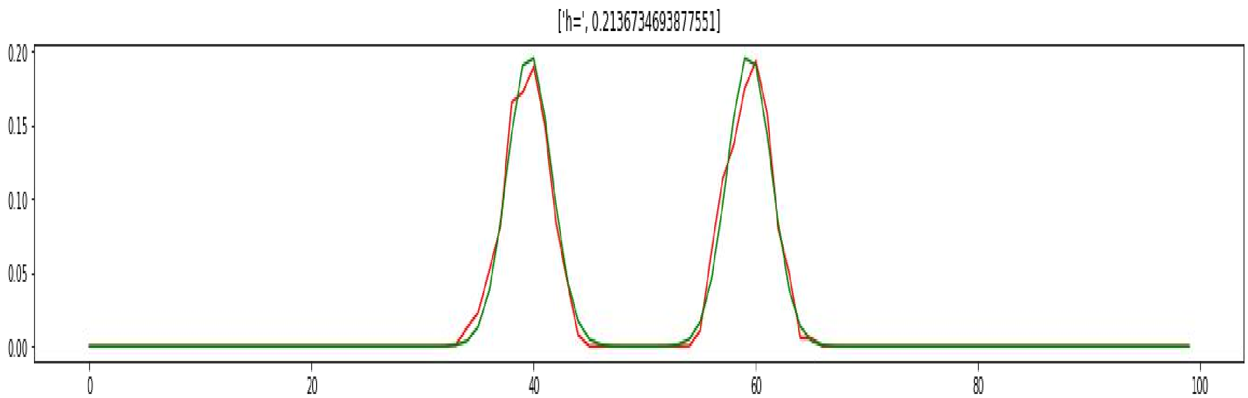
h= 3.05



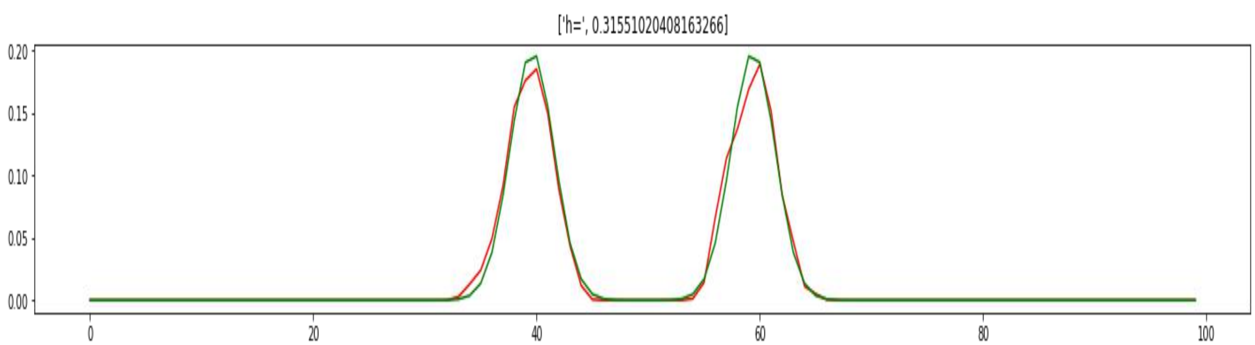
h= 0.01



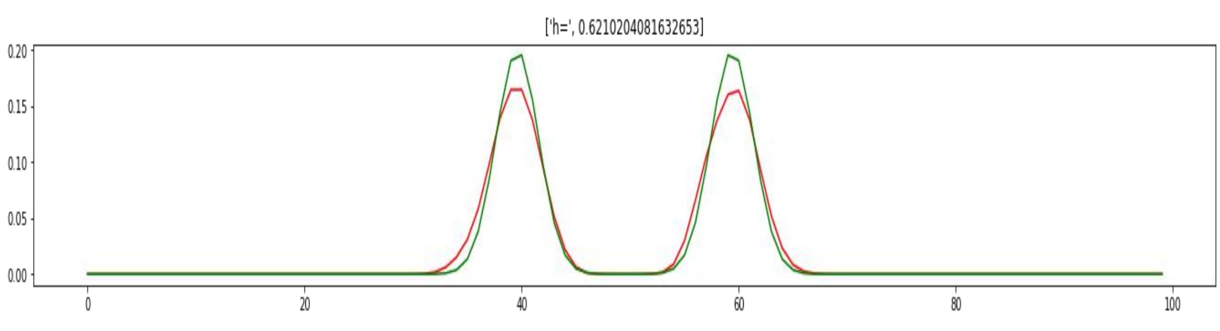
h= 0.21



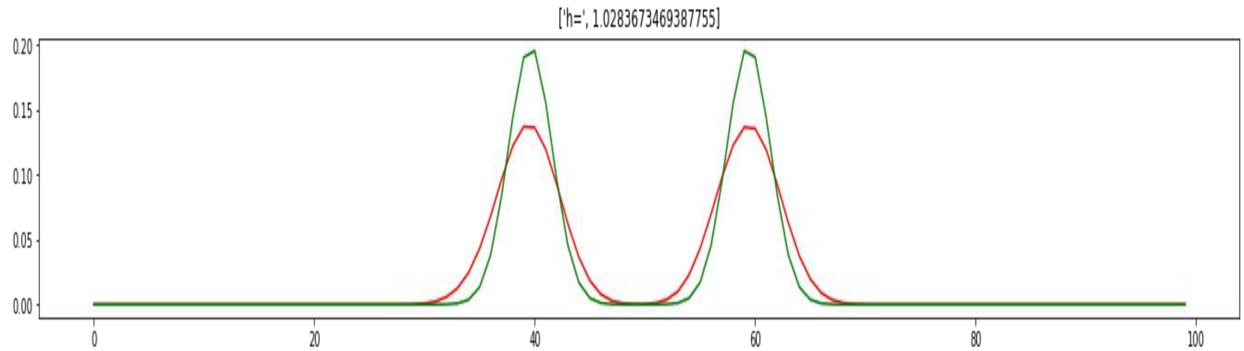
h= 0.31



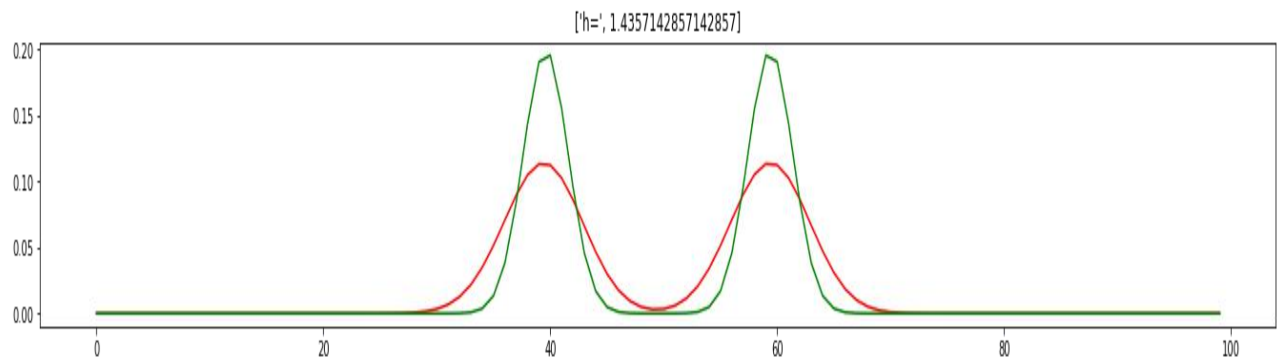
h= 0.62



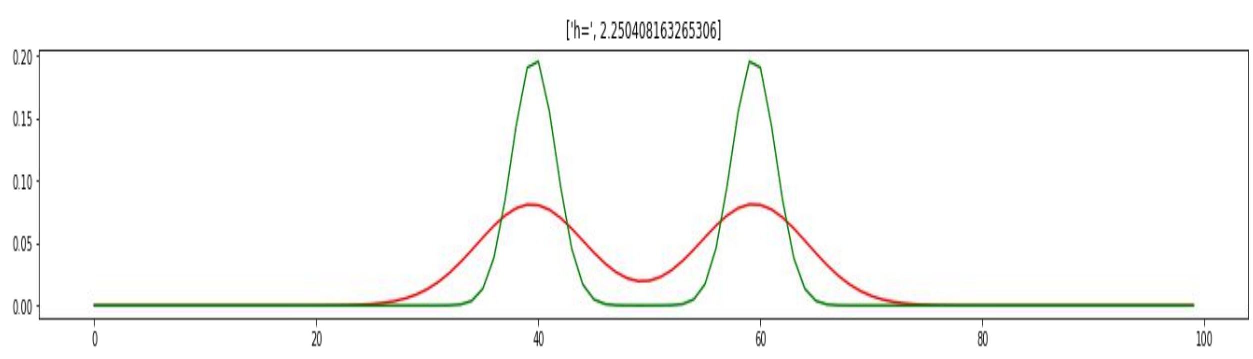
h= 1.02



h= 1.43



h= 2.25



h= 3.9