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#import necessary libraries
import random
import matplotlib.pyplot as plt

#initialize values
n=10 #number of bits
alpha= 0.1 #noise level
z= 120 #given
count= 10000000 #number of iterations

values= [2,5,8,10]

numerator= 0
denominator= 0
bits= [0 for i in range(10)] #initialize to 0
constant= ((1-alpha)/(1+alpha))

#lists to store values for 2,5,8,10 for different iteration counts
l = []
plot_points= count/500 #for 500 different values

for i in values:
   temp_list = []
   for j in range(count):

      #Randomly generate numbers between 0 and 1
      bits= [random.randint(0,1) for i in range(10)]

      #Calculating f(B)
      #f(B)= sigma i=1 to n (2^i-1)*Bi
      temp= [(2**i)*bits[i] for i in range(10)]
      f_B= sum(temp)

      # Calculating P(Z|B1, B2, . . . , Bn)
      power= abs(z- f_B)
      prob= constant * pow(alpha, power)
      #summing all probabilities for denominator value of equation
      denominator+= prob
      if bits[i-1]== 1: #indicator function
         numerator+= prob

      #calculating probabilities for every 20000 iterations for plot
      if j%plot_points == 0 and j>0:
         t= numerator/denominator
         temp_list.append(t)

   temp= numerator/denominator
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    l.append(temp_list)
    print(i, temp)


#Probabilties for all iteration counts for 2,5,8,10
l_2 = l[0]
l_5 = l[1]
l_8 = l[2]
l_10= l[3]

x_axis= [num for num in range(20000, 10000000, 20000)]

#Plotting
plt.plot(x_axis, l_2)
plt.plot(x_axis, l_5)
plt.plot(x_axis, l_8)
plt.plot(x_axis, l_10)
plt.legend(['2' ,'5', '8', '10'])
plt.xlabel('Number of iterations')
plt.ylabel('Probability')
plt.show()
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