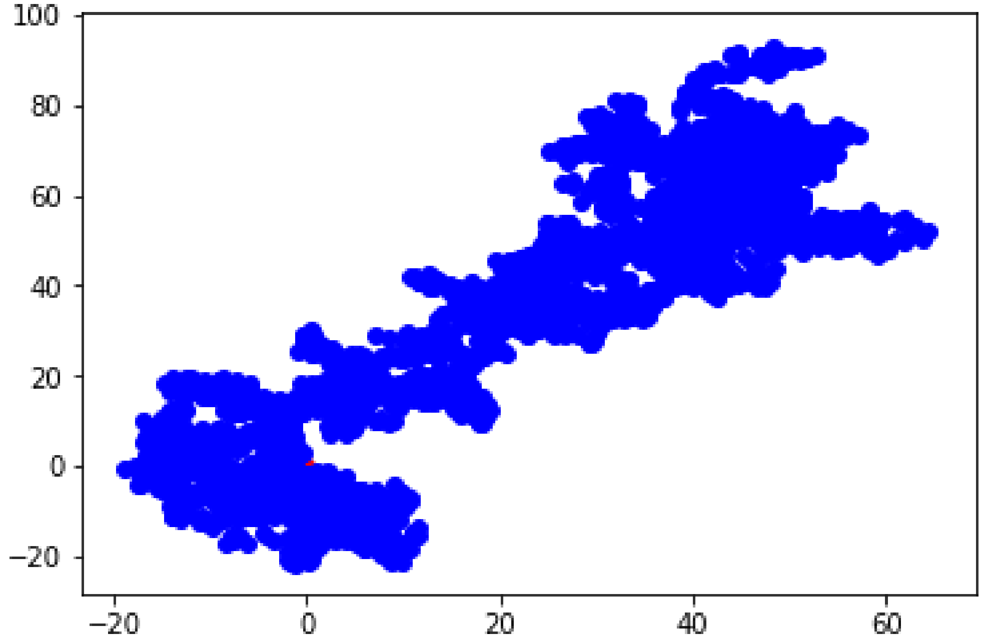
CogSci131 HW1

Summer, 2019

In [25]:
```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
from math import*
```

In [43]:
```
#1a. Suppose that an ant wandered randomly by taking steps (x,y), one per second, whe
#come from a normal distribution with a mean of 0 and a standard deviation of 1.0mm (
#Plot a trace of the ants path over the course of an hour.
x=0
y=0
plt.scatter(0,0, color='red')
for i in range(1,3600): #3600s for an hour
    right=np.random.normal(0,1,1)
    up=np.random.normal(0,1,1)
    x+=right
    y+=up
    plt.scatter(x,y,color='blue')

plt.show()
```




```
In [13]: #1b.Lets think about why ants need to perform path integration. Suppose that instead 
         #Is this a good strategy? Why or why not?
         #denote start point as (0,0), record food location. keep wanfering, check if currnet
         def homerun1():
             x=0
             y=0
             for i in range(1,3601): #left include right exclude
                 right=np.random.normal(0,1,1)
                 up=np.random.normal(0,1,1)
                 x+=right#one step in x direction
                 y+=up#one step in y direction. x,y denotes food location
             time_back=1
             while(time_back<=3600):
                 right=np.random.normal(0,1,1)
                 up=np.random.normal(0,1,1)
                 x+=right
                 y+=up
                 if x**2+y**2 < 100:
                     return True
                 else:
                     time_back+=1

         count=0
         for i in range(1,1001):
             if homerun1()==True:
                 count+=1
```

```
prob=count/1000
print(prob)

#no,this is not a good strategy, because the probability of returning to within a ran
```

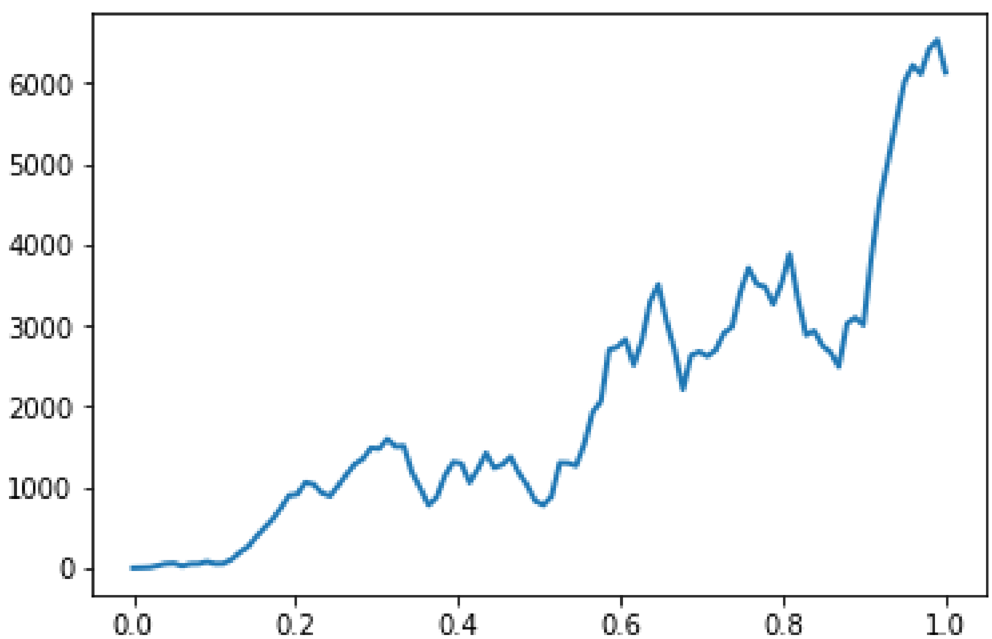
```
0.205
```

In [49]:
```
#1c. what is the random closest distance to the nest?
min_dis=[]
for i in range(1,1001):
    for j in range(1,3601): #left include right exclude
        x=0
        y=0
        right=np.random.normal(0,1,1)
        up=np.random.normal(0,1,1)
        x+=right
        y+=up
    distance=[]
    for k in range (1,3601):
        right=np.random.normal(0,1,1)
        up=np.random.normal(0,1,1)
        x+=right
        y+=up
        distance.append(sqrt(x**2+y**2))
    min_dis.append(min(distance))


avg=np.mean(min_dis)
avg
```

Out[49]:
```
0.7452743539145392
```

In [59]:
```
#2. show a range of s values to show what is going on. First we use a fixed S as the
X=0
Y=0
x=0
y=0
mean_dis=[]
for s in range(1, 10001, 100):
    s = s*10**(-4)
    distance=[]
    for i in range(1,101) :
        for j in range(1,3601):
            right=np.random.normal(0,1,1)
            up=np.random.normal(0,1,1)
```

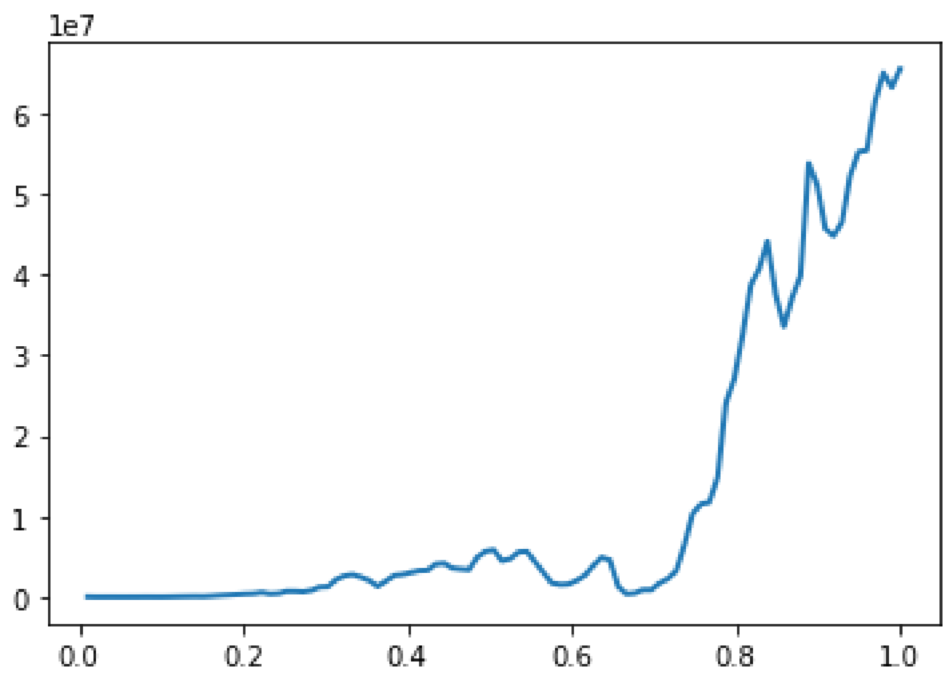
```
            ex=np.random.normal(0,s,1)
            ey=np.random.normal(0,s,1)
            x+=right #actual location
            X=X+right+ex #memorizede location
            y+=up
            Y=Y+up+ey
        distance.append(sqrt((X-x)**2+(Y-y)**2))
    mean_dis.append(np.mean(distance))


mean_dis

x=np.linspace(0.0001,1,100)
y=mean_dis
plt.plot(x, y, linewidth=2.0)
plt.show()
#conclusion: as s becomes greater, the mean distance from the ants to the nest become
```




```
In [60]: #3a.
         X=0
         Y=0
         x=0
         y=0
         mean_dis=[]
         mean_energy=[]
         for s in range(1, 10001, 100):
```

```
    s = s*10**(-4)
    distance=[]
    energy=[]
    for i in range(1,101) :
        for j in range(1,3601):
            right=np.random.normal(0,1,1)
            up=np.random.normal(0,1,1)
            ex=np.random.normal(0,s,1)
            ey=np.random.normal(0,s,1)
            x+=right #actual location
            X=X+right+ex #memorizede location
            y+=up
            Y=Y+up+ey
        distance.append(sqrt((X-x)**2+(Y-y)**2))
        energy.append(((X-x)**2+(Y-y)**2)+np.exp(0.1/s))
    mean_dis.append(np.mean(distance))
    mean_energy.append(np.mean(energy))
```

```
mean_energy
x=np.linspace(0.0001,1,100)
y=mean_energy
plt.plot(x, y, linewidth=2.0)
plt.show()
#conclusion: the minimum acheives at when s is relatively small but not the smallest.
```



In [ ]:
```
#3b.
#Evolutionary significance
#Supposing that s1 is the sd which acheives minimum energy consumption. And suppose th
#will acheive minimal energy consumption while searching food, thus have a higher chan
#offsprings. In the long run, in the ant colony, number of ants with s1 as their food 
#will evolve into the direction that acheives minimum energy consumption( food searcd 
```